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9. internationales Symposion zur Rolle der
Informationstechnologie in der Stadt- und Regionalplanung
sowie zu den
Wechselwirkungen zwischen realem und virtuellem Raum

9th international symposiun on
info- & communication technologies in urban & spatial planning
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GEO MULTIMEDIA 04

COMPUTERGESTÜTZTE RAUMPLANUNG

COMPUTER AIDED SPATIAL PLANNING

Beiträge zum 9. Symposion zur Rolle der
INFORMATIONSTECHNOLOGIE
in der
STADT – UND RAUMPLANUNG
sowie zu den
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MANFRED SCHRENK

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Vorwort / Preface

Innovation & Technologie
für mehr Nachhaltigkeit und Wettbewerbsfähigkeit

Willkommen bei der CORP2004 & GeoMultimedia04, dem 9. internationalen Symposion zur Rolle der Informations- und Kommunikationstechnologien in der und für die Stadt- und Regionalplanung an der TU Wien.

Wie üblich stehen am Anfang einer solchen Veranstaltung viele Fragen und für Ihre konkreten Anliegen finden Sie hoffentlich in den nächsten Tagen die richtigen Antworten.

Wenn man sich heute mit räumlicher Planung beschäftigt, schweben einige Grundfragen über den Einzelthemen, die sich in keinem der Einzelvorträge letztgültig beantworten lassen, wo aber gerade das kreative Zusammensein bei einer Konferenz zu mehr Erkenntnis und neuen Ansätzen führen kann:

Wie wichtig ist der Raum noch? Informations- und Kommunikationstechnologien ermöglichen eine grenzenlose „Informations- und Netzwerkgesellschaft", neben der „realen", physischen Welt existieren zahllose „virtuelle Welten", in denen Menschen ihre Aktivitäten entfalten, und die nicht an physische oder an Verwaltungsgrenzen gebunden sind.
Ist eine gezielte Stadtplanung und Regionalentwicklung mit dem Ziel der Weichenstellung für eine positive künftige Entwicklung unter diesen Rahmenbedingungen noch möglich? Welche Instrumente benötigt sie dazu? Und wessen Aufgabe und Verantwortung ist die Planung? Was bedeutet das für die Handlungsmöglichkeiten von Städten und Regionen?

Weil sich diese Fragen nicht im engen fachlichen Kreis beantworten lassen, ist die CORP eine in höchstem Maße ***INTERDISZIPLINÄRE VERANSTALTUNG.*** Das verbindende Element ist das ***"Denken in raum-zeitlichen Dimensionen und Zusammenhängen".*** Vortragende und Teilnehmer kommen aus Wissenschaft, Wirtschaft, Politik, NGOs und Öffentlicher Verwaltung.

Die CORP ist eine höchst internationale Veranstaltung mit TeilnehmerInnen aus aller Welt. Eine besondere Freude und Ehre ist es, heuer erstmals eine hochrangige Delegation der ISOCARP, der Internationalen Gesellschaft für Stadt- und Regionalplanung, bei der CORP begrüßen zu dürfen. Herzlich Willkommen Prof. Milica Bajic-Brkovic, Generalsekretärin, sowie Judith Ryser und Ric Stephens, Vizepräsidenten der ISOCARP.

Zwei Themenschwerpunkte stehen diesmal im Mittelpunkt:

IT-Regionen: Innovation und Technologie als Schlüssel für eine nachhaltige Stadt- und Regionalentwicklung"
Nachhaltigkeit ist nicht erst seit dem Rio-Gipfel oder den Lokale Agenda21-Prozessen ein Kernthema der Stadt- und Regionalentwicklung. Es gilt, optimale ökologische, ökonomische und soziale Rahmenbedingungen für Menschen und Umwelt zu schaffen und langfristig zu sichern.
Es wird davon ausgegangen, dass durch „Konservieren" und „Alles beim Alten belassen" oder gar den Versuch, „die Zeit zurückzudrehen" eine nachhaltige Entwicklung nicht sichergestellt werden kann.

Innovation and technology
for increased sustainability and competitiveness

Welcome to CORP2004 & GeoMultimedia04, 9th international symposion on IT in urban and spatial planning and impacts of ICT on physical space at Vienna University of Technology.

As usual at the beginning of such an event there are numerous questions and I hope that you will find the answers for your specific tasks during the next days.

When discussing spatial planning nowadays there are some fundamental questions always present that can not be answered in a single presentation, but where the creative surrounding of a conference can bring more insight and new approaches:

How important is physical space nowadays? ICT allow seamless worldwide info- and communication-networks, beside the „real world" there are numerous „virtual worlds", where people enfold their activities. Does urban and spatial planning with the goal of positively shaping the future still make sense under such conditions? Which methods and tools are required? And whose responsibility is it? What possibilites to shape their future do cities and regions have?

Since these questions can not be answered only within the planning disciplines CORP is a highly interdisciplinary event, with participants coming from various fields, sharing a common interest in spatio-temporal questions.

Speakers and participants do come as well from research and educational institutions, private sector companies, from politics as well as from public administration.

CORP is an international event with participants from around the world. It´s a very special pleasure and honour to be able to welcome a high-ranked delegation of ISOCARP, International Society of City and Regional Planners. A very warm welcome Prof. Milica Bajic, secretary general and Judith Ryser and Ric Stephens, Vice Presidents of ISOCARP.

There are two special topics for this years CORP:

"IT-Regions: Innovation and Technology as driving forces for sustainable regional development"
Not only since the Rio summit or local agenda 21 sustainability is a major issue in urban and regional planning . A well-balanced framework of ecological, economical and social conditions for man and the environment has to be established and its perseverance has to be secured.
Can sustainable development be achieved by preserving actual conditions or even by attempting to turn back time? Or is innovation and technology the only possibility to achieve sustainability?
Continuous innovation and intelligent application of technology are key factors to enable sustainable development. The creative and intelligent use of technology in spatial planning and environmental management is crucial for the successful development of cities and regions.
How can competing cities and regions become successful sustainable IT-regions? How can they find their position by intelligent use of their local and regional potential.

Permanente Innovation und intelligente Technologie-Anwendung sind notwendig, um eine nachhaltige Entwicklung zu ermöglichen. Stadt- und Umwelt-Technologien sowie den IKT kommt eine entscheidende Rolle zu.

Wie können Städte und Regionen durch Innovation und Technologie im „Wettbewerb der Regionen“ zu erfolgreichen „IT-Regionen“ mit nachhaltiger Entwicklung werden, die sich durch intelligente Nutzung ihres lokalen und regionalen Potentials erfolgreich positionieren?

Open Source für den Öffentlichen Sektor!?! Die Diskussion über die Vor- und Nachteile Source-Code-offener Software, die frei verwendet, weitergegeben und v.a. auch weiterentwickelt werden kann, ist in vollem Gange. Sind Open-Source-Produkte für die Öffentliche Verwaltung eine seriöse Alternative zu „professioneller Lizenz-Software“? Wie funktionieren die zugrunde liegenden Geschäftsmodelle? Ist ein “friedliches Nebeneinander” von Lizenz- und Open-Source-Produkten denkbar? In zahlreichen Beispielen wird gezeigt, welche praktischen Erfahrungen bereits vorhanden sind?

Selbstverständlich sollen auch die „allgemeinen CORP-Themen“, wie neue Methoden und Werkzeuge für die Planung, Öffentlichkeitsarbeit und BürgerInnen-beteiligung, Animation und Visualisierung, Datengrundlagen uva. nicht zu kurz kommen.

Herzlicher Dank gilt Herrn Prof. Georg Franck, Vorstand des Instituts für EDV-gestützte Methoden in Architektur und Raumplanung der TU Wien, und Herrn Prof. Klaus Semsroth, Dekan der Fakultät für Architektur und Raumplanung, die sehr bemüht waren, trotz schwierigster Rahmenbedingungen die Veranstaltung bestmöglich zu unterstützen.

Die CORP & GeoMultimedia-Veranstaltungen sind grundsätzlich Teamwork des CORP-Teams, und allen Beteiligten sei herzlich gedankt. Ganz besonders heraus-zuheben sind der unglaubliche Einsatz von DI Uschi Dorau, die seit Jahren eine der wichtigsten Stützen der CORP ist und heuer den größten Teil der Vorbereitungsarbeiten übernommen und koordiniert hat, sowie von MA Timo von Wirth, der erst seit vergangenem Dezember das Team von MULTIMEDIAPLAN.AT unterstützt, sich aber sehr schnell bestens eingelebt hat..

Ich wünsche Ihnen eine anregende CORP2004 & GeoMultimedia04, die Ihnen das Pflegen bestehender und das Knüpfen neuer Kontakte ermöglicht und Ihnen viele neue Ideen und Erkenntnisse bringt.
Mögen auch diesmal wieder „Visions-Kompetenz“ und „Umsetzungs-Kompetenz“, das „Know-What“ und das „Know-How“ zusammenfinden und zu neuen Projekten und Lösungen führen.

Ihr
Manfred Schrenk
Wien, im Jänner 2004

Open source for public sector!?! Discussions about advantages and disadvantages of open source software, that can be used, distributed and advanced without licence costs is a very hot topic.
Are open source products an interesting and acceptable alternative to commercially licensed software for public sector? What´s the advantages and disadvantages? What´s the business model behind open source and what about the overall costs of different solutions? Is it either-or, or is there a coexistence of licensed and open source software? Which practical experiences do already exist?

Of course all the other CORP-topics like new methods and tools for planning, public participation in planning processes, animation and visualization, data sources and much more may not come too short.

Many thanks to Prof. Georg Franck, Head of Departement of Computer Aided Methods in Architecture and Planning, and Prof. Klaus Semsroth, Dean of Faculty for Architecture and Planning at Vienna University of Technology who supported this years CORP although the circumstances were very difficult.

CORP & GeoMultimedia-events are always teamwork – many thanks to everyone involved this year!
Very special thanks to Uschi Dorau, for years the heart and soul of CORP-Team, who has done a great job in preparing CORP2004, and to Timo von Wirth, only from December 2003 active for MULTIMEDIAPLAN.AT but already deeply involved in all the activities.

I do wish you an interesting, inspiring CORP2004 & GeoMultimedia04. May you meet long known and find new interesting people to discuss and exchange experiences - and may you find new friends here.

May the “competence for visions” and the “competence for solutions”, the know-what and the know-how come together again and create new projects and solutions!

Manfred Schrenk,
Vienna, January 2004

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Planning in the Information Age: Opportunities and Challenges of E-Planning

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1 INTRODUCTION

During the last twenty years the planning profession has undergone a tremendous transformation. Not only have the planning philosophy and ideas changed, but the overall framework for the planning discipline has changed as well. The changing reality affects the way planners work, but it also encroaches on the very meaning of the profession itself, and the role it plays. The planning world of today is a different world, and a new culture of planning is on the horizon.

There are many important processes that participate in creating what is referred to as a new framework for the planning practice. While some argue that globalisation is a fundamental phenomenon of our time, others are of the view that the phenomenon of the information and communication explosion marks the era. Often placed on the top of development agenda world-wide, the two rank amongst the key determinants of the future of urban development. Taken alone however they do not determine the urban future nor do they guide and shape the cities independently of other forces - political, social, economic, environmental and cultural- their influence on urban development, and planning and management mechanisms, are undeniable and ever increasing. If globalisation reflects and demands fundamental changes in our ideas about society and the organization of space, it is also the case that the information and communication involve fundamental transformations in our concepts of the relationship between humanity and space, and indeed of the very concepts of humanity and space.

For some, it is planning in the era of globalisation that is the issue today, for the others it is the information age that provides the background. However, the two are interrelated and connected and often, they work together. Both are complex and multi-faceted phenomena, therefore most time neither one could be analysed and discussed independently from the other. For the purpose of focusing on particular relationship between the age of information and the planning practice, which is the focus of this conference and a general topic of this presentation, the reduction is necessary, and in this paper is being undertaken intentionally.

The key issue today is the mobility of information, which is the crucial factor in the world of international competition. A new generation of information and communication technologies creates a new opportunity for this process. The global electronic network supports mobility in space and time, and as such is relevant for any planning or development action, be it at a local, national or international level. Yesterday of a limited use, tomorrow will become an intrinsic part of the professional routine. E-space is not only a place where people meet meet but it is also an economic place, a powerful economic resource that fully participates in shaping development of many regions and cities world-wide. As such, it is vital to the planning profession. Transparency, efficiency and economy, the key words of the e-option, support a call for information networking on the Internet to channel organisational and operational resources for planning purposes.

This paper casts some light on the e-based planning option. Starting from the belief that it is the context that creates new opportunities and also make them successful, this is a general view on the reality within which planning is taking place today that will open the discussion, following which, discussion will focus upon the emerging e-based planning paradigm, and the questions associated with it. The potentials of the e-based alternative will be outlined and analysed against the principles of good planning practice. The challenges of the alternative will be highlighted/identified in the last section, and debated vis-à-vis the observed benefits. Implications for the concrete planning practice will be at the heart of the overall discussion.

2 A CHANGING LANDSCAPE OF THE PLANNING PROFESSION

A major transition from traditional and rule-book practice has already taken place world-wide. In the early days, planning was concerned with creating "grand plans" for building and construction. Spatial policies were used as a set of instruments to shape the welfare state and improve the overall living conditions as well. While this is still status quo in some countries, this is no longer the general rationale for planning practice in the most countries. Current efforts are focused on flexible and innovative planning practice that creates new opportunities as well as resources. "Planning becomes a vehicle for enabling private initiatives from citizens, firms and institutions, balancing different interests and managing uncertainty " (van den Berg, 200). The ideal pattern is not the one that prescribes, but the one that provides and supports (Bajic Brkovic, 2002). The planning practice of today has a different, and a new role. It is aimed at creating flexible frameworks and orientation, while cities and regions continue to evolve.

There are several key shifts and key characteristics of the world today that underline this process. Some of them refer to the environment within which planning takes place, while others come from within the profession itself, either in response to stimuli from the outside world, or as a result of the ongoing internal transformation of the profession itself. While this discussion will name some of the shifts or key processes, it will neither exhaust nor close the list. It is only from the very perspective of the topic discussed in this paper, that they are seen as the most relevant.

Globalisation - Regionalisation – Localisation. Often described as a process of integrating national economies into the world market, or as a transitional passage from a high volume economy to the high value economy, globalisation is among the key world-wide phenomena that marks the turn of the century. The scope of globalisation certainly goes beyond economics and also embraces science and technology, politics and culture. Much emphasis has been placed on the social, technological, political and cultural structures and processes it embraces. It is said that globalisation deeply modifies the structural framework of rational choice and as such is relevant for planning and the planners' practice.

In the 1990's the economic aspects of globalisation were in focus. From then on the pendulum swung towards other facets changing the entire vision. As globalisation has opened up national economies and increased the mobility of the factors of production, it has also reduced the power of the state to independently manage its affairs, giving national policies a new framework for development and implementation. A corresponding shift in planning took place, resulting in diminishing the need for comprehensive and grand plans for future development, and increasing interest for development control. The physical plans with a defined end state solutions are less often in demand, while supply of functional space is replaced by supply of opportunities. Planning is expected to provide development strategies and schemes, and an ultimate goal is a "framework" planning attuned to implementation and action. These processes have been accompanied by the ever increasing demand for information, communication and networking, resulting in a completely new and yet unseen environment for the planning practice.

Sustainability. Following the 1987 Brundtland report - that humanity has the ability to make development sustainable - to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs, the concept of sustainability grew into a much more complex system of values, and gradually advanced into a world-wide development strategy.

While many aspects of the sustainability are relevant for the planners' work, it is the call for social sustainability, developed as a counterpart to the globalisation process, that is impacting the profession today. The notion of diversity is in its fundaments, and is among its key features. Diversity is not a question of culture only. Simplified and culture related interpretations belong to the past. Today, the notion of diversity is closely associated with the development of potentials or development options, as well as community and civic life. Diversity in planning, and planning for diversity thus has become a new motto in the profession. And again, it is within such a framework that communication and development of networks play a central role.

In the early days, planning products were exposed to the general public usually at the end of the planning process. Today, the sustainable practice calls for public involvement from the beginning and, consequently, co-operation and partnership have become conditio sine qua non of the planning standard. It is unlikely that, examples of the planning practice with no public involvement could be found any more. The top-down practice has been replaced by a model where partnership and public participation have a major role. Equity of access, and involvement of the stakeholders are but a new standard of the quality of the planning practice.

Quality of life and urban democracy. While the quality of life (defined in various ways) has been with planners since the early beginnings of their profession, it is a set of new attributes referring to the urban democracy and creation of open and transparent governance that makes it relevant for the discussion here.

There are many actors that ask for their share in development decisions, and the number of stakeholders or shareholders (as same prefer to say) that fully participate in the planning process has dramatically increased during the last two decades. Governments are less often in a position to set the planning stage, and the process of planning is often much more engaged in the task of building consensus around issues, and among the participants, than producing physical plans. Consultation meetings to which invited stakeholders come from the business community, unions, NGOs, representatives of the social sector, financial experts, urban specialists from academia, representatives of local communities and local residents' groups, and both politicians and civil servants from different levels of government, municipal, provincial and federal, most often create a real framework for planning actions. Active involvement and participation enhance local democracy which is placed among the key factors that define the quality of life.

The more actors there are the more communication is needed. Managing communication is a new challenge for the planning profession (van den Berg, 2003).

The planning subject. In the beginning, cities were viewed as enlarged architecture, the physical structures mainly defined by their physical characteristics and attributes. The first major change occurred during 60s and 70s, when planners discovered the complexity of social, economic or political forces and processes taking place behind, and within these physical structures. Gradually, the social and economic perception of place took over the physical form. A second big shift took place in the late 80s and early 90s. Today, there are a growing number of both theoreticians and practitioners who view cities as the complex structures of resources, processes and effects of these processes. These structures are dynamic, with numerous internal and external links, and rest on the two fundaments: information and communication.

Such a perspective has an important message for planning by opening up new areas for the planners' work. Planning is more and more concerned with issues such as the search for information, access to information, creation of information networks, and the development of technologies and instruments, to work with and within these networks. Another side of the same process is communication. There is a growing need for the efficient ways and means to communicate information, as well as to establish links among people, resources and information as well.

ICT and a digital option. Many countries place the Communication and Information Technologies (CIT) high on their development agenda, and rank them among the key determinants of their future urban development. The ease with which one place can be reached from any other place, and the ease with which one individual can reach another, independently of the distance, are already the more common characteristics of contemporary societies, but the development goals as well.

Part of the ICT reality is the World Wide Web. Introduced on a large scale less than two decades ago, it grew rapidly, first into a new communication channel, but very soon into a parallel economic and social space. Today, it constitutes part of the reality that can no longer be ignored, and a place where part of urban and spatial development and management functions take place. "Wiring" the nation and creating the "intelligent nation" are often not the development goals only, but the indicators of progress as well.

The intersection where the technology and the new planning requirements meet create a point where the planning profession stands today. It is the point where many important questions yet to be answered originate. It is also a departure point for creating the new opportunities for the profession. Communication, access and mobility are the cross cutting issues, and it is at this stage that the ICT and e-option in particular, occur in and become so relevant for planning.

3 E- BASED PLANNING PARADIGM

Today, there are many e-services in operation, ranging from simple tools for disseminating information and facilitating access and communication, to the most complex forms created and maintained to improve planning and management of cities and regions. Some of these technologies (instruments) have been around since the advent of the Internet. Others have gone mainstream over the last few years. All of them are aimed at using the web networking to enable the geographically distributed users to access databases and computational resources, to provide efficient messaging and data exchange, and facilitate sophisticated real-time communication. In general, introducing the e-based option into the planning procedures, does not necessarily lead to the entirely new paradigms or development models. Rather, they are aimed at providing supplementary means to facilitate and support the existing ones. Web networking is aimed at providing supplementary means to facilitate access to different information resources related to urban development and management, to sustain and foster further development of urban democracy, and to annex the new forms of urban management to the existing ones. Public services and resources thus become closer to their citizens, and different actors participating in the development process are afforded/provided with a new arena for developing dialogue, cooperation, and exchange. The ultimate goal is to construct a more comfortable urban milieu, and a more democratic and fair social environment.

The e-services are amongst the most rapidly growing development sector of today, and the remarkable results in that field have been achieved in many countries world-wide. In more developed countries there are hundreds of thousands of operating modules with different tools in almost every city or region. Some countries, like Italy or Singapore have begun to gradually replace a traditional model of the face-to-face office work by the e-alternative.

How does "wiring" nations and creating the "intelligent environment" affect the way we plan and manage our settlements? Does the planning benefit, do we - the professionals, benefit? Does the public benefit, and is it that an omnipotent tool for working in the network society has been invented?

4 ADVANTAGES OF THE ON-LINE WORK

It has been repeatedly emphasised that the e-alternative generates positive effects to all the parties involved, from the individual to the societal level. The benefits are usually summarised as follows:

Individual/Citizens

- Offers alternatives
- Enhances public participation in the democratic process
- Enhances social and community life
- Provides instruments for carrying out activities
- Provides access to information and facilities
- Develops new skills and creative thought
- Supports cosmopolitanism and trans-localism
- Extends opportunities to integrate less privileged or otherwise marginalized groups

Business/Corporate Sector

- Supports business and economy
- Improves service delivery business-client and business-business
- Creates opportunities to improve delivery at lower costs
- Enables greater efficiency in job performance
- Opens the door to new business opportunities
- Provides opportunities to integrate into regional/international business/economic world

Public Sector

- Creates opportunities to government to improve service delivery at lower costs
- Provides potentials to improve quality of local urban management
- Supports efficiency of local governance and the quality of the decision-making process
- Improves quality of communication between local authorities and their citizens, and adds new opportunities for public participation in the community affairs
- Provides a platform for communication and cooperation between different local bodies and departments
- Enables citizens to communicate with their governments in an easier and more efficient way
- Provides citizens with easier access to different information, government departments and bodies, etc.
- Supports democratization and public involvement
- Supports cosmopolitanism and trans-localism and is opening up an opportunity to integrate into regional/international wider framework.

5 ON-LINE WORK VIS-À-VIS CRITERIA OF A GOOD PLANNING PRACTICE

A set of the technologies (instruments) chosen for the analysis here are practically all recognised today:

- E-mail
- Web site
- Electronic Listserv / Discussion Group
- Electronic Conferences

- Web-based Audio/ Video Conferences
- Electronic Journal/ Newsletter
- Online Sharing of Documents/Publications
- Online Database of Legislation / Policy
- Web GIS
- Web Portal/Electronic Gateway
- On-line Communities
- On-line Planning Studio
- Content Management System

In evaluating the likelihood of making a shift from a traditional planning technology to the e-based alternative, a number of criteria may be employed. The analysis presented here focuses on the key issues - applicability and accountability, and therefore the technologies (instruments) are analysed against the following:

- The relevance of the communication mode to the planning process;
- Potential of the alternative to be applied throughout the planning process;
- Likelihood of the alternative to meet the quality standards;
- Relationship and ratio between the impacts and availability.

5.1 Communication mode and the planning process

While planners have been confronted with a question of communication ever since the advent of their profession, and especially since participation and public involvement become a standard, and a required part of the procedure, it is by introducing the e-based alternative that for the first time they have a communication option they can use efficiently. There are different technologies (instruments) available to provide the service for different stages throughout the whole planning process. Simple data access or data/information exchange can be made even with the simplest tools, and technical requirements for their use are practically minimal. Access to people can be made in the same way. However, it is the most sophisticated technologies (instruments) that have the highest potential to substantially increase the efficiency and effectiveness of planning. They provide the interactive real time communication that can be employed throughout every planning stage, be it a pre-planning survey, plan-making itself, or the decision-making process. However, the technical and know-how requirements for their use are substantial as well.

Table 1: Communication mode by instrument

	Exchange	Access Data/ Information	Access People	Interactive Communication	Real Time Communication
E-mail	•		•		
Web site		•			
Electronic Listserv / Discussion Group	•		•	•	
Web-based Audio/ Video Conferences	•		•	•	•
Electronic Journal/ Newsletter		•			
Online Sharing of Documents/Publications		•		(•)	
Online Database of Legislation / Policy		•			
Web GIS		•			
Web Portal/Electronic Gateway	•	•	•	(•)	(•)
On-line Communities	•	•	•	•	(•)
On-line Planning Studio	•	•	•	•	•
Content Management System	•	•	•	•	•

5.2 Applicability

Not all technologies (instruments) are equally functional. Some of them may be employed throughout the whole planning process, while others may provide good service only for a part of the process, or serve at a particular stage. The more sophisticated they are, the broader and more extensive, but their application may be intensive as well. As for the perspective of a single use, it is interesting to observe that complexity and refinement of the instrument do not always play a major role. For example, a simple web site is a very useful instrument for many pre-planning activities, and in terms of its performance ranks as equal to the most sophisticated ones. However, it is not the same as for the other procedures. In the plan-making process, decision making, and procedures for monitoring and implementation only the most sophisticated rank as very successful, while the more simple often are of no use. Web GIS, on-line communities and CMS are the most successful and can practically be applied at any stage as superior tools. Technical requirements for their use however are quite high, and many countries and communities, for the time being, can hardly afford them.

Table 2: Applicability

	Pre-Planning	Planning Process	Decision Making	Implementation	Monitoring
E-mail	●				
Website	●●●	●	●●	●	●●
Electronic Listserv / Discussion Group	●●●	●	●		
Web-based Audio/ Video Conference	●	●			
Electronic Journal/ Newsletter	●●	●		●	
Online Sharing of Documents/Publications	●●	●	●	●	●
Online Database of Legislation / Policy	●●	●	●	●	●
Web GIS	●	●●●	●●●	●●	●●●
On-line Planning Studio		●●●		●	
Web Portal/ Electronic Gateway	●	●●	●	●●	●●●
On-line Communities	●●●	●●●	●●●	●●	●
Content Management System	●	●●●	●●●	●●●	●●

Number of dots indicate the level, ranging from applicable (one dot) to very applicable (three dots).

5.3 Quality of planning

Quality of planning may be assessed against a number of parameters. However, it is a group of basic principles that every good planning practice relies on, against which the potential of the e-based technologies (instruments) can be evaluated. These parameters are:

- Efficiency (performing in the best possible way and least wasteful manner);
- Effectiveness (capacity for producing a desired result/effect);
- Collaboration/cooperation (capacity for enabling two or more parties to work together effectively);
- Transparency
- Public involvement
- Equity of access

In general, all technologies (instruments) contribute to the quality of planning, and enhance the quality of its performance. Some of them contribute more though in respect to a particular criterion, or a set of criteria. The general rule observed before - the more sophisticated instrument the more effective it is, does not apply always and everywhere. For example, a website ranks as good as some of the most sophisticated ones against the criterion of effectiveness, transparency and to some degree is relevant for public involvement and the equity of access. The fact that even the simplest technologies (instruments) may substantially improve the planning practice is an interesting observation, especially with regard to the often heard argument that financial and technical limitations restrict their use.

The majority of instruments meet the criterion of providing or improving the transparency of the planning process. They may also be used to enhance collaboration and cooperation among the stakeholders in the planning process in general. Some of the instruments are likely to increase the efficiency and effectiveness of planning, while quite a number can be employed to support public involvement and public participation.

Table 3: Quality of Planning

	Efficiency	Effectiven-ess	Collaboration/ cooperation	Transparency	Public Involvement	Equity of Access
E-mail			●			
Website		●	(●)	●	(●)	●
Electronic Listserv / Discussion Group		●	●		●	
Web-based Audio/ Video Conference			●		●	
Electronic Journal/ Newsletter				●		
Online Sharing of Documents/Publications	●		●	●		●
Online Database of Legislation / Policy		●		●		●
Web GIS	●	●	(●)	(●)	(●)	(●)
On-line Planning Studio	●	●	●	(●)	(●)	
Web Portal/ Electronic Gateway	●	●	●	(●)		●
On-line Communities			●	(●)	●	(●)
Content Management System	●	●	●	●	●	●

(●) conditioned

6 CHALLENGES TO THE ON-LINE OPTION: IMPACTS VS. AFFORDABILITY

The ICT in general, and some of the technologies (instruments) in particular, require a sophisticated environment in order to be implemented and to work successfully. Some of them can be successful only if a corresponding know-how is secured, or a technical infrastructure developed. The more complex and sophisticated they are the higher the requirements they impose. Only the simplest ones may work in the environment that exist today in the majority of countries.

Discussion and literature on the issues of social deficiencies and problems are limited, however, a digital divide has been recognised and discussed broadly. Recently it was placed on the world agenda: "At first sight, it might appear that new computing and communication technologies offer tantalising possibilities for transcending traditional social and geographical barriers....the reality however, is very different and quite alarming; there is growing evidence that the main trends surrounding the application of CIT support processes and practices that intensify urban polarisation" (GRHS:Habitat+5:2001). The dominant logic of the CIT- based development supports urban polarisation, and tends to extend the reach of the economically and culturally powerful, thus contributing to the restructuring of human settlements (Graham, 2001). The uneven effects of such a process advance the idea of the heterogeneity between privileged and non-privileged territories or social groups (Bakis 1984, Bressand, Distler 1995, Allemand 1996). Therefore, there is a need to include into the course of analysis a number of other issues like accessibility or to address the question of social justice as well. The e-based option may become effective only under the condition that the majority of the population have a secured access to it, and the adequate know-how to use it. Only where there is a critical mass of users who already exists or is likely to emerge, the alternative may become a real option and serve the purpose (Bajic Brkovic, 2001, 2002).

It is necessary therefore to compare the affordability of these technologies (instruments) against the positive and planning related impacts they produce or are likely to produce. The assessment and comparison presented here present an interesting relationship between the two. The more affordable technologies at the same time create fewer or less relevant impacts, while the less affordable apparently are more important from the point of view of the impact creation.

Table 4: Affordability vs. Impacts

	Affordability	Impact
E-mail	●●●	
Website	●●●	●
Electronic Listserv / Discussion Group	●●	●
Web-based Audio/ Video Conference	●	●
Electronic Journal/ Newsletter	●●	●
Electronic Journal/ Newsletter	●●	●
Online Sharing of Documents/Publications	●	●
Online Database of Legislation / Policy	●●	●
Web GIS	●	●●●
On-line Planning Studio	●	●●●
Web Portal/ Electronic Gateway	●	●●●
On-line Communities	●	●●●
Content Management System	●	●●●

Number of dots indicate the level, ranging from fair (one dot) to very high (three dots).

This observation raises an important and interesting question on the perspectives of the e-planning option in different countries, in relation to the level of their development. With no intention to get into discussion on the topic this time, it is worthwhile to mention the results of of two recently conveyed surveys on the future of the e-support planning, one conducted in the Caribbean region (M. Frojmovich 2002), and another in Serbia and Montenegro (M. Bajic Brkovic 2003). Although the two entities hardly have anything in common except that both belong to the developing world, the results obtained are quite similar. In both cases, the e-option exists, although on a rudimental level only. Both in Serbia and in some countries in the Caribbean, the strategy on e-government has been already adopted or is on its way. The implementation has hardly if at all started. Not only is there almost no interest among the professionals to introduce and experiment with a new practice, but the overall attitude is rather skeptical and with a lot of doubting tones. Affordability is the key issue of concern among the respondents, while the lack of adequate infrastructure, a weak know-how and a lack of support from the governments, are among the obstacles most often mentioned.

7 CONCLUSION

Would high-tech and high-touch technologies truly replace the traditional way of plan-making and decision making, the way the professionals work and communicate? Would on-line public participation replace community meetings and public hearings? Would the decision-making process take place in cyber place, and is the red tape bureaucracy likely to be replaced by a transparent and ever reaching e-option?

The ICT has gained the momentum and a digital opportunity has been created. A digital option may provide many advantages, it has a potential not only to replace the traditional tools but also to substantially improve professional work by creating added value. While during the first years it was accepted as a medium for communicating and sharing information, today it has moved onto the next generation transforming into a development supporting tool. The option has been admired particularly for the role it plays in supporting businesses, locally and internationally, and as a new economic resource in general. As for its social role, the contribution towards enhancing openness and transparency of local governance, and the development of citizenship and urban democracy, have been amongst those mostly praised.

Taking the overall performance and the assessment criteria used in the analysis presented here, it is evident that the more sophisticated technologies (instruments) create the more relevant impacts, while the simple technologies, the so called “soft instruments” stand important for some aspects of the planning practice. The “soft instruments” may be used to enhance the transparency and democracy of the planning process, or to support the public involvement. Still, their application is rather limited. The more sophisticated ones, on the other hand, are opening up new frontiers thus becoming a real guiding force in transforming the profession.

There are the questioning and doubting tones as well. In addressing the concerns of those who are skeptical, it should be noted that the e-alternative does not necessarily exist to replace the existing and traditional mechanisms of doing things, but it rather offers a more efficient alternative and provides options. In fact, the new technologies offer the opportunity, for the first time, for improved delivery at a reduced cost. Yet, in addressing the pros and cons more attention should be dedicated to the observed challenges, in order to assess the alternative justly, and in a fair way, and to develop ways and means to overcome the shortcomings.

The decision to go on-line though does not rest with the planners only, for they are but one actor in a digital game. Clearly, countries that have already gone on-line provide more opportunities and a shift in the profession is already taking place. In many others, the option either does not yet exist or exists on a rudimentary level and in a very restricted sphere of professional work.

The information and communication technologies and a digital reality in particular are but one segment of the overall reality named the Information Age. Clearly, there are other processes that are as relevant for the profession as they are. In evaluating a perspective for further development of the planning profession, these complement processes have to be carefully observed and their impacts thoughtfully studied.

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Smart Communities: A California Master-Planned Community Case Study

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1 CALIFORNIA MASTER PLANNED COMMUNITIES

The rapid urbanization of California has created an environment that enables innovative community master-planning. One aspect of contemporary place-making is the incorporation of advanced information technology and communications (ITC). Of particular interest are the ITCs that may become defining characteristics of the master-planned community.

1.1 General Plan—The Long Range Vision

All cities and counties within the State of California are required to adopt a "comprehensive, long-term general plan for the physical development of the county or city, and any land outside its boundaries which in the planning agency's judgment bears relation to its planning." [OPR] The General Plan must include the following elements: land use, open space, circulation, noise, housing, safety, and conservation. The General Plan may include additional elements, and many cities and counties add elements that address issues of particular interest to their communities. Riverside County has recently adopted a progressive form of General Plan that focuses on the relationship between land, transportation and the environment. The Riverside County Integrated Project (RCIP) combines advanced geographic information services (GIS), Internet, and information management.

[For more information on General Plans, visit the Governor's Office Planning and Research website at http://www.opr.ca.gov/ For more information on the Riverside County Integrated Plan visit the RCIP website at www.rcip.org].

1.2 Specific Plan—The Community Development Plan

California has designed a framework for developing a precise plan that implements the General Plan: the Specific Plan of Land Use. The Specific Plan is a "tool for the systematic implementation of the general plan. It effectively establishes a link between implementing policies of the general plan and the individual development proposals in a defined area. A specific plan may be as general as setting forth broad policy concepts, or as detailed as providing direction to every facet of development from the type, location and intensity of uses to the design and capacity of infrastructure; from the resources used to finance public improvements to the design guidelines of a subdivision." [Miner] Since the inception of Specific Plans in 1965, they "have gone beyond the original legislative intent and incorporated detailed development plans with environmental policies, programs and goals to create defined areas which are functional, livable, and affordable and which offer the sense of place commonly envisioned in the creation of the general plan." [Miner]

[For more information on Specific Plans, visit the California Environmental Resources Evaluation System at http://ceres.ca.gov/planning/specific/]

1.3 Smart Master-Planned Communities

The rapid urbanization of California creates opportunities for innovative large-scale community development. The Specific Plan provides the structure to design communities that not only meet the fundamental requirements of the General Plan, but also create a sense of place and sense of community. Specific Plans include implementation programs and may include development standards and design guidelines. Combined with land use, circulation, energy, and environmental considerations, the Specific Plan is a powerful technique for place-making. In addition to these components, innovative master-planned communities may consider information technology and communications. Those communities that utilize information technology combined with state-of-the-art planning techniques are **smart communities**. The Domenigoni Valley and McSweeny Farms Specific Plans represent state-of-the-art development of smart communities. The Domenigoni Valley Specific Plan near Winchester in Riverside County, California is a proposed ~1,700-acre [~690-hectare] master planned community that defines the cutting edge of community dynamics in both physical and virtual design. The Master Plan envisions an information 4,600-home community linked by a local area network (LAN) and the Internet. At the other end of the 4.5-mile [7.2-kilometer] Diamond Valley Lake is the McSweeny Farms Specific Plan near the City of Hemet. This master-planned community contains ~670 acres [~270 hectares] and 1,640 homes with an ITC network to support the "village" lifestyle. Both Specific Plans include an ITC Master Plan and development guidelines.

[For more information on the Domenigoni Valley and McSweeny Farms Specific Plans, visit their websites at www.domenigonivalley.net and www.mcsweenyfarms.net]

2 MASTER-PLANNED COMMUNITY INFORMATION TECHNOLOGY & COMMUNICATION

Although information technology and communication advances affect all aspects of modern master-planned communities, there are several technologies that will become defining components of smart communities.

2.1 Community Intranets—Connecting Citizens with Local Resources

Within the last decade, planners and community developers have searched for techniques to create distinctive environments and cohesive citizenry—sense of place and sense of community. Although the Internet is rapidly becoming integral to professional, educational, and social life, it is—by nature—aspatial. An *internal* Internet, or **Intranet**, provides content that is relevant to the targeted community. Businesses, institutions and citizens developed the first Intranets such as Blacksburg Electronic Village (Virginia, USA) to enhance community networking. Disney created one of the earliest developer-sponsored Intranets for the master-planned community Celebration (Orlando, Florida, USA). Disney made an early marketing decision to actively pursue online communication with local businesses, health-care providers and schools. "By encouraging these organizations to post useful information online, the community intranet engaged the interest of homebuyers from the key demographic groups targeted in Celebration's marketing." [Paradise] Evanston Illinois has one of the most advanced networks: e-Tropolis. The e-Tropolis Evanston Electronic City, the first-page-up when an e-Tropolis Evanston subscriber signs on, is a directory of all things Evanston, linking to any and all. The e-Tropolis Evanston home page is known as the "Town Square." Intranets like Evanston, engage all groups—from neighborhoods, organizations, public agencies, institutions, and individual residents—to add to the Web site with rich local content. [e-Tropolis] A comprehensive master-planned community Intranet would include:

- World Wide Web Portal – access the Internet and Intranet anytime from anywhere
- Community Information – access to community news, calendar of events, announcements, rules and regulations, guides, and directories
- Community Participation – create personalized calendars, make reservations for amenities and events, participate in homeowners association polls and questionnaires
- Citizen Networking – master-planned community email addresses for all residents, businesses and organizations allowing access to the intranet for personal communication to participate in forums, locate other residents with similar interests, review places and events, obtain referrals, and more with interactive tools
- Distance Learning – access online learning programs from local Kindergarten through university and continuing education
- Health-Care Services – use personal, interactive online health care from local and distant facilities
- Entertainment & Recreation – provide online entertainment and organize and coordinate community recreation activities and events
- Financial Services – access to the intranet anytime from anywhere for financial transactions
- Business Development – online transactions, special offers and promotions, online service and product searches, and direct access to local businesses
- Site Administration – design and maintain website with user-friendly web-based forms and generate online reports, service requests, and property management activities

The community Intranet helps develop and support community living, working, learning and playing. Both the Domenigoni Valley and McSweeny Farms Specific Plans provide for Local Area Networks (LANs) and Internet Service Providers (ISPs) to provide the enabling infrastructure for Intranets.

2.2 Wireless Communications—Ecumenopolis

The Greek city planner C. Doxiadis coined the word "ecumenopolis" to describe the city of the future as a continuous system linked electronically. Smart Communities will capture the benefits of the ecumenopolis while retaining the character and spirit of the local culture. The Domenigoni Valley and McSweeny Farms websites (and eventual Intranets) provide historical, archaeological and paleontological foundations through documentation in conjunction with cultural resource programs. In addition to the wired infrastructure (cable and fiber), smart communities require **wireless communications systems** to support mobile ITC. The Intranet helps preserve local natural and cultural heritage, and this is supplemented with the wireless communications system provision of mobile access to the local and global community. The Domenigoni Valley and McSweeny Farms Specific Plans provide for the wireless communications system by locating freestanding antenna structures referred to as 'monopoles.' Currently these wireless communications facilities are concealed or 'stealthed' to be unobtrusive by disguising them as trees (monopalms and monopines), architectural features such as building facades, or other structures such as water tanks. Riverside County is currently in the process of developing a Wireless Communication Facilities Ordinance to regulate these structures and the Specific Plans may further refine this ordinance.

2.3 Geographic Information Systems—Mapping, Monitoring, Maintaining

Geographic Information Systems (GIS) have countless applications for smart master-planned communities and will be transparent to most citizens. GIS was—and continues to be—used in the planning for these communities. The Riverside County Integrated Plan incorporated a GIS to 'integrate' the primary elements of land use planning, environment, and transportation. GIS was also employed in identifying sensitive habitat. An example of this was the electronic tracking of species such as the Stephens Kangaroo Rat. Captured K-rats were 'injected' with an electronic chip that enabled biologists to follow their movements, which would then be entered as GIS data. At the other end of the spectrum, GIS serves to identify properties suitable for development based on such factors as level of infrastructure, zoning, availability of services, and so on. Areas to be further explored for master-planned communities include:

- Energy – monitor and regulate power and gas consumption at the individual, neighborhood and community level. GIS programs are being developed to conserve energy from simple measure such as regulating night lighting, to more complex efforts to restructure the local power grid.

- Resources – monitor and regulate resource consumption, reuse, and disposal. GIS programs are being developed to make real-time decisions on resources from simple measures such as regulating irrigation to maximize efficiency to more complex efforts to design water reclamation systems.
- Safety & Security – monitor people and property for health and safety. GIS programs are being developed to regulate traffic signalization, provide surveillance and tracking, and are being developed for personal, neighborhood and community-wide applications.

The Domenigoni Valley and McSweeny Farms Specific Plans include provisions for various GIS programs to enhance the master-planned community lifestyle.

3 SMART COMMUNITIES—CONCLUSIONS

Smart Communities planning represents a dynamic approach to creating sense of place and sense of community—two areas which are becoming redefined by their electronic counterparts: virtual reality and e-networks. The challenge for smart communities will be to balance these in ways that make life more enjoyable and meaningful. How can we establish a sense of place that is valuable in terms of natural and cultural heritage and simultaneously expand an indefinable "cyberspace." How can we foster a traditional sense of community while supporting virtual community networks? Or, simply stated, how does the master-planned community encourage a 'resident' to become a 'citizen'?

Planners must become familiar with the **ITC tools** for creating smart communities including:

- Internet and Intranet Programs
- Wireless Communications Services
- Geographic Information Systems

The Smart Community planning techniques must include the following:

- Use ITC applications in conjunction with 'smart' development such as the Smart Development Principles [American Planning Association], Ahwahnee Principles [Local Government Commission] and Environmentally Sustainable Urban Development: A Charter of the Planning Professions [ISoCaRP]
- Master-plan ITC infrastructure to enable community-wide networking to be phased with development
- Support ITC administration to ensure a level of service for viable physical and virtual community

Strategic planning must achieve the following **Smart Community objectives**:

- Design sense of place and local "cyberspace"
- Create sense of community and virtual community networks
- Enable individuals and communities to realize their desired lifestyles

Smart Communities offer the opportunity to create and enhance these environments. They are dynamic models for the future of community development. Place-making must provide for both realms—real and virtual—to ultimately transcend the independent limitations of each. Perhaps we will even have places that not only support our lifestyles, but also give our lives meaning.

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Urban Gallery, Urban Curation

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1 A PROTOTYPE PLANNING TOOL

This presentation will give a brief introduction into a prototype for a new planning tool which combines the use of an interactive web based digital database in four layers (the Urban Gallery) with a methodology which consists of fieldwork, research in innovation, scenario games and dynamic masterplanning (Urban Curation). The methodology has been developed by CHORA architecture and urbanism based in London, in collaboration with the Architectural Association in London and the Berlage Institute in Rotterdam. The Urban Gallery is a virtual space that enables the storage and management of information and research, but it also is a public space that connects different actors and agents and creates a continuous meeting place for the sustained development of dynamic masterplans for regions, towns or localities. An important factor of the Urban Gallery is the potential for comparative modelling and simultaneous development in different locations. Versions of the Urban Gallery have been tested in Tokyo, Copenhagen, and Sector E, a territory stretching between Rotterdam and the Rhein-Ruhrmetropole. Currently applications are in preparation in Aberdeenshire, Scotland, and Hackney, in London, and a project joining up five Urban Galleries in five different continents to test prototypes related to ecological processes in urban environments is in preparation for a major event in a few years. This prototype and methodology was also presented in my keynote speech at the EU conference ‘European Cities in a Global Era’, 14,15 November 2002, as part of an argument about new tools for urban planning in the expanding Europe.

2 TAMING THE DIGITAL STORM

There is something like a permanent storm of data, information flows and digital spaces raging through our urban spaces, uprooting habits, social patterns, modes of doing business, and the ways that cities are inhabited and organised. As with many storms, it can be frightening to be undergo its powerful forces, to lose control in its violence. But it can be exhilarating too, to feel the winds tearing against everything permanent, literally becoming winds of change, to be blown away with its force. There is real drama in the way the digital revolution is affecting us and all those that try to understand, map, organise regulate and design cities. Major questions are facing us in this storm. What are the stable zones, where some form of permanence remains, where are the quiet areas in which speed is not an issue yet? Precisely what is the nature of the storm, of the forces it unleashes, of the types of winds that it consists of? What will it destroy, and what should we protect against its forces? But the most exciting questions are about its positive aspects. How can we use its forces, how fast can we travel on its winds, and how can we harness its forces in order to produce new cities, better qualities of life, new forms of mobility and communication? In many institutes of architecture you see this exhilaration being expressed in exuberant designs, strange new shapes, endless amorphous objects that appear to take the digital storm literally and answer that misunderstanding with quasi aerodynamic aestetics, not unlike the fins that appeared on new cars in Detroit during the fifties. The question will be more about a real understanding of the kinds of spaces that emerge through the power of the digital storm, and the new ways that patterns of behaviour, action, production and communication are organised.

2.1 Curating emergent phenomena

Taming the stor[1]m is but a metaphor, an image to focus on the nature of the emergent phenomena we are dealing with. The problem is how we can adapt our current methods and tools to the phenomena emerging from the storm. We recently published a book, Urban Flotsam, in which we ask four questions: How to see? How to play? How to tell? How to act? The book traces the recent history of our attempts to develop a methodology that could anwer these questions. The problem is two-fold: how do you see new phenomena without knowing them, and how do you use them? That means how do we see, classify, order, name what we do not know initially, or what we have no inkling of? The assumption is that we need to cross the boundaries of disciplines and professional sectors, to mutate exisiting tools and methods in order to observe and register new urban phenomena emerging from the digital storm. But we also have to be able to play with them, to experiment with their potential, so we need modelling techniques that allow us to grasp them, to handle them in simulations, in scenario games. Scenario games are exercises in telling stories about the future, creating possible narratives of how things may evolve, and narratives about how different futures can be imagined and what has to be done to choose one or the other future, and how and at what point to act. What tools do we have that can be used to bring out the potential of the storm. The digital storm in conjunction with other global forces require forms of management of information and orchestration of processes that are relatively new, and more akin to the work of an art curator then to the traditionla urban planner. We have introduced the term ‘Urban Curation’ in order to have a name for the practice that is involved in the handling of urban changes in the digital era.

2.2 metaspaces

Spaces in which we can see temporality are metaspaces. They are spaces above or beyond the space in which we live, the Skin of the Earth. The metaspace has an innate ephemeral character. It is the site of the search for knowledge; it is the container of knowledge management processes, but it is also a vehicle for the search for meaning in the dynamic chaos in which we live. The metaspace is a vehicle for thought processes, a vessel in which urban consciousness has a chance to gel. When dynamic processes are given form, this form gives meaning to the processes, a handle to their understanding, and, if necessary, their manipulation. The metaspace is the

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[1] Raoul Bunschoten, Takuro Hoshino, Helene Binet and CHORA: Urban Flotsam, 010 Publishers, 2001, Rotterdam

space in which this form becomes visual. Whether it emerges or is described is a second debate that depends on the character of the metaspace: self-organizing organism (life form) or mechanical instrument. The challenge for us is to use this concept of a metaspace for the development of a planning instrument that is simultaneously a new public space for the interaction and intertwining of urban actors and their desires and interests. In the process of developing a specific metaspace as instrument, we are constantly oscillating between research and production: using the metaspace as a laboratory in which to learn and also applying the instrument to specific situations and urban environments, increasingly as commissioned projects.

2.3 The Gallery: an incubator of urban evolution

The Urban Gallery is a peripatetic instrument of instable, dynamic and ultimately ephemeral phenomena. It is a device for the management of transient states. This management is done with the help of four service structures or floors: the Database, Prototypes, Scenario Games and Action Plans. They contain the following:

- Database: Mini-scenarios and Operational Fields
- Prototypes: Urban Prototypes as moving singularities
- Scenario Games: simulation and testing of dynamic environments
- Action Plans: theses that lead to the proliferation, adaptation, and implementation of the prototypes

The Urban Gallery is like a cabinet with drawers: four drawers contain the main service structures, but each drawer has another set of drawers inside it. However, the substance of the structure of the cabinet is porous—all contents communicate with each other, or are linked according to specific trajectories. In the database floor for example we employ random sampling methods to determine processes that form the dynamics of a particular territory, combined with research into the nature of these processes. The random sampling points are called ‘bean sites,’ named after the technique of throwing beans that we introduced to demonstrate the principle. Recently the Database has been expanded to include a layer of Operational Fields alongside the catalogue of Mini-scenarios. Each Mini-scenario is constructed with four basic processes: Erasure, Origination, Transformation, Migration. Together, these four processes are able to describe any of the dynamic conditions at a given point, but they have a specific sequence: they follow a metaphoric succession of stages that are modelled on a seed. This set of basic processes is both a taxonomy as well an unfolding, both as narrative and as proto-evolutionary map. We have been working on this particular component for over ten years, but discovered much later that some of the work done by the Santa Fe Institute (in Santa Fe, New Mexico, USA) also contained a basic set of four processes, fairly close to ours.

Prototypes are organisational forms that combine processes from the database in a new way. Prototypes are new in the context in which they are introduced, but they are never one-off solutions: they become significant only if they proliferate in different situations and adapt to the circumstances specific to these different situations. Scenario games are played by actors involved in particular processes, with agendas and desires. They play simulations of specific evolutions, and create and test in these the conditions for specific prototypes. The action plans contain the tools, both traditional (the blueprint, the masterplan, the building regulation, the business plan etc) with which prototypes can be realised.

Urban Curators observe emergent phenomena and, as keepers of the transient states, act as animators for the dynamic contents of the Urban Gallery. Urban Curation is a new profession, although it can be recognized in many instances as being part of existing actions. In a recent competition project for the City Museum of Contemporary Art in Rome, we looked at curatorial prototypes that could cater to emergent and quite fleeting art forms that apparently disdain the institutional and physical structure of the museum. Our project searched to create an interactive meeting place in which curatorial prototypes intertwine different interests and actions in order to give form to a particular movement or vision. This development in curatorial practices in the art field inspired us to develop, together with the artist Jeanne van Heeswijk, the concept of Urban Curator.

2.4 Knowledgemanagement, moving singularities and artificial life

The Urban Gallery is a knowledge management tool that creates temporary holding patterns for knowledge and intertwines these patterns to fuel the urban prototypes. Inside one of the layers, the Action Plan, the thesis forms an inspirational core, containing deep research. This is something like the soul of the system, introducing potentially a highly specific “wind of change.” It provides the system with a kind of conscience and intention. This intention is aimed at the main product of the Urban Gallery: the evolution (adaptation) of Urban Prototypes and their proliferation though an action territory; adaptive states shift the prototype forward into a multiple proliferation, the multiple proliferation shifts into new states or situations, and the prototype is forced to adapt.

In the context of educational collaboration, initially at the Architectural Association, later at the Berlage Institute and other institutes, we have created Urban Galleries as teaching experiments, turning them into temporary abodes in which collaborations of teachers and students simulate the workings of the Urban Gallery in an urban context. The Urban Gallery in Sector E (the territory between Rotterdam and the South Flank of the Deltametropool and the Ruhr Rhine metropolis) has been such an experiment. The experiment turns the Urban Gallery into an artificial life-form in which the main structure becomes an organism given ‘life’ through the individual input of the participants. The concept of ‘life organism’ is both a metaphor and a reality: interactions in a Urban Gallery are like a life-form, but the intertwining of prototypes actually create new evolutions of prototypes that introduce ‘newness’ or ‘birth’ into the system. The Urban Gallery is like a frame imposed n a particular territory undergoing transition, it is a moving singularity, as well as an incubator for urban evolutions. The collaboration with Gordon Pask, one of the world’s great experts on Cybernetics, in the Architectural Association in London has proved fruitful in that he linked the early explorations on the Urban Gallery with scientific models and work done in Cybernetics. Takuro Hoshino, one of the initiators of the Urban Gallery, is currently taking these links further with the help of a pupil of Gordon Pask, Gerard de Zeeuw, professor of theoretical physics at the University of Amsterdam. Takuro Hoshino has introduced the notion of new life forms into the Urban Gallery, and is doing tests on that notion.

2.5 The Urban Gallery in action: tools and governance

Project W, Sector E, and the Netherlands in the context of a new Europe

We are now involved in several projects that implement the Urban Gallery as a planning tool and methodology. In fact, we have become Urban Curators of a large organizational process to bring together a variety of actors that want to apply the Urban Gallery, and are similarly training organizations to play this role. In the Netherlands, we are working with a consortium that aims at being a Community of Practice related to the development of Sector E. The consortium comprises planners on a national level, local authorities, private enterprises, and experts on a case project for a logistical node that simultaneously will be city and landscape. We act as process-managers for this community with the help of the Urban Gallery. While this guidance is based on the intersection of individual interests, we also have to act as planners and begin to tune the Urban Gallery as an instrument to the processes of planning, implementation and even inhabitation. We are now at the start of stage two in which we have introduced a game board into the actual site under consideration in order to orchestrate sub-groups of the consortium—subgroups that have vested interests in specific prototypes but can interact with others. These groups we also call communities, but in this case the term community refers to the product: a community of inhabitants, users and agents. In the second stage we will take the Community of Practice through all four service structures: the Database, Prototypes, Scenario Games and Action Plans. The project is not fixed yet in its location. It may move through a larger space for which it eventually must act as a model project. This space, called Sector E, stretches from the harbor of Rotterdam – still the largest in trading volume in the world – into the heart of the Ruhr area in Germany. Sector E is an emergent Eurozone, but also a site of the growth of a new urbanity. It is situated within the growing conflicts generated by the intensification of the flows of goods between this harbor and large parts of Europe. Because of the need for the regulation of these flows, the invention of dynamic systems for this regulation, and the management of the urbanization process, the Urban Gallery is a potential planning tool for Sector E. But for the time being it is a support system for a model project inside it, Project W.

Trans-national flows of many kinds—migration, expanding financial markets—are some of the products of the radical transformation Europe is currently undergoing. We have studied these phenomena at the Berlage Institute, in which individual students have developed one or more Prototypes and created Action Plans for their proliferation and adaptation in Sector E. This project will soon be on-line as an interactive version of the Urban Gallery. This is an experiment in real time dynamics, in which the educational space becomes a kind of Metaspace. In simulating the evolution of an environment, the professional actors in the consortium for Project W gradually move through different stages of the construction of an actual and virtual planning environment with concrete, physical products: a harbor, new landscape processes, new forms of living, education, and industrial enterprise. In the long run, the Urban Gallery Sector E may form a tool to test new forms of governance for such regions, but this is an ambitious agenda, and will take time.

Can planning mediate between sustainable communities and digital divide?

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1 INTRODUCTION

My paper addresses four interdependent aspects of contemporary urban and regional development in a globalising and dematerialising world. It examines the role of planning and governance in fostering sustainable communities while stemming digital divide.

Information and communication technologies (ICT) are making continuous inroads into every aspect of people's lives. However, their unequal geographic and social effects are incompatible with the notion of sustainability and its promise of economic and social justice and care for the planet. Can planning redress digital divide and promote sustainable development? Planning strategies are in the public domain and require democratic governance to make them acceptable to the citizenry. Thus it is a political act to mobilise interactive debate on digital equity and sustainability which provides the context to resort to planning when formalising the outcome of such debates and putting into place mechanisms of implementation. The understanding of universal access to digital communication and of sustainable places and communities derives from this political process which legitimises the reconciliation of contradictory forces.

Governance, planning, digital divide and sustainability have evolved rapidly over recent times. Governance is becoming more transparent, open and accountable due to the shift from representative to participatory and increasingly discursive democracy. This has changed the planning system from a prescriptive to a more interactive mode. At the same time the concept of sustainability has emerged from environmental and ecological concerns and lack of universal access to ICT has produced the notion of digital divide.

Both digital divide and sustainability are global issues, but their occurrence is local, as is remedial action against digital divide and intervention in favour of sustainable development. These issues have to be considered simultaneously at the global level in structural and theoretical terms, and at the local level in practical and operational terms. The Global Forum, an annual international ICT think-tank conference, has addressed many aspects of the rapidly evolving relationship between government, ICT industry, regulator and civil society.[1] It showed that the interplay between international strategies and local policies amounts to a power game. Governments, planners, ICT suppliers and civil society are key players in the quest of a sustainable information society. Their powers vary with their often contradictory interests. An example is the application of redistributive principles to global agreements or local implementation. This means that, within a given system of governance, the role of planning has to take into account its dual function as subject and object of ICT in promoting sustainable communities and curbing digital divide.

London and the English planning system have been selected as illustration because they deal explicitly with sustainability. As the largest city in the European Union (EU) London is able to reflect the complexity of the deliberations presented here.[2] Its population of 7.4 million (2002 estimate) is expected to rise to 8.1 million by 2016 when it will reach the size of Austria (8.1 million population in 1998). The first directly elected mayor of London has produced his first spatial development strategy for Greater London, 'the London Plan' which is nearing statutory endorsement.[3] Presenting London as a sustainable world city (arguably a contradiction in terms) the Plan endorses sustainable communities and condemns social exclusion. Nevertheless, London may be too fragmented to prevent digital divide and too large to achieve sustainability, a challenge lodged by environmentalists on the grounds of London's ecological footprint alone. It is important, therefore to relate the understanding of sustainability, digital divide, governance and planning to the urban region in question and to treat any outcomes with care, if applied to other urban environments.

1.1 DRIVING POWERS OF GOVERNANCE, PLANNING, DIGITAL COMMUNICATION AND SUSTAINABLE COMMUNITIES

Regional and urban development is driven by economic pursuits. Their physical manifestations are mainly generated by the private development industry. However, developers, financiers, land owners, contractors and other key stakeholders of the built environment have to comply with plans and planning guidance while securing clients and users for their developments. Their motivations are not necessarily compatible with social goals and environmental values which governments are responsible to safeguard. Democratic political regimes empower their governments to regulate conflicts between economic, social and environmental forces within the framework of their political goals. One of the regulatory instruments is spatial and land use planning. It is called upon by consensus brokering between conflicting interests in the physical development process.

Regulatory activities have increasingly resorted to ICT. In the UK, the e-government initiative aims to improve access to public services, including planning which, in turn, is used to overcome the digital divide, initially in the areas covered by the planning system. As sustainable communities are one of the new elements of the impending English planning system its contribution to the resolution of digital divide forms an integral part of sustainable community building.

Judging from current inequalities of access to public services, as well as to ICT generally, this neat strategy has not materialised yet, probably because powers and motivations differ between those representing the public, the private and the civic interest.

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[1] Judith Ryser. 2000. 2001. 2002. 2003. Synthesis reports. ITEM's International, France <http://www.items.fr>

[2] Of course, worldwide and also in Europe there are other large conurbations. With its 11 million population, the Paris region is similar to London's metropolitan area of some 11 million population; so is the Moscow conurbation or the polycentric urban region of the Ruhr in Germany.

[3] Mayor of London. 2002. The Draft London plan. Draft spatial development strategy for Greater London. Greater London Authority

The powers of democratic governance are vested in citizens and their votes to safeguard their collective welfare. Planning powers form an indirect part of this relation. Industry is the driving power behind ICT. It also lies behind digital divide as it is motivated by profit and considers universal access the responsibility of the public sector. What closes the power loop is civil demand for greater social justice and respect for the environment which governments have to pursue if they want to retain their power base. The notion of sustainable community stems from this process.

In the following section, it is proposed to examine the four selected components of urban development and their respective power base to understand how their interplay can potentially shape an economically successful and socially acceptable information society or, conversely, thwart integrated equitable development.

1.2 GOVERNANCE: FROM DEMOCRATIC DEFICIT TO DISCURSIVE DEMOCRACY

As democracy requires engaged citizens, it is not surprising that representative democracy has evolved into participatory and eventually discursive democracy. ICT has certainly facilitated this evolution by making information more widely accessible and citizens more knowledgeable about political issues. If representative democracy engendered the modern planned city in the 19th and first half of the 20th century, participatory democracy took citizens to the streets in the nineteen-sixties to wrest power from government. Added to that more recently, discursive democracy is threatening the prerogatives of elected officials, economic and cultural elites and other technocrats by reclaiming privileged knowledge from them.[4]

> *e-government is supposed to be about more accountable and user friendly governance. However, withdrawing human contact from public service delivery and enforcement of citizens' obligations may cause alienation.*

Even British democracy - with its first past the post system of *de facto* two party confrontational politics and unwritten constitution - has gradually undergone greater pressures from its citizens who want a larger share of decision powers, especially within their own communities. Following the EU initiative, the UK government intends to implement e-government by 2005. How interactive it will be remains to be seen, but thanks to the provision of ICT facilities, information should reach citizens more easily and trigger responses which, hopefully, will influence policies and government action. Increased electoral turnout would indicate a departure from current apathy of disaffected voters. But no attempt has been made yet to study, let alone experiment with e-voting, continuous electronic feedback from the electorate to the policy makers, digital interactive debates or any other ICT driven mechanism which would improve trust of civil society in politicians and thus legitimacy of politics and governance, and by extension planning.

1.3 PLANNING: FROM PROSCRIPTIVE END STATES TO MEDIATED PROCESSES

Since its heydays after the second world war, planning in the UK has undergone a number of fundamental changes. It has basically evolved from a proscriptive end state system to a mediated process. The UK is currently updating its planning legislation[5] rooted in the 1947 Town and Country Act. It evolves towards frameworks based on longer term visions, together with shorter term specific sustainable community- and/or area-based plans, as opposed to comprehensive countrywide land use allocation and unitary development plans.

> *The aim of the new UK planning system is to regulate regional development and land use in the public interest – but can it become a better respected public service?*

The evolution of ICT has facilitated the shift from proscriptive planning and restrictive development control legislation to looser frameworks open to flexible interpretation. Conceived as a sub-set of e-government, e-planning can take advantage of the political will which is promoting e-government as a means to reduce democratic deficit and voter apathy by bringing government closer to the citizens.

e-Government development and the growth of a seemingly untameable worldwide web are enhancing the use of interactive communication in general, as well as between planners and the planned in preference to one-way instructions. In the past, the public sector kept its information confidential while the private sector invoked commercial secrets. They still do, albeit to a lesser extent. Public consultation and participation has only taken off after protests against secrecy and planning decisions taken behind closed doors with little regard to affected third parties like local communities or single interest groups. In the UK, public planning inquiries are still conducted like quasi tribunals, involving lawyers and public inspectors who are arbitrating like judges, although the government of the day does not have to follow their advice. Now, the government is proposing electronic Planning Portals for which £ 6 million are available, as well as ICT terminals publicly accessible in planning departments for public consultation of on-going planning applications and appeals. These measures should provide better access to planning information for citizens and enable them to participate more actively in the development process.

> *Planners produce plans and documents; but does more planning equal less sustainable environment?*

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[4] Robert A Beauregard. Democracy, Storytelling and the Sustainable City. In: Story and Sustainability. 2003. Barbara Eckstein & James A Throgmorton. MIT Press.

[5] Planning Green Paper and consultation documents; Planning and Compulsory Purchase Bill; Local Development Frameworks; Planning Obligation: Delivering a Fundamental Change. http://www.odpm.gov.uk/stellent/groups/odpm_control/documents/contentservertemplate/odpm_index

Liberalisation and privatisation has not spared planning and much planning work is contracted out, with the effect that more planners start to operate in the private sector than in public authorities. No longer a major force of the public sector, planning has lost its dominance over physical development. Negotiation between major stakeholders of changes in the built environment is taking preference over formal development control procedures and emphasis has been shifting from the public good to individual property rights.

These trends are not confined to the UK. The International Manual of Planning Practice (IMPP) published by the International Society of City and Regional Planners (Isocarp)[6] shows that such trends occur throughout the planning world, despite the wide range of powers, procedures and types of plans currently operating at national, regional and local level in the 63 countries and 5 autonomous regions presented and analysed in IMPP.

1.3.1 ICT: subject and object of planning

What planners share, especially in developed countries, is increasing use of ICT, not least to establish a more democratic relation with citizens, often at the receiving end of planning decisions. At the same time, ICT is regulated by planning. The location of the production of ICT hardware and software and its distribution, as well as the provision of networks under ground and in space for ICT use have all become part of land use and spatial planning. It could thus be construed that, by implication, ICT is both 'subject' and 'object' of planning which, in turn, may influence the role of planning in curbing digital divide.

1.4 EMERGENCE AND DYNAMICS OF DIGITAL DIVIDE

If the proposition "information is knowledge, knowledge is power" is true[7] the planning system has a lot of potential power as it holds knowledge, including on ICT location and infrastructure development which it controls, together with conventional as well as digital access to its information. By restricting or withholding access to its databases it would affect adversely universal access to, and universal service of digital communication, and thereby seriously hamper empowerment of civil society. The same arguments apply to governments, should they carry out such restrictive practices. Conversely, criteria regarding the safeguard of the public interest do not apply to the private sector. Competition principles dispenses it from supplying either universal access or universal service, traditionally a public sector function delivered by the state as, for example, universal distribution of ordinary mail, or universal health care at the point of need. Civil society would prefer universal services to universal access of ICT, although higher levels of provision of either would contribute to the sustainability of communities.[8] The debate about these choices has to be put into the context of ICT evolution.

1.4.1 The context of ICT evolution

At the global level, the International Telecommunication Union (ITU), a United Nations specialised agency which confederates governments and industry worldwide is promoting the information society. Its emphasis lies on global open access to digital means of communication, expected to evolve into universal service in the long term. Many other international and intergovernmental organisations, such as the World Trade Organisation (WTO), the United Nations Educational, Scientific and Cultural Organisation (Unesco), the World Intellectual Property Organisation (WIPO), the Organisation of Economic Cooperation and Development (OECD), the European Union (EU)[9] are also involved in the construction of a borderless cyber-network to achieve seamless digital communication.

> *"Telephones will not feed the poor, and computers will not replace textbooks. But information and communication technologies can be used effectively as part of the toolbox for addressing global problems".*
> *Yoshio Utsumi, Secretary-General of the International Telecommunication Union at the Global Information Society Summit, GenevaDecember 2003*

Aware of the gradual globalisation of the information society and the worldwide evolution of digital communication the European Union (EU) has made the Information Society a priority. It has produced a number of Directives to liberalise communication infrastructure and services, including telecommunications and audio-visual, universal broadband connection in the public sector and interoperability (compatible software, universal standards for satellite, cable, terrestrial networks and radio frequency). The EU aims to make interactive public services accessible to everyone via broadband and multi-platform terminals (e.g. telecommunication, TV, PC) by the end of 2004 and to provide easy access to the Internet for all citizens at public entry points (PAPI). Overall, the eEurope 2005 programme intends to stimulate development of all three: services, applications and contents, as well as to speed up deployment of secure broadband Internet access.[10] The EU's aim to achieve e-government by 2005 has a direct impact on the planning process which is resorting to the same means of communication.

ICT has penetrated every aspect of human life, at work, in the home, on the move, at play and even at rest. Since 2002 most schools and businesses are online and household connections have doubled in the EU[11], e-commerce and related security measures have

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6 Derek Lyddon and Adriana dal Cin (eds). 2002. International Manual of Planning Practice. Latest edition on CD. Isocarp Secretariat, the Netherlands.

7 Domination or Sharing, endogenous development and the transfer of knowledge. The Unesco Press, 1981, p 9

8 Jago Petzer's winning poster of the Isocarp Carfax prize in 2001 gives an example of ICT empowerment in the developing world.

9 http://europa.eu.int/scadplus/leg/en/lvb/124193.htm

10 COM(2002) 263 final; implementation: OJ C 48 28/02/2003

11 eEurope final report 2002

come on stream in 2003 and many other e-initiatives are being taken up more widely, such as tele-medicine, distance learning, e-transport management and user information, intelligent household appliances and bar-coded labelling of consumer goods. Shared research cyber-networks and mobile, flexible tele-working have become an integral part of 21st century economy.

Digital Access Index (DAI) 2002

= measure of overall ability of individual in a country to access and use ICT. It consists of 8 variables organised into 5 categories (1 infrastructure: fixed and mobile tel/100 pop; 2 affordability: I-net access as % GNI/capita; 3 knowledge: adult literacy & education enrolement levels; 4 quality: bits/capital & adsl/100 pop; 5 usage: I-net users/100 pop) converted into indicators with value 0-1, weighted within its category and averaged to obtain overall DAI value

Sweden	*0.85*	*highest, world*
USA	*078*	
UK	*0.77*	*highest, EU*
Austria	*0.75*	
France	*0.72*	*like Slovenia*
Latvia	*0.54*	*lowest, EU (25)*
Niger	*0.04*	*lowest, world*

Source ITU

New ICTs are coming on stream continuously, such as digital TV, latest generation of multi-tasking mobile phones, growing footprint for GES, miniaturisation of communication tools, expanded cyber-services, etc. The increasing number of industry standards is enhancing competition, convergence and price reduction. Together, these developments have contributed towards the exponential uptake of ICT in every walk of life, thereby transforming work practices and lifestyles.

Besides all these advantages, ICT has also brought along drawbacks. In particular, two major problems need to be addressed: protection of privacy and electronic data security.

1.4.2 Advantages and drawbacks of ICT: Free flow of information, privacy and data security

The overwhelming paraphernalia of new ICT instruments have raised citizens' awareness of their right to know. Knowledge of their information rights has also sharpened their determination to obtain protection from information abuse. Security has thus become just as central a preoccupation in cyberspace as in the geo-political sphere.

If the free flow of information is the lifeblood of an innovative society, protection of privacy and electronic data has to form part of civilisation, owing to respect of democratic principles and human rights. However, protection has been eroded continuously since '9/11' (terrorist attacks in the USA). ICT can be used to locate and trace citizens in their daily activities. Already, the UK has the highest number of CCTV surveillance cameras per population (1 for 14 citizens) which raise planning control issues. It is estimated that in London people are photographed some 300 times a day. No wonder that citizens are becoming suspicious of electronic communication and tend to resist e-commerce and even e-communication with the public sector generally.

In the UK, data on citizens which the state is collecting with its compulsory powers is shared increasingly between government departments, quangos (quasi governmental organisations) and with other contracted out and even private bodies, often without the knowledge of the citizens concerned. Opportunities to check and amend such personal data are poor, as citizens have to ask to view specific information while guessing what is collated on them. The proposal to store a host of personal data electronically and invisibly on an identity card as well as on interconnected databases is anathema to citizens in a country ruled by common law and *habeus corpus* rights. Not surprisingly, the human rights lobby is opposing these trends and asking for security and safety guarantees.

Planning data was always a valuable asset. It may not have been by chance that during the cold war the Salzburg Seminars of American Studies held an annual session on planning at which senior planners from centrally planned economies (Eastern Europe) and market economies (Western Europe) exchanged their experiences based on case studies they brought along. Today, being in the public domain, planning and development control has access to the databases which owe their existence to the introduction of advanced ICT. This could give rise to potential misuse, especially where large developments are concerned with substantial betterment and land value gains. Anecdotal experience shows that it is much harder for the general public to come by such planning information. Anything deemed 'confidential', including correspondence between planning authority and planning applicant can be withheld from the public part of local planning committee deliberations.

With increasing digitalisation of data in the public sector on private aspects it is important to agree on an equitable and democratically acceptable balance between open access to, and free flow of information and the protection of privacy, intellectual property and commercial rights. This principle needs to apply also to planning.

1.4.3 Emergence and dynamics of digital divide

Most critically, both the growth of ICT and access to it have evolved very unevenly worldwide, between countries and continents, urban and rural areas, as well as within countries and urban agglomerations. In its action plan, the World Summit on the Information Society (WSIS) held in Geneva in December 2003 sets out the goals for 2015 to redress such inequalities, especially between the developed and the developing world. [12]

Universal access depends on two conditions. It has to be supported by hard and software infrastructure at affordable prices. It also depends on the know-how of those who seek access and their opportunities to acquire necessary skills and overcome psychological barriers. Often, but not necessarily always, this presupposes literacy and numeracy, although the audio-visual dimension of digital

[12] http://www.itu.int/wsis/documents/listing-all-en-s|1.asp

communication can compensate for that to some extent. Voice activated communication is evolving and "images are worth a thousand words", provided they project cross cultural content. There is still the language barrier to consider and the dominance of English on the Internet, despite improvements of machine translation. The free market is hampering the provision of all these facilities worldwide and has led to digital divide, especially between the developed and the developing world, but also within countries, regions and cities, between affluent and poor areas, not least because externalities are neither captured nor redressed.

It is a mute point to find out whether digital divide is aggravating already unacceptable polarisation between rich and poor, enabled and deprived, and exacerbating spatial segregation between and within cities, between dysfunctional and sustainable communities. Most importantly, it has to be established how digital divide can be remedied, who should bear the responsibility and what planning can realistically contribute towards improvement.

1.4.4 The London case

The mayor of London tried to find out what the digital divide actually is in London and how to improve the situation.[13] In a study of Londoners' actual Internet access[14] income comes up clearly as the crucial divider between those who have, or could have access to the Internet and the others. When controlling the data for other aspects, such as ethnicity, marital status, household type, social belonging, age or gender, health or disability they appeared marginal.

This revelation was compounded with the findings on attitude. The survey shows that 45% of Londoners had access to the Internet in 2002, (albeit only 16% of those with household incomes under £ 10'400). However, 40% of the remainder (respectively 50% of the lowest income group) said they did not want it. In a city in which income differential is growing not shrinking despite its wealth and low average unemployment, these outcomes are quite alarming.

Household Internet access by household income (%)

Income	*Yes*	*No can't afford*	*No don't want*
<10400	*16*	*35*	*50*
10400-15599	*30*	*20*	*50*
15600-20799	*44*	*16*	*40*
20800-25999	*55*	*10*	*36*
26000-36399	*64*	*5*	*31*
36400-52000	*69*	*2*	*29*
over 52000	*80*	*1*	*19*
all households	*445*	*15*	*40*

Source: Mayor of London. Londoners on-line 2003. GLA

The survey shows that, while people consider passive 'information' consumption supplied by television a basic 'need', not everybody has the urge to be wired up. Minority groups use e-communication primarily for e-mailing (to keep in touch, often abroad, with family and friends at a cheaper rate than by telephone). E-mailing is followed by 'education' (consisting of information gathering not active e-learning) and, for those used to the Internet, job search. These findings challenge the notion that deprived Londoners would benefit most from electronic access to get their social contributions paid, seek a job, or simply obtain help with their various needs, such as health, education, old age or small children. Classified in another way, most Internet activities of Londoners would fall into the category of 'fun' with less use of e-government services than Internet shopping, albeit more than banking.

The survey results should not distract from improving digital interaction between the planners and the planned. Judging from the relative high use of the Internet by people who were born well before the widespread use of electronics it is possible to overcome access hurdles. Planning debates should not be left to the media which pick and choose and usually emotionalise subjects, such as tall buildings, favoured by the London mayor, without enabling the public, and especially disadvantaged citizens to influence planning decisions and policies on these matters.

1.4.5 Planning for a balance between digital and physical interaction

It should be remembered that cities are cradles of civilisation, brought about by human interaction with much of it played out in the urban public realm. London's Hyde Park Corner is a symbol of free speech and Trafalgar Square the traditional locus of popular assembly for protest as well as celebration. Digital interaction cannot replace that and may have its drawbacks, especially for people who are already isolated and confined to their homes due to age or disability for example. Giving everybody a computer at home may be much cheaper than to supply collective infrastructure - such as schools, community halls, health centres, shopping malls, public transport, open spaces, leisure facilities and public realm generally. In the past, such facilities often failed to materialise for cost reasons, despite forming an integral part of traditional planning briefs. Relying on higher densities for their viability, they have reappeared in planning briefs of sustainable communities. Clearly digital communication cannot replace face to face interaction and it may be a planning task to find a balance between electronic and physical provision capable of mutual reinforcement.

It could be argued that replacing the last opportunities of face to face contact between citizens, their elected representatives and their administrators with sophisticated broadband communication will, if anything, create an even greater gulf between them and erode the little trust there is. Yet, without trust and respect desperate people are unlikely to change their attitudes to adopt a more socially accountable behaviour. More people-centred attempts may lure citizens into using ICT, such as the digital champion schemes of Scottish Enterprise which locate access to electronic communication in pubs and supermarkets instead of institutional establishments.

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[13] Mayor of London. 2003. Connecting people: tackling exclusion? An examination of the impact on, and use of the Internet by socially excluded groups in London

[14] [Mayor of London. 2003. Londoners on-line; an analysis of home Internet access from the London Household Survey 2002

Even a goldplated pipe cannot guild what it carries

It should be kept in mind though that not everyone who requires and pays for local public services lives in doom and gloom and the case for putting the lion share of public resources into socially depressed areas and ailing businesses remains to be made. In the USA local authorities are 100% financed from income they raise themselves. What matters to them is to change mindsets gradually which they achieve by small actions with single rules of engagement and constant feedback. e-Government means empowering e-citizens to carry out their own agenda, not necessarily according to the assumptions of technologists. Such a climate of empowerment may even stimulate corporate social responsibility and generate cooperation between citizens, business and local government in the interest of the community as a whole.

One example is the city of Stockholm's political decision to remain in charge of ICT infrastructure. It laid black fibre to every front door. The negative impact on the environment is infinitesimal compared to the multiple trenches which competing companies dug in London until the dot.com bubble burst to the great detriment of the environment and the streetscape. Black fibre gives everyone access to disseminate content, enabling community television networks which exist alongside commercial broadcast operators and public sector communication networks.

1.4.6 Content

Digital infrastructure and terminals only provide the conduits for content which is generated by ICT based providers and/or the users themselves. While Stockholm devolved care of content essentially to third parties, except for its municipal communications, other countries and cities, including the UK and London left both infrastructure and content provision to others, except for government websites which provide mainly one-way information.

Perhaps citizens lack interest in digital access because they do not see the value of information on offer, nor do they believe that they are being heard. Before setting up its earmarked electronic hub for planning data to monitor London's physical development, the Greater London Authority (GLA) should clarify what such a database of planning activities can contribute to enhance sustainable communities and to improve communication with planning authorities by decreasing digital divide while improving service delivery.

Content consists of substance expressed in a certain language. In the UK, the Office of the Deputy Prime Minister (ODPM) responsible for planning and sustainable community development has made £ 660 million available for capacity support of local authorities to take up the benefit of e-government in a 'multi-channel way' and thereby connect them better to local communities. However, often officialdom uses obtuse language which prevents citizens to grasp content and makes them lose interest. Reducing digital divide encompasses the provision of infrastructure, skill training for users, together with change in public sector culture to make content and language more accessible to ordinary citizens.

Not surprisingly, a host of new institutions, such as London based UK online centres, the University of Industry, LearnDirect, CitizensOnline the International Electronic Commerce Research Centre and others have sprung up in response to the government's e-drive. As the restated aim of the English planning system is to regulate regional development and land use in the public interest planning would do well to resort to such resources to enhance its digital voice. Where does this leave the planners? Can they extract some benefits from the e-drive for their profession? And do they have to legitimise their role in the digital divide debate by taking a more forceful stance on the sustainability of communities?

1.5 FROM ENVIRONMENT TO ECOLOGY TO SUSTAINABILITY

It could be argued that what has become a sustainability issue at present was debated under the banner of ecological concerns in the nineteen-eighties and, in turn, formed part of the green movement of the nineteen-sixties which aimed to protect the environment against frantic urbanisation. The focus has thus shifted first from nature to man-environment relations and then to the impact of human activities on the current and future natural as well as man-made environment.

A sustainable community is where economic growth, social justice and environmental quality coexist. It is aided and abated by discursive democracy to guide public debate and by transparent and open governance which translates the resulting consensus into actions for the common good, while respecting future generations.

For arguments' sake, let us assume that sustainable communities are places where social justice, economic well-being and good resource husbandry coexist. That still means that their sustainability relies on people who congregate there and practise discursive democracy. They know that many of their diverse interests depend on communalities for their fulfilment. Therefore they engage in public debate and carry out actions for the common good while upholding respect for future generations. In this process, resorting to ICT amounts simply to adding a tool to their kit. How can planners engage in dynamic interaction with sustainable communities? How much should take place in real space and real time and how much in cyberspace using remote electronic communication? Isocarp is one of the planning lobbies which has debated the role of planning in the information age at its 2001 congress[15].

Eradicating digital divide would be a precondition to assist sustainable communities in achieving their triple goal of healthy economy, equal opportunity and environmental quality. However, such a concept of 'sustainability' may seem idealistic, especially to the custodians of the necessary resources to achieve it. Most likely they have a different interpretation of sustainability. Accountants, for example, speak of 'sustainable business plans' when in fact they siphon off revenue expenditure from existing budgets. They could make a better contribution to sustainability by resolving the seminal dichotomy between capital investment and

[15] Judith Ryser (ed). 2002. 'Honey I shrunk the Space. Planning in the Information Age. Isocarp

revenue costs, and by including externalities so often omitted by developers and officials in their sustainability equations. Providing universal access to ICT is one such externality which should be reintroduced in assessing the sustainability of developments.

ICT user survey results show a lack of interest in ICT access but also increased uptake of ICT use once the access barrier, mainly due to lack of self confidence and skills is broken. Thus, further efforts are required to provide universal ICT access to create a level playing field for citizens and to enable human resource capacity building. Nevertheless, needs of ICT access are not homogeneous and differentiation may be appropriate. Type and degree of ICT provision should become part of briefs for sustainable communities, designed by planners as their contribution to the empowerment of citizens. Let us not forget, however, that other measures are needed besides reducing digital divide to overcome exclusion and achieve self-managed and self-reliant sustainable communities.

2 CONCLUSION

The underlying premise of this paper is that the information society is expected to evolve into a sustainable knowledge society. It asked how planning could enhance citizen-led sustainable communities while reducing incompatible digital divide.

Answers may be more easily identified by relating them separately to the three sustainability criteria identified above: economic growth, social justice and environmental quality.

ICT is seen as a driver of economic growth. Spatial planning can influence the location of ICT firms, the provision of ICT infrastructure and physical access to end users. Designated land use for ICT company clusters, for example in science parks in proximity to higher education and academic research establishments, is expected to generate innovative synergy. However, evidence that physical proximity guarantees interaction is ambiguous.[16] High density, mixed use development privileged by current planning ideology creates favourable conditions for efficient ICT distribution, akin to public transport. Finally, the provision of public premises with easily accessible ICT terminals, preferably combined with ICT training facilities would reduce digital divide. Together, these dispositions could stimulate the local economy.

Secondly, good links between the science park establishments and community based ICT training facilities would offer the local population a better chance to obtain ICT jobs. It would combat both social injustice and digital divide. Similarly, outreach links providing access to ICT skills and jobs in deprived areas would contribute to social justice. Planning gains could also be included in briefs to provide the local population generally with better access to ICT through affordable hardware, software and skill training. This, in turn, would give better access to public services and expand e-government to all segments of the local population, thereby contributing to social justice.

Thirdly, compact development would improve the environment as it would reduce polluting transportation of people, goods, as well as waste. Theoretically, mixed use should curb the need for travel between work and home. Better ICT infrastructure would also reduce journeys by facilitating more homeworking, e-shopping, e-banking or e-learning.

However, all these provisions are subject to human behaviour and freedom of choice. It could be argued that people prefer to live next to their leisure activities rather than to their work, thus commuting would continue even in high density mixed use developments. Similarly, high income and low income households would not chose to live next to each other, despite public social engineering. Home zones without provision for car ownership are not a universal success and high density developments could well become the slums of the future.

A high quality public realm would satisfy all three sustainability criteria as well as making a contribution to future generations. However, transport tends to claim the lion's share of public spaces. In cities where land is at a premium, the public realm enjoys little protection and with growing fear of crime the public realm is threatened by privatisation. This leaves less public spaces for free assembly, face to face encounters, or even just for being there, thus jeopardising *'civitas'* the fundamental *raison d'etre* of cities.

Finally, it is wise to remember that a single power cut can bring the whole information society and its ICT powered activities to a stand still. Luckily, human beings have their human intelligence to cope with such crises.

Judith Ryser, CityScope Europe, London January 2004.

[16] for example: Simmie, J & Sennett, J. 1999. Innovative clusters: global or local linkages? In: National Institute Economic Review 170. 87-98; or: Buck, N, Gordon, I, Hall, P, Harloe, M, Kleinman, M. 2002. Working Capital. Life and labour in contemporary London. Routledge

Knowledge -based urban and regional development in the ICT age - The rich and the latecomers

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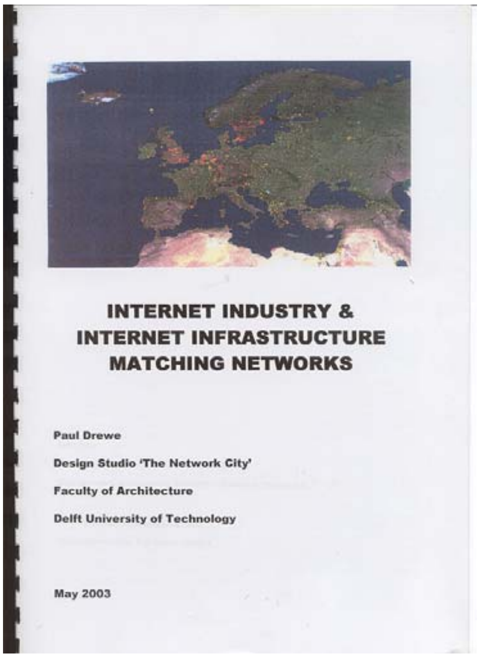
1 THE RICH GET RICHER OR 'NOT EVERYBODY PLAYS IN THE CHAMPIONS LEAGUE'



This recent study shows that, with the rise of ICT, the regional distribution of both the Internet industry and the Internet infrastructure is not substantially changing. It is the rich regions that get richer.

Moreover, innovative capabilities are concentrated in a few regions and there are 'islands of innovation in Europe'.

If the rich get richer others must be classified as **latecomers.** A realistic positioning of regions is preferable to the unqualified claim that one's region is 'playing in the Champions League' as this claim may lead to misplaced (public) investments.

1.1 The Internet Industry

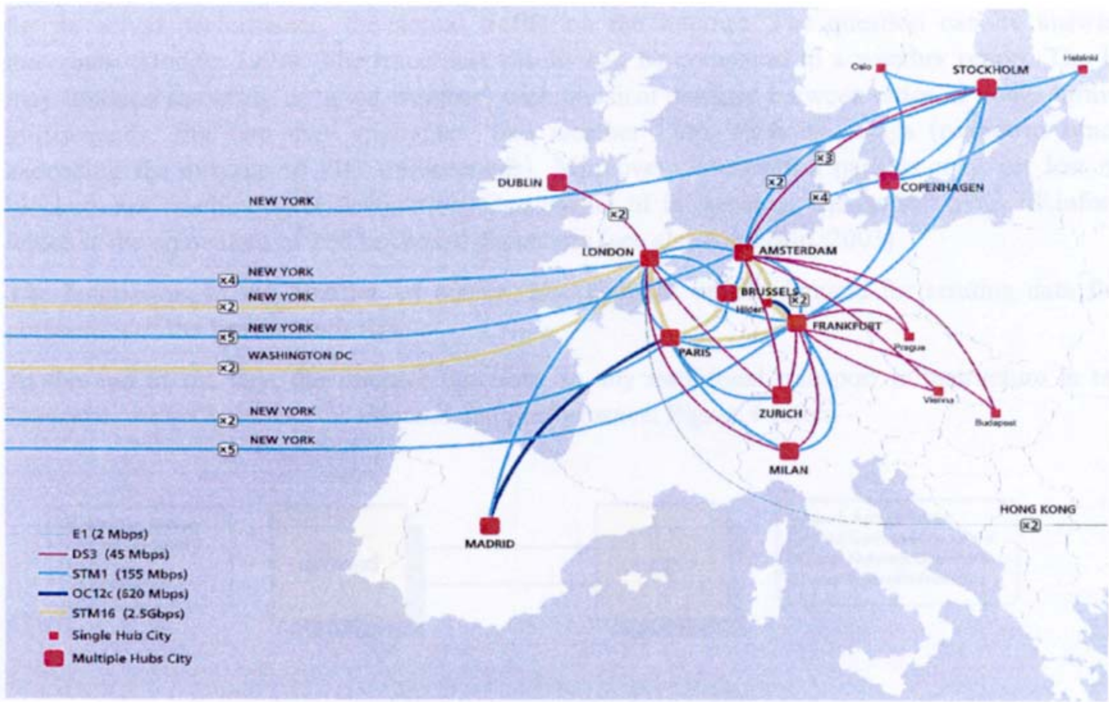
It would be erroneous to refer to the Internet industry in terms of 'new economy' as opposed to 'old economy': '… the new economy appears less like a new economy than like **an old economy that has access to a new technology'** (Porter, 2001).

'The hype is over, but the' … real legacy of the Internet is not the birth of thousands of new online companies but **the transformation of existing businesses'** (Barabasi, 2002).

1.2 The Internet Infrastructure

There are many nods with only a few links and only a few hubs with a large number of links.

The European transit backbone of MCI



1.3 Innovative Capabilities:

See for example the 2002 European Innovation Scoreboard

Table 2. 'Local' EU innovation leaders

Rank	Region	Country	RRSII [1] [2]
1	Stockholm	Sweden	225
2.	Uusimaa (Suuraleu)	Finland	208
3.	Noord-Brabant	Netherlands	191
4.	Eastern	United Kingdom	161
5.	Pohjois-Suomi	Finland	161
6.	Ile-de-France	France	160
7.	Bayern	Germany	151
8.	South East	United Kingdom	150
9.	Comunidad de Madrid	Spain	149
10.	Baden-Wurttemberg	Germany	146
17.	Wien	Austria	126
21.	Vlaams Gewest	Belgium	112
22.	Lombardia	Italy	112
31.	Southern and Eastern	Ireland	108
49.	Lisboa E Vale Do Tejo	Portugal	94
50.	Attiki	Greece	93

2 HOW CAN LATECOMERS MAKE IT IN A WORLD WHERE THE RICH GET RICHER

Will only fittest regions survive, facing the external shock of globalization?

No, because there are different degrees of fitness. As far as the match between the Internet industry and the Internet infrastructure is concerned, it is important to achieve a balance between demand and supply at **all** levels. Demand is the driving force for the growth of the networks involved. See the French experience (Dang Nguyen, 2000).

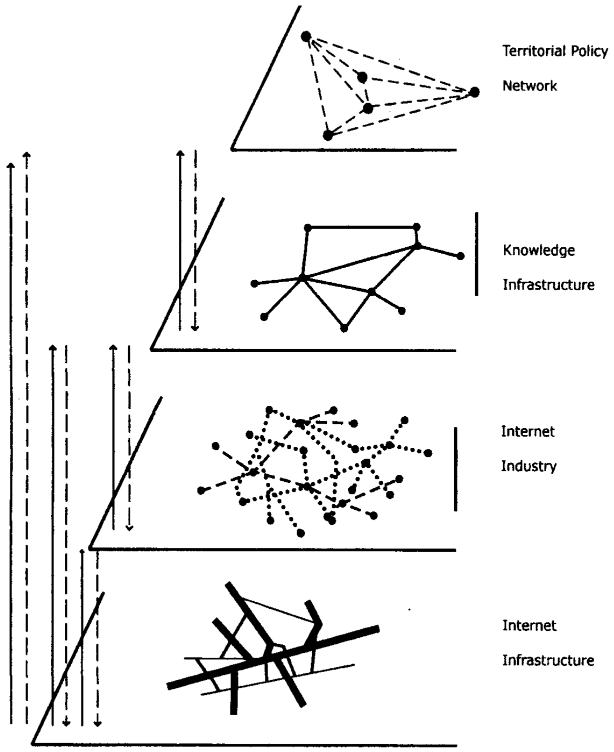
A Glocal scenario holds. Glocal refers to a dual world of top companies and local innovative milieux or environments. **Innovative milieux**, in brief, are based on the synergy of business firms (in particular small and medium-sized enterprises or SMEs) territorial authorities and knowledge centers. Milieux are about local interactions, which promote technological innovations. See the work of GREMI, the 'Groupe de Recherche Européen sur les Milieux Innovateurs' (for example, Crevoisier and Camagni, 2000).

1 The RRSII (revealed regional summary innovation index) is calculated as the average of the RNSII and the regional European summary innovation index (REUSII). The REUSSI is calculated as the average of the indicator values indexed to the EU mean.

2 In total there are 148 regions for which a RRSII could be calculated.

With the introduction of innovative environments, two networks are added to those of the Internet industry and infrastructure:

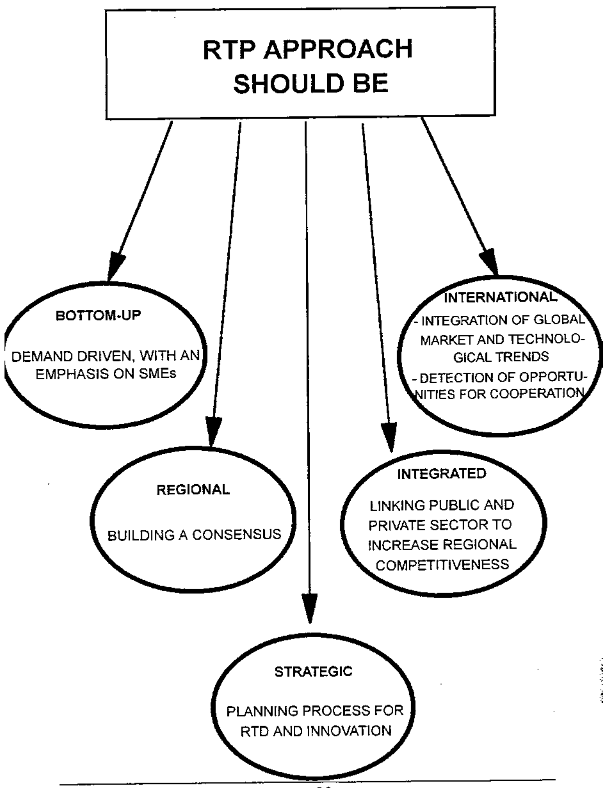
- **Territorial policy networks**, and
- Networks of knowledge centers or the **knowledge infrastructure**.



This complicates the task of matching. It may help to do this per cluster of economic activities.

There are lessons to be learned from the Flevoland Regional Technology Plan (RTP) from 1996, updated in 2002 as Regional Innovation and Technology Plan.

According to the European Commission (1994) a RTP approach should be:



While **REGIONAL** refers to innovative milieux, **BOTTOM UP** and **INTERNATIONAL** are singled out here for further explanation.

This means that the assessment of regional R&TD and innovation **demand** should be tackled **before** the analysis and assessment regional technology **supply**.

'Various studies have pointed out that the approach followed in many regions was a top-down (and technology push) approach rather than a more bottom-up (and demand pull) approach which takes into consideration the R&TD needs of local firms' (European Commission, 1994).

The problem is that knowledge centers and universities in particular tend to favor an approach that is supply-led.

Drawing the picture of a regional cluster of economic activities, it should comprise research laboratories as well as manufacturers and subcontractors.

The essence of innovation lies in new or improved goods, services and processes. However, studies and policy papers seldom measure those. See for example the national indicators for Europe (European Commission, 2003) or http://www.cordis.lu/indicators

And to produce those innovations the economically relevant knowledge goes far beyond 'technology'.

Creation of knowledge		Knowledge base		Application of knowledge
Own knowledge creation: * technical research and development work: - products - processes * non-technical knowledge build-up * practical experience	==>	Economically relevant knowledge: * technology * design * management * organisation * marketing * logistics * administration finances	==>	Internal use: * new or improved goods * new or improved services * new or improved production processes
External acquisition of knowledge: * acquisition of production means * information from printed and audiovisual sources * congresses and trade fairs * acquiring licenses * external service-lending - sub-contracting - bringing in consulting agencies * cooperation - with clients - with colleague companies - with knowledge centres * new employees or trainees * 'brains' * informal networks	==>		==>	External use: * patenting * transfer via cooperational alliances * supply of production means * supply of services * dissemination via media, group meetings, networks * outflow of "brains"

Neither the Internet industry nor the Internet infrastructure has territorial boundaries. And knowledge centers, too may engage in transnational networking.

Therefore it is important for territorial authorities to follow in lockstep. As a consequence, successful city marketing is going to rely more on 'a specialized "politics of flows" than a place-based politics of competition' emphasing indigenous factor endowment such as the presence of 'critical infrastructure' (Doel and Hubbard 2002).

Note that knowledge, can be imported as well as exported.

There are various European programs to promote international cooperation in particular focusing on 'latecomers' (and SMEs) involving the four networks mentioned above.

The policy of the European Union is increasingly focusing on '**Regional programmes of innovative actions**' in an attempt to match the four networks:

There are three priorities:

- To encourage regional economies based on knowledge and technological innovation
- To stimulate the information society at the service of regional development
- To strengthen regional identity and sustainable development.

The innovative actions favor 'latecomers' as innovation, too, is 'a rich-get richer phenomenon'. (European Union, 2003).

Ideally, international cooperation should involve all networks functioning as synergetic innovative milieux as envisaged by 'Erik', the new network program of innovative actions (jointly submitted by the regions of Toscana and Emilia Romagna): http://www.eriknetwork.net

As always: the proof of the pudding is in the eating.

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High Tech and High Touch in Chinese settlements –
communication and sustainability in the EU-project SUCCESS

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1 HIGH TECH AND HIGH TOUCH

From the welcome speech of a village leader addressing a Sino-European expert team coming to his village:

我非常高兴, 今天你们能到这里来, 跟我说这么多话, 我一高兴也许能再活一百年. 我也没啥要求, 我最后只有一个要求: 希望你們今天中午能留在这里吃吃我们的家常饭	I am very happy. Today, you people can come here. With me, you talk so much. So perhaps I can still live until I'm 100. I have no other wish left. I have but one final wish: I hope today at noon time you can stay here at my place and eat and share our daily food.

2 INTERVIEW OLD MAN IN XIAFUTOU, PROVINCE HENAN, CHINA, MARCH 2003

The experts bring two things to the village - high tech and high touch. High tech is the knowledge they bring with them, their instruments, their digital devices and also the way they organize their research. This information will be part of the village life.

But they also become part of the high touch in the village: not only do they share their knowledge with the village people, they should also share their day-to-day life with them. In terms of the village leader: they should share the normal, daily food – not a specially cooked meal as for festival days. No, the invitation is to become part of the daily village life and its conviviality.

The combination of these two kinds of communication makes him so happy that he now has enough happiness for the rest of his life - until his 100th birthday.

With the study team, the new time, the era of globalisation has arrived in this tiny remote village in a central Chinese province: a team of 20 Chinese and European experts has landed in their village to help them to develop sustainable future images.

This astonishing high tech event is inserted into a fully traditional life: high-tech ideas for energy, agriculture, economy, socio culture, communication brought here by its first ambassadors.

For the ex-village leader, this high-tech event needs to be compensated through high touch: to do so he invites these strange people to have lunch with him – high touch, the form of information that is familiar and therefore can be trusted.

Talking about a process of sustainability is a task that requires both: High Tech and High Touch. Even in a tiny Chinese village, the globalisation era calls for a presence in the global village – and all over the country, regional development plans reach even remote rural villages. Thus High Tech is wanted and needed and has its effect. But sustainability as an effective process for a transformation that can actually take place in China is just as important: Only if the topic reaches out to every dweller in the village, and specially to the village dwellers as a coherent human community, will they uncover future images and the related effective fields of action.

In the Chinese as well as in the European context, sustainability is a relatively new notion. Whereas in Europe, it is a concept born in post materialism and postmodernism, the Chinese concept of transformation unites all these factors in one: the village needs and wants modernisation, but it also needs and wants to preserve some aspects of the life qualities inherent to any traditional society that leads back to pre-modernisation times (in Chinese time terms).

As sustainability is part of the concept of post modernity, it gets its main features by its critique of American-European, so-called western development concepts. Yet even the proponents of the concept of sustainability live with all the benefits that modernity has to offer.

The sustainability concept, therefore, is possible for a threshold country like China only if it takes seriously the need for modernisation within the critique of this modernisation.

How to combine the need for a modern quality of life with new communication technologies and the local management of sustainable development within the limits of nature for the next generation, and how to discover potentials and spaces of possibilities (Möglichkeitsräume) where the villagers can develop future scenarios and future images is the core topic for Chinese rural development. In the work of the SUCCESS project in small Chinese villages, the research team accompanies and assists local villagers in discovering their path to a modern way of life within the limits of nature, including aspects of an urban lifestyle combined with the potentials of a rural life based on agriculture.

In a village with dirt roads, with no or little home heating or cooling devices, with no other employment than the hard physical labour of agriculture, without access to the new information media except for official Radio- and TV-programmes,

the need for development of the physical infrastructure and for better services is manifest to every serious visitor. But the interviews that we made in these villages show that there is a need for modernity beyond its practical dimension, we found a wish for symbolic change even more than for usefulness. This is the case, for instance, for the houses: "*The old houses are not good. They are not modern*". (Film maker 6) The village film maker considers the new house as a value although the glassed in balcony is not used at all. "*Newly built house is a sign for personal wealth.* "(filmmaker interview 2). In all case study villages there is an ongoing discussion between people about the old traditional poor life and the modern new life that they consider the icon of emerging wealth. The symbol for the new modernisation is the new house. Even if the houses are not practical, the house is a symbol for the newer and better life.

The following article gives an overview about the high touch areas of Chinese village communication and the places where it happens. The results presented are based on the experiences of all seven case study villages of the SUCCESS project, but the examples we have used are taken mostly from the villages of Beisuzha in the province of Hebei, of Xia Futou in Henan and San Yuan, province Yünnan. The SUCCESS project shows the combination of scientific investigation with the combination of high tech solutions from the Sino-European expert along with the case study field work which is a high touch process.

The concept of high tech-high touch came about in a conversation between Heidi Dumreicher and the trend-researcher John Naisbitt about life quality held in Vienna in 1999: we felt that we need both, a combination of good neighbourhood and a link to the global village, a will of preserving the near and well known allowing also for the far away.

3 THE SUCCESS PROJECT

The SUCCESS project – Sustainable Users Concepts for China Engaging Scientific Scenarios[1] – develops and carries out seven case- studies of peri-urban and rural settlements in six different provinces in China. The project started in September 2002 and will continue for another two years.

In this interdisciplinary project the following disciplines work out sustainable future scenario's for the villages: economy, ecology, socio culture and architecture. SUCCESS has a strong bottom-up approach, combined with top down elements. The basic question of the research is what to maintain and what to change. From a proto-sustainable Chinese village to contemporary sustainable village systems - this process supports an emergent future, respecting human needs combined with the needs of nature.

The theoretical basis of this project is the fact that in the chosen Chinese settlements a proto-sustainable socio-economic system can be found with very little waste and many regenerative systems, with the usage of earth and clay for the housing construction, and the usage of human manure in the agriculture. Most of the villages also have consistent social systems which allow them to consider community as a basis for common identity. As social change happens very quickly in the whole China, the project has also to deal with a changing environment in the villages. Above all the peri–urban settlements are strongly influenced by the forces of social change and the images of modern life. At the time of the writing of this paper, the field work is has been finished and the work on future scenarios has begun.

3.1 Interdisciplinary communication

SUCCESS is an interdisciplinary, transdisciplinary and multicultural research project. Besides the combination of bottom up and top down approaches, the integration of the findings is the main innovative aspect of this project. One of the issues that has been emerging is that natural scientists and social scientists tend to look at the question of sustainability in very different, sometimes incommensurable ways. The researchers have been prone to make recommendations which have the potential of negating one another and compete with one another. Four modules - economy, ecology, socio culture and architecture each work separately and then attempt to synthesize a common knowledge about the village.

The output of the project consists of different scientific scenarios for the future development in the case study villages, having two main topics: to remain within the limits of nature and to achieve a higher life quality. The project is structured with phases of field work and phases of analyses as in other scientific projects. But the task to develop future scenarios of sustainable development affects the approach to doing the field work. The field work in the villages has been done during three periods by the researchers:: in September 2002 and in April and October 2003, when the teams of experts of 17 disciplines (communication sciences, political sciences, sinology, sustainability, ecology, climatology, ecology, geology, energy, economy, agro forestry, agriculture, sociology, land-use planning, architecture, media-sciences, participation) worked in the seven SUCCESS case study villages.

Integrated communication between the disciplines is the main innovative aspect of SUCCESS The spatial dimension of the case study approach proves to be a primary condition for the transdisciplinary approach: the fieldwork is done in a one-week stay in each village where the emerging data knowledge is immediately exchanged among the disciplinary teams. Thereby, the social scientist enriches the knowledge of the water specialist, the architect enlivens the knowledge of the energy people, the agricultural scientist works together with the sustainability economist. This makes the work efficacious within the strict given budget lines; it gives new incentives for the methodology as it is a very new research situation , especially for the colleagues from natural sciences, collecting the data at a local level in a case study approach, is a very important scientific innovation. All researchers work in the selected village and start with their disciplinary approach, but share the data in a common process of discussion in the research group during the field study time.

Another communication system is the transdisciplinary one: the case-study approach supports the accessibility to the local knowledge, to settlement dwellers themselves. The close contact to the local population brings the high touch quality into the scientific approach, whereas the research itself is done with all the available high tech tools, including video cameras, internet-linkages and computer based systems analysis.

The transdisciplinary and interdisciplinary approach together are a chosen tools in China's rural areas where the available data are of very different reliability depending on the specific disciplines. By cross-checking the results between the different researchers, the group of researchers develop a common scientific knowledge. These results give an integrative scientific picture of case study village's systems characterized by the following qualities: integrated, spatially based, participatory, authentic, straight, pristine, unadulterated, intuitive, direct and cross-checked.

[1] ICA4-CT-2002-10007, www.china-eu-success.org

The photo interview: an innovative method of social science in the SUCCESS project

We–(the authors) are working in the module of socio culture with the specific methodology of the photo interview (Harper 1987, Wuggenig 1990) to investigate the local life quality.

Selected persons in the village take photos of their view of their own home village and give an interview where they make a narrative about the topics which are photographed.

The basic assumption of our qualitative socio scientist approach is that each individual is constructing his or her own reality (Schütz 1981/1932) giving a meaning to each activity, – by choosing a photograph, the interviewee allows the expert to follow the way in which she or he has given meaning to a specific approach and has constructed his or her respective reality.

We make steps to find out the perception of life quality in the present and in the future following the research question “What to maintain - what to change” under the aspects of sustainability. The photo interview as an active participatory process in visual sociology, generating empirical data for the photo and text analyses (Oevermann 1993), is the basis for our interpretation that figures manifest as well as latent aspects. Our material is the outcome of photos taken by the dwellers, their interpretation of their own situation and the scientific hypothesis building process. In the SUCCESS project, we combine two qualitative approaches to a new set of methods that is specially welcome in the data situation in China; the empirical data of the photo and interview as well as the text analyses with objective hermeneutics(Oevermann 1979, p 352). We combine these empirical results with a theoretical interpretation, and this counter-checking guarantees a good path to authentic information.

4 PLACE AND SUSTAINABILITY

Working out seven case studies gives the local place in the village a specific meaning. What to change , what to maintain is located on a place in the village. So spatiality is the basic condition for our interdisciplinary research approach; it is also a condition for our definition of sustainability:

“Sustainability is a local, informed, participatory balance-seeking process, operating within a Sustainable Area Budget, exporting no negative imbalances beyond its territory or into the future, thus opening the spaces of opportunity and possibility.”

-local: it happens at a specific place – the living environment of a settlement within its region, including living patterns and creativity of the tenants

-informed: it benefits from the tools of the global scientific community and requires an interdisciplinary approach which provides cause and effect feedback

-participatory: it needs informed, empowered, gender sensitive human actors who are the stakeholders in the sustainability negotiation process

-a balance-seeking process: it models alternative future scenarios, taking into account the classical triad of sustainability: economy, ecology, socioculture , complemented by the context of built environment

-spaces of possibilities : sustainability considers the future as an open space where socio cultural life quality, economic equity, and ecological needs converge towards balance

(definition slightly renewed after Dumreicher, Levine, Yanarella)2

5 HIGH TOUCH, HIGH TECH AND SPACE: THE CHINESE VILLAGE

5.1 The inner information space: - the village my home

The main high touch in the Chinese rural area is the native village with its complex social system. The interview partners are aware of their being an active part of the village community as a whole, including communicative and interactive qualities of their village environment:

毕竟我生在这儿，长在这儿，怎么说，是自己的老家，再好，再不怎么样，也觉得挺好的，挺满意的。	After all, I live here and grow up here. How to say here is my own native home. No matter how good or how bad it is, I feel nice, I feel satisfied.

Miss Wang Chong, paragraph village

With her description, Wang Chong gives an example of “integrated information digestion: she tells her integrative connection to her native village that does not depend on a detailed analysis of pro and contra, but is based on an overall feeling of a place where life is good for her. With the growing attraction of the urban environment, defining a future image for the village is crucial in order to maintain its liveability. Only if the village is an attraction for the young people will they stay there. In our interviews, we found out that the young people’s desire is to stay in their home village, but is also the strong hope that a modern way of living arrive in the settlement. The results of the SUCCESS project shows that people want to stay in the villages although the town, the place for modern urban life is very close to them and well known, mostly through the experience of the many working migrants. People described the wellbeing in the village as an integrated quality: one basic characteristic is the daily communication within the families, in the peer groups and between neighbours and friends. These communication networks have a specific quality of safety and trust

2 Definition Dumreicher Heidi, Levine Richard S.,Yanarella Ernest J., (Oikodrom The Institute for Urban Sustainability, Vienna, Austria and Center for Sustainable Cities, Lexington, KY), 1998-2001

because the network has stood the test of time – from the day you are born these communications networks are working and showing people which part of the systems fits to a given situation. The relationships and the conviviality in the village is the social resource for the wellbeing and life quality in the village.

In our interviews the inner quality of the village is described in comparison with the "modernity" of the town. Right now, the outside world is not yet familiar enough to the dwellers of Beisuzha, but the more they migrate for earning money there, the more they will know that there is a choice to make. Wang Chong, the young woman who works in a factory in a nearby town, comes regularly back to the village. She sees the village in direct opposition to the outside world to which she migrates for work. The information structure within the village relies on two categories: on the family – and on the friends.

在外面就是没有亲戚，没有朋友，在一个陌生的地方，肯定不容易。	Outside, there are no relatives, there are no friends, and staying in a strange place, it is really not easy.

Wang Chong, paragraph village

Communication in the village relies on two time systems: the chronos time and the kairos time. Chronos time means the ongoing daily activities that form the basic line of trust and networking; kairos times are outstanding events of short duration (Galtung 1997: 100).

The village people are aware of the double quality of these events. In San Yuan (Yünnan), villagers describe on the one hand the ongoing communication system in the day-to-day-village life, but also the yearly market in a nearby town: this market is an event where they go for selling and buying – but just as much for meetings friends, other members from their clan and relatives who have married out. They also go there for information exchange. Both communication systems together build the inner village information network. People who are migrating for work to the neighbouring towns come back to the village for important cultural community events:

也是过国庆节，现在在家也是秋收了。	I come back both for National Day and for harvest.

Wang Chong, paragraph. house

The cultural life fits in a daily life and village cycle. Harvest – the festival which comes out of the villages life and is part of the agricultural yearly cycle - stands next to the national day, imported from outside and representing the political structure.

Wang Chong doesn't say what kind of plant she is harvesting and she doesn't tell us, who will help harvesting. It is a thing without saying, a system of agricultural and familiar events, which do not need any explanation not even if she is in a discussion with foreigners.

High touch and sustainability: the trust that the village community is working well and will support the pathway into an uncertain, but imminent future is a possible basis for establishing a sustainability process in the villages. Based on this value, the modernisation process of sustainability can trust the existing integrity of the village in order to encourage an openness and curiosity to what social and other changes the future might bring about. In our research, we met this confidence in a coming future mostly in the villages with good governance whereas in villages with high social disparity and distrust in the local administration, people sowed no visions for the future and seem reluctant to proactive approaches.

5.2 Spaces of communication and interaction within the village

The communication and information flow within the village seems to be an abstract value, but in the high touch situation within the settlement, these information flows are supported by the spatial patterns. The role of these material artefacts - the house, the school, the road or the village square is changing, but their support for the integrity of the village is still very strong. The village as a built environment , especially the public space with its communicative quality is directly linked with it's emotional co-ownership (Dumreicher/Kolb: 2001).

In the photo interviews, the dwellers show us the places in the village that they consider of interest, selecting along their own intuition. In Beisuzha, the communication places selected by the local dwellers for their photograph were: the village street, the primary school, the village square, the green house. At the manifest level, these places in the village are the same for the older and younger generation, but at the latent level, their meaning is more sophisticated. All places have some common meaning for all generations: they stand for the integrity of the whole village and they all represent places of communication, the shops as well as the party-centre. We have no signs for high tech: this new topic had not yet reached Beisuzha until our visit.. In one other village, our partners gave us photos of the newly established telephone cables; in another village, the SUCCESS team established a direct link to the internet for the first time. In three villages, the SUCCESS project turns a participatory videofilm where the farmers, for the first time, have a chance to give an active contribution to the new media - they themselves learn in workshops how to use the video camera and how to proceed in editing a film.

The local younger people talk of modernisation in the village, which includes a proper road and a modern house for their families. For the old generation yingbi and party centre carry the idea of traditional China, for the young generation their own family house and the small shops are the outstanding symbols. Both generations have a sense for representative architecture and for aesthetics and show awareness of the architectural landmarks in the village. Also both generations think that the school is an important issue in the village.

The following table shows different connotations of places and the common meaning of the young and the older generations in the village of Beisuszha. The photo material shows that there are different places on the photos linked with specific social meanings. We found out that there are some common fields of interest for both generations, like the importance of education, and there are on the other hand fields with different meanings like the Yinbi wall in front of the party centre, the role of the new shops in the street or the meaning of the new road.

Place in the village	connotation/ old generation	connotation/ young generation	common meaning
The school	The school is a symbol for the interest in the next generation: it was made by the common effort of the whole village-community to finance its rebuilding	The school is a place for the future: here, the children learn the Chinese Putongua which will enable them to communicate in the city	The school has an outstanding value for the village: it is the carrier of the future
The newly rebuilt road, the streets	Comfortable for pedestrian use, shows the modernity of the village Important inside the village	The space for motorcycle, lorry, tractor. Symbol of a new mobility for leisure and work: Link to the outside world	The rebuilding of streets and roads makes the village more attractive for both - the insiders and the outsiders at two levels: it is practical and symbolically important
Built environ-ment on the street	The motive of the ying bi, the traditional Chinese wall, stands for continuity and value of traditional China	The small shops stand for the upcoming needs in modern life: timesaving and availability. they stand at the edge of tomorrow with their mix of monetary and non monetary economy	Both buildings show that the dwellers have a sense for representative architecture and aesthetics.
The landmarks map	The common party centre is the outstanding landmark in the village	Their own house is the most important place in the village	Societal issues need a place: buildings are stone built ideas.
Greenhouse as a working place	The eternal overload for the women is growing; lack of information especially for women	Women live an especially quick change in their professional biography, concerning profession and working place	awareness of gender issues

The table shows the places of interest that the dwellers of Beisuzha took photographs of. It shows the different symbolical meaning those places carry for the different generations.

6 THE SCHOOL AS COMMUNICATION PLACE FOR THE VILLAGE

Place one in the range of important places in Beisuzha is given to the school. This building is seen as an interface of communication systems: between the generations, between the donors (who gave money for building it) and the users- the children, between the countryside where the children live now) and the urban envirionment (where they think the children are going to live in the better future). The school is important now – because it shows that Beisuzha is a well-off village. It is important for tomorrow: only with good basic education will the children have a place in the future.

The social change that comes with the transformation era is one of the big challenges in the Chinese country side, and the need of education and the efforts to build and run a school is very important in every SUCCESS case study village. In Beisuzha both generations – old and young- were convinced that the school is the condition sine qua non for the access to a better life for the children. "*Only when they get a good education, can they have a future*"(filmmaker interview 1).

The school is the place where the community can make a common effort for the common future of their children. It is also an indicator for the wealth of the village, especially in the former times when the village was not as wealthy as today, remembers a party member:

"Our village was very poor, the house of the school nearly broke down. "(Zhang Lan)

When selecting an image relating to the school, the interview partners took a photo of the fashionable wall at the school courtyard that carries all the names of the supporters donating money for the modernisation and adaptation of the building for contemporary needs. This is not a special quality in Beisuzha – donating for schools and universities is a common ritual in China. Building such a wall is a culturally imbedded Chinese way of memorialising important events.

Beisuzha, Donators wall at the school. Photo by Wang Chong

The photo shows the yinbin, which is located at the entrance of the school building. The black board shows all the names of the donors. The villagers are proud of this social process and in order to memorialise it, they built this wall. The wall – as a building – reminds the villagers of this important narrative, the story of Beisuzha as a place worth investing in a common effort. For the whole village, the school is a place and a symbol of the social coherence of the community. People were ready to make quite an effort, as the party member remembers: "*My whole year salary was input in it. One year making no money"(Zhang Lan).*

7 A MEMORIAL FOR COMMUNICATION TOOL NUMBER ONE: THE LANGUAGE

China with its more than 1 Billion inhabitants has a communication systems that supports the integrity of the country: the common written language- Peking Chinese, sometimes in the West called mandarin, in Chinese terms Putonghua.

For the young generation, the school in Beisuzha carries this most important meaning: the school is the place for good education, it is also a basis for the future. Besides social and other competence, what the school offers in the first place is a tool for communication: learning Putonghua means learning the right Chinese language.

我上学校。我好长时间没回到学校看过了. 我拍照的时候，就是我走到学校，我看见的这个。我上学的时候，老师也不怎么样，也没写作，我觉得这个变化挺大的。	I went to school and I haven't gone back to the school for a long time. When I made the photo , I went to the school and I saw this. When I learned in this school, the teacher was not so good, there was no such writing, I feel this change is very big.

Wang Chong, paragraph. School

Wang Chong describes a yinbin wall in front of the school, which invites pupils to speak the right language, the putongha. She is aware of the advantages speaking putongha, because in the town where she is working people speak another dialect than in here home village; this is difficult for her in social as well as in professional terms.

If today's children can learn this language at an early age, it will give them a tool for their outside life, the outside world.,.

The school is a place where children prepare for this scope. What the village people do not see: by giving them the chance to make their own lives outside the village, the school also furnishes the basis for the upcoming braindrain from the village to the town, thereby promoting a process that helps the individual to have a better life quality, but which impoverishes the village in the long term. Discussing these long term perspectives is one of the topics in SUCCESS.

The awareness of high touch - the relation to the school, to the parents, to the "warm" atmosphere in the village as opposed to experiences in urban encounters - prove to be consistent. But the attraction of the urban field with its working place, its infrastructure and its higher children's education is so strong that people tend to go that way, and from a demographic point of view, these upcoming transformations of the agricultural sector seem inevitable.

The challenge is to maintain the social integrity of Beisuzha into the future and in a sustainable way. If this can be done, a scenario with a balanced dynamic between urban and rural environment becomes possible.

Street and road as communication tools

The way that the new world chooses to come into the village is the street – a special place for village communication. People use this public space for many diverse communication activities: for business and selling like the shoemaker, the hairdresser, the massage specialist, for working on the harvest, for holding cattle, for selling hot noodle soup and for knitting, but also for leisure life, for cooking and eating, chatting or playing games. These human activities get in the way of new activities - the street is also the place for the upcoming transport business: the cars, tricycles and lorries that enable material to come into the village and to leave the village.

Beyond the materiel flow, the road brings also new ideas and a symbolic connection with the world outside of the village. The arrival of the foreigner in the SUCCESS case study village was obviously made possible by the road, and the many cultural activities organised for our first day welcome ceremonies also were delivered by the road. As the traffic is very low in the Chinese villages, these public events, often occupying the whole public space in a village could be done without any traffic jams.

Our expert team has seen different stages of road development: muddy roads, small concrete roads, bigger roads, no roads at all. The building of new roads is under ongoing discussion among the dwellers of the SUCCESS case study villages. In every stage the villagers told us the wish to achieve the next higher standard. From and earth street to asphalt to concrete – from a small narrow footpath to a big town like boulevard. The road is a symbol for a better future, because it promises to connect the local people with the outside of the village. So the road develops as a communication link to the outside world: people transport goods and experiences inside and outside the village and take the wealth out of the village and back again.

Photo from Zhang Lan

The photo shows an asphalt road outside the village, to the side of the road there are trees and fields. Far away in the centre of the photo the observer can see four persons on the street. The biggest part of the photo shows the big dark nearly black surface: the asphalt. The photo interview gives an interpretation: on the road, there are four representatives of the village elite promenading on it – and by photographing them, our partner herself has a stake in this importance. There is a link between the new road and the better life at the edge of Beisuzha. The new roads have different meanings for different generations in the village: for the old generation, it is a sort of fashionable boulevard where walking on foot is easy. It is also a way of getting rid of one of the attributes of poverty: the dust. The interviewee sees its importance mostly inside the village.

"Before the road was built, transport was difficult and walking was difficult". (Film maker 6)

For the young generation, the new road is a symbol of prosperity and the basic condition for the prosperous future of the new small shops that are emerging along the main street. It is the carrier of the new emerging mobility, the place for the motorcycles, the trucks. The newly built road to the village as well as the newly built main street have a high value to the village. The young and the old generation find this fact very important: it makes Beisuzha more attractive. It is good for the village life, and it calls for respect from other villages who have not yet managed to finance their own new streets and roads.

The Green house: Information and professional activities

In times of rapid change it is not easy to get new information about agricultural production to develop the farming economy. In Beisuzha we found out the following situation: Wong Chong is interested in her village, and would even like to live here. But it seems that for this young woman it is easier to find a working place in the city 300km away, than to get information about high outcome farming. Other villagers are aware of this situation; the village has invested a lot of labour in the last few years and has had unrewarding results for their effort: *"People who cannot read or write cannot deal with pesticides or with the green houses"* (Film maker 6). Zhang Lan who is part of the local elite knows that the solution for this situation lies in organising education for the other village dwellers:

帮助他们，给他们一些信息，年年种大棚，或者棚菜得了病了，或者来了什么新品种了，给他们点信息。	I will help them, give some good information to the young women. Every year they work for green house. And they have some problems with green house farming, for example the vegetable growing not well or there is some information on new products. Give them some information.

Zhang Lan, paragraph women

A long term sustainability policy helps to overcome the existing bad experiences, insecurity and doubts with new technologies. This also prevents the outlook that old knowledge gets lost – like the traditional common work that is still the rule in many Chinese villages, but not in Beisuzha: *"We all do farm work, but everyone does his own fields. People don't work together"* (Filmmaker 4) In this way innovative people like Wang Chong finds a satisfying working environment within the village. In this way they ensure the integrity of the village in two ways: finding modernity and new working places which generates new income.

Zhang Lan sees that some modernisation has come into her settlement, by using "fertiliser": the traditional way of doing agriculture is not "good enough" anymore.

就象现在种地,有的不像样的玩意, 上粪不行, 总得跟上形势.	Such as farming, there are too many (old fashioned) ways that are not good. Using dung is not effective, we should better catch up the modern ways

Zhang Lan, paragraph traditional thinking

„Just like Mao said: we need animals, services, agriculture, factories. Just being a maize farmer is not enough, we need new ideas."(Film maker interview 3)

Agriculture is a constant topic in the village Beisuzha: the method of drying maize on the public streets and squares, working in common and in public on the harvest, or going daily to the fields. The green house represents the new way of doing agriculture with all its contradictory implications: Farmers are officially encouraged to further employ greenhouse methods.. Some farmers work in the green houses of the nearby "high tech zone", others have their own green houses in the settlement. The farmers see the greenhouse as something which comes from outside. The greenhouse is mainly a working place for women and an occasion for gender discussion in the village. The interview partners describe the growing overload of the women and also women's quick change of the working place. The statements show clearly that there is a serious tendency towards growing social and economic gender disparity. The green houses are the concrete battlefields of the emerging problems. When developing new strategies for the agriculture, the gender topic will be of growing .importance. Only when both, the technical and social questions are taken into consideration can the greenhouses become attractive working places for young people. The interviews show that the farmers have a will to try out new technologies like the green house; only when their courage fails are they forced to give up and to look for other opportunities, mostly in the city.

前两年有，现在没有了。这温室大棚，时间长了，土地里细菌挺多的，种别的蔬菜，长的效果就没有以前好，现在拆了。	We had a green house two years ago, but now we don't. In the green house, after planting some vegetable for a long time, the soil became full of some bacteria. If we grow other kind of vegetable, they can not grow as well as before. Now we removed it (the greenhouse) away.

Wang Chong, paragraph greenhouse

In sustainability thinking diversification in agriculture is a need for a sustainable future, but this can only work if the farmers get the necessary information on appropriate technologies. In the case of Wang Chong's greenhouse, it was easier for the family to give up the greenhouse than to look for appropriate set of methods of cultivation, combining the traditional and the contemporary approaches. This is not out of a lack of interest for agriculture – on the contrary, the young woman tells us that she came back home from the city at harvesting time to help her parents, but lack of information.

7.1 The outer circle: village, region, province, country

Beside the inner communication circle where the Chinese villages have great independence there is an outside one: the national and provincial policies. This top-down-approach influences the farmers in their decisions about what to plant and how to grow. At our visit in 2002, we were told that it was the officials who suggested the present green house – wave. The dwellers keenly observe outside activities like road building, electricity, biogas and other infrastructure input that potentiates a growing economy. For the village the information from the outer cycle is hard to integrate. The outside information is not available in the village, only the consequences. So it is easier for the farmers to keep their daily know how without making relevant changes. But the information is increasingly coming further into the villages.

8 SUSTAINABILITY AS AN INFORMED PROCESS: HIGH TOUCH AND HIGH TECH IN THE CHINESE VILLAGE

The concrete highway and the data highway reach the Chinese village at the same time, namely: now. Suppose the money becomes available.

为什么三元村以前没有程控电话及闭路电视.	Expert: Why didn't San Yuan have telephone and TV before?
因为没有钱, 现在政府为村民修了水泥	Villager: Because there was no money. Now the government has cemented our roads and set up television and telephone cables.

San Yuan, interview doctor, Oct 2003

The high-touch-situation in the Chinese villages is a traditional quality developed over thousands of years, the high tech comes in the seven SUCCESS-villages only in the recent years. Nearly every household has a radio or television: often of poor quality, often in black and white, but the villages have a stable connection to the outside world. There are many regional TV stations in the rather small towns; most bigger universities have their own TV-team and programmes. The SUCCESS team managed to make numerous presentations in these local and regional TV-programmes, and influences the high tech situation in the villages with the existing project.

All villages also have the old public radio: it consists of a microphone, mostly situated in the party centre, and used for all sorts of public announcements – like, for instance, the arrival of the SUCCESS team that was communicated over loudspeakers to the whole village. Also here the SUCCESS project affects the work of the public radio with a new topic.

The telephone is still a rare technology, but even small villages in remote places have at least one public telephone operated by some shop keeper or by the health station. A private telephone in private houses is still a very rare artefact of luxury.

村民有了电话就很方便, 有了电视就了解很多信息	Villager: If the villagers have a telephone, this is very convenient, if there is television, they get a lot of information.

San Yuan, interview doctor, Oct 2003

The team of SUCCESS often ended up to be a valuable carrier of outside information, and high tech in the SUCCESS villages was mainly represented by the researchers and their instruments: The teams come with their computers with their film cameras, with their photo equipment, with their high tech presentation tools.

The participatory video effected in three of the villages gave the farmers the first possibility and experience with such a tool, enabling them to crate their own village film that is immediately available on CD for all the dwellers.

9 THE RIGHT OF ACCESS TO INFORMATION

In a process of modernisation, from a western point of view information plays a crucial role. Availability and non availability of information is at stake when discussing winners and losers in the digital age – in the western neo-liberal situation as well as in the era of transformation in China. In all case study villages there are different issues where people signalised need for more information on different levels. The lack of transparity is obvious to many of our interviewees, even at the village level. Sometimes the whole village is not informed about their future development and the governmental plans concerning their region.

In specific issues we could observe that specific problems are solved by showing how to handle the daily life but not to give background information: The available knowledge at village level relays mainly on high touch communication: the village common knowledge base relies mainly on oral communication – an historic know how. In the Chinese tradition, the village has a reliable independence on organising itself without much contact to the outside world. This situation undergoes dramatic changes right now, but we can still study this traditional pattern: cases where the outside knowledge is needed and - hopefully – available is for instance the water supply.: when Xia Futou has not enough water for the daily supply of the households and fields, people trust that the village leader knows the telephone number where he must deposit the need for water; the dwellers trust that the problem will be solved and the water will flow again. This situation changes today: outside influences become more stringent in the era of modernisation, high tech is coming at the country and regional level – and the sovereignty of the village is at stake. In the recent case of drought where the lake of Xia Futou has been dried out, the village available knowledge is not enough anymore.

The access to the global information networks can come about when high tech enters the village – but it needs an effort to do so, the digital revolution has an ability to decentralise activities, but according to recent studies, the world's digital communities, though geographically divided, share some common trends that can be found in the US as well as in china: the centres of Internet production and consumption are found in the existing large metropolitan areas. The perception that the internet contributes to the collapse of spatial and temporal boundaries, is in sharp contrast with the fact that they display a strong tendency towards spatial agglomeration. In August 2001, China already counted for 5.2 percent of Internet users in the world ; but they are concentrated in Beijing, Shanghai and Guangdong – thereby sharing the trend in the US where San Francisco, New York and Los Angeles are leading for Internet content in terms of both absolute size and degree of specialisation (Loo 2003). The internet by itself, thereby, contributes to enlarging the gap between urban and rural regions. Starting a different pathway is a challenge for studies like SUCCESS that tend to develop future images where the rural region can gain, not loose importance in the upcoming sustainability scenario.

CONCLUSION: WHAT TO MAINTAIN- WHAT TO CHANGE? THE CHALLENGE OF SUSTAINABILITY

The team of the SUCCESS researchers represents the high tech knowledge of modern science which leads to the development of sustainable future scenarios. When speaking about establishing a sustainability process in the village, this new concept is well received by our rural partners because it carries the symbols of the new information era: by high tech – from contemporaneous energy saving tools to mind map software for generating sociocultural results and presenting a film in the village square which also was produced with high tech instruments. The combination of high touch and high tech is a possible way to support the potential for a sustainable modernisation era.

Global and local village in one the **glocal village**.

Interviews made on the spot in the seven villages in the frame of the SUCCESS study in 2002 and 2003:

- Photo interviews/ local experts referring to their personal photos (Interviews by Heidi Dumreicher and/or Bettina Kolb):
- Wang Chong, village Beisuzha, province Hebei: female, 20 years, parents: farmers, profession: factory worker.
- Zhang Lan, village Beisuzha, province Hebei: female, 55 years, parents: military, profession: teacher.
- Old Man, village Xia Futou, province Henan: 86 years, former village leader
- Male doctor, village San Yuan, province Yünnan: 40 years, holder of a shop and a small health station
- Additional data: Film-maker interviews made by Ina Ivanceanu, Nr. 1 – 6 (WP participatory filmmaking), village Beisuzha, province Hebei
- Interview with Burghart Schmidt, philosopher, made by Heidi Dumreicher and Bettina Kolb, Vienna 10.1.2004

- All interviews are led in the original language of the interview partner (Chinese, Naxi, English, German) and than translated, on the spot as well as literally. The names of the village dwellers are changed to guarantee anonymity.
- Review of the English version of this article: Richard S. Levine

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The impact of new technologies on regional and urban development

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Analysis of the influence of the new intercity transport infrastructures and their specific impact on the urban nuclei within the metropolitan area of Madrid and, more precisely, as regards the city of Segovia (Spain)

URBAN INTERVENTION IN A GLOBALISED WORLD

Within the context of globalisation, at the present time suitable conditions are being created to facilitate changes in all aspects of our lives.

There have been changes in communication, in economy, etc. and these have been or will be transferred to the social and urban structure, creating new opportunities which will arise and must be adopted so that they can be used to our advantage.

Both the Public Administration and private enterprise find it extremely difficult to take decisions in this regard.

This leads us to establish an integral view of urban development, in which leadership, and the will and consensus of the citizens are fundamental to fixing objectives for development both collectively and individually. Concepts such as governability, competitiveness, shared financing must be assimilated with others such as sustainability, risk management, markets, price, short-term aims, etc. which, together, contribute to the creation of conditions which improve the quality of life.

On the one hand, there is external action. As the standardisation of the cultural frontiers leads to a loss of individuality at all levels due to the use of criteria which are perhaps excessively close to the interests of the market and communication, this area is a negative aspect of the uniform development.

On the other hand, there is the internal reaction as this global uniformity can be the reason for local differentiation, understood as the encouragement of differentiating positive aspects.

Most European cities were conceived in the past, and have suffered from the new possibilities rather than benefit from them. Change could mean updating many aspects which could then become an improvement in the quality of life.

Creative urban policies are of greater importance. At management level, these entail an increase in the importance of companies and local governments which have the capacity to increase competitiveness, infrastructure, technology, etc.

It is necessary to reconsider the techniques concerning the evaluation of investment projects, which fundamentally affect items such as: costs and social benefits, not only taking profit into account but also welfare and profitability.

Long term decisions may negatively affect some current interests, thus the tendency to seek short-term results prevails.

This requires a change of mentality since growth, traditionally, has come about based on natural, geographical and other "inherited" resources, and this tends to promote only part of the city, and the consequence is the weakening of public centres.

The threat of being absorbed by development must be turned into an opportunity!

THE METROPOLITAN AREA OF MADRID

In the last few years, the urban centre of Madrid has undergone serious communication problems and the a decrease in quality of life and the periphery of the city is where new possibilities and better conditions are being created for expansion with regard to several population nuclei.

Currently, although the centre – periphery split no longer exists as this was understood before, as the urban centres also made up of periphery urban nuclei with a complex system of economic, political, cultural and communication relationships, in this specific case, there is a substantial difference as the periphery has a countryside environment which is much more developed than the centre and is also relatively near to the centre at certain points.

The spatial distribution of these nuclei are at a greater level of development than the population nuclei which make them up, and are influenced moreover by the new technologies. This is fundamentally due to the public transport which has been relatively well conceived and has contributed little by little to joining up the city centre and the periphery.

The increased population and the success of the periphery developments have led to the expansion of the metropolitan area of Madrid, which has absorbed important towns within its environment together with historical cities such as Toledo and Segovia, both of which are world heritage and close to Madrid, and give rise to problems which differ from those of others types of nuclei. Therefore, due to the characteristics of these developments and the way they have been managed locally and the fact that they are subject to different regional governments, this entails substantial difficulties as regards the spatial intersections and the processing involved.

Our focus is the definition of work in two directions, as this work has been absorbed by Madrid, however, this may be taken advantage of by positive action, especially in recent years with the development of new technologies.

THE CASE OF THE CITY OF SEGOVIA

The case of the city of Segovia with a population of approximately 50,000 inhabitants, clearly illustrates these problems both as regards the intervention of public administrations and the role of public enterprise in urban development.

Until now there has been tremendous passivity in the public sector as regards the global aspect. The city has been functioning like a “theme park” at the service of Madrid, particularly due to the wealth of its historical heritage.

However, thanks to new infrastructures and technologies which are finally being created in the city, the opportunity may be there. The new motorway and the new high-speed train will reduce the travelling time to Madrid, 45 and 20 minutes respectively, and will open up a city which had concentrated on its historical environment to new alternatives for development.

Fortunately, there are signs of change thanks to the new impulse given by the local corporation and it seems that the existing opportunities may be taken advantage of and alternatives offering a better quality of life than that which exists in the city centre may be established. Current passive growth may be alleviated by managing planned development with an adequate analysis of the environment, which will save Segovia from becoming a satellite city during the week and will consolidate the idea of a theme /heritage park on weekends.

As regards the analysis of the external influences such as the proximity to Madrid and the possibility of receiving tourists, the following should be taken into account:

- Positive Consequences are the creation of wealth and influence and an increase in the quality of human resources due to education and training offered by the city. There is also the possibility of the generation of more work due to growth.
- Negative consequences, as regards a decrease in quality of life, which includes the difficulties of the rush hours and the busy days, and the consequences deriving from the rise in prices of goods, such as housing, and services which are affected by the former.

In addition, there is the analysis of possibilities:

- Positive: a city which forms part of the world heritage, a small sized nucleus with the possibility to expand, nearby countryside and a quality environment, etc.
- Negative: lack of industry, commerce, employment, education, etc. Entrepreneurial initiatives are lacking and there is a certain amount of exclusion as regards the provincial nuclei and the autonomous communities they belong to.

Strategic planning would have to be carried out while taking into account the role of the public sector with regard to the agents involved and their role in the real estate risk deriving from the uncertainty of the administration and production of the land which currently entails a great deal of risk.

This affects the rise in house prices which is taking place at the present time, and makes these more competitive as regards the price rises occurring in the periphery closer to Madrid.

The successive planning which has been carried out since 1989 and whose approval has taken until the present time is now beginning to be implemented.

The impact on the city will be substantial and will generate a debate on the economic and social conditions with a view to facilitating new possibilities as regards urban development.

A study is being made of the growth resulting from the development of four partial plans, with an approximate 8,000 houses (in a population of 50,000), involving a surface area of over two million square metres.

We will analyse the last of these approved in 2002 which is contained in the so-called "Sector Bonal", as this fits in with what has been stated above, as I understand it.

This has come about through private initiative and with the consensus of the administration and the team which drafted the new general plan.

This approach is also included in the "Modification to the General Plan for the Urban Regulation of Segovia", a plan which is in the process of being approved. Thus, the possibilities of acting together have been improved by this situation.

This includes 1,200,000 m^2 and 2,500 houses which have also been included in this plan together with special characteristics as this connects the city with the high speed train and the new motorway. This is being carried out in an area which is specially protected due to the countryside environment.

The low density and the fact that it provides commercial and administrative support to this development which is somewhat disperse are significant aspects.

It could be an example of sustainable development because of the density, adaptation to and respect for the environment, as well as the coordination and consolidation of an area which at present is extremely split up.

There are also peculiarities which add interest to this development as it involves a number of elements which enrich the proposal as it requires the unification of a number of different aspects.

- Global conditions deriving from the directives on national and regional development and the development of the metropolitan area of Madrid, the ring roads, the high-speed train, the motorway, commercial equipment, services, etc.).
- Local conditioners which are very strong and difficult to deal with, but enrich the proposal as regards the landscape, rivers, traditional sheep tracks, Roman Aqueduct, etc.).

As there are no highly developed industries in the city of Segovia (nor are there conditions for such industry), new options must be created for urban development as well as for new sources of employment.

This point must be specified imaginatively, while evaluating the need to create alternatives and free ourselves from the current dependence on Madrid.

CONCLUSIONS

Although it is not easy to choose the most appropriate developments, the present time may be crucial when planning the future of our cities. Action must be taken in the light of the general approach while taking the following questions into account:

>Mixed strategy, combining the short-term and the long-term. Although the unifying objective would be long-term, it would be advisable to include partial /additional objectives which are welcome and involve the people in the urban process (participation, civic culture and social consensus).

>Concentration. Initiative and competitiveness as regards the management of the options to be developed in the urban environment. This affects the concentration and favours cohesion and governability creating the proper dialectic between centrality and mobility.

>Coordination. An integrated system of infrastructures with regional transport which is a complement and continuation of the local model (public transport and private parking).

>Quality of Life. Re-thinking some concepts by relating the approaches to the environment and those of the built –up areas. The influence of *technical progress* at the service of quality of life. (quality growth).

>Risk Management. Several approaches in relation to the way of acting of the administration, by reaching a consensus on urban development, sharing out posts and benefits and involving the population in the illusion of a city project. This will affect the production and use of land, and lead to competitive results in relation to other urban areas.

>Flexibility and approaches. The near future and the adaptation of the possibilities provided by the new technologies and the progress which can fit in with a new concept of city. This is necessary if the possibilities arising from this new development are not to be wasted.

To end, perhaps we should question some concepts such as price, economic yield, maintenance, etc.; besides changing some approaches deriving from the financial problems due to the rapid growth and the outsourcing of services which would make it necessary to reconsider the techniques for the evaluation of investment projects in accordance with the criteria of social benefit.

Therefore, creativity in the assumption of new social approaches and criteria which favour the standard of living of the community and the participation of citizens could lead to these aspects finally being materialised and encourage the community to get involved with these new projects.

City Documentation: Creation and Visualization of High Resolution Panoramic Image Mosaics

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1 ABSTRACT

We present a novel system for 2D city documentation utilizing panoramic image mosaics. Current panoramic stitching methods often produce poor results and available visualization tools are not able to deal with high resolution panoramic image mosaics. For the construction of a full view high resolution panorama, we introduce a rotational mosaic representation, which includes the rotation parameters, the focal length and the principal point with each input image. A local registration algorithm is developed to quickly align two images exclusively from the image data. In order to reduce accumulated errors a global registration algorithm is performed to simultaneously minimize the misregistration between all overlapping pairs of images. By combining both registration techniques, we improve the quality of full view panoramic image mosaics. Finally we introduce a weighted blending algorithm to generate spherical or cylindrical panoramas.

Furthermore we present an efficient visualization tool to display our produced high resolution panoramas. We developed a method to warp panoramas by utilizing the OpenGL graphic system to overcome the restriction of common panorama viewers, which are only allowing the visualization of small panoramas. The panoramic image is digitally warped on-the-fly to simulate camera panning and zooming. Walking through the virtual environment is currently accomplished by jumping to different panoramic points. The presented documentation system provides the creation as well as the efficient visualization of high resolution panoramic image mosaics to document important areas in urban environments.

2 INTRODUCTION

The automatic construction as well as the visualization of high resolution panoramic image mosaics is an active area of research and can be used in several applications described in Irani [5] et al.. For applications such as virtual travel or architectural walkthrough, it is desirable to have a complete panorama, i. e., mosaics which cover the whole viewing sphere or cylinder.

The first goal of our city documentation system is to introduce an efficient method to construct high resolution panoramic image mosaics, for instance image mosaics with an resolution of 14000x3000 pixels, to obtain as much details from the panorama as possible. In the construction part we additionally avoid manual interaction, thus our stitching method is able to produce high resolution panoramic image mosaics fully automatic. The second purpose is to visualize this large panoramas at interactive framerates. Current available visualization tools, such as QuickTime VR (http://www.apple.com/de/quicktime/) are only suitable for the visualization of small panoramas up to 3000x500 pixels. For high resolution panoramas the rendering performance of such tools is not acceptable. To overcome this restriction, we developed a visualization tool, which can handle these high resolution panoramic image mosaics.

3 RELATED WORK

There are two classes of studies related to our method: creation of panoramic image mosaics and visualization of panoramic image mosaics. Many advanced creation methods have been developed in recent years. A very popular approach is the panoramic image mosaic concept proposed by Shum and Szeliski [6] and its variants. In these approaches a rotation matrix is associated with each input image and to reduce registration errors a local as well as a global registration step is initiated. However, there also exist some commercial and non-commercial products such as the QTVR Authoring Studio (http://www.apple.com/), 3D Vista Studio (www.3dvista.com) or the non-commercial PanoTools by Helmut Dersch [2]. Unfortunately most of these products are limited to cylindrical panoramas obtained with cameras rotating on levelled tripods equipped with a panoramic head to minimize motion parallax. This has limited the use of panoramic building to researchers and professional photographers who can effort such specialized equipment.

The other class of methods represent the visualization of panoramic image mosaics. One of the most important methods in this research field is the image based rendering approach introduced by Chen [1]. This technique has been used in the commercial product QuickTime VR, a virtual reality extension to Apple Computer's QuickTime digital multimedia framework. The system provides a technique which uses 360-degree cylindrical panoramic images to compose a virtual environment. But this and other commercial products are generally restricted to the visualization of small panoramas with a resolution of 3000x500 pixels and are therefore not suitable to deal with our high resolution panoramic image mosaics.

4 CREATION OF HIGH RESOLUTION PANORAMIC IMAGE MOSAICS

Our stitching step is divided into several steps, each dealing with one specific part of the algorithm. At the end we demonstrate the results of applying our method on different types of data-sets.

4.1 Overview

Image mosaics are collections of overlapping images that are transformed in order to result in a complete image of a wide angle scene. The transformations can be seen as simple relations between coordinate systems. By applying the appropriate transformations and merging the overlapping regions of an image, it is possible to construct a single image covering the entire visible area of the scene. Normally, those coordinate transformations are not known beforehand, unless the camera parameters are tracked with high precision. Therefore the central problem of panoramic image mosaicing is to compute the transformation parameters exclusively from the image data. Such a problem is called image registration.

However, we restricted our method to a single viewpoint constraint approach, which means that all images are taken from the same viewpoint without zooming. Consequently the eight transformation parameters are reduced to three angles (ω, θ, ϕ).

4.1.1 Cylindrical and Spherical Panoramas

Cylindrical panoramas are commonly used because of their ease of construction. To build a cylindrical panorama a sequence of images is projected onto a cylinder. The x-axis is proportional to a full rotation and the y-axis can be interpreted as the elevation. One disadvantage of cylindrical panoramas is that they do not cover the zenith (straight up) or nadir (straight down). In contrast to cylindrical panoramas, spherical panoramas cover the entire sphere, i.e. 360° horizontally and 180° vertically. One can see straight up and straight down. Consequently both axis of the panorama image are interpreted as angles. To build a cylindrical panorama, we map world coordinates p = (X, Y, Z) to 2D cylindrical screen coordinates (θ, v) using

$$\theta = \tan^{-1}(X / Z), v = Y / \sqrt{X^2 + Z^2}$$

where θ is the panning angle and v is the scanline. Similarly we map world coordinates into 2D spherical coordinates (θ, ϕ) using

$$\theta = \tan^{-1}(X / Z), \phi = \tan^{-1}(Y / \sqrt{X^2 + Z^2})$$

4.2 Work Flow

Our workflow, illustrated in Figure 1, comprises four consecutive steps where the first step consists of calibrating the camera and correcting the lens distortions. Detailed information about geometric camera calibration can be found in Heikkilä [4]. The second task is known as local registration of image sequences where a complete initial panoramic mosaic is assembled sequentially by computing local registration parameters between each image pair. In the third step we need to deal with accumulated misregistration errors, which are always present in any large image mosaic. For example, if we register a sequence of images using pairwise alignments, there is usually a gap between the last image and the first one. Therefore the third step includes a global optimization technique to find the optimal overall registration. The last step activates the stitching algorithm to stitch all image pairs together and to create a coherent panoramic image.

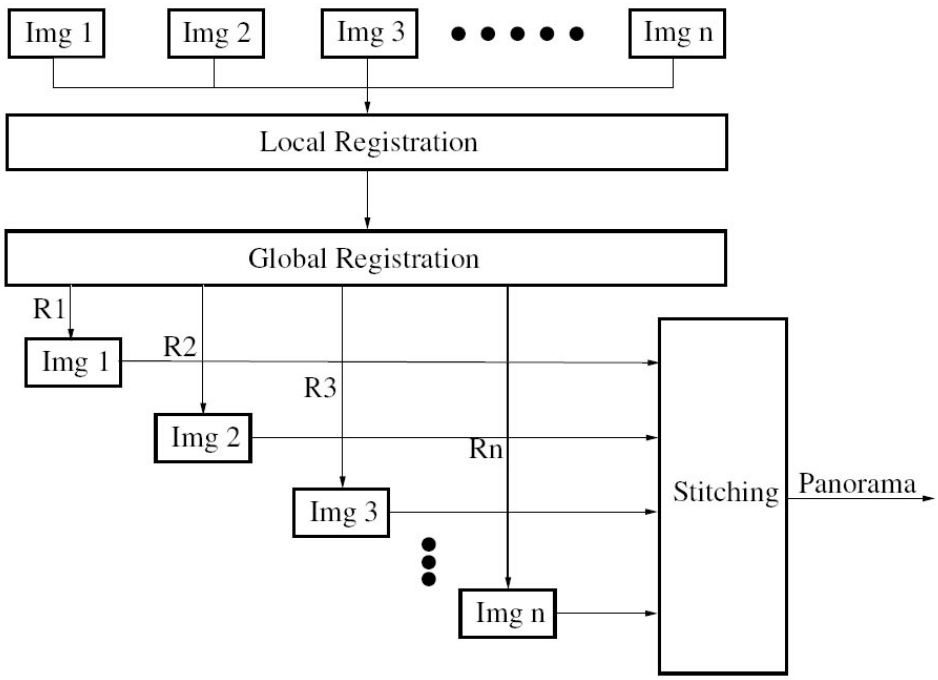

Figure 1: Outline of the major components of our panoramic image mosaicing approach.

4.3 Local Registration

The local registration consists of considering each pair of image and finding the best transformation that maps the first image on the second one. A search for the best match for all possible image parameters can be computationally extremely expensive. Therefore we implemented a feature based method relying on the accurate detection of image features. As a consequence of our wide angle lens, it is necessary to resample all images in a preprocessing step to compensate for any lens distortions. The lens distortions and intrinsic parameters are determined with an automatic calibration process described by Heikkilä [4]. Our feature based matching algorithm can be split into three major parts: extract the feature points, find the initial registration and iterative refine the initial solution.

4.3.1 Feature Point Extraction

To locate common points of interests in the images we combine a generalization of a gray image Harris corner detector introduced by Harris and Stephens [3] with a matching algorithm to detect accurately feature points.

4.3.2 Initial Registration

Considering one image pair, it is possible to match the features from the first image to some of the features of the second image. From those point pairs, called homologues points, it is possible to derive the transformation that map all points of the first image into the second image. The approach for our initial registration is based on the following steps:

- Select all feature points in both images.
- Set an approximate range for all rotation angles (ω, θ, ϕ).
- Compute the sum of point to point distances of all possible rotation angles.

4. Keep that rotation angles (ω, θ, ϕ) which provide the minimum sum of distances.

So far we obtain from each image pair the initial 3D rotation parameters (ω, θ, ϕ).

4.3.3 Iterative Refinement

For a more precise registration of the image pairs it is necessary to initiate a simple iterative refinement step. The refinement is based on the fact that the initial rotation angles, obtained from the second step, are approximately correct. Thus we select the distributed feature points in the overlapping area and iteratively refine the initial rotation angles utilizing the sum of point to point distances.

4.4 Global Registration

Even with the best algorithms for recovering rotations and eliminating lens distortions, when a complete panoramic sequence is stitched together, there will be either a gap or an overlap, due to accumulation errors in the rotation estimations. Thus it is essential to reduce accumulated errors by simultaneously minimizing the misregistration between all overlapping pairs of images. A common way to solve such a problem is the following:

- Convert the misregistration into a gap angle θ_g.
- Distribute the gap angle θ_g over all image pairs.
- Compute the optimal rotation angles using a gradient descent optimization.

4.5 Stitching

Once we have determined the absolute rotation matrix for every single source image, it is possible to create one panoramic image by utilizing one of the traditional projection methods. The most common mapping techniques are the spherical and the cylindrical mapping. The color associated with each pixel is computed by first converting the pixel address to a 3D ray, and then mapping this ray into each input image through our known transformations. Further we introduce a weighted blending function to obtain a smooth transition between each image pair. This blending algorithm has to weigh each pixel in the overlap region with a factor such that the edge pixels weight is zero. Hence we implemented a simple algorithm, which measures the distance of a given point to the closest edge in a given image. The pixel weight is then proportional to this distance to some power of n. The overall stitching algorithm for a spherical panorama is the following:

1. For each pixel (ω, θ) in the spherical map calculate the corresponding point p on a unit sphere.

- For each p determine its mapping into each image utilizing the computed transformation parameters.
- Render a composite blended panorama image from the single source images.

As additional improvement we integrated a kind of filtering algorithm into the stitching process to filter disturbing objects (pedestrians, biker) from the final high resolution panoramic image mosaic.

4.6 Results

Two different locations were chosen to demonstrate our creation approach: the main square in front of the city hall and the square at the entry side of the Kaiser Mausoleum. Note that all results illustrated in this report were obtained on a 1,6 GHz Intel processor with 512 MB main memory and GeForce4 with 64MB graphics memory.

Figure 2: Collections of 18 source images (4064x2704) taken in front of the city hall with an angular separation of 20°.

Figure 3: High resolution spherical panorama generated from illustrated source images covering the main square in front of the city hall. We obtain a geometric resolution of 14000x2704.

Figure 4: Spherical panorama generated from 18 input images covering the entry side of the Kaiser Mausoleum.

5 VISUALIZATION OF HIGH RESOLUTION PANORAMIC IMAGE MOSAICS

Our visualization approach is divided into several subsections where we will give an brief overview of the visualitzation process and present some results.

5.1 Overview

As mentioned before, our panoramic stitching algorithm produces very large panoramas with a resolution of 14000x3000 pixels. State of the art visualizations tools are not able to visualize such high resolution panoramic image mosaics and therefore to overcome this restriction our method warp panoramas with the use of the OpenGL graphic system.

There are many possible surfaces upon which perspective projections can be mapped. One possibility is a set of six planar projections in the form of a cube with the projection center in the middle. While this representation can be easily stored and accessed by a computer, it is difficult to achieve the precise camera position and orientation. Also the planar cubic mapping does not represent a uniform sampling, it is considerably oversampled at the edges and corners. It is complicated to avoid artefacts from discontinuities at the image borders. In contrast the most natural projection is a sphere centered around the viewpoint. One problem of the spherical projection, is the representation of the surface of the sphere in a form which is suitable for storage and fast access on a computer. This is particularly difficult because a uniform discrete sampling is desirable. A trade-off is a projection on the surface of a cylinder. One advantage of the cylinder is, that it can be easily unrolled into a simple planar map, making computer access easy. Most of the commercial stitching tools support this class of panoramic images. A drawback is the limited vertical field of view.

5.2 Virtual Camera

With the virtual camera all known rotations can be emulated. A full rotation about the vertical axis is possible as well as a limited rotation about the horizontal axis. A roll motion can also be simulated, but this rotation of the image is not reasonable, because such a motion is not common in conventional photography. By modifying the field of view of the artificial camera, a zooming effect can be achieved. But through this image magnifying no new details can be seen.

5.3 Geometry

Due to the curved projection surface large distortions are inescapable in panoramic images (see Figure 3 and 4). New views are generated by mapping the panoramic image onto a cylinder or sphere which are viewed through a central projection from the center. Thereby the distortions are corrected.

In other systems (e.g. QuickTime VR by Chen [1]) a custom image warping algorithm has been used for this task. However the goal of this work is to use the OpenGL graphic system and therefore a standard rendering pipeline. One can produce arbitrary image distortions by texturing a uniform polygonal mesh and transforming the vertices appropriately. To warp the panoramic image, a cylindrical or spherical surface is approximated with a triangular mesh and the synthetic camera is placed in the center as illustrated in Figure 5.

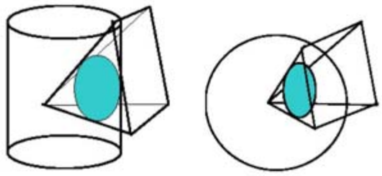

Figure 5: Camera positions in the approximated surface

5.4 Recording and Reproduction

By taking a point in 3D world coordinates (X, Y, Z) and mapping this point using a central projection onto the approximated surface, we obtain the transformed coordinates.

In order to warp the panorama for viewing, the image is projected from the approximated surface to a plane, which is normal to the optical axis and tangents at a defined point. Consequently a point on the surface is projected over a known transformation into a point on the plane. The process of warping can now be accomplished by an algorithmic operation, called warp operation. Detailed information about this algorithm can be found in Chen [1].

5.5 Texturing

The polygon mesh, whose shape was derived in the previous section, has to be textured with the panoramic image. Therefore we divide the large panoramic image mosaic into suitable parts and sent these parts as single textures to the OpenGL rendering pipeline.

6 RESULTS

Figure 6 shows a screenshot of the current implementation. To illustrate the quality of the high resolution panoramic image mosaic Figure 7 presents a magnified view of the city hall during the visualization. In Figure 8 we illustrate the underlying geometry of the textured cylinder overlapped to the warped image.

Figure 6: Visualization of a 14000x2704 high resolution panorama covering the main square in front of the city hall. We obtain a frame-rate of 70-100 frames/sec on a 1,6 GHz Intel processor with 512MB main memory and a GeForce4 with 64 MB graphics memory.

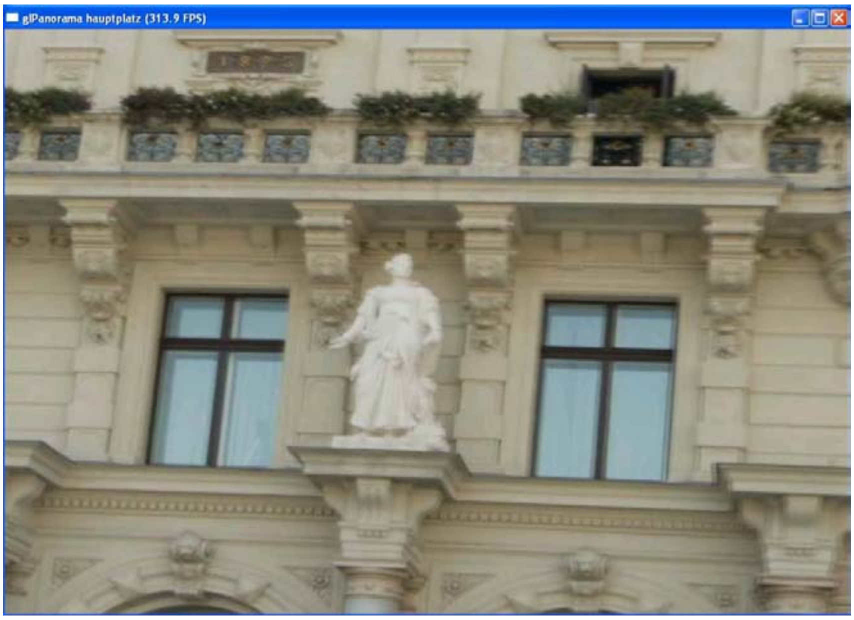

Figure 7: Magnified view of the main square in front of the city hall to illustrate the quality of our panoramic image mosaic.

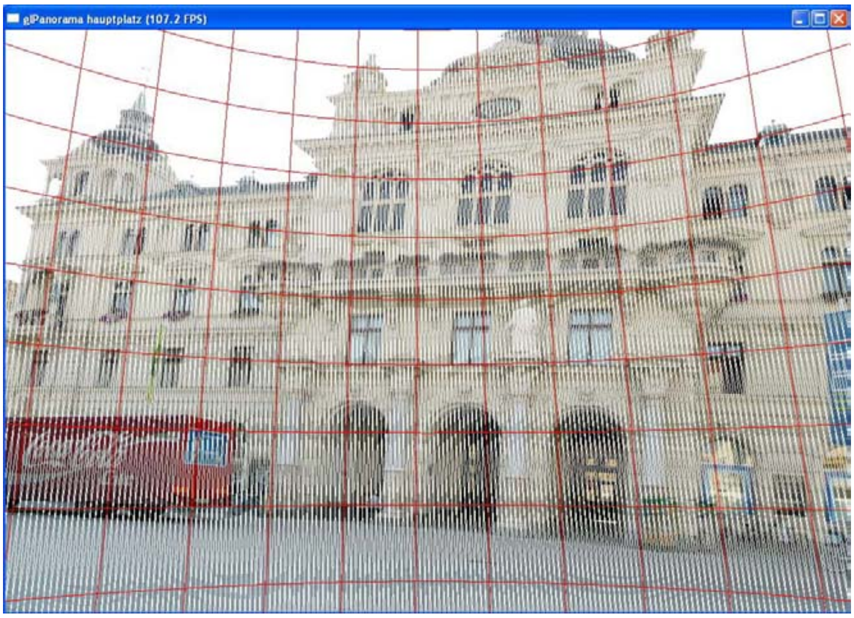

Figure 8: Underlying geometry of the approximated cylinder during the visualization process

7 CONCLUSION AND FUTURE WORK

We have presented a 2D city documentation system based on panoramic image mosaics. Moreover a stitching method was shown to create cylindrical as well as spherical high resolution panoramic image mosaics from image sequences fully automatic. Furthermore we illustrated some results of applying our method on different types of datasets. The second part of our framework demonstrates a visualization tool, which is able to visualize high resolution panoramic image mosaics by utilizing the OpenGL graphic system. Navigation through the environment is accomplished by jumping to different panoramic points.

One possible extension of the presented framework would be the creation and visualization of stereo panoramas to give the user a realistic sense of depth. Furthermore it would be useful to integrate metainformation about the presented environment into the final panoramic image mosaic.

8 ACKNOWLEDGEMENTS

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Construction Supply Chain Management and Coordinated Design Drawings: An outlook of the construction industry and sustainable urban planning

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1 INTRODUCTION

This paper examines the utilisation levels of Information and Communication Technologies applied in the construction industry and urban planning. It focuses on the potential application of Construction Supply Chain Management system amongst organisations in the construction industry and the readiness of application of Coordinated Design Drawings for new township developments.

2 ICT APPLICATION IN MALAYSIAN CONSTRUCTION INDUSTRY AND URBAN PLANNING

Applications of Information and Communication Technology (ICT) have been on the increase since the last three decades. Many sectors of the economy, including the built environment and the construction industry, have reaped great benefits from the variety of ICT applications and apparatus. In the drive towards sustainability in the physical and socio-economic developments, ICT may play the roles of increasing the efficacy and effectiveness of managing the environment. The marriage of advancement of computer and telecommunication technologies enable sharing of information, bridging of distance and information gaps, better and well-informed decision making as well as quick-response to the current crises through the availability of supply and and reliability of real-time information.

In Malaysia, however, the trend has been on the uprise only since the Multimedia Super Corridor idea was first mooted in the 1990s. Multimedia Super Corridor is a physical space of 15 km by 50 km streching from Kuala Lumpur city centre in the north to Kuala Lumpur International Airport, Sepang in the south. The corridor will eventually be supported by broadband wireless communication facilities and other flagship ICT applications. Some of these applications include (Mohd Nasir, 2002):

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- Computer Aided Design (CAD);
- Geographical Information System (GIS);
- Traffic Management Control (TMC) and Intelligent Transport System (ITS);
- Database Management System (DMS);
- Facility Management System (FMS);
- Electronic submission of planning application on-line (E-submission);
- Construction Supply Chain Management system (CSCM); and
- Coordinated Design Drawings.

In many developed and developing countries, these applications are becoming the norms for organisations related to the industry and urban planning. Singapore, for example, has been implementing the e-submission of plans for urban regeneration projects for many years (Urban Redevelopment Authority, 2000). Meanwhile, other countries are still exploring the potential benefits of ICT. Malaysia, for instance, has only recently been introduced to the Integrated Tranport Information System which encompasses Advanced Traffic Management System (ATMS) and the Advanced Traveller Information System (ATIS) to manage traffic conditions along major roads in the city of Kuala Lumpur (ITS Consortium, 2003). Additionally, in Putrajaya and Cyberjaya, the electronic method of layout plan submission (E-submission) has been in place for almost five years.

Sustainability of physical and socio-ecnomic development also demands that development projects to be undertaken with the greatest care for the natural environment and resources. Achieving this, which is one of the aims of Malaysia's Vision 2020, poses some challenges to urban planning and the construction industry. This is true of Malaysia, whereby increasing population and economic prosperity warrant some new establishment of townships, more often than not, in the outskirt of cities and in suburban areas.

This paper examines the varying degrees of utilisation of ICT in the construction industry and urban planning practices. Focusing on only two of the applications listed above: Construction Supply Chain Management system (CSCM) and Coordinated Design Drawings (CDD), this paper further explores the levels of awareness, acceptance and willingness of related organisations to undertake these applications in their daily operations.

There exist two main activities in Malaysian urban planning namely forward planning and development control. In forward planning, development plans indicating future trends of physical growth based on the nation's socio-economic policies are prepared. Before undertaking these physical development and construction of buildings, a planning permission should be sought from the local authorities. The applications for planning permission and building construction (plans) are usually accompanied by several plans and reports explaining in detail, amongst others, types of development being proposed, their impacts on existing landuse, the manners in which they are to be carried out, whether or not minimum required standards employed so as to ensure the well-being of end users.

The development actors involved at the pre-planning application stage are physical planners, architects, land surveyors, landscape architects, civil and structural engineers and electrical and mechanical engineers. During post-planning application or after securing planning permission, landscape architects, architects, constructors, engineers and quantity surveyors will play their respective roles to see to it that the building plans have the appropriate approval from the authorities. According to *Appendix A*, the minimum duration of active involvement by these professionals is 53 weeks. About 17 weeks are for outline permission of conversion of land use, 12 weeks for planning permission approval (without conditions), 10 weeks for approval of full conversion of use and subdivision, and 6 weeks of building plans approval. Additional 8 weeks are required for licencing and sales or advertisement purposes. Normally, land clearing and contruction works take about 2 to 3 years e.g. in a housing project. In practice, however, this may take longer time.

Since the process involves high levels of interactions between different professions, information regarding the various stages of development need to be shared in order to keep these professionals up-dated with the most current changes (Baharudin, 2003). Currently, there exists very little integration and sharing of information amongst the professionals that sometimes conflicts might arise due to ignorance and unawareness of changes to plans or details of the development and construction processes. This greatly warrants effective and efficient management and dissemination of information.

An integration and sharing of information, in particular reports and plans of physical development and building construction, have been practiced in both the United Kingdom, to a greater extent, and Malaysia, to a lesser extent. In Putrajaya, Malaysia, for example, actors of development prepare and share development and construction information before finally submitting them to the local authority via internet platform. The process is known as e-submission. Currently, the major benefits decrease in the number of trips generated due to the need to visit to and meeting at the local authorities offices and the number of face-to-face discussions held amongst the professionals themselves (Abdul Rahman, 2002). The benefits of less paperwork and printing have also been reaped. Major changes in plans and reports can easily be communicated through electronic means. The local authority can establish a 'one-stop-centre' for development control process without having to reproduce reports and plans on papers to be circulated to other agencies and authorities within and outside the organisation (Abdul Rahman, 2002). All the information, up-dated reports and plans are easily accessible to those relevant actors and authorities through designated the inter- and intra-net channels.

In order to illustrate this more clearly, the paper presents two case studies: CSCM in the UK and CDD in Malaysia. They are to illustrate the interesting and distinctive approaches used to propogate further applications of ICT in both fields as well as the unique circumstances and fortunes limiting the introductions and implementations. Citation of these cases: the supply chain in the construction industry and the urban development sector (new township planning applications), will assist the study in translating the benefits of ICT into substitutions for journeys-to-work; thereby reducing travel demand, lessening air and noise pollutions and eventually promoting safer, healthier and more sustainable urban development.

3 CONSTRUCTION SUPPLY CHAIN MANAGEMENT

3.1 Definition

Supply chain is a term used to explain the life cycle processes supporting physical, information, financial, and knowledge flows for moving products and services from suppliers to end-users. Understanding the supply chain is certainly important to those involved in related process and system improvement. In the context of the contruction industry, supply chain can be identified as system through which design teams and builders working together to deliver an end-product to their clients. As such, construction supply chain management may be defined as a field of study that concerns in improving the system implemented to ensure improved project performance along various metrics such as speed, cost, rehability, quality. The supply chain management in construction offers a way to integrate the traditional islands between the members of the construction team and thereby reducing the time and cost.

3.2 Application and Implementation

The construction industry is a very fragmented industry. Numerous projects have derailed from their original schedule, thereby increasing the project cost to unrealistic values. One of the reasons is the traditional model of planning, scheduling, controlling and contracting, where each functions as different islands. At the best they try to optimise individual activities, but seldom look at each other's activities. The construction supply chain process involves of different stages in the construction process. The work stages are as follows (RIBA, 1973 cited in Seeley, 1997):

- Briefing Stage (comprising of inception and feasibility)
- Design Stage
- Outline proposal
- Scheme design
- Detail design
- Production information
- Project contracts/ Tendering Stage
- Bills of Quantities
- Tender action
- Project planning
- Construction

The construction supply chain process involves many different team members. The members of the construction supply chain are the clients, architects, planners, quantity surveyors, engineers, landscape architects, interior designer, main contractor, sub-contractors and the suppliers. Each team members is a link in a chain of activities, adding value at each stage, designed to satisfy end-customer demand in a win-win situation. The process also embraces all the information technology necessary to support and monitor the activities. Since the members of the construction supply chain process are fragmented across many diverse disciplines, each using different systems, and approaches to comply with clients' requirements, poor management and communication problems often occur.

The control of time, cost and waste is of paramount concern to all parties involved in construction projects. Many problems related to issues of control result from inadequate communication of information within the supply chain. The amount of information flow in any construction project from start to finish should not be underestimated. Different types of information / data are required by various people in the construction supply chain in various formats. Amongst identified problems are: fragmentation of professional expertise, lack of information sharing, lack of awareness of available technology for integration, inefficient manners of managing information and an overall ineffective coordination along the construction supply chain.

For the construction industry to be competitive, it needs ICT applications encompassing all the professionals and stages involved. It is inevitable that conflicts may arise during communications between parties (Eddie W.L. Cheng *et al.*, 2001). This is an area where ICT helps to support and achieve efficient and effective communication between members of the construction supply chain.

The construction industry has widely used information technology to improve the capability and efficiency of many aspects of the construction process. Large amount of investments have been made and focused on providing ICT support for specific activities within the construction process. At present, the integration of the construction process through electronic sharing and communication of information is not widespread (Construct IT Bridging The Gap, 1997). This is indeed the major area of opportunity. An application of ICT is to automate different parts of the construction process. ICT can ensure a collaborative information technology, which tends to support improvements in communication and interaction between project partners. Currently, the industry utilises ICT as a tool to provide support for specific tasks, but yet as a coordinating tool to integrate activities or provide more efficient communications along the stages as a way to save time, costs and other conflicts. Traditionally, before the usage of ICT, project information was passed on linearly – lack of integration and coordination between sequential stages.

Information technology applications in construction are widely available and are also widely exploited, but the production side of construction industry is still resistant to the attempts to computerise site activities. The use of ICT in the construction supply chain process has so far concentrated on discrete applications. Members of the construction supply chain should now work together towards implementing ICT as a strategic advantage. ICT potentially provides new strategic opportunities and if used effectively can bring great benefits to the construction supply chain process. The members of the construction supply chain should consider where their opportunities lie now to take advantage of the competitive situation. Tendering and supplier selection is amongst the important stages in a construction supply chain process. Time is usually limited and a constraint in doing these two activities. Implementing ICT is seen as a medium to improve these two processes strategically. There are many benefits that can be achieved in implementing ICT in the construction supply chain process. It is an integrating solution for problems of fragmentation and clients would be able to receive a more timely and accurate information on their project. Moreover, it enables new and improved service in the supply chain, e.g. collaborative extranets are seen as a medium to improve the tendering and supplier selection process. ICT also adds value to clients' investment from an improved construction process as this also means better quality in the end product. They would also be able to save time and in construction by saving time it would also mean save cost.

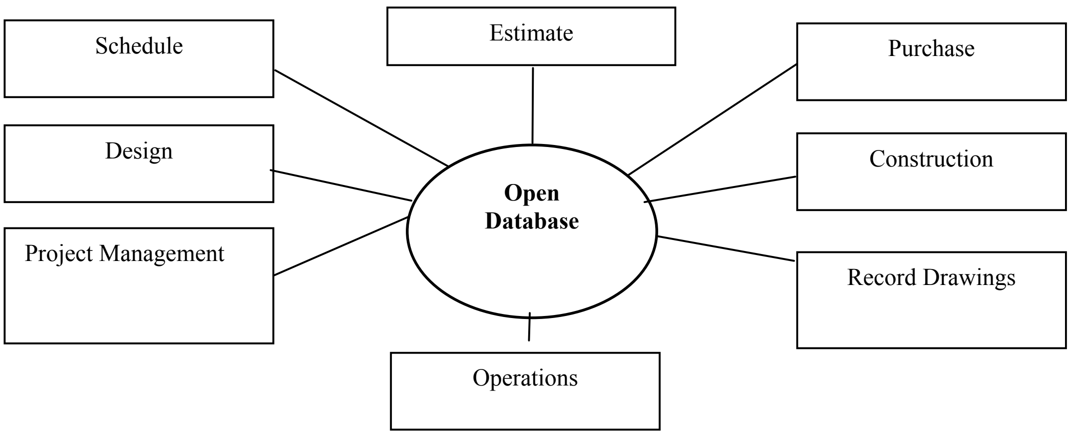

Figure 4.2: Integrated and Collaborative Information System (Frederick E. Gould *et al.*, 2002)

ICT may be utilised at Project Applications stage. Some of the benefits include providing database platform to support all the project and product information. It also has a potential role in 3D presentation to allow complete product description. ICT links design information, component lists with cost estimates. It also links project database with facilities management applications. Use of intelligent databases through ICT will provide some of the necessary data manipulation and control facilities.

At the Briefing Stage, it may assist in modelling client's requirements and provide performance benchmarks and cost trade offs, Life cycle cost can be modelled using ICT. ICT is able to create visualisation modelling techniques that will allow clients to visualise different design options (e.g. usage of virtual reality). Meanwhile, at the Design Stage, ICT helps integrate suite of knowledge based engineering into the project database and industry knowledge base. 3D CAD systems can be used to model basic geometry with associated product information. Project database used as interface to knowledge based analysis and design tools. Project database would also be able to provide facility to access impact of design changes and allowing 'what if' analysis by consultants, contractors and clients. Project database then would be able to automatically inform design team members of changes, which affect parts of design for which they are responsible, automatic access to industry knowledge base for standard component lists. The next stage in construction supply management is the Project Contracts/ Tendering Stage. At this stage, ICT create interfaces between technical and commercial applications. It also provides parallel costing which can be attached to design packages. This allows cost implications of design decisions to be assessed. ICT based estimating models to support human judgement may also be developed. ICT helps store standard contract information on project database or provide access to this through industry knowledge base.

On-site communication may also benefit from ICT application. Site communication infrastructure could support email and videoconferencing. Visual links would allow remote access to 'virtual team' for any changes in design. This would also include the availability of 3D models on site. Contractor 'head office' information would be able to be brought to site using better communication links. Site communication would be able to use wireless networks to control transmission of information around site. The following stage is Supplier Management. ICT is able to provide communications infrastructure between suppliers and contractors. Project planning information can be shared electronically with suppliers direct from planning systems. Electronic order and payment management are also some of ICT benefits.

A typical construction supply chain process usually involves an ad hoc team of different firms, each of which will only deal with a certain aspect of the project. Very often, each firm would only be interested in improving their own activity. This is one of the reasons why many of the currently available ICT applications are directed at a single activity, such as drawing production or cost estimation. The construction supply chain process will result in a unique product e.g. a specific building for a specific context of site conditions and client's requirements (Sun, 2002). The use of collaborative ICT would definitely create a good sharing information environment. And since there are a lot of different teams working together in the supply chain, this environment would definitely create a better understanding and communication interaction between all parties involved.

Collaborative ICT relationships in the construction supply chain in general have a number of advantages. They include being able to develop and provide a good background for improved production control within each contractor and supplier in the supply chain; giving a better and clearer understanding between all parties involved and having the ability to manage their resources across project, as well as creating a good information-sharing environment. The exchange of information between the various parties involved in the supply chain is a vital issue. This is because information sharing is the most important thing in the construction process in enabling the project to progress effectively.

The progress of ICT in the construction industry and the use of integrated and collaborative ICT systems in the process of planning, evaluation and construction phases have brought about great benefits to the industry. Implementing a dedicated and fully integrated construction management system enables the members in the construction supply chain to gain significant competitive advantages. A reduction in travel demand, which indirectly lessens air and noise pollution, a cost reduction for both the client and themselves and greater business efficiencies are three of the advantages offered by ICT. Other benefits range from better communication and understanding between members of the team to an in crease in profitability and an on-time or often early completion of projects. Eventually, all these will lead to overall customer satisfaction and better environment.

3.3 The Readiness of the Industry

3.3.1 Assessment

A set of assessment tables have been designed as an assessment tool in assessing the effectiveness usage of ICT and being able to identify the current level of awareness and readiness of the organisations to accept ICT along the construction supply chain process. Selected samples are to select the most relevant descriptions which fit their firms' current level of application based on the assessment categories below. The various selection of degree of ICT application may be further explained by Appendix B.

Category 1: Level of ICT usage in the organisation

A.	ICT applications exist mainly in financial operations, i.e. within financial developments
B.	ICT application is being concentrated in financial operations, but steps are also being taken in using ICT for some business activities such as using standalone word processing systems, spreadsheets, etc. No exchange of information is performed between your organisations and others.
C.	Organisation has started using specific in-house I.S. / ICT systems applications in support of core business functions such as using RIPAC for the preparation of Bills of Quantities and CAD in designing.
D.	Organisation is implementing E-business techniques across the supply chain; i.e. e-tendering, materials can be ordered online with the use of internet.

Category 2: Level of ICT infrastructure in the organisation

A.	ICT applications are independent and unconnected within departments, i.e. each department are using different types of software applications according to their own needs whereby there is no means of sharing information across organisations.
B.	Organisation has implemented commerce-enabled extranets, in establishing and maintaining a one to one relationship with other organisation and clients at very low cost through the web. Project information can be shared and exchanged between supply chain members via the internet.

Category 3: Level of ICT awareness and training in the organisation

A.	Organisation is still not willing to change and is comfortable with the traditional method of running their core business functions manually.
B.	Organisation is realising the needs of ICT to support their core business functions, BUT they are only focusing on individual skills needed for individual projects.
C.	ICT applications are not only seen as a support to their core business functions, but are also seen as a strategic advantage for the organisation to stay competent in the construction industry, i.e. the usage of virtual reality, interactive web-sites, videoconferencing and others.

Category 4: Level of ICT as a communication tool in the organisation

A.	ICT applications such as electronic messages are being used extensively via the organisation's intranet; i.e. team leaders are able to communicate with supply chain members easily.
B.	Organisations in the construction supply chain are using electronic mail via the organisation's intranet in order to share and exchange information within the organisation.

Category 5: Level of ICT in the coordination of data and storage

A.	The ICT applications implemented are still not properly coordinated throughout the organisation; sometimes the purpose, function and data stored are still overlapping.
B.	Some old-developed systems are still being used in uncontrolled, uncoordinated manner even though new systems are centrally developed, installed and operated by ICT functions.
C.	There is a central project database to be used by members of the construction supply chain (database maintained with proper systematic referencing, etc)

Category 6: Level of ICT in the management support system in the organisation

A.	Organisation is developing decision support systems (DSS) and executive information systems (EIS) for the use of senior management.
B.	Organisation is successfully using knowledge management systems (KMS) to manage organisational learning and business know-how, i.e. organisations relying on internet or intranet web sites, knowledge bases and others as key technologies for gathering, storing and distributing business knowledge.

In assessing the organisation's current level of ICT readiness, an analysis is made of the result obtained from the categories of assessments. This is elaborated in Appendix B. For example, if the user selected option A from category 1, option A from category 2 and also option A from category 3 and they either select the column *don't agree* or *don't know* from categories 4, 5 and 6, then the current level of ICT readiness can be classified as Level 1.

LEVEL OF ICT READINESS	DESCRIPTION OF LEVEL
Level 1	• The organisation only uses ICT for financial operations and according to each group's needs in isolation of the rest of the organisation. • Has limited understanding of the value and potential of ICT
Level 2 *Occasional*	• An increase of ICT application systems being developed but concentration is still more on operational systems. • Many of the ICT application systems still overlap in purpose. • There is a possibility of network sharing between groups. • All data are stored in units' systems, except data needed for organisational reporting are transferred to central systems.
Level 3 *Responsive*	• In-house ICT applications covering most major operations areas with office automation exists but in an isolated stand-alone manner. • Technical infrastructure consists of unconnected systems where no shared applications exist. • Some ICT applications have been put together by users, and old user-developed systems are being used in uncontrolled, uncoordinated manner even though new systems are centrally developed, installed and operated.
Level 4 *Planned*	• All needed operational ICT is mostly in place and some DSS start to appear. • Office automation of an organisation is integrated and standardised organisation-wide. • Existence of an organisation-wide network, where all groups are connected and the central ICT function provides communication services for all groups in the organisation. • Central coordination in the use of ICT throughout the organisation. • Shared applications and information systems are being utilised
Level 5 *Strategic*	• Strategic ICT applications are developed with external-oriented data along with DSS and EIS. • New systems intended to provide strategic advantages to the organisation and supply chain, where ICT is used to add value to organisational end-product or services. • Most systems are decentralised but with central coordination and control. • DSS and EIS systems are developed for the use of senior management.
Level 6 *Integrated*	• Using inter-organisational systems with outside entities (government, suppliers, etc), with the use of Internet and e-commerce technology. ICT is integrated with all the supply chain members and other business partners. • Intranet provision improves effectiveness. • No geographic constrains on the provision of information. • Existence of diverse hardware architecture according to each member's needs. • GSS and KMS systems are developed and successfully used.

Table 3.3: The description of levels of ICT (Saleh, 2002)

From the categorisation and assessment, scenarios may be built. For instance a Highly Optimistic Scenario is a situation whereby half (30 percent) of the trips are related to exchange of digital information that could be transmitted and disseminated via the inter- and intra-net, and firms having very high acceptance towards application of CSCM and CDD; therefore can be wholly substituted by utilisation of CSCM and CDD. The scenarios reflects an advanced state of technological awareness and readiness to apply ICT in the industry, possibly 50 years from now. The same method is applied for the different scenarios, each with their own characteristics and conditions governing the rate of trip substitution as a result of ICT applications within the individual firms.

Three different organisations in the construction supply chain were given the assessment categories (1 to 6) to determine their level of ICT readiness via electronic mail. Each organisation was assessed according to six categories, as follows:

- Level of ICT usage in the organisation

- Level of ICT infrastructure in the organisation
- Level of ICT awareness and training in the organisation
- Level of ICT as a communication tool in the organisation
- Level of ICT in the coordination and storage of data
- Level of ICT in the management support system in the organisation

The answers given by each respondent were then compared with the table of indicators as per *Appendix B*. This can roughly determine their level of ICT readiness.

Case Study 1 : Based on the comparisons made, the research can roughly say that the level of ICT readiness is level two. They are not really ready to integrate ICT throughout the construction supply chain. Although there have been an increase in the number of ICT development in their organisation, but concentration is still on operational systems in the financial area, while only a small number of core business-oriented systems are being developed. Many of the ICT application systems are still overlapping in purpose, function and data stored. Their organisation is realising the need of ICT to support their core business functions, but till now, they are only focusing on individual skill needs rather than using ICT as a strategic advantage to stay competent in the construction industry.

Case Study 2 : Results obtained from the second case study showed that they can be categorised as in level 4. Their operational ICT is mostly in place and there is an existence of organisation wide network, where all groups are connected and the central ICT function proves to provide communication services for all groups in the organisation. The second case study shows that the organisation is well planned in terms of ICT implementation and should be ready to start collaborative ICT between all members of the construction supply chain. Integrated collaborative ICT between the members of the construction supply chain can help to save cost and time as well as producing better end-product through coordinated communication network. Misinterpretation of information that often leads to conflicts can be also be reduced whereby everyone gets the same information at the same time.

Case Study 3 : Results found that organisation three still consists of unconnected systems where no shared applications exist. Systems have been implemented in most operational areas, but the ICT applications are still independent and unconnected within departments and other members. As comparisons are made using the table of indicators, results show that the third organisation can be categorised as Level 3.

3.3.2 Summary

The results from the survey show that there are a variety of ICT readiness levels in the current construction supply chain in the United Kingdom. Some are moving forward towards strategic advantage of ICT implementation, while there are organisations that are still left behind in terms of readiness, awareness and their willingness. The construction supply chain is still lacking in using ICT as a tool in the management support system. They have to work really hard in improving their level of ICT readiness in moving forward towards strategic advantage ICT.

ICT has been seen as an important tool in ensuring good flow of the construction supply chain process. Members in the construction industry have also now realised the need for aligning strategies, people, processes and technologies in their business environment. Implementation of collaborative information technology in the construction supply chain process would definitely be a success if all stakeholders decide to work together as a team.

4 COORDINATED DESIGN DRAWINGS

4.1 Definition

The advantages of computerised design drawings outweighed the advantages of manual/paper-based drawings in many aspects. The respective advantages and disadvantages of paper-based system and the Computer Aided Design drawings are illustrated below:

	PAPER BASED SYSTEM (Manual Drawings)	COMPUTER AIDED DESIGN (Computerized Drawings)
Information Management	• Difficult to retrace drawings • Does not have drawings back up • Accessible by any person (no security on the drawings) • Have to redraw the standards parts and components • Analysis has to be done manually	• Finding drawings in seconds • Backing up important work without risks of deterioration • Preventing unauthorised access to drawings • Accessing libraries on standard parts and components • Computer-aided analysis
Networking Communi-cations	• Does not provide any networking capabilities • Not very effective in terms of project management • Difficult to coordinate progress of the design teams • Less productivity (abortive work)	• Several users at different locations can access the same data or drawings • Managers can continuously supervise and maintain the progress of the project • Different teams can work simultaneously rather than being delayed by one another • Better communication means less abortive work
Editing and Updating Functions	• Have to erase or even redraw the whole drawings • Less accuracy • The drawing scale cannot be changed • Calculation of diameters, perimeters, areas and co-ordinates be done manually • More laborious	• Can edit and automatic update drawings instantly • Greater accuracy • Drawings can be plotted at any scale • Automatic calculation of dimensions, perimeters, areas and co-ordinates • Less laborious

Table 4.1: Differences between paper-based system and the computer aided design system

The compilation of design information from a multidiscipline team of consultants inputted into a single database forms a Coordinated Design Drawings or CDD (AJC Planning Consultants, 2000). Currently, AJC Planning Consultant is undertaking the compilation and coordination of the drawings from other professionals for the preparation of CDD plan (Baharudin, 2003). Information included in the CDD is based on inputs from the surveyor, civil engineer, electrical engineer, architect and landscape architect. Overlaying of design information allows a CDD to identify design issues and conflicts between services prior to construction works.

The application of CDD is one of the tasks that AutoCAD can perform. The application of CDD will further enhance the benefits of CAD. The reason why AutoCAD software is recommended to be used in the production of CDD -instead of other software such as Microstation and MapInfo-, is because most of the drawings prepared by the consultants in Malaysia are drawn using AutoCAD (Baharudin, 2003). Furthermore, even the submission of plans to the local authority is in AutoCAD format. Nevertheless, there are a few consultants, who use MapInfo for drawing purposes. However, the number is small. Thus, based on familiarity and its nation-wide application of the AutoCAD software, it would be recommended that the production of CDD also be done in the AutoCAD format. *Appendix C* illustrates the various layers of plans that form the final Coordinated Design Drawings.

4.2 Application and Implementation

Studies on planners and architects revealed that cooperation between the design team is vital in realising sustainable development initiatives. This can be done through the production of CDD in the design process (AJC Planning Consultants, 2000). With the ability of CDD, better environment can be planned in manners that promote the idea of sustainable living initiatives as in the case of Kota Kemuning new township development (Baharudin, 2003). However, the implementation of sustainable development initiatives can only reach its prime goal, if all the parties work closely with concerted effort – from the designers to developer and from the government officials administering the community amenities to the residents themselves.

The standardisation and unification of formats for drawings are essential to reduce errors and increase coordination of drawings. As a general rule, standards are not mandatory, but are for voluntary application. However, they can be a determining factor for individual firms to be receptive towards CDD and other ICT applications. Baharudin (2003) in his work has highlighted the input components of professionals involved in producing CDD. They are shown in Table 4.2 overleaf.

Professional Input	CDD elements
1. Surveyor's input	Precomp Plan
2. Town Planner's Input	Overall layout plan Data on the Socio Economic Sector: - Existing Population - Population Projection Data on the Physical Development Sector: - The suitable building height - Green linkages
2. Civil and Structure Engineer's Input	Roads Drainage Traffic Management Water Supply Sewer
3. Mechanical and Electrical Engineer's Input	Power Telephone Street Lighting
4. Architect's Input	Site Plan
5 .Landscape Architect's input	Soft Landscape Hard Landscape
6. Construction Stage- All actors	Construction Materials and Specifications

Table 4.2: The common task of each professional within the design team and CDD elements (AJC Planning Consultants, 2000)

4.3 The Readiness of the Industry

Sustainable development initiative is exemplified by the effort put by the developer (HICOM-GAMUDA Development Sdn. Bhd.) with full cooperation from the consultants as well as support from the local authority (Shah Alam City Council). The developer has made it compulsory for the consultants to prepare CDD throughout the project, in this case study, the Kota Kemuning new township. From the interview conducted with the developer, the officer highlighted that development of Kota Kemuning was made easier with the application of CDD, as it draws up the sequence of job effectively which could avoid problems during construction period.

Since the goal of Kota Kemuning, Shah Alam, is to provide residents with all the conveniences and amenities, with appealing quality life, it is inevitable that the development necessitates thorough and detailed planning and designing. Thus, Kota Kemuning has taken the initiatives by applying CDD in the development process. Photos of the developments are supplied in *Appendix D*.

It is crucial to get the professionals' opinion on CDD as it will be the basis for the formulation of any efforts towards the development on the application of CDD. In this study, three professional parties have been interviewed, from the public and private sector to the developer's point of view on CDD (Baharudin, 2003). Those are the Shah Alam City Council (SACC), AJC Planning Consultant (project manager), and HICOM – GAMUDA Development Sdn. Bhd. respectively.

SACC has been selected since Kota Kemuning is under SACC jurisdiction. It is, thus, appropriate that the authority's expert opinion on the development of Kota Kemuning be recorded. AJC Planning Consultant is the pioneer of the idea and preparation of CDD. In fact, it is the only planning consultant that applies CDD in its development projects. Moreover, the current user manual, procedure and guidelines on CDD are prepared by the firm. Therefore, input from AJC Planning Consultant is essential. HICOM – GAMUDA Development Sdn. Bhd. has taken the initiative to make it compulsory for all the appointed consultants to apply CDD. Hence, information on the effectiveness of CDD in terms of cost and time formed the basis for selecting HICOM – GAMUDA Development Sdn. Bhd. as a sample.

4.3.1 The Local Authority

In Baharudin's work (2003), an interview was conducted on *Shah Alam City Council* (SACC), the Local Planning Authority for new township of Kota Kemuning. SACC, which was formerly known as Shah Alam Municipal Council, was established in 7th December 1978. This is due to the declaration of Shah Alam as the capital state of Selangor Darul Ehsan. Initially, SACC was fully operational on 1st January 1979. Shah Alam was upgraded from a municipal to city authority on the 10th October 2000. Ever since, the responsibility of SACC has become more significant in shaping the development of Shah Alam. At the same time, it is also reponsible to accommodate the increasing needs of the community, inline with the vision: to `*develop Shah Alam as a beautiful, competitive, and harmony with the environment towards creating a comprehensive community with sustainable development'.*

From time to time, the area of jurisdiction or SACC has increased accordingly. Starting with only 19.68 km^2 in 1960, the area has increased gradually. The latest survey which was conducted on 2nd January 1997, recorded that, SACC covers an area of 290.3 km^2.

Since CDD is initiated by the consultants and developer, the local authority was not well informed on what CDD was all about. SACC, for example, was not aware that CDD has been applied in Kota Kemuning. The reason being, CDD is the own initiatives of the developer with commitment from the consultants whose aims is to develop a more livable and pleasant living environment. Furthermore, CDD currently is not one of the requirements in the application for planning permission. This might be due to the none-existence of standards on CDD which is applicable to all relevant parties in the built environment including the local authority.The local authority only requires the consultants (urban planners) to submit the proposed layout plans. This layout plan needs to comply with the standards and guidelines prepared by Federal Town and Country Planning Department (FTCPD) as well as the local authority's requirements. According to the Town Planning Officer of SACC, the proposed layout plan itself should have actually identified whatever conflicts or disagreements of the alignment and placement of utilities and other facilities.

The proposed layout plan was not in CDD form during the preparation process. As such, for example, when the appropriate alignment and placement of utilities and facilities were due for inspection and scrutinisation, it was difficult for the urban planners to incorporate these into the layout plans. Moreover, coordination and integration of other professionals' drawings into the layout plan have been proved to be difficult due to the absence of CDD application. As a result, contractors will encounter problems during the construction phase. This, somehow will have an effect on the adherence to the project schedule.

4.3.2 Professional Consultants

AJC Planning Consultant is one of the prominent urban planning firms in Malaysia. It offers a wide range of services, from the preparation of development plans, environmental impact assessor to the physical planning and urban design services. Within 10 years, the firm has undertook numbers of development projects, several Structure Plans and Local Plans, National Physical Plan, Bandar Botanic, Valencia, Bukit Rimau, Bukit Jelutung, Kota Kemuning, to name but a few. Amongst the projects, Kota Kemuning, located on the outskirt of the city of Shah Alam, can be considered as the best, as it was awarded the Planning Innovation and Concept Award 2000 by the Malaysian Institute of Planners (MIP).

Believing that *planners is a man with a vision*, much effort has been introduced by the consultants in their development project, with the goal of improving the quality of the living environment. One effort is promoting the use of Coordinated Design Drawing (CDD).

CDD was introduced due to the increasing awareness on the *degradation of the living environment* in the country (AJC Planning Consultant, 2003). In many housing development projects of the last decade, the end products have not really made the residents *happy* in many senses. These are due to the improper planning of the facilities and utilities (except for the high cost housing development). The reason behind the scenario is that, during the period the nation had experienced a rapid economic development, with many new housing schemes being constructed haphazardly to accommodate the increasing population. As a result, the quality of the end products was compromised. Ad-hoc planning of facilities and utilities have created improper neoghbourhoods environment.

Furthermore, in those days, developers were not fully aware of the roles of urban planners. Architects have been holding the most important role as they were the ones who handled and managed the projects, right from the planning stage to the construction stage. The engineers, on the other hand, will handle the engineering part. It was difficult to coordinate the progress of each professional since there were no specific party who are going to oversee and monitor at the project as a whole (Baharudin, 2003).

Accordingly, much effort has been put by the Malaysian Institute of Planners (MIP) in promoting the profession of urban planners, It was only then that developers began to realise the importance of urban planners' roles. Since the architects were only concern about the aesthetic values of their product, and the engineers concern only about the practicality of the product but not on the aesthetic value, urban planners seems to be the most appropriate professionals to manage a project as they are able to look into both aesthetic and practicality of the designs. At the initial stage of the development of wetland in Kota Kemuning, for example, the engineers proposed a concrete drain (practical but not aesthetic). In contrast, the urban planner proposed a wetland (practical and aesthetical). Finally, the developer agreed with the urban planner's proposal and the developer later found out that the wetland did not only reduce the construction costs but could also be utilised for purposes such as recreational and waterfront parks (Baharudin, 2003).

Despite the capability of urban planners, the coordination issues between professionals will still exist if each professional continue to work on their own without considering the requirement of other parties. With the introduction of CDD, the issues pertaining to the *degradation of the living environment* may be dealt with efficiently. CDD conveys to the design team the planner's vision of the project This means that planners will lead the project from the start. Planners need to clearly highlight to the design team what to be achieved after being briefed by the developers and clients. The task of the design team then, is to translate these visions into three dimensional forms. Through CDD, good usage of zoned land can be ensured. For example, if the area is zoned as green areas, that particular area will be properly landscaped without any 'unwanted' elements on it.

CDD does not add extra costs to resources and time. In fact, a project that is not applying CDD may incur even more costs and time compared to those adapting CDD. For example, when a non-CDD project encounters some conflicts during the construction period, the contractors will have to report to the developers and then to the design team to redo the plan. This will definitely consume more time for redrawing of plans. Furthermore, it will also increase the construction costs as the developers may have to eliminate the conflicts and then reconstruct it. Through CDD, these conflicts can be detected and even resolved prior to the construction period.

4.3.3 Developers

HICOM-GAMUDA Development Sdn.Bhd. is one of the renown developers in Malaysia. A joint-venture company, both have been in the *industry* long enough to understand the scenarios of built environment field (Baharudin, 2003). DRB HICOM is one of the leading local companies who has experienced numerous achievements, be it in manufacturing sector or the construction industry. Similarly, GAMUDA Land is no stranger to the built environment field. Over the years, GAMUDA Land has developed numbers of townships. The merging of these organisations for the development project of Kota Kemuning, has resulted in even greater impacts. With both organisations striving towards creating a livable modern township, it is inevitable that Kota Kemuning be the most suitable project to exemplify their objectives. With the application of CDD in this project, it will assist these organisations to reach their targets successfully.

Unlike the town planner's point of view on CDD, the developer's part on CDD will focus on the practicality of CDD. Currently, upon planning approval, the appointed consultants will have to prepare CDD with the supervision of the urban planners. Developers will require each of the consultants to provide their inputs, the engineers with the common infrastructure and local infrastructure, the landscape elements and the overall planning from the urban planners.

Prior to the preparation of CDD, there are a few information needed such as the existing contours, the design level or the ultimate level and the existing road system if any. Based on all the above information, planners will prepare a sketch of the layout plan, and circulate the layout plan to the other consultants (Baharudin, 2003). The engineers will then, include the proposed contours and road system, while the landscape architects will come out with the preliminary landscape design concept. After three meetings between consultants and developer, one portion of CDD will be completed. CDD for a 20 acre-piece-of-land will take about only one week to be completed. Thus, it means CDD actually does not consume time contrary to beliefs that that it would delay or prolong the construction period of the project. Cost wise, the consultants were paid on time charge basis, the longer the preparation of CDD takes, the more the developer will have to pay. Nevertheless, developer is willing to bear the costs on the production of CDD rather then putting more money on the reconstruction of any conflicts during the construction period. Another advantage that the developer gained from CDD was that CDD's ability to smoothen the stages of construction (Baharudin, 2003). Through CDD, developer can easily draw up the flow of the task for each consultant.

So far, CDD has gained positive responses from all the consultants involved in the development of Kota Kemuning. The main reason was firstly, due to the fact that CDD was the developer's requirement. Secondly, it did not consume time and cost. Thirdly, the consultants were in general satisfied with the results of CDD. But most importantly was that the sequence of job or tender have been strictly adhered to. If these factors were not carefully *dealt with* earlier, the whole idea of having CDD would be useless.

It is therefore recommended that other developers to follow the examples set by HICOM-GAMUDA which made CDD compulsory to be prepared by the consultants. But, what needs to be done first is to prepare a comprehensive standard on CDD so that it will be applicable to be used by the other developers.

4.3.4 Summary

Based on the information collected from the private and government sectors, it can be deduced that CDD is a significant tool in improving the living environment quality. The main objective of any town planner in designing the development is to fulfill as many as possible the needs of the community and minimise conflicts between stakeholders. Therefore, CDD will assist them in ensuring a more livable environment. Furthermore, since CDD is able to resolve any conflicts prior to the construction works, it has given a great advantage to the developer to see to it that resources are efficiently utilised with minimal costs. This is because with CDD, developer is able to avoid reconstruction of works which could increase the project cost and possibly delay the project's progress.

5 SUBSTITUTION OF TRIP AND SUSTAINABLE URBAN PLANNING

The construction industry and the field of built environment are two major sectors contributing to the physical development of the countries, both in the UK and Malaysia. In the case of Malaysia some 5,000 firms are registered with the governing bodies. The nature of their jobs include attending meetings and discussions with the agencies or the authorities, meetings and discussions with their counterparts and most importantly those with their clients.

It may be assumed that for a development project with a lifespan of one year, many trips will be generated by these professionals as a result of the above face-to-face meeting requirement. Based on Appendix A, the professionals will be required to attend meetings, be involved in discussions and up-dating their plans and proposals which required face-to-face meeting prior to the applications of CSCM and CDD.

Based on the assumption that journeys have to be made by these professionals in the absence of these technologies, one may further assume that the number of trips made are positively correlated with the number of professionals involved and the number of meetings or discussions or exchanging the up-dated plans and reports. Based on Appendix A, the calculation for a ywar's project would require professionals working for individual firms to make a trip per week for whole project duration, say a year. For a cluster of 7,000 professionals working in some 2,500 firms handling one project per annum and each project requiring them to communicate face-to-face and travel once a week, it may assumed that some 130,000 trips were to be generated. Using different scenarios as proposed in Syaed Khuzzan Al-Habshi (2002), calculations on the number of trips reduction may be made if an assumption is made that these trips could be substituted by ICT applications such as CSCM and CDD. The scenarios are categorised into six, reflecting the different levels of readiness for ICT application and implementation:

The calculations are illustrated by the following Table 5.1:

Level Of ICT Readiness	Percentage Of Potentially Substituted Trips	Total Substituted Trips
Level 1 + (Resistance scenario, needs 50 years to fully adapt to ICT)	1	1,300

Level 2 *Occasional+* (Highly pessimistic scenario, needs 30 years to fully adapt to ICT)	3	3,900
Level 3 *Responsive+* (Pessimistic scenario, needs 20 years to fully adapt to ICT	5	6,500
Level 3 *Responsive +* (Moderate scenario, needs 10 years to adapt to ICT	10	13,000
Level 4 *Planned +* (Optimistic scenario, needs 5 years to adapt to ICT	20	26,000
Level 5 *Strategic+* (Highly optimistic scenario, needs 2-3 years to fully adapt to ICT	30	39,000
Level 6 *Integrated +* (Ideal scenario, can immediately adapt to ICT)	50	65,000

Table 5.1: Scenarios of potential substitution of generated trips as a results of ICT applications amongst built environment professionals in Malaysia.

The estimated figures may be used to further project the number and rates of reductions in vehicle emissions and other polluting impacts be them quantifiable or non-quantifiable. However, these are not within the realm of this study. It is also recommended that up-dating of information on the number of firms and the development planning and construction activities be carried so as to reveal a more reliable and valid estimation of the real impacts that ICT have on the industry.

Additionally, the utilisation of ICT applications such as CSCM and CDD also promotes better planning for the environment of the new townships. The example of Kota Kemuning and UK showed that the adoption of CDD and CSCM as tools for integrating or coordinating technical/design drawings brought some new perspective towards the management of the public and semi-private spaces in the residential areas. In effect, these have been the very purpose of urban planning, i.e. to enable for the provision of integrated infrastructure and amenities to physical development such as these and to reduce conflicts resulted by the various interests and professionasl involved in the planning, development and construction of projects.

6 CONCLUSIONS

The surge of information and communication technologies have been received with mixed feelings by the built environment community. This minute and limited study illustrated the awareness, acceptance and utilisation levels of ICT in two countries with contrasting background and circumstances. Examples of the construction industry in the UK and new township development in Malaysia have illustrated these. Whilst the study revealed that some of the professionals, authorities and clients indicated strong willingness of acceptance and applications of ICT in both the construction industry and urban planning practices, these were conditioned by the current states of available hardwares and the utilisation of certain software which are in compliance with others used by rest the players in the industries. In the case of CDD, the AutoCAD software application in firms or organisation and the existence of nationally recognised standards for CDD are important factors in determining the level of applications of these concerted and coordinated efforts of multi-layering of technical drawings. A pro-active approach taken by the developer HICOM-GAMUDA requiring submission of coordinated drawings to the authority also contributed to the success of the project (Baharudin, 2003).

The clear messages conveyed by this paper, however, are that ICT applications do open up new platform for integration and coordination of the professionals' outputs, be it in terms of information sharing or on-line discussions and decision makings. Furthermore, the scenarios building of the potential substitution of trips generated, as a result of the conventional method face-to-face meeting, has illustrated how some of the reduction in trips may contribute towards better and healthier living environment. Additionally, with CSCM and CDD as support tools to coordinate judgemental disparities and conflicts amongst the professionals, more new townships and building constructions will be undertaken in environmentally friendlier manners leading to more sustainable built environment (Baharudin, 2003 and Syed Khuzzan Al-Habshi, 2002).

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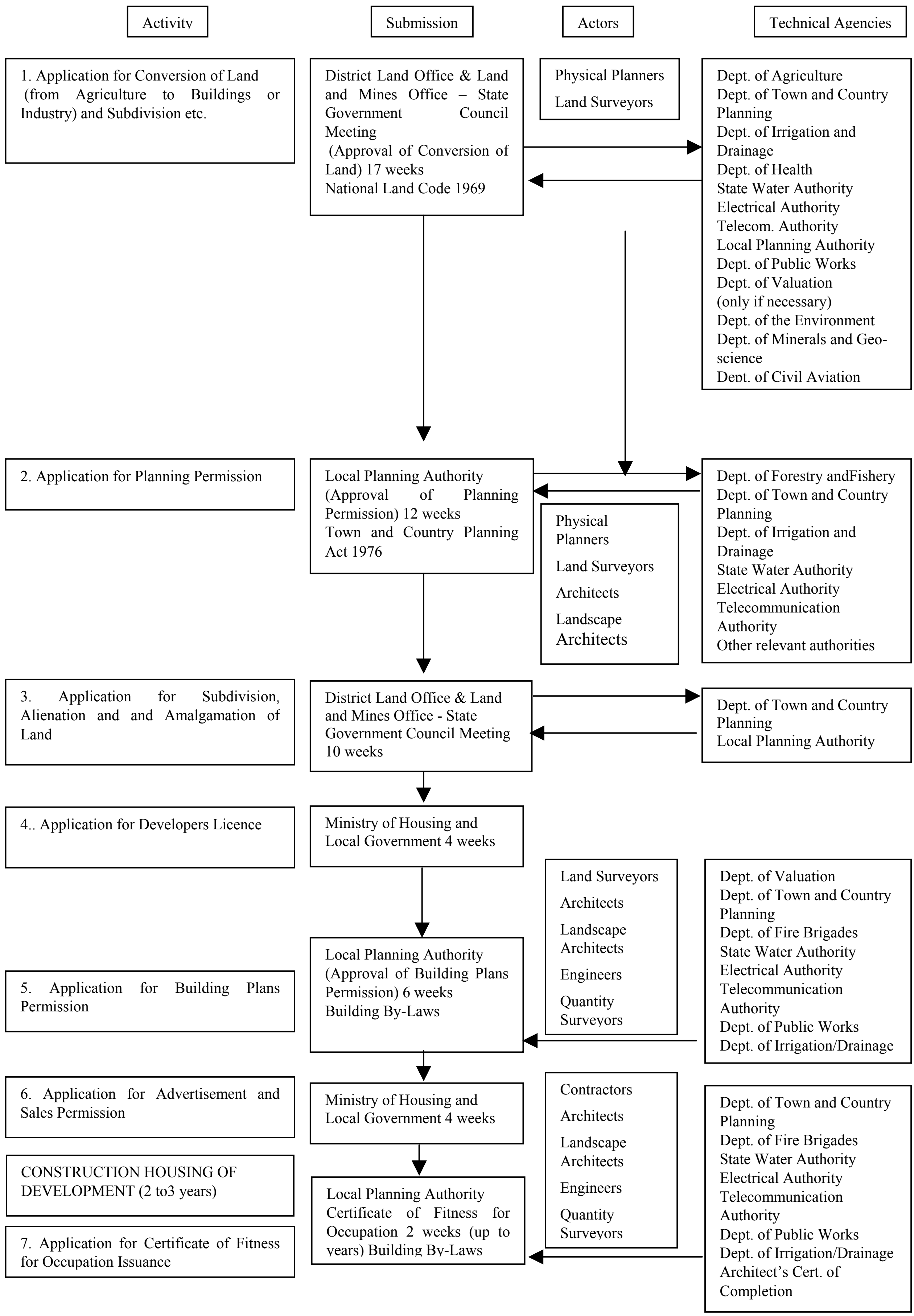

Appendix A: A Typical Planning and Building Layout Application Process (Federal Town and Country Planning Department, 2000)

Table 1: Level of I.T. usage in the organisation

Description	Strongly Agree	Agree	Don't Agree	Don't Know
E. I.T. applications exist mainly in financial operations, i.e. within financial developments				
F. I.T. application is being concentrated in financial operations, but steps are also being taken in using I.T. for some business activities such as using standalone word processing systems, spreadsheets, etc. No exchange of information is performed between your organisations and others.				
G. Organisation has started using specific in-house I.S. / I.T. systems applications in support of core business functions such as using RIPAC for the preparation of Bills of Quantities and CAD in designing.				
H. Organisation is implementing E-business techniques across the supply chain; i.e. e-tendering, materials can be ordered online with the use of internet.				

Table 2: Level of I.T. infrastructure in the organisation

Description	Strongly Agree	Agree	Don't Agree	Don't Know
C. I.T. applications are independent and unconnected within departments, i.e. each department are using different types of software applications according to their own needs whereby there is no means of sharing information across organisations.				
D. Organisation has implemented commerce-enabled extranets, in establishing and maintaining a one to one relationship with other organisation and clients at very low cost through the web. Project information can be shared and exchanged between supply chain members via the internet.				

Table 3: Level of I.T. awareness and training in the organisation

Description	Strongly Agree	Agree	Don't Agree	Don't Know
D. Organisation is still not willing to change and is comfortable with the traditional method of running their core business functions manually.				
E. Organisation is realising the needs of I.T. to support their core business functions, BUT they are only focusing on individual skills needed for individual projects.				
F. I.T. applications are not only seen as a support to their core business functions, but are also seen as a strategic advantage for the organisation to stay competent in the construction industry, i.e. the usage of virtual reality, interactive web-sites, videoconferencing and others.				

Table 4: Level of I.T. as a communication tool in the organisation

Description	Strongly Agree	Agree	Don't Agree	Don't Know
C. I.T. applications such as electronic messages are being used extensively via the organisation's intranet; i.e. team leaders are able to communicate with supply chain members easily.				
D. Organisations in the construction supply chain are using electronic mail via the organisation's intranet in order to share and exchange information within the organisation.				

Table 5 Level of I.T. in the coordination of data and storage

Description	Strongly Agree	Agree	Don't Agree	Don't Know
D. The I.T. applications implemented are still not properly coordinated throughout the organisation; sometimes the purpose, function and data stored are still overlapping.				
E. Some old-developed systems are still being used in uncontrolled, uncoordinated manner even though new systems are centrally developed, installed and operated by I.T. functions.				
F. There is a central project database to be used by members of the construction supply chain (database maintained with proper systematic referencing, etc)				

Table 6 Level of I.T. in the management support system in the organisation

Description	Strongly Agree	Agree	Don't Agree	Don't Know
C. Organisation is developing decision support systems (DSS) and executive information systems (EIS) for the use of senior management.				
D. Organisation is successfully using knowledge management systems (KMS) to manage organisational learning and business know-how, i.e. organisations relying on internet or intranet web sites, knowledge bases and others as key technologies for gathering, storing and distributing business knowledge.				

Assessing the organisation's current level of I.T. readiness

After interviewing the user and from the result obtained from the table of assessments, a table of indicator would help in classifying the current levels of I.T. readiness for each organisation. For example, if the user selected option A from table 1, option A from table 2 and also option A from table 3 and they either choose don't agree or don't know from table 4, 5 and 6, then the current level of I.T. readiness can be classified as level 1.

Table Indicator for Level 1

Table 1	Table 2	Table 3	Table 4	Table 5	Table 6
A	A	A	-	-	-

Table Indicator for Level 2

Table 1	Table 2	Table 3	Table 4	Table 5	Table 6
B	A	B	-	A	-

Table Indicator for Level 3

Table 1	Table 2	Table 3	Table 4	Table 5	Table 6
B C	A	B	-	A B	-

Table Indicator for Level 4

Table 1	Table 2	Table 3	Table 4	Table 5	Table 6
D	-	-	A	C	-

Table Indicator for Level 5

Table 1	Table 2	Table 3	Table 4	Table 5	Table 6
D	B	C	B	C	A

Table Indicator for Level 6

Table 1	Table 2	Table 3	Table 4	Table 5	Table 6
D	B	C	B	C	B

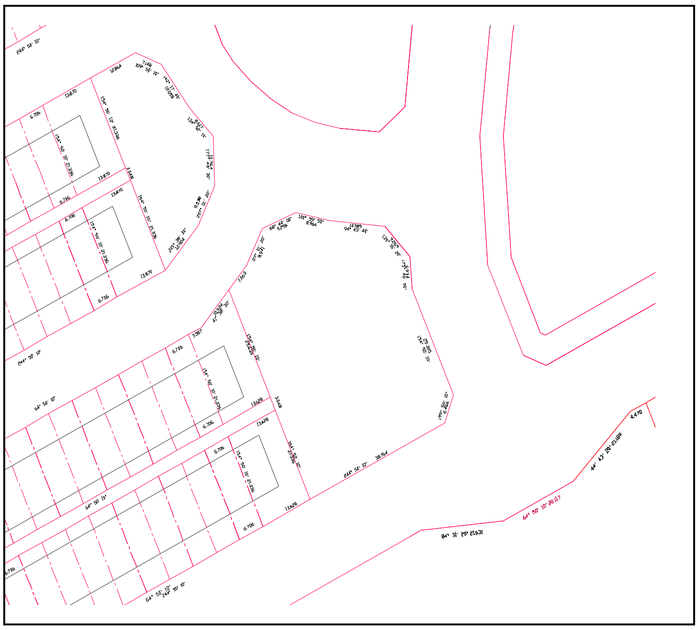

Figure 4.1: Input from Surveyor

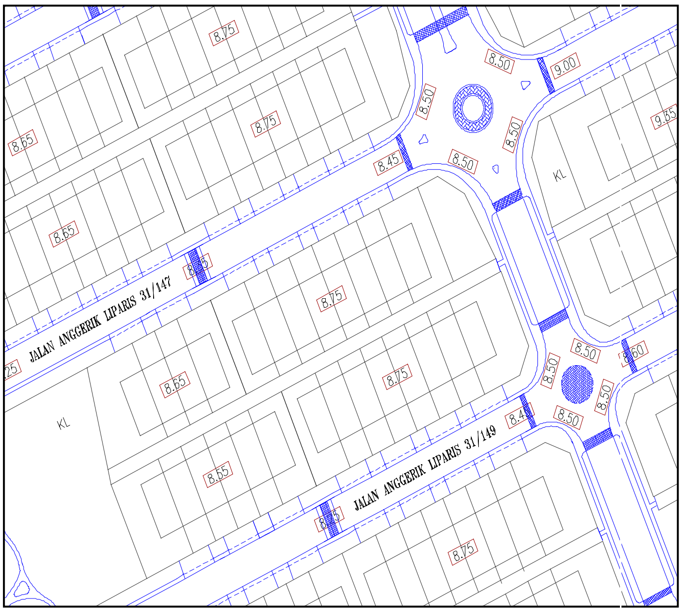

Figure 4.2: Input from Civil Engineer on road

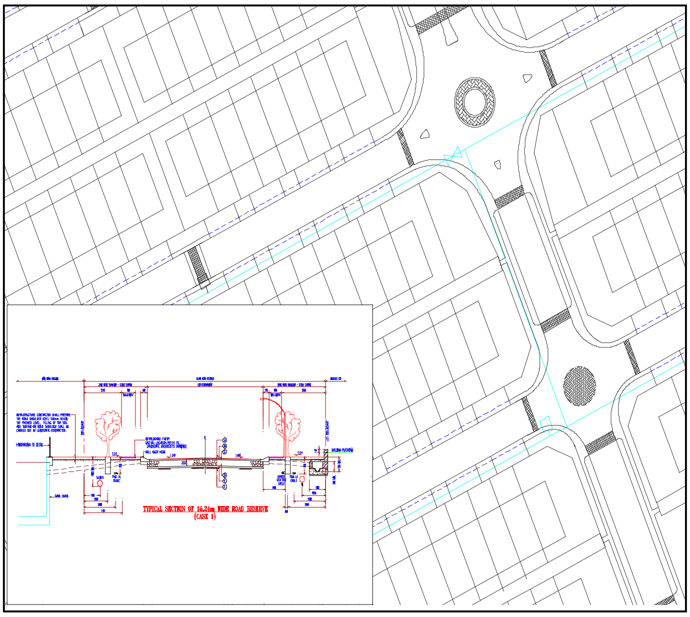

Figure 4.3: Input from civil engineer
- Drainage plan

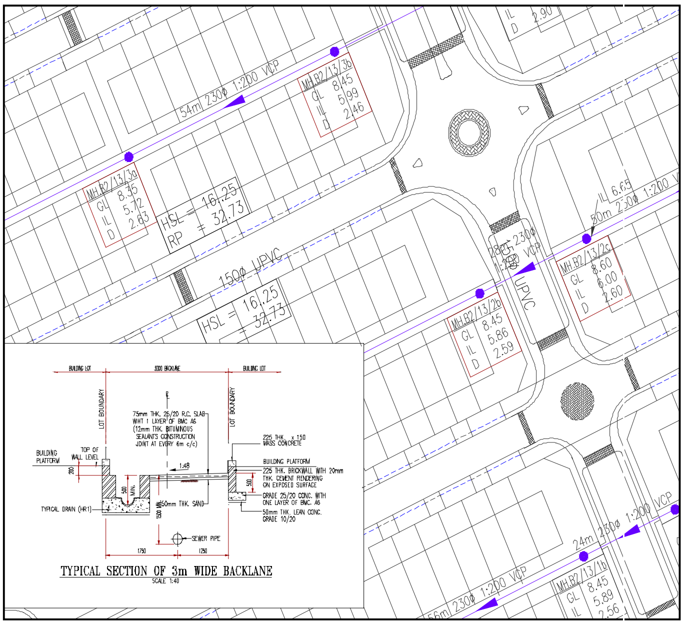

Figure 4.4: Input from civil engineer
- Traffic management

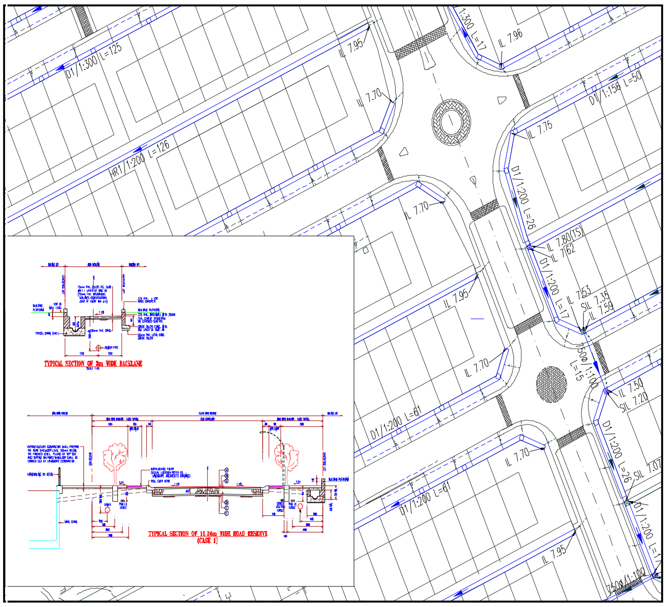

Figure 4.5: Input from Civil Engineer on Drainage

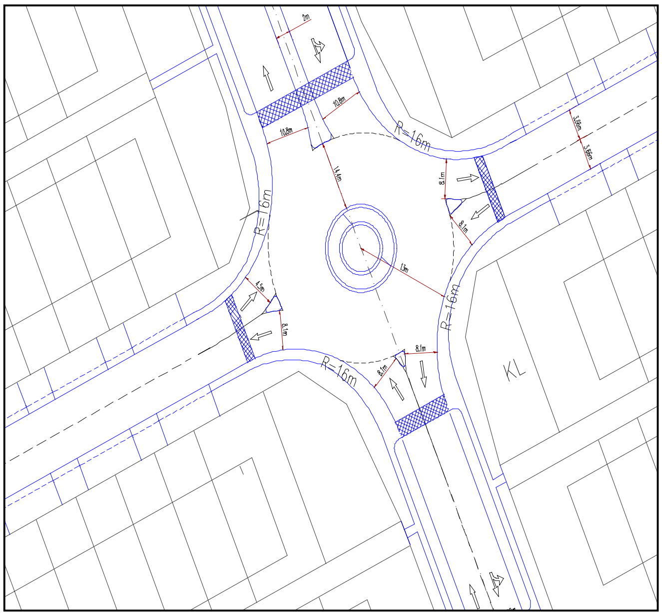

Figure 4.5: Input from Civil Engineer on Traffic Management

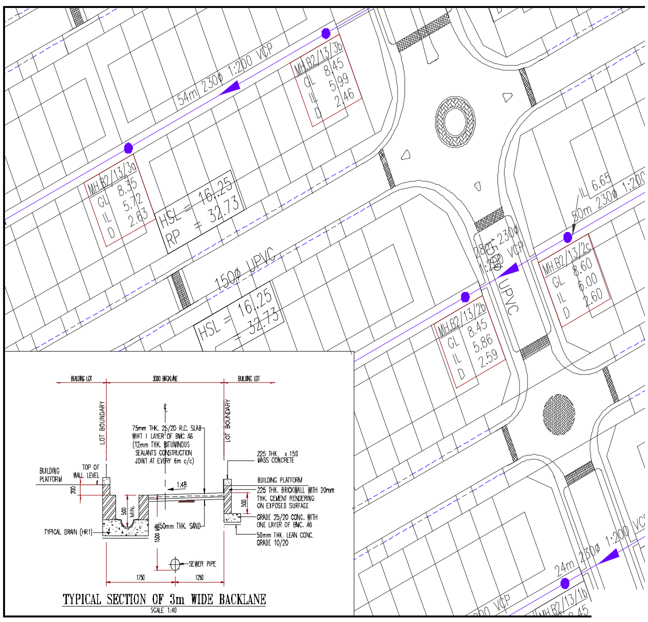

Figure 4.7: Input from Civil Engineer on Sewer

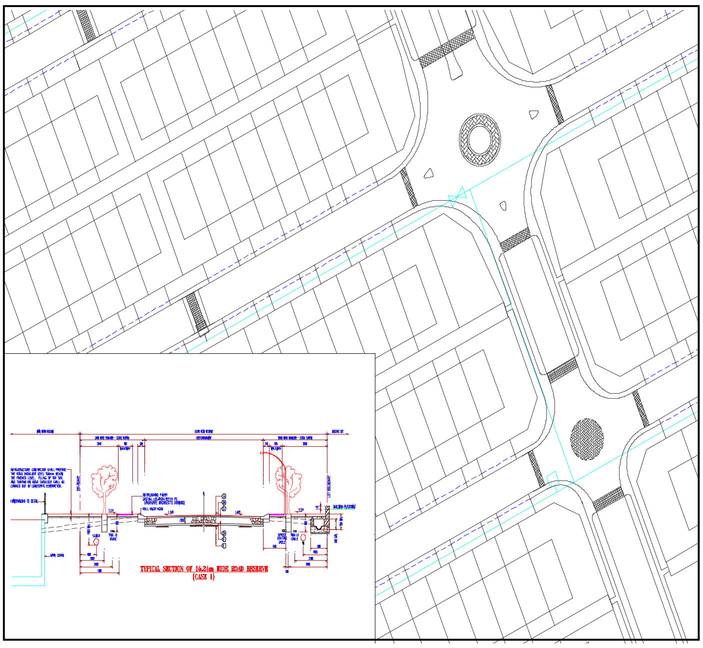

Figure 4.8: Input from Civil Engineer on Water Supply

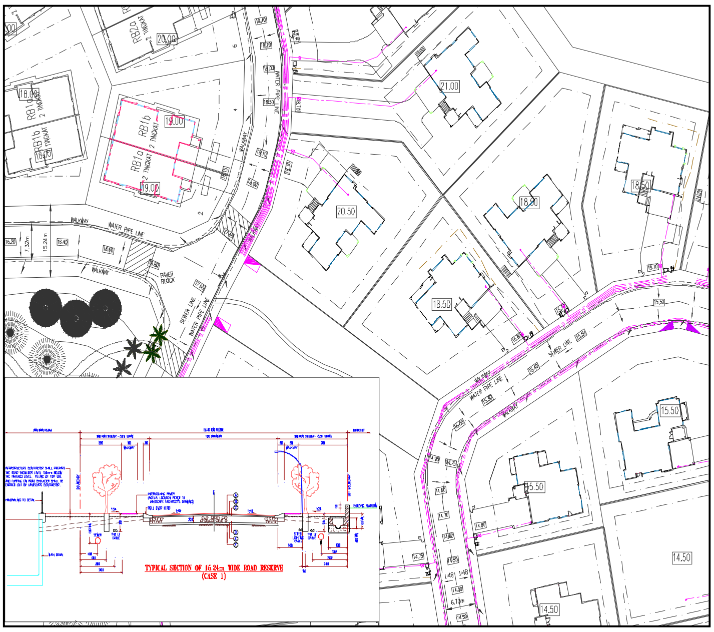

Figure 4.9: Input from Electrical Engineer on Power Supply

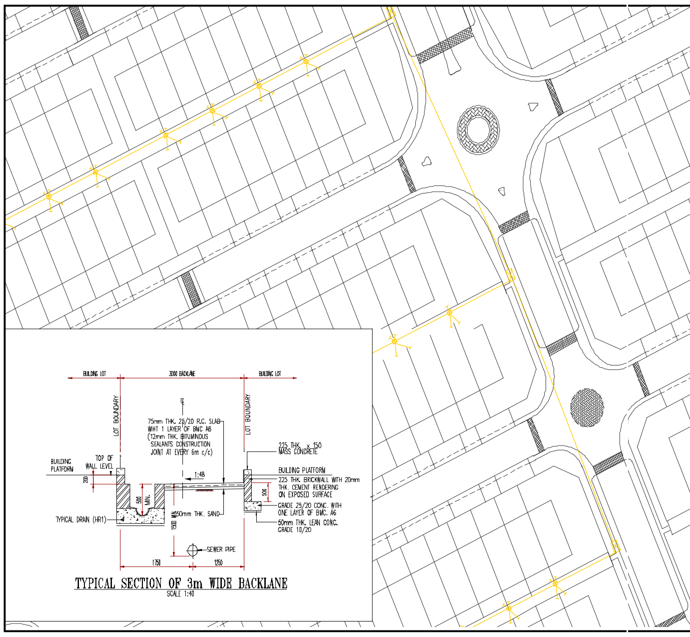

Figure 4.10: Input from Electrical Engineer on Telecommunication

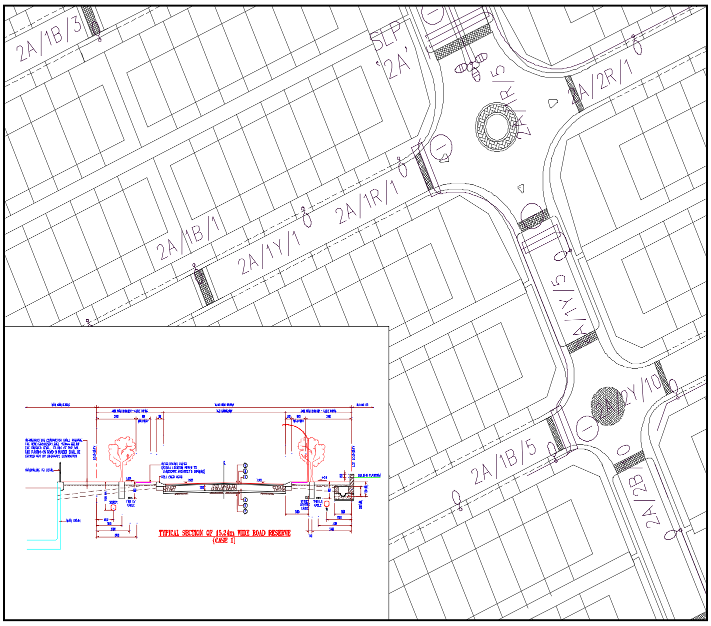

Figure 4.11: Input from Electrical Engineer on Street Lighting

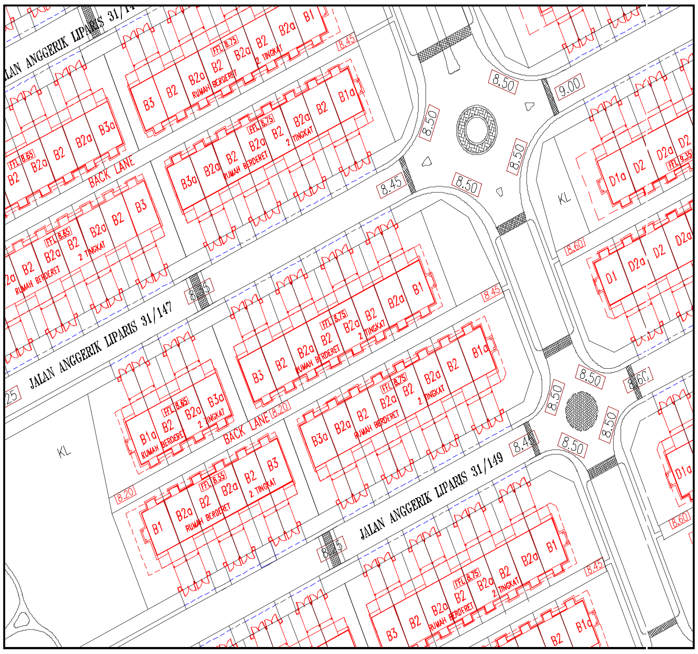

Figure 4.12: Input from Architect on Site Plan

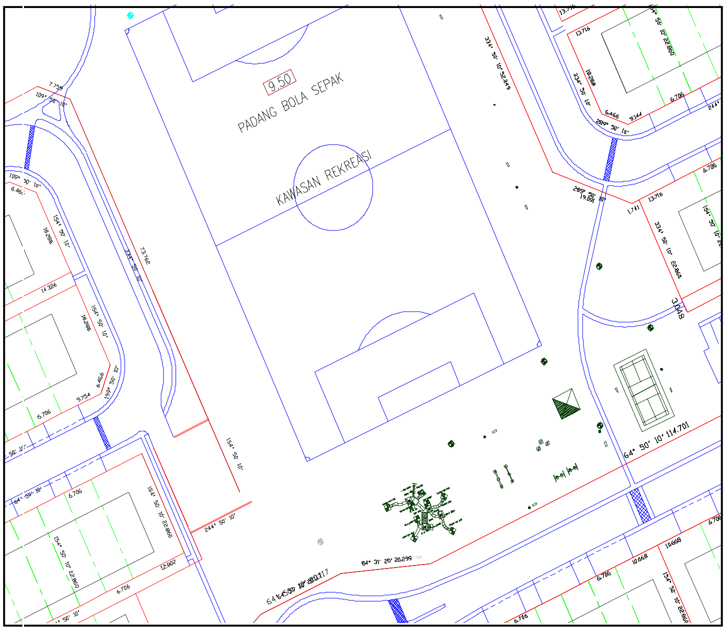

Figure 4.13: Input from Landscape Architect on Hardscape

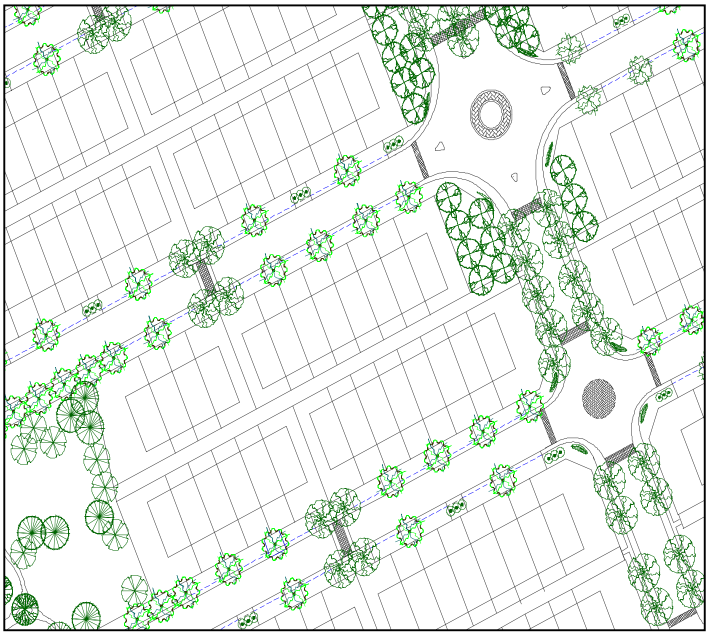

Figure 4.14: Input from Landscape Architect on Softscape

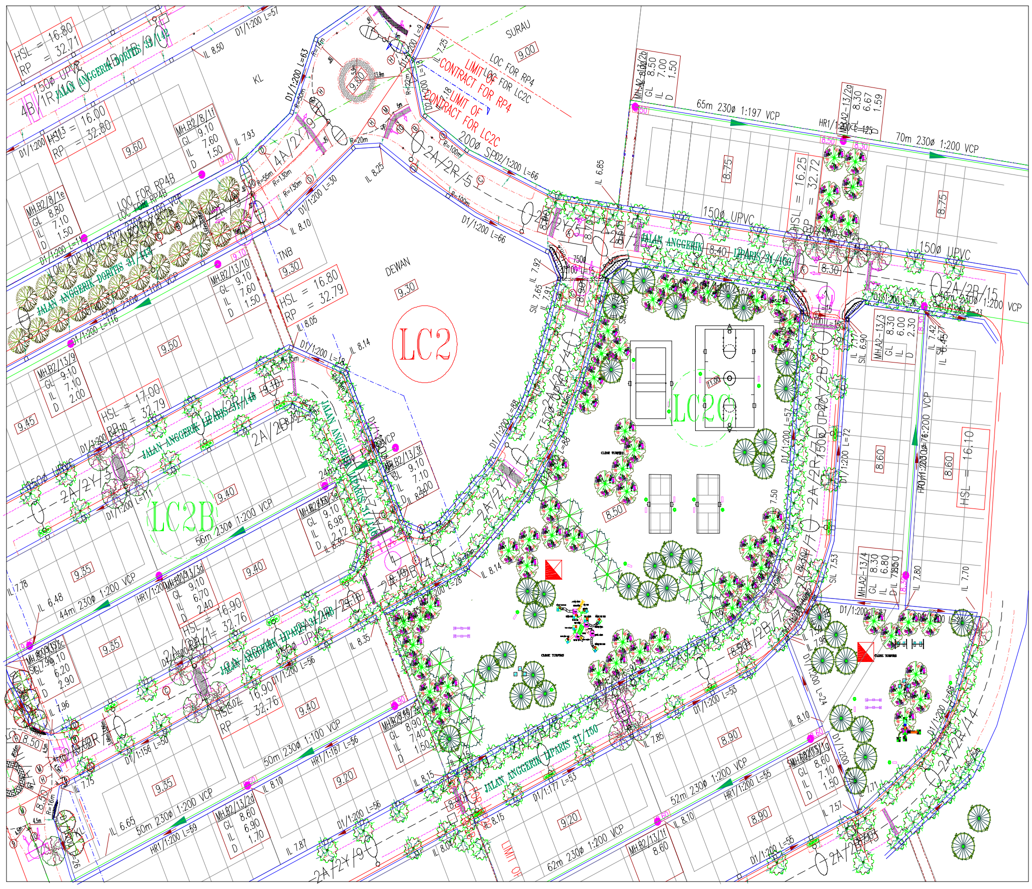

Figure 4.15: Example of a completed CDD plan

Source: AJC Planning Consultant, 2002

Digital Atlas of lands and human impact on the environment by the example of Nuratau

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1 ANNOTATION

The Digital Atlas proved to be an important tool of analysis of human impact on the environment. It is used to work with various datasets and represents the instrument of thematic classification, storage, analysis and visualization of a wide range of geographic information. The Digital Atlas is, first of all, the software designed to visualize geographic information with some mathematical functions. The Atlas allows the user to view various spatial data from an unexpected perspective. Using the Digital Atlas it is possible to associate information by various objects with mapping information. This enables better understanding the interaction between people and the environment, and revealing main indicators of threats based on the analysis of these data. The Digital Atlas is designed to view raster maps developed on the basis of GIS technologies. The Atlas contains a series of thematic and analytical maps reflecting modern condition of lands, dynamics of the changes occurred for the last 15 years, level of development pressure and the corresponding indicator of manmade threats for the environment of the test site. The thematic maps were developed on the basis of the analysis of satellite imagery obtained at different times using GIS software MapInfo, with following vector-raster transformation. Population data for 2002 were taken from the State Statistics Department.

This work reviews functions and complexes of tasks of the Digital Atlas.

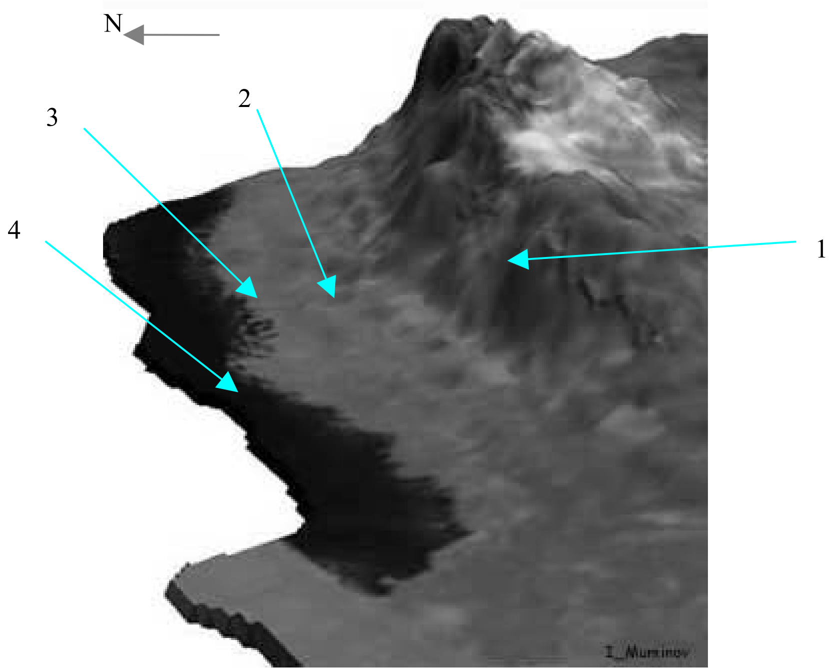
2 INTRODUCTION

The idea of development of the Digital atlas was started up due to the problem of insufficient completeness of data on environmental condition and assessment of human impact, existing information fragmentation and inaccuracy. The objective of this work was development of an infrastructure in enabling to classify and analyze large volume of a variety of thematic information on environmental condition and assessment of human impact. The Digital Atlas is designed for collection, recording, classification, storage, editing, analysis, carrying out some mathematical calculations, and visualization of various geographic data. This Atlas can be used in the field of environmental objects registration: conservation areas, game husbandries and national parks. Novelty of the results lies in the fact that the Digital atlas enables effective classification and analysis of large volume of various spatial data sets. Furthermore, it has simple and user friendly interface making application of the Atlas accessible for ordinary computer users who do not possess specific knowledge in digital mapping. Application of this Atlas enables to improve assessment of reliability of the received information obtained for various conditions, develop recommendations for rational use of the natural resources. Thus, the Digital Atlas becomes an important tool for geographic information analysis for the specialists who do not have substantial computer technology knowledge.

It is appropriate to note that the Atlas utilizes raster mapping base.

3 THE TEST SITE

The test site was selected in Nuratau and adjacent territory, including Farish steppe and Aidar-Arnasay depression. The test site is located in the center of the Republic of Uzbekistan at the borders of Navoi, Djizak, and Samarkand Regions. The Study Area includes foothill alluvial fan deposits plain, which starts from northern slopes of Nuratau, sandy clay plain occupied by sand and honeycomb ridges and hillock sands. On the south of the territory there are northern slopes of Nurata Ridge which are dissected with dingles. Graph 1 shows the Study Area. On the scheme of physiographic zoning for the Republic of Uzbekistan, the northern slopes of Nurata Ridge with adjacent alluvial fan deposits plain are distinguished as independent Farish physiographic zone. The latter, as a part of the Golodnosteppe physiographic territory is characterized by internal patchiness determined by complexity of geological-geomorphological condition that influence climate, soils, and vegetation cover. Selection of this site was justified by the fact that this area is, first of all, not a sample of a wild nature model. Secondly, human impact on this territory has been in place since c Paleolithic age. Thirdly, this territory is subject to desertification processes, land and vegetation degradation, as a result of human activity. Fourthly, this territory has conservation areas, including Nurata state reserve, and Arnasay wildlife sanctuary. Fifthly, this territory is the zone of contact of settled and nomadic cultures.



Graph 1: Test site.

1- Northern slopes of Nurata Ridge; 2 – Alluvial fan deposits plain; 3 – sandy clay plain occupied by sand and honeycomb ridges and hillock sands; 4 – The Aidarkul Lake (1).

4 PURPOSE OF THE ATLAS

The Digital Atlas is designed to fulfill complex inventory, analysis and registration of assessment of human impact on environment. The Atlas is a thematic database with information editing functions (see Graph 2).

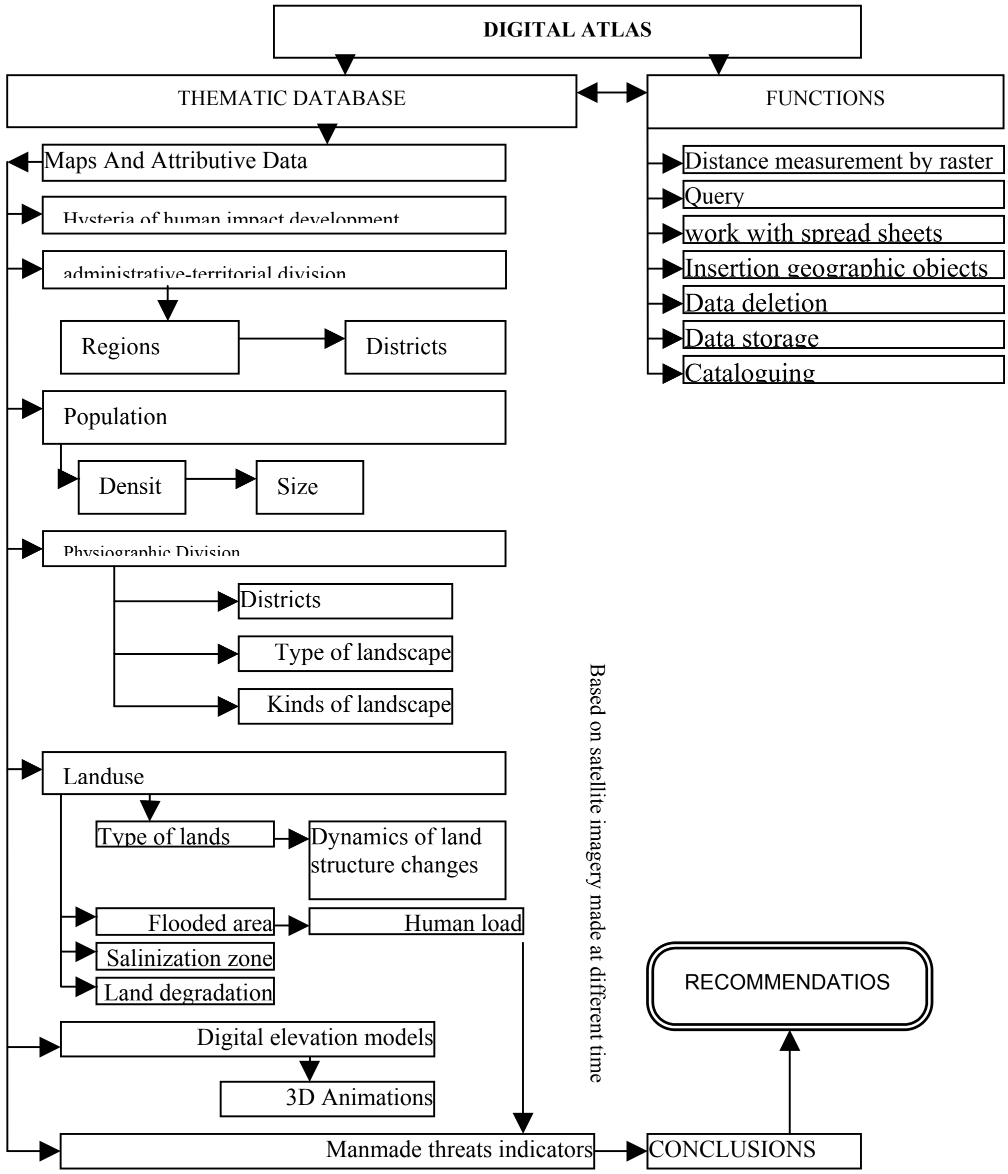
Functional purpose of the Digital Atlas is:

- Registration and timely updating of qualitative data about environmental condition and assessment;
- Insertion of information on mapping base;
- Assessment analysis and to revealing of human threat indicators;
- Development of recommendations to improve environmental condition.

Thus, having such a tool with a broad set of spatial data and some editing functions at hand, the user can view the Study Object from an unexpected perspective. The unexpected perspective shakes the established concepts, refreshes day-to-day, almost familiar perception, and forms new ideas and possibly directions on the study object.

The Atlas has several components. The first component includes the map of human impact development on this territory, from its beginning in Holocene period and to the beginning of the 20th century A.D. this map is compiled on the basis of archaeological and historical data. The second component includes a number of maps on administrative-territorial and physiographic division, particularly, types and kinds of landscapes were determined using satellite imagery visual interpretation. The third component is dedicated to population, its size and density at the oblast level. The fourth component contains thematic maps on land types, changes dynamic, flood zones, salinization zones, land degradation, as well as development pressure. The sixth component includes Digital Elevation Models and 3D animations, which allow viewing the Study Area in perspective. The seventh and the last component includes combined thematic map on manmade threats. This map was developed using overlay analysis of several thematic maps: land use, road network, sources of water discharge, flood zones.

The end result of the development is the software enabling to view various datasets consisting of geographic images, maps in raster data format, text descriptions, spreadsheets, and tools to work with this information (classification, and editing). The Digital Atlas consists of information, mathematical, language as well as software tools: centralized collection, storage, editing, and visualization. The Digital atlas has a function of arbitrariness and retrieval of any stored information both as separate data and in arbitrary combinations with other datasets as required. The Atlas, as it has already been mentioned, works with raster geographic data in BMP format. This graphics format was selected because it is open and it has structural description, and, furthermore, it is commonly used. The Atlas works with text data in *.txt format, Digital spreadsheets in format close to *.xls, it allows to view animated files in ai format.



Graph 2. Information structure of the Digital atlas

4.1 Functional Specifications Requirements

The Digital Atlas functions as an open, semiautomatic structure that performs data entry, storage, classification, editing, analysis, and visualization.

The Digital Atlas consists of the following modules:

- The data entry module
- Module of thematic classification and information editing
- Information visualization module

In relation to the information, all modules are linked together with common semantic database. ID numbers of the objects, identification classes, their names, and numerical characteristics of the objects and etc., are entered into this database.

Composition and content of the data entry module (E) is determined by the following main input data types:

- Graphics raster format (thematic maps, photographs);
- Text format (geographic, historical descriptions);
- Spreadsheet format (geographic, administrative-territorial, attributive);
- Video – animation visualization format (3D animations of elevation models),
- The part of data (text and tables) in the data entry module are entered using the keyboard as well as CD ROM drive, also graphics data formats are entered (thematic maps, photographs, video animation).

Information thematic classification and editing module (TC & IE) allows the following kinds of operations:

- Thematic cataloging of the project *;
- Opening of the project (graphics raster format with a thematic map);
- Changing of the project (insertion of new graphic information on the thematic map);
- Connection of an attributive database to the project;
- Mathematical functions (measurement of distances between graphic objects, thematic queries, work with Digital spreadsheets);
- Saving changes in the project.

* The project means an original of the graphics data format (thematic map).

Information Visualization Module (V) is used for combined viewing of graphic data formats (thematic maps, photographs), video formats (3D animation) and the semantic database.

All the information of the three modules has a uniform data format common for most of users.

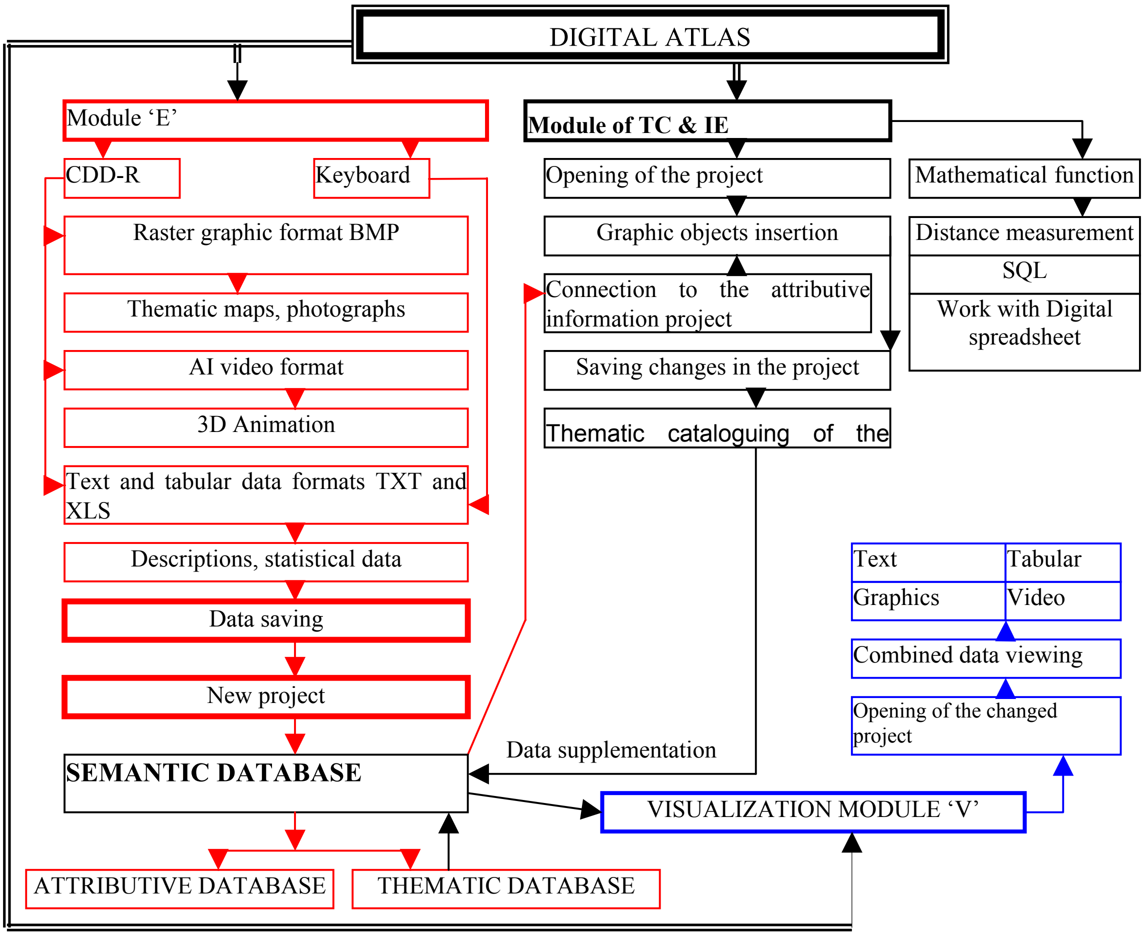
4.1.1 Information Compatibility Requirements

The input graphics information (thematic maps) entered to the Digital Atlas is in the BMP standard data format. A special format is used for output. The Digital Atlas works under MS Windows 98 SE operating system. It was developed using Delphi programming language.

4.1.2 Functions, Complexes of Tasks, That can be Solved by the Digital Atlas

The Digital Atlas foresees automated data exchange with the entry module, thematic classification and editing, as well as visualization. All information at every stage of the work is saved as a project in this semantic database, in the module of thematic classification and editing. The scheme of functional structure of the Digital Atlas is presented in Graph 3.

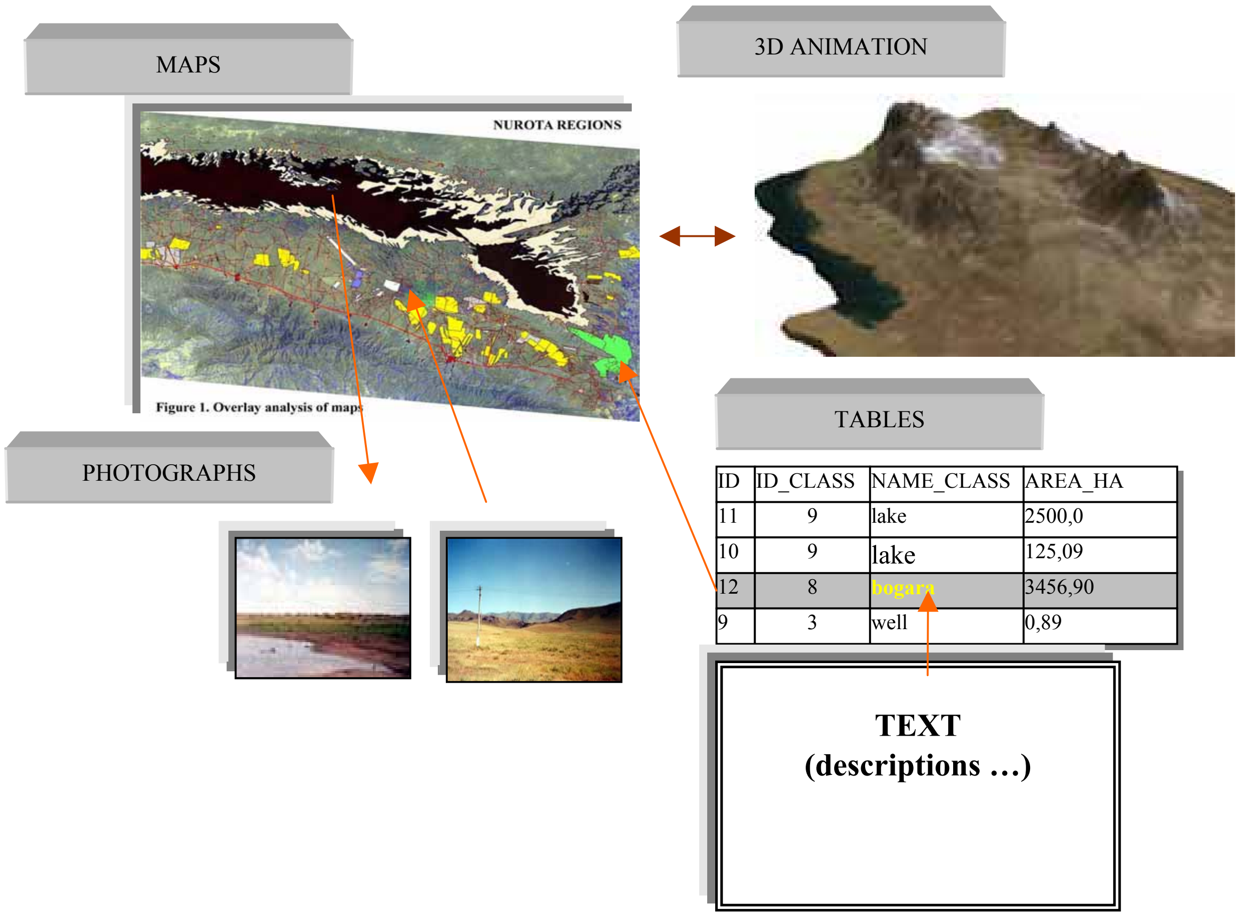
Data entry module «E» solves the task of entry of a wide range of spatial data on the status of environment and assessment of human



Graph 3

impact (taking into account numerical indicators, such as dynamical change in area of lands, aquarium of water surfaces, land degradation, zone salinization and flooding and etc.).

Also, entry of different types of raster thematic maps (see graph 2), photographs of landscapes, text and geographic and analytical descriptions of the territories and objects, statistical data in tabular form and 3D animation of the test site is carried out. All graphic information is saved as a new project in the semantic database into the subsection of thematic databases, and all the text and tabular information is saved in the subsection of attributive databases. Then, the TC & IE module is used to open the project. The product itself consists of raster thematic maps with overlay of graphic objects (map symbols), which in their turn are interactive. At that, this graphics objects have hyperlinks to the semantic database and when pressed – windows with additional information about the study object open. Furthermore, this module enables to add new text information to the existing one (using some functions of the data entry module), as well as to save them. Also, the functions of distance measurement on the thematic map from one object to the other. In addition, there is a system of thematic queries by the keywords. Link of the spreadsheets to the TC & IE module and work with them is foreseen. After changes to the project were made (editing) the project is saved under a new name and is recorded into the thematic catalog, which is added to the thematic database, included in the semantic database. Then, using the visualization module the changed project is open and combined viewing of all data types both from the attributive and thematic databases is carried out. The combined viewing of these data enables to have both mapping base of different themes on environmental status, as well as numerical indicators on land changes due to human impact, besides there are photographs of landscapes changed by people and the Digital Elevation Model that shows the test site in perspective and in motion. Thus, we can visualize both mapping statistics and descriptive information about environmental condition and assessment of human impact in the Digital Atlas (see graph 4).



ID	ID_CLASS	NAME_CLASS	AREA_HA
11	9	lake	2500,0
10	9	lake	125,09
12	8	bogara	3456,90
9	3	well	0,89

Graph 4. Combination of different spatial datasets

The atlas enables to classify this information, as well as to edit and update it, while carrying out integrated registration of changes. Having classified and combined spatial environmental data and human impact assessment information the specialist can easily perform an integrated analysis and develop necessary recommendations on rational natural resource use.

5 CONCLUSION AND FUTURE RESEARCH

Thematically classified spatial information opens new ways of more rational and cost-effective use of natural resources.

In the modern complex world not a single significant problem can be solved without processing of large volumes of information and established communication processes. One feature of information attracts attention: when it is accumulated and processed from certain perspective, it provides new information and knowledge. Updating information from the environment, its analysis and generation is one of the main functions distinguishing human being from the rest living creatures. Information enables people to orientated in the environment. Search for information is one of the main functions of creativity [2].

Work of a scientist is closely linked with “information raw materials” processing, at that, nowadays, this process is complicated with abundance of information sources and their dispersion… needed information is first of all to be retrieved from the information ocean. Furthermore, information must be important, accurate, and up-to-date. To assess modern condition of environment and development pressure in arid zones efficiently and objectively an infrastructure that enables to systemize and analyze fragmented data comprehensively is required. The Digital Atlas is an instrument enabling to classify dispersed different-type information thematically, combine, store, update and analyze it. At that, this instrument is rather user friendly for those are not so good in computers, as the Digital Atlas uses common and open formats not requiring installation of special software.

The Digital Atlas reflects interrelation of the environmental condition in the study area and intensive human impact. It generalizes the experience of applying of different human impact assessment methodologies. The Atlas integrates editing functions. The Atlas includes 15 thematic maps, many photographs and text descriptions.

In the future it is planned to test the Digital Atlas in conservation institutions, taking into account possibility of data transmission to Remote users in rural and urban areas through Internet according to recommendations of the users.

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Free Software: The Open (GIS) Source Solution for Local Governments A Case Study: Perspectives, Experience and Possibilities for the City of Frankfurt (Oder)

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1 ABSTRACT

Modernization of public administration, increasing budget deficits and increasing demand for public services are just some of the major processes challenging local government adminstrations. For many public administrations faced with increasing budget deficits, "free software" *(also referred to as "open source software")* is often regarded as only a "low budget"solution. Questions with regard to the potential impact of "free software" on traditional methods of dissemination of and access to public sector information within a traditionally rigid administrative structure is often disregarded. Most importantly free software along with open standards provides an open infrastructure to support and enable new public management organizational structures to develop and coexist alongside a traditionally rigid public administration.

In context of the above mentioned organisational environment, this paper will look at the perspectives and experience of the City of Frankfurt (Oder) with an "Open (GIS) Source" solution as well as the possibilities offered by free software in further development of a spatial data infrastructure in a private public partnership.

Keywords: local government, public administration, public sector information, spatial planning, free software, open source software, OpenGIS, open standards eg. WMS and WFS, democracy, information society, spatial planning, spatial data infrastructure, Linux, UMN Mapserver, Mapbender, Postgis, PostgreSQL, MySQL

2 INTRODUCTION

Much has been written about the topic of organisational change in a public administration environment. This paper will not try to attempt to deal with the complex field of organisational change. However, to understand this process of change faced by most local governments, particularly in relation to implementing an electronic data processing (EDP) strategy in their public administrations, one should take into account the visible organisational structure in an historical context as well as the hidden social factors which interact with each other.

In 1949, with the founding of the influential local government advisory institution KGSt ("Kommunale Gemeinschaftsstelle für Verwaltungsvereinfachung") in Germany, local governments began to “simplify” their administrations. However, much has changed since then. The “simplification” of local public administrations is just not enough. Today, the forces of globalization and liberalisation of market economies as well as the “technolization” and “informatization” of society are creating challenges and opportunities for all local governments. Due to these forces local governments can no longer afford to support rigid, bureaucratic and reactive administrations. More than ever local governments are being forced to make fundamental changes in the way they do “business”.

In 1993, under the auspices of the KGSt, Prof. Gerhard Banner, one of the most famous proponents of “new public management” in Germany, published the report “das Neue Steuerungsmodell" (“*The New Steering Model"*). The ideal of the “*The New Steering Model"* is a service orientated public administration to be equaled with that of an enterprise in the public sector. With the publication of this report a new era of "new public management" began in Germany. In this report Prof. Banner remarked that the era of growth as we have known it has come to an end. More has to be done with little. The demands on the public administration are clear: an increase in services with less or no growth The new model proposed by Banner is *not* about whether services should be undertaken or not, it is about getting things done better. Banner proposed a management culture that emphasizes the centrality of the citizen or customer, as well as accountability for results. In order to face the challenges in ever changing world, a "modernized" public administrative system, at the same time encouraging and supporting creativity and innovation from the bottom up, should be flexible, consultative, result-oriented and proactive (Banner 1993).

Although most local governments have taken steps to reform their public administrations, not much has changed since the publishing of Banner's “*New Steering Model" in* 1993. In today's information society public sector information is a basic resource and commodity. In order to govern and provide services to a more demanding public, accessibility to and dissemination of public sector information is a prerequisite for achieving economic and organisational effeciency. However, in most attempts to “restructure” public administrations, it seems the important role of information technology (IT) is disregarded (Reinermann, 1997). For many public administrations faced with increasing budget deficits, "free software" is often regarded as only a "low budget"solution. Questions with regard to the potential impact of "free software" on restructuring a traditionally rigid administrative structure as well as on traditional methods of dissemination of and access to public sector information is often disregarded.

3 FREE SOFTWARE / OPENGIS

Free Software

In order to explain the concept of "Free Software" we quote from the page of the Free Software Foundation (FSF):

"Free software is a matter of freedom: people should be free to use software in all the ways that are socially useful. Software differs from material objects--such as chairs, sandwiches, and gasoline--in that it can be copied and changed much more easily. These possibilities make software as useful as it is; we believe software users should be able to make use of them. Free software is a matter of liberty, not price. To understand the concept, you should think of ``free" as in ``free speech," not as in "free beer." Free software is a matter of the users' freedom to run, copy, distribute, study, change and improve the software. (http://www.gnu.org)"

The item "Open Source" means, that the user can see the source code of the software (e.g. Microsofts© Windows source code is one of the most treasured secrets in the world). There can be software, which is Open Source, but not free software - because you only get the source-code, but you are not allowed to redistrubute the software or there can be software, where you can buy the source code. For more details on this topics it's worth to familiarize one's self with the different forms of the General Public Licence, one of the most famous Open Source software licences *(http://www.gnu.org)*.

Open GIS

The Open GIS Consortium (OGC) is a non-profit international trade association with a mission of developing interoperable geodata processing standards. The idea is, that "*open interface specifications enable content providers, application developers and integrators to focus on delivering more capable products and services to consumers in less time, at less cost and with more flexibility " (http://www.opengis.org).*

The standards defined by the OGC can be used to *bring about* interoperability between different software-packages. The basic idea is *"whatever software you use, your data should not get lost"*. For example, with the application of the OGC WebMapService interface (WMS) standard it is possible to overlay a variety of thematic maps from different „map“ servers. What ever the data type and source or distance seperating the servers crossing all borders, if they support a WMS interface - in a users browser, freedom of and to spatial information can be supported.

The Software

UMN Mapserver

a) The UMN Mapserver is a powerful webmap-engine. It supports a great variety of input data formats as well as direct access to geodata from geo-databases like PostGIS, Oracle Spatial or even ArcSDE. The current version 4.01 of the UMN Mapserver supports the OGC WMS specification. WMS provides a standard for Internet-based retrieval of geospatial maps, and is a core component of the OGC Web Services suite.

Mapbender Client Suite

The Mapbender Client Suite is an OSS and provides user interfaces for displaying, navigating and querying interactive maps. Mapbender furthermore contains an interface for user and group administration and provides management functionality for any number of different maps. Based on the WMS standard, Mapbender is able to overlay different WMS services from different servers in one map.

UMN Mapserver and Mapbender together provide a powerful tool for the dissemination of and access to spatial information via the web. However, they do not provide real GIS-functionality. In order to get more GIS functionality like buffering, routing, etc. into webmap-applications, a spatially enabled geodatabase is required.

PostGIS

PostGIS is an extension to the PostgreSQL object-relational database and enables the support for geographic objects just like ESRI's ArcSDE or the Oracle Spatial extension. PostGIS follows the OpenGIS "*Simple Features Specification for SQL*". The combination PostGIS with the UMN mapserver allows the mapengine to implement real GIS functionality into webGIS applications such as buffering, routing, measuring or digitizing.

Integration of existing GIS Software and Open Source Software

Whatever the IT landscape, if there is a public administration, which works well on a desktop-GIS based on the OGC specifications, a combination between the existing GIS infrastructure and newly planned steps based on OSS are no antagonism.

There is no problem to deliver basic spatial information such as cadastral maps, topographic maps or orthophotos via a WMS service based on the UMN Mapserver. Information can be accessed through a locally installed desktop GIS like ESRI's ArcView© or Intergraphs GeoMedia©. As most of the major GIS companies have accepted the OGC standards, a GIS-infrastructure which is based on the WMS and Simple Features OGC specifications should be able to inter-operate system-wide.

An example is the City of Soest, where the main desktop-GIS applications are based on ArcView© and where the webmap-service is provided via UMN Mapserver and Mapbender Client Suite, both systems access the same data-pool. Experience has demomstrated that often desktop-GIS performance is decreased as it loads raster maps. However, by loading raster maps via a central WMS enabled UMN Mapserver server, performance is unhindered.

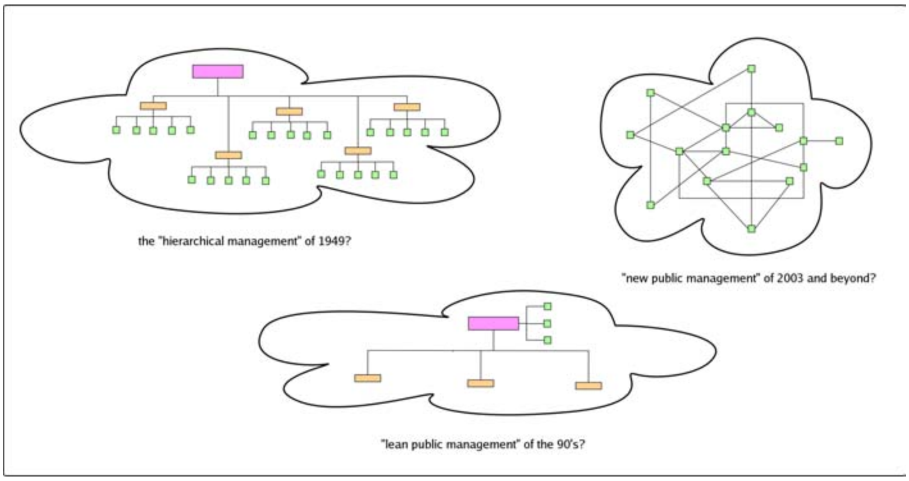
4 PRESENT PERSPECTIVES: CITY OF FRANKFURT (ODER)

As mentioned in the introduction, the main objectives of the Banner's "new public management" is economic and organisational efficiency. The challenges, without doubt, are enormous. The local government of Frankfurt (Oder) is faced with the dilemma of acting as a private sector enterprise along with the reality of harbouring a "traditional", and at times dysfunctional, public administration. If one is to compare the administration of private sector enterprise with that of a local government such as the City of Frankfurt (Oder), one must concede there are differences. The functions and services of public administration are more varied than that of an average large size enterprise. As the organisational structure is determined by the product or services to be delivered, the diversity of organisational environments and responsibilities in which a public administration operates is much greater than those in the private sector.

Some of the major development processes to be observed within the City of Frankfurt (Oder) are modernization of its administration, increasing budget deficits and an increasing demand for services from politicians and citizens alike. *What seems to be a common element to all three developments is a necessity for economic and organisational effeciency.* However, in its attempt to modernize the public administration, it seems the important role of information technology (IT) is often ignored or completely forgotten. If one is to consider the "technolization" and "informatization" of the public administration the role of IT should be an integral part of any modernization strategy.

It is not obvious whether "technolization" and "informatization" of the public services leads to more or less strict boundaries of organizational distribution of work. Situational and social factors might have unexpected consequences in delivering public services as well as in the supporting processes. In implementing an IT strategy the process of change faced by most public administrations must be understood. One should take into account the visible organizational structure in an historical context as well as the hidden social factors. Taking these aspects into account one can observe three organizational structures within the administration of Frankfurt (Oder) at work (see diagram 1). At one extreme there exists a hierarchical or "traditional" form of a long established administrative structure, on the other extreme, a network form of an administrative structure working under the auspices of "new public management" which is mainly based on "personal" contacts or relationships and in the middle lies a form of "lean public management". At times contradicting or competing with each other, they seem to be surviving side by side.

Diagram 1.



As mentioned above, public sector information is a basic resource and commodity. Accessibility to and dissemination of public sector information is a prerequisite for achieving economic and organisational competitiveness survival as well as efficiency. To support the integration of different levels of "social" networking at the same time managing the change, information technology can play a very vital role.

As the Organizational structure is determined by the product or services to be delivered, the questions now arises, how can such diversity in the administration's organizational structure be supported as well as its departments and information flow be optimized to coincide with present objectives of new public management.

The answer is quite simple. Here is a brief look at a formula put forward by Prof. Dr. Heinrich Reinermann (Reinermann, 1997):

$$AIS = f(PAS, IT, X)$$

"This formula is meant to express a functional relation between AIS as the informatic systems as we find them in the public domain, first of all computer hardware, networks, application and operating software as well as data, PAS as the information needs expressed by the political-administrative system, mainly parliaments, governments and administrations , IT as the information technological potential and X as a general term for further influential factors such as the level of liberalization of the telecommunication market which effects price structures and the availability of services among others, the acceptance of technology by society, or legal arrangements.

....

In other words: the strategies for the development of state and administration and the strategies for the AIS must be integrated, together with the development of the IT-potential and the other influential factors. The strategies for administrative development must include also the AIS. Or, as seen from the other side: the AIS-strategies must be a logical consequence of the strategies for the development of state and administration. ...." (Reinermann, 1997).

As the city administration of Frankfurt (Oder) proceeds with further development of a spatial data infrastructure in context of the aformentioned "environment", experience has demonstrated that Open (GIS) Source solutions are a viable alternative to "traditional" information infrastructures.

5 THE OPEN SOURCE (GIS) SOLUTION: THE FRANKFURT (ODER) EXPERIENCE

Since the first initiative to implement GIS in the city administration in 1993, the IT and GIS landscape was primarily based on proprietary software. In 2000, the city adminsitration decided to "officially" coordinate GIS related activities. In 2001 the first steps were taken to enable access to spatial information from every desktop within the city administration. At this stage, the administration was only in the conceptualization phase of implementing a city wide GIS solution. There was no budget. However, in order to understand the administrations acceptance of new technology and demonstrate the potential of GIS and to identify users as well as potential users needs, it was found essential to give people access to basic spatial information such as cadastral or topographic maps and orthophotos as needed in day to day activities. Everything that was needed was available, except a budget to acquire an "out of the box" solution. Hardware, internet/intranet access, personel, a little bit of IT knowledge and the will to "go where man had gone before" was all there.

In the early stages of the conceptual phase it was also decided to design and implement a spatial data infrastrucure founded on the 7 principles mentioned below: The 6 basic principles proposed by INSPIRE (INfrastructure for SPatial InfoRmation in Europe) *(http://inspire.jrc.it/)* and a seventh added by the City of Frankfurt (Oder).

1. Data should be collected once and maintained at the level where this can be done most effectively
2. It should be possible to combine seamless spatial information from different sources and share it between many users and applications
3. It should be possible for information collected at one level to be shared between all the different levels, detailed for detailed investigations, general for strategic purposes
4. Geographic information needed for good governance at all levels should be abundant under conditions that do not refrain its extensive use
5. It should be easy to discover which geographic information is available, fits the needs for a particular use and under which conditions it can be acquired and used
6. Geographic data should become easy to understand and interpret because it can be visualised within the appropriate context selected in a user-friendly way
7. Independance of companies, partners and engineering firms is to be as much as possible minimised (Private-Public Partnerships (PPP) is not nessecarily to be omitted).

With these basic principles in mind and a little bit of experimenting as well as many hours of work from people all over the world, spatial information is now accessible through every internet browser in the city administration. There is now no need to wait for basic spatial information. Along with the implementation of OpenGIS standards such as the Simple Features *Specification*, WMS and WFS, spatial information can be accessed by internet browsers and various proprietary GIS packages such as ESRI's ArcView© .

It is to early to exactly write about how the functional relation between AIS referred to by Reinermann has changed. However, one thing is clear, the way spatial information is to be disseminated and accessed has changed. Everyone now has access to spatial information when they need it and most of the time how they want it. Time and space (social barriers) are not a problem anymore. Further analysis over the year will be needed to look at resulting impact of an "Open (GIS) Source" solution on the integration of different levels of "social" networking and the management of change.

As described above, there is a great diversity of organisational environments and responsibilities in which a public administration operates. Any further development of GIS applications or the spatial data infrastructure, based on the above principles, must be designed accordingly. There is no one "out of the box" software package that can deal with the situation of a local public administration. For information technology to play a vital role, the integration of and adaption to old and new systems as well as to the users responsibilities and requirements are to be taken into consideration. In context of the predicament in which most local public administrations find themselves today, an Open (GIS) Source solution seems to be the most viable choice. An Open (GIS) Source Solution, as an enabling technology, can integrate existing technology within established structures and allows for change at a pace and at a cost with which everybody can afford – social as well as monetary.

6 THE PUBLIC/PRIVATE PARTNERSHIP ENVIRONMENT

IT service providers working with Open Source software have a complete different business model than those going the "classic" way: Getting the contact, make a presentation of their software and sell it afterwards, eventually together with some services. The Open Source IT service providers ("we") concept is to involve the customer much more in the development processes of the solutions they need. Such a Modern IT service provider has a kind of "toolbox", with elements or „modules“ which can be put together in order to deliver a solution geared to the customers real needs. This requires close co-operation between the service provider and the awarding authority: The process using Open Source software (OSS) is a complete different one, because there is no pre-development followed by a distributor telling the administration where their problems are and then sell them their solution.

For example, many administrations have the problem to convert the EDBS data format to the format of their choice. The idea was to deliver an EDBS to PostGIS converter based on OSS and display the ALK (german cadastral maps) as *WMS* with the UMN Mapserver.

The procedure was as follows: The customers were contacted and made a kind of "collection" for the money required in order to develop the converter. When enough money was in the "pot" and the problems and demands to this piece of software was precisely defined, the development of the solution began. Afterwards the whole software will be released as Open Source. Of course, one can say, *"let's wait until somebody finances this and then I can use it and save the money"*. To understand that somebody finances this and another one that element or „module“ of a „needed“ software solution, the open source requires more idealism or social responsibility.

A re-organisation of the proportion between the public administration and the IT service provider is an essential part when implementing this model. In order to re-organize this proportion, the public administration needs to be involved into the development processes. This requires a higher expertise on the side of the public administration and, of course, an increased co-operation between the public administrations and the IT service provider.

Another point is to involve the public administration directly into the development process. This can only be achieved, when the software is Open Source. As we consider Germany, in every single public administration, there is at least one person who develops some type of software for one hour per week (presumably much more). Together this is a great number of development-hours per week! The problem is, that this development is not well coordinated, so that a lot of this power gets lost (beside the problem, that often the developers are not allowed to share their work with the public because of internal constraints). But OSS has the power and the ability to co-ordinate its own development. This is demonstrated by every well known Open Source project. Linux or MySQL being good examples. The developers of these two software packages are spread over the whole planet, and it works!

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Building SDIs with Free Software – the deegree project

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1 INTRODUCTION

Building Spatial Data Infrastructures (SDI) raises organizational as well as technical challenges. On the technical side, the use of standardized components guarantees sustainability of investments due to a vendor-neutral architecture. The SDI acts as a whole, while its parts be built using software from different vendors. The Free Software project[1] deegree started as a framework for integrating software products of different vendors on base of OpenGIS® and ISO standards[2]. After three years of continuous development it includes now all components necessary for building SDIs. Its Free Software nature opens new ways of cooperation between software vendors/consultants and the organizations responsible for building SDIs. Available resources can be used where they are needed most, and financial funding can be substituted by a collaborative work environment. Compared to other strategies it is easier to start SDI activities on a low cost basis. And it is easier to spread SDI infrastructure from a nucleus to many users without managing (and balancing) complex and precious license agreements.

In 2000 the GIS division of the Geography Department of Bonn University together with its spin-off company lat/lon started to develop a software library called JaGO – Java framework for Geographical Solutions. It was planned to be used in a variety of projects concerned with spatial data processing and should be based as intensively as possible on OpenGIS® standards. Its predecessor was a project called "Simple Features for Java", a project developing a java library for geodata processing based on the Simple Features concept. Learning from this approach, the first part of JaGO was a bunch of java interfaces and classes for the modelling of geodata based on ISO 19107 that allows a more general approach than Simple Features.

In the meantime the project changed its name to deegree and now includes implementations of the greater number of OGC Web Services needed for building SDIs, namely Web Map Service, Web Feature Service, Web Coverage Service, Gazetteer Service, Catalog Service, Web Coordinate Transformation Service and Web Terrain Service. Together with two other Free Software projects deegree even provides the official Reference Implementations for WMS and WFS.

deegree is used in a number of SDI projects over the world, e.g. its catalog service in the national German SDI portal "GeoMIS.Bund" and in the Northrhine-Westfalian state SDI, its WMS and WFS as part of the City of Hamburg's local SDI and the national SDI of the Grand Duchy of Luxembourg, and last but not least its Gazetteer Service on top of the USGS Geographical Names Information System.

a) deegree Architecture overview

The deegree architecture is based on the service paradigm – and more specifically on the geoprocessing concepts of the OGC and ISO/TC 211. From a conceptual point of view the Portrayal Model (Cuthbert 1998) helps to outline the deegree service architecture. The model describes the map production process with four processing units and four representation components (Figure 1). A data selection process which is controlled by query constraints delivers Features – the key concept of OGC/ISO-standardised geoprocessing (OGC 1999). The selection interface technology depends on the DCP type (distributed computing platform). Access to vector data via CORBA, SQL, or OLE/COM is provided by implementations of the Simple Features Specification, whereas the corresponding technology for the Web is defined by the Web Feature Service Specification (WFS). A typical representation for Features and Feature Collections is a GML (Geography Markup Language) Dataset.[3]

A Display Element Generator applies style rules to features and produces a graphical representation. The resulting Display Elements can be rendered into an image by using constraints such as color depth, image size, and image format. Implementations of the OGC Web Map Service Specification (WMS) which defines an interface to access map images thus represent both the Display Elements Generator and Render process components. The resulting map image finally is displayed to the user. Today, a typical display component for map images in a Web environment is a standard Web browser.

In deegree, each of the processing, representation, and constraints components is represented by Java interfaces or classes. Each deegree Web service implements the interface org.deegree.services.OGCWebService. Accordingly, the WMS implementation is realized in the class org.deegree_impl.services.wms.WMService. The OGCWebService interface simply defines one method - doService(...) - that receives an OGCWebServiceEvent object and starts the process of handling the WMS request (GetCapabilities, GetMap, GetFeatureInfo). The submitted OGCWebServiceEvent contains the request to perform and information concerning the class which shall receive the result.

The WMService class then delegates the performing of the request to a:

1. MapFilterHandler for accessing the required data
2. DEGHandler for generating display elements from the geospatial data and the associated portrayal rules
3. RendererHandler for rendering the display elements to a map

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[1] Read more about Free Software in general on the Free Software Foundation's Web Site: http://www.gnu.org/. "Open Source Software" is a competing concept of the Open Source Inititative with more emphasis on pracitical than on social aspects (http://www.opensource.org/).

[2] See http://www.opengis.org/ and http://www.isotc211.org/

[3] All adopted OpenGIS® specifications are available on the OGC Web Site: http://www.opengis.org/specs/?page=specs

The WMS is a servlet-based implementation (org.deegree_impl.enterprise.WMSServlet) which acts as a client to WMService objects and offers the network connection interfaces.

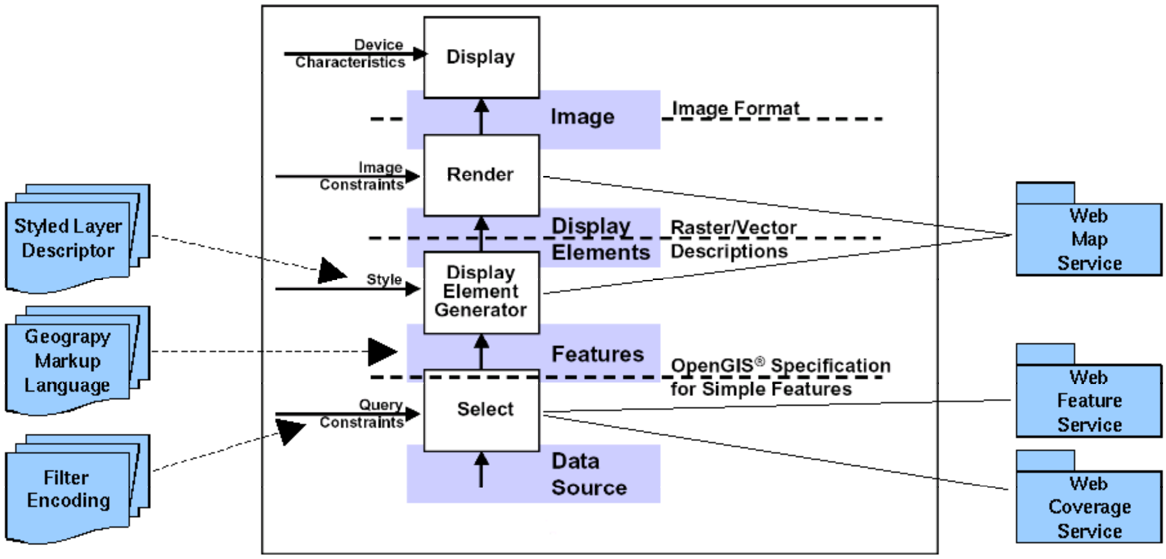


Figure 1: The Portrayal Model (derived from Cuthbert 1998)

1.1.1 Data Access

In the sense of the Portrayal Model a WMS uses a filter service to access the data needed to render the requested map and/or to perform GetFeatureInfo requests. For flexible data access the deegree WMS doesn't implement specific classes for accessing data but offers access to Data sources as WFS or WCS (org.deegree.services.filterservice package). One WFS or WCS can be registered as datasource to the WMS. This does not necessarily mean that an actual Web Service has to be accessed but that data sources (even Java Classes) act like WFS or WCS (Figure 2).

The required additional configuration information is added to the configuration (capabilities) document of the WMS and will be provided by implementations of the interfaces contained in the org.deegree.services.wms.capabilities packages. Because only a small amount of additional information is needed no extra configuration package exists. If a client sends a GetCapabilities request the additional information will be filtered out of the capabilities before the document is sent to the client.

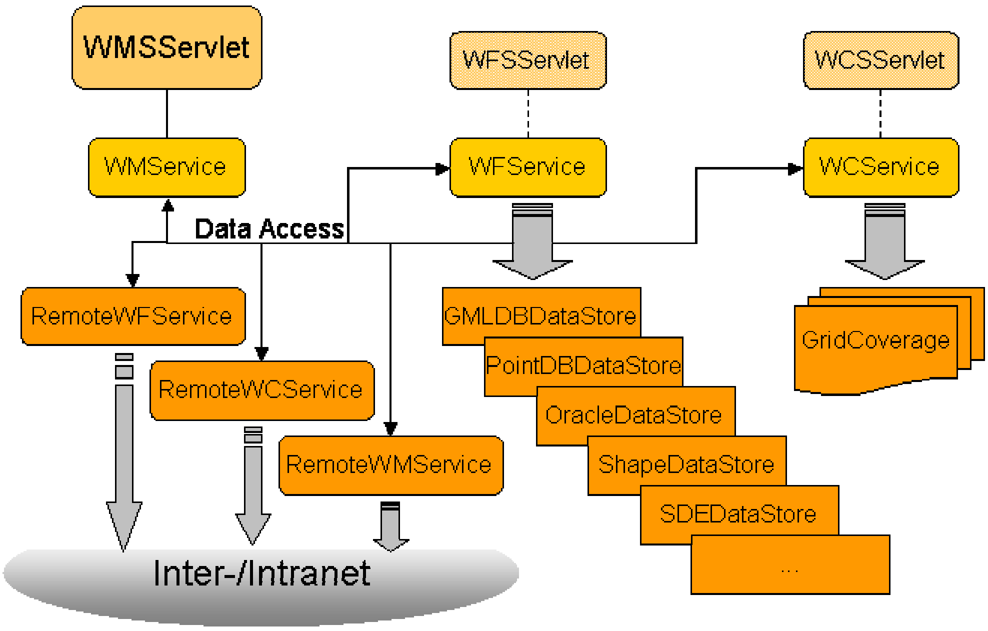


Figure 2: Data access in deegree WMS (from deegree WMS documentation[4])

A typical internal service chain invoked by a GetMap request to the WMS is outlined in Figure 3. Here, the Web Coordinate Transformation Service (WCTS) is used to perform a coordinate transformation.

[4] http://deegree.sourceforge.net/

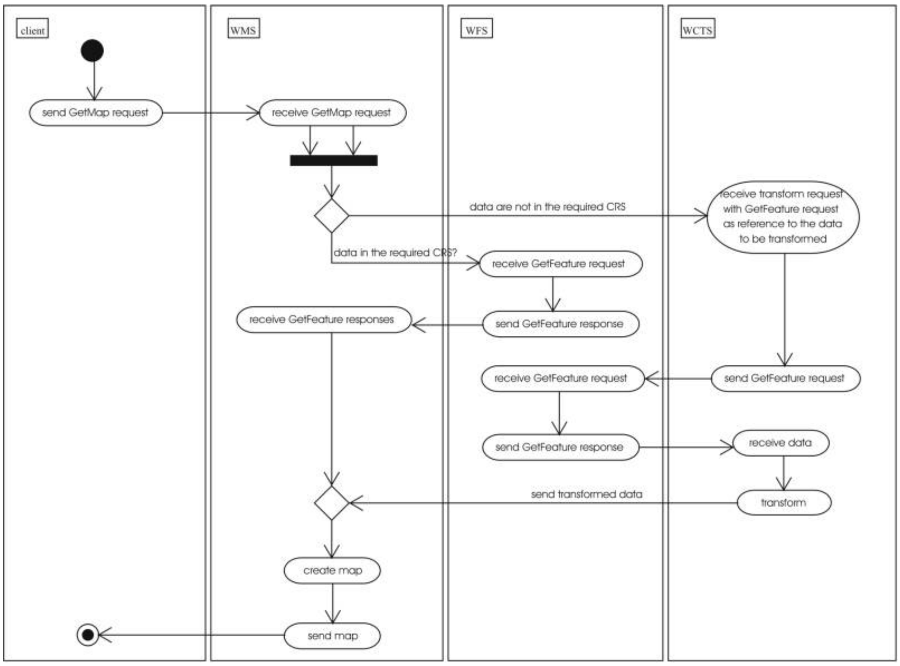


Figure 3: UML activity diagram for a WMS request

1.1.2 From Services to Spatial Data Infrastructures

As pointed out in the GSDI cookbook (Nebert 1991) ...

> *The word infrastructure is used to promote the concept of a reliable, supporting environment, analogous to a road or telecommunications network, that, in this case, facilitates the access to geographically-related information using a minimum set of standard practices, protocols, and specifications.*

From a technical point of view "standard" is the key property of SDI components allowing for plug-and-play interoperability of geospatial information resources. Today, Web Service technology provides a stable baseline for network-based collaboration through all application domains. The OGC, in close collaboration with ISO/TC 211, is providing specifications for a variety of tasks or components necessary for Spatial Data Infrastructures based on concepts which anticipate functionality of the Semantic Web, the intended successor of the WWW.

In deegree the following OGC-based services are available:

Name	Functionality
Web Map Service (WMS)	Web-based creation of maps out of raster and vector datasets. The generated maps can be visualized by common web browsers.
Web Feature Service (WFS)	Web-based access to vector geo-data, that is delivered as GML 2.1.1 conformant XML-documents to clients, which can the further process this data (for example in a desktop GIS).
Web Coverage Service (WCS)	Web-based access to raster geo-data, that can be delivered in several image formats (e.g. TIFF, GIF, JPEG, BMP, PNM) and can then further be processed.
Web Catalog Service (CS-W) based on OGC Web Services Stateless Catalog Profile.	Web-based catalog service for administration and querying of metadata describing geo-data and geo-services. A catalog service allows retrieval of data and services based on spatial and textual search criteria.
Web Gazetteer Service (WFS-G)	Service allowing geo-referencing of geographic entities based on textual identifiers (e.g. place names)
Web Terrain Service (WTS)	Creation of views out of 3D-data like city models and digital elevation models. The generated views can be visualized by standard web browsers.
Web Coordinate Transformation Service (WCTS)	A WCTS allows the web-based transformation of geographic coordinates from one coordinate references system into another.

The collaboration of these services is shown in Figure 4.

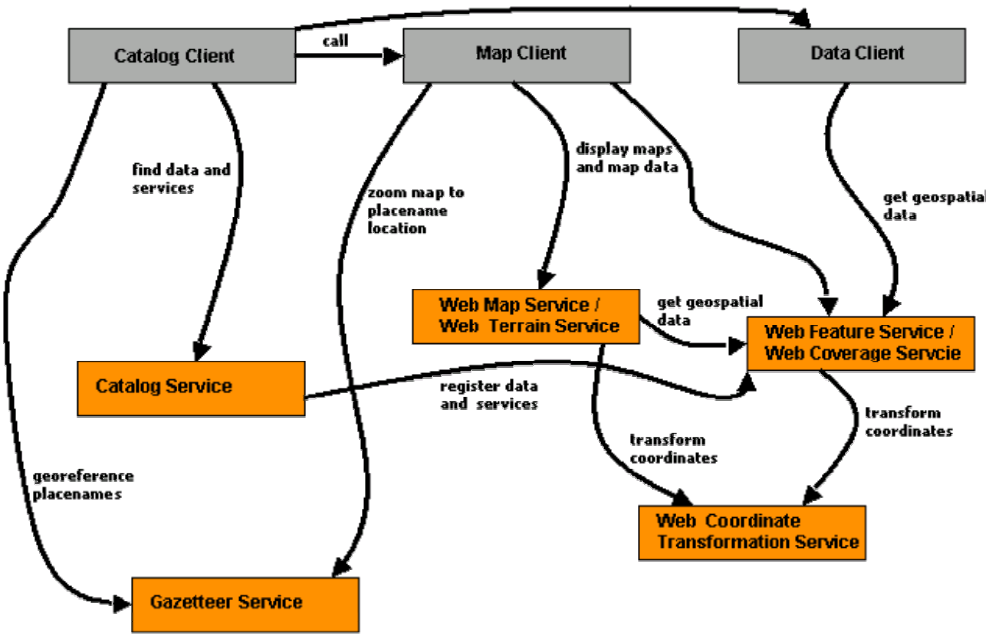


Figure 4: Collaboration of OpenGIS® Web Services

The creation of an SDI with deegree Web Services can be realized in two (or more) stages.

1.1.3 Stage 1: Catalog and Map Service

In this first stage a WMS and a CS-W is being installed as a base system allowing querying metadata, finding geodata and displaying it in a intra/internet (Figure 5). This can be coupled with an access control component, allowing only limited access to maps and metadata.

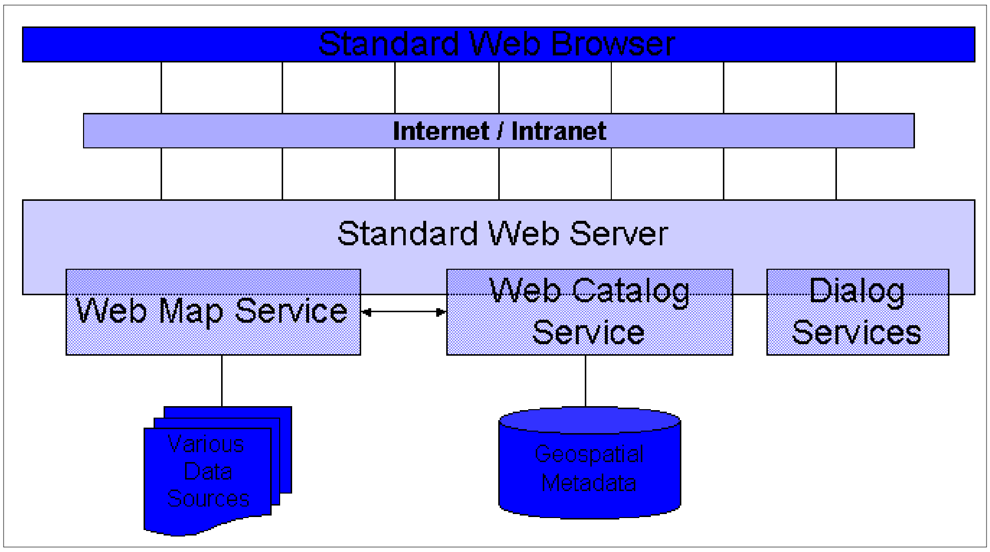
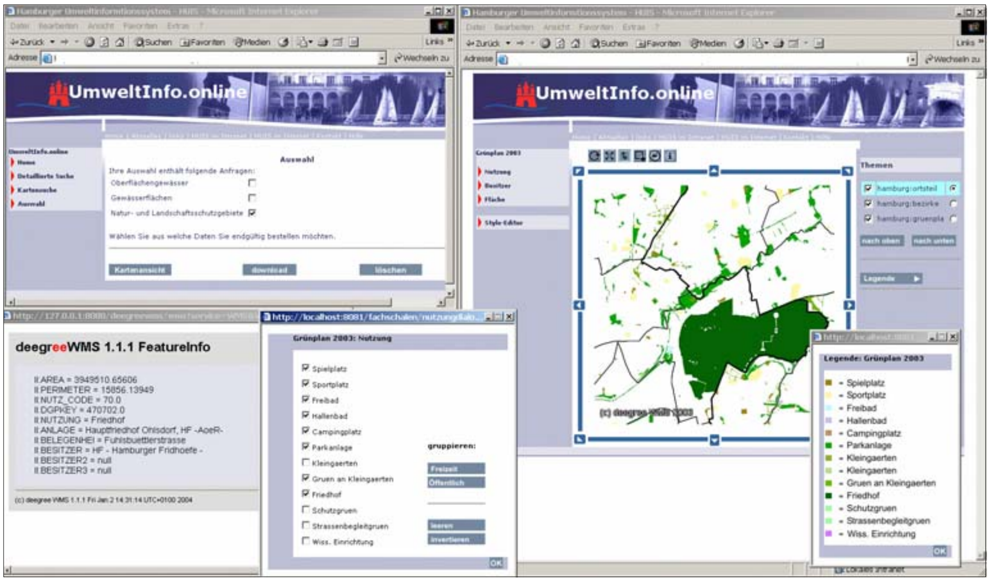


Figure 5: A simple SDI base containing a Map Service and a Catalog Service

The metadata catalog stores its data conforming to ISO 19115 (geodata metadata) and 19119 (services metadata). With the WFS-based implementation of the deegree Catalog Service object-relational mapping capabilities can be used to convert legacy metadata schemas on-the-fly to ISO 19115.

Figure 6 shows a compilation of user interface components provided by the application server components provided within stage 1. These are called "Dialog Services" in Figure 5. The upper-left browser window shows the shopping basket interface, which contains selected datasets from one or more catalog queries. From here, the user can either view or download the data depending on his/her privileges – supposed that an access control component is integrated into the application server. The "view dataset" button switches to the WMS client component shown in the upper-right browser window. The popup-windows show dependent components of the WMS client with: 1) information on a selected feature, 2) layer control functionalities, and 3) a map legend (from lower-left to lower-



right).

Figure 6: Screenshot from the user interface of the environmental data infrastructure "UmweltInfo.online" for the city of Hamburg, Germany (cf. Müller et al. 2003)

(a) Stage 2: Direct access to geodata

In the second stage the architecture is extended by further services. By integrating WFS and WCS, more than visualization is possible. Geodata can be directly accessed, processed and adapted data may be made available by persons with proper access rights. Especially for the manipulation of geodata, but also for complex data retrieval, specialized clients have to be installed. These also allow for creation (digitization) of geodata. Gazetteer and Coordinate Transformation service can be included to support querying and data supplying capabilities.

Because the second stage only extends the existing architecture by integrating further components, the overall architecture does not have to be changed. The Spatial Application Server now supports client-functionalities for further services and allows use of these by way of an easy to use and highly customizable user interface. Furthermore, access control is handled by this SDI layer since a corresponding and adopted concept does not yet exist in Web Services-based geoprocessing.

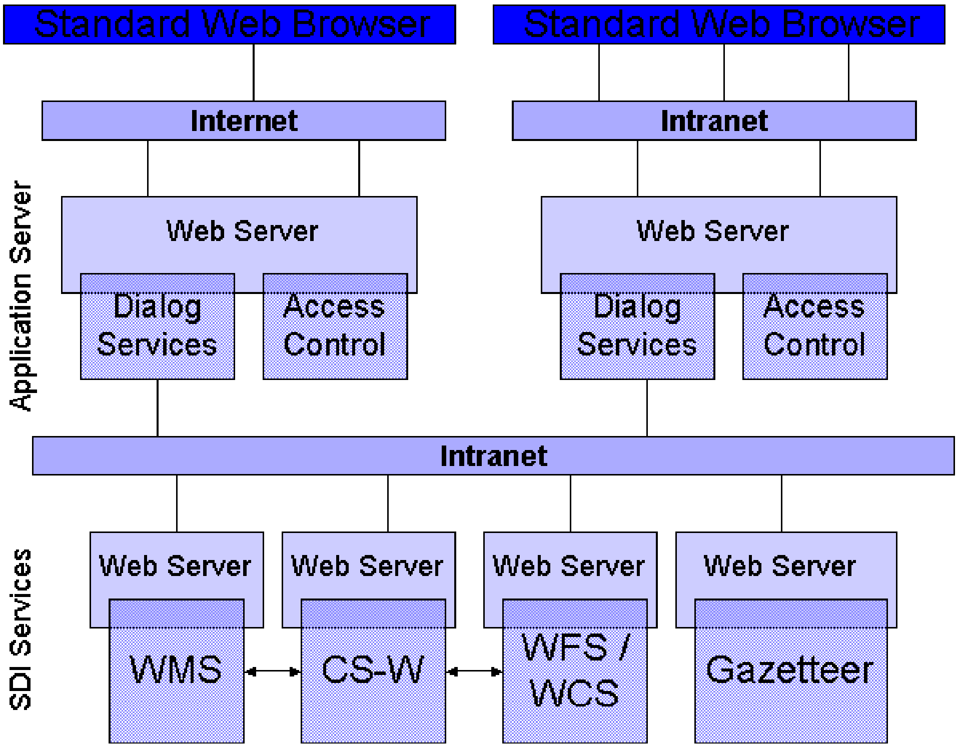


Figure 7: A more elaborated and distributed SDI, including Catalog, Map View and Data Access components

WMS, WFS, WCS, WCAS and Gazetteer interact in controlling data access cooperatively. WMS and Gazetteer support use of the Catalog Service in providing mechanisms for spatial retrieval and/or using geographic names. The Catalog Service identifies relevant datasets of a query and stores information allowing access to the data over suitable Web Services (WMS, WCS, WFS) or by ordering digital copies of the data on CD or DVD.

All services can be realized decentralized.They can reside on different servers, maintained by different organizations. This allows decentralized data storage by the responsible parties for the specific data holdings. Besides, the system is easily scalable as services can be moved to dedicated servers in case this becomes necessary.

Why building SDIs with Free Software?

It is "the double openness" which makes free and interoperable Software so effective in SDI build-up. As far as only the interoperability aspect is considered there is no difference between free and proprietary software, both implementing standardised interfaces.

The freedom[5] aspect gives even more options. In general, the notion of a world-wide user and developer community is a great advantage: in the majority of cases problems reported to the community are solved promptly. The same is true for a local development community consisting of team members of different organisations, e.g. IT staff from the SDI-driving corporate body together with software engineering staff from a GIS company.

This kind of code level-based openness or collaboration is needed whenever the technical or user requirements exceed the functionality of a software package. Two real-world problems may exemplify this issue: The implementation of thick clients and the integration of exotic spatial reference systems.

As already mentioned, the requirements for clients are increasing when the system becomes more elaborate or more complex queries or transactions are executed. Depending on the profile of the user (simple user up to administrator privileges), different clients can be utilized. A standard user might be allowed to query and visualize specific datasets, for which a HTML-based thin client may be sufficient. In this case the "thin client" only includes the Display component of the Portrayal Model (Figure 1) wheras the underlying services are part of the "fat server". If a user – supposed that he/she has the privileges to do this – wants to be able to edit data in his/her client a "fat client"is needed. This application may then comprise the three upper processing components, including the Feature representation layer of the Portrayal Model whereas the corresponding server simply acts as a Select component. The implementation of this scenario asks for software assembly on at least API level. Full access to the source code improves the performance of the development process a lot and may even help to solve problems which exceed the API level.

[5]Free Software is defined by four kinds of freedom: The freedom to ... 1) run the program, for any purpose – 2) study how the program works, and adapt it to your needs (access to the source code!) – 3) redistribute copies so you can help your neighbor – 4) improve the program, and release your improvements to the public, so that the whole community benefits. (http://www.gnu.org/philosophy/free-sw.html)

The support of exotic spatial reference systems is a second example for real-world problems easily solved by a free geoprocessing software package. A lot of spatial reference systems exist which are used only in a small area or within a small group of institutions. Access to data referenced to these systems can only be realized by adding transformation capabilities to the respective software. Again, this task can more easily be accomplished with full access to the source code.

Knowing about these advantages and willing to provide a deep insight into a technical solution the Open GIS Consortium has decided to rely on free software in its reference implementations for the various services:

> *An excellent way of providing reference implementations is via open source software under the GNU Public License, since the code can be examined in full without limiting the ability of companies to develop commercial products. For these reasons, an open source Web Feature server and client, and a Web Map server were developed for the CITE initiative [...]*
>
> (OGC 2003)

The OGC reference implementations support the conformance testing program in providing components for the online test suites and in gaining access to the internals of a tested implementations. In the above named CITE inititative[6] the free software projects deegree, GeoTools, and GeoServer[7] realized the reference implementations for the WMS 1.1.1 and WFS 1.0 specifications.

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[7] http://[deegree|geoserver|geotools].sourceforge.net

New technologies, research and marginal rural regions: The strategic formula promoted by ADIMMAC for the Local Agenda 21 of the La Mancha Alta Conquense (Spain).

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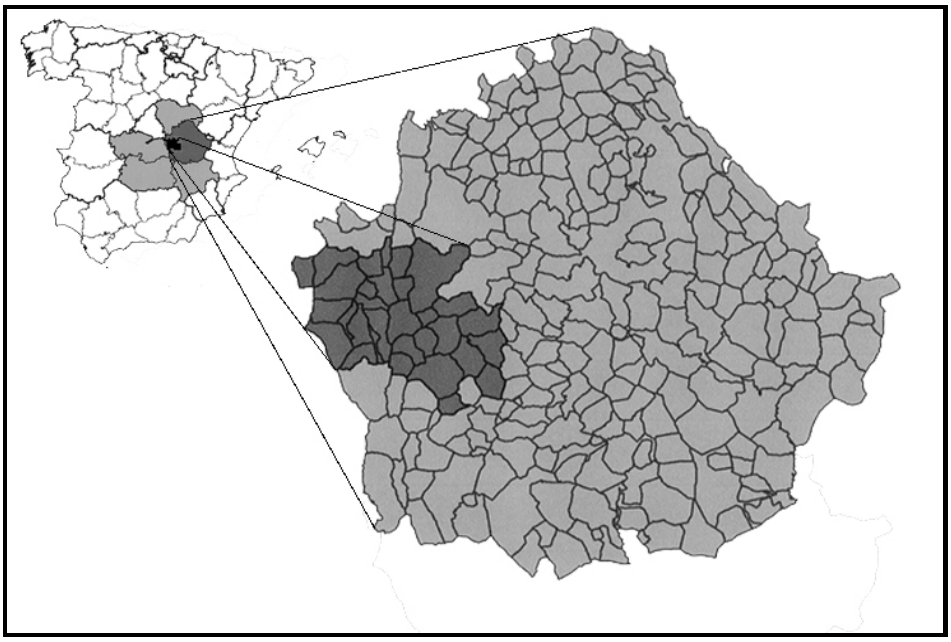
1 INTRODUCTION:

This paper examines the way new technologies (GIS & Remote Sensing Technologies) can help the management of marginal rural regions, analysing the case of an area composed by 29 municipalities within in a region known as *La Mancha Alta Conquense* (1,824 km²) located in the Autonomous Community of Castilla-La Mancha, Spain (Graph. 1) which decided to produce its own Local Agenda 21 (LA 21).



Graph 1: Study Area, (Source: ARC-GIS).

The paper is focused on this process and its results in terms of New Technologies (NT) application (partial until now, being a process still in progress) with the aim to portray the power of the NT to help the development of rural areas. The structure of the paper runs along two axes: the role of the local association that promotes the LA 21 (ADIMMAC) and its technical objectives, and its strategic alliance with the Institute of Economics and Geography (IEG), a national research institution for the provision of technical support.

The paper analyses the responses to cope with the needs related to the process of the LA 21 formulation: from the diagnosis to the decision taking process, including the training requirements for the local administrators to close the gap that characterizes marginal societies like this one.

2 THE ROLE OF THE NT IN THE PROMOTION OF SUSTAINABLE DEVELOPMENT

In the European Union the rural regions are facing a process of change that pursues the dinamization of the economic, social and cultural life trying to balance the conservation of nature as a way to maintain the natural resources for the coming generations. In this commitment for the future, promoted since 1992 by the EU and the United Nations as a result of the Summit of Rio de Janeiro, where local leaders play an essential role as the responsibles of impelling this process of change. The programs for local leaders' education and training are fundamental to create favorable conditions for the generation of strategic activities included in Local Action Plans aimed at promoting a sustainable development in their regions.

The role of the scientific and academic institutions in the promotion of this process of change is essential, giving help in several fields such as formation of local leaders; the application of geomatics technologies (GIS, Remote Sensing and Automatic Cartography) in the elaboration of instruments of sustainable administration (specifically Local Agendas 21); the diffusion of the geographical information by means of Web Mapping technologies as facilitators for the process of decision taking; or the training of the end users.

3 ADIMMAC AND IEG: A STRATEGIC ALLIANCE TO COPE WITH THE PROBLEMS OF A MARGINAL TERRITORY.

- IEG: the Institute of Economics and Geography is a research centre located in Madrid, specialized in territorial studies and in the use of NT applied to regional diagnosis, that belongs to the Spanish Council for Scientific Research.

- ADIMMAC**:** acronym of the Association for the Integral Development of the Municipalities of La Mancha Alta Conquense, a group of municipalities including in a rural region characterized by a declining situation, included in an operative program of economic and rural development (PRODER-2) promoted by the Spanish Ministry of Agriculture, similar in its objectives to those of the initiative LEADER + of the European Union. The territory has the following profile:

- *an eminently rural base economic*: most of the active population is devoted to the agrarian sector.

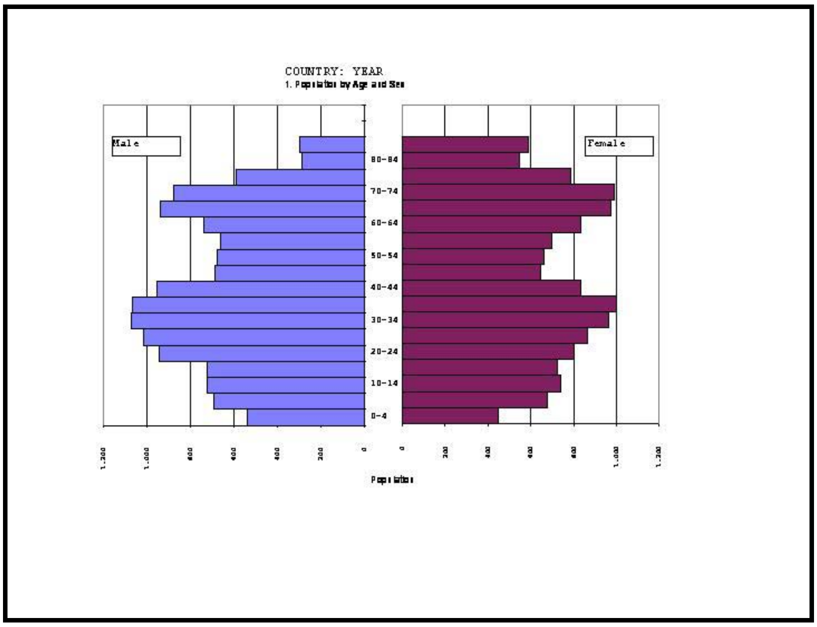
- *scarce industrial activity*: only one city - Tarancón, the biggest of the local urban system - possesses an important number of workers in this economic sector.

- *progressive loss of population*: most of the population has emigrated to urban settlements of higher hierarchy next to the local urban system (mainly Madrid and Valencia).

- *aged population*: the average ageing index is 36,46 (Graph 2).

- *unbalanced system of cities*: Tarancón is biggest city (11.796 hab.) while 18 municipalities (46% of the region) possess less than 500 hab.

- *scarce social cohesion.*



Graph 2: Population Pyramid (Source: Population Census, 2001)

- The project: the idea of beginning a process of collaboration between both institutions arises as a result of the attendance of the president of ADIMMAC and the manager of the program PRODER-2 to the International Master on Local Development, organised by the IEG. The training of these directives was a decisive factor for the agreement of collaboration (signed in April 2002) to produce a LA 21 for the region. The objectives of the agreement were the following:

- *knowledge of the regional reality*, in terms of the existing environmental, social and economic variables.
- *improvement of the municipal management,* by means of recommendation derived from the territorial diagnosis.
- *definition of a sustainable model for the region,* resulting from *a* bottom - up and participative process.
- *implementation of the model,* giving contents to a Local Action Plan.
- *continuous improvement of the municipal management,* as a way to promote new forms of governance.

3.1 Expected results

Five are the main expected outcomes:

1. *Environmental Audit*, an instrument used for the territorial analysis and diagnosis as well as for the definition of new strategies. The Territorial Analysis is directed to produce an inventory of the strategic natural resources; an assessment on the state of conservation; a profile of the population dynamics and its socioeconomic characteristics; and an evaluation of the main environmental vectors. The Diagnosis identifies the regional weaknesses, threats, strengths and opportunities.

2. *Sustainable Objectives and Strategic Lines,* required for the Environmental Forum to guide the definition of programs and projects included in the future LA 21. Seven were the key strategic areas selected: *agriculture, economy and enterprise; towns and cities; tourism and cultural heritage; territorial interrelations; conservation of nature, environmental education and formation.*

3. *Elaboration of a GIS,* conceived as an add-on product of the LA 21. From the beginning, the ADIMMAC local leaders realised the convenience of using the NT to help the local development process within the context of the society of the information. It is expected that the use of this GIS will help the decision taking process of all agents involved: authorities, local action groups, enterprises and society in general. On the other hand, the GIS will be the space database that support the map server in Internet used for consultation through the Local Net.

4. *ADIMMAC Local Net*, the 29 municipalities will be linked by a computerized system to follow the results of the Local Action Plan.

5. *Training of local leader in the use of NT,* by means of specific courses and workshops.

4 TECHNICAL RESPONSES

4.1 Environmental Audit.

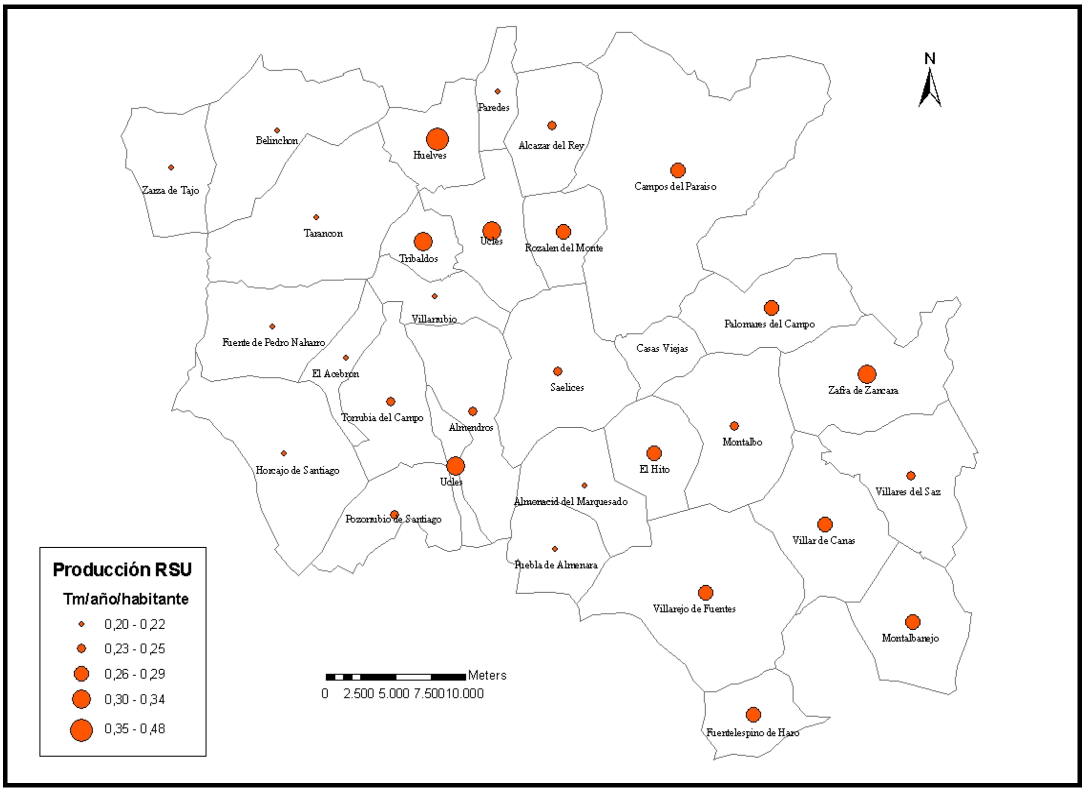
The Environmental Audit is a method that allows local communities to get regular and systematic assessments of their environment, including the impacts of the public policies (Barton and Bruder, 1995). It is an operative instrument that analyzes the regional sustainability, providing information of the existing territorial conditions.

The elaboration of the territorial diagnosis has been produced at two simultaneous levels: the treatment of the existent information in form of reports, maps and thematic SWOTs, and the definition of the database for the GIS. The existing information gave contents to a Document of Synthesis composed by two chapters:

1- *Qualitative Diagnosis*, outcome of an ample opinion surveys directed to grasp the way local people *perceive* the present regional situation. In October 2002, 80 leaders and key agents were asked about environmental, social and economic aspects, with the aim of identify the capacity of the region to cope with a process of sustainable development. The survey data – *ACCESS* was used for tabulation and statistical treatment – gave contents for the elaboration of a qualitative SWAT.

2. *Quantitative Diagnosis***,** based on the existing statistical information from different sources (population censuses, agrarian censuses, directories of economic activities, reports of heritage elements, surveys of infrastructures and facilities) as well as the information produced by the GIS using space analysis operations. This information has been stored in EXCEL and has been linked to ARC-GIS through a common ID. The attributes of each municipality have been linked to different maps, traducing the numerical information into a cartographic mode to facilitate its understanding (Graph. 3). A quantitative SWOT was produce from these inputs.

To evaluate the sustainability at a municipal and regional level several geographical, social, economic and environmental indicators were selected, following the ones recommended by EEA (2000) and OECD (1993). Using the so-called *iconographic comprehensive matrixes* (Franchini, 2000) it was possible to evaluate the level of sustainability of any municipality and, at the some time, the magnitude of the public and private efforts required to be carried out to improve the present situation in the short, medium and long term. The matrixes rank the situation according to the value the indicators assume: under or above the critical threshold of sustainability defined for each case (positive or negative), modulating each case in three possible levels: high, medium or low. To facilitate the lecture, each cell has been coloured in a green range (positive) or red range (negative) (Table 1).



Graph 3: Solid Waste Production (Tm/year/inhab) in La Mancha Alta Conquense (Source: ARC-GIS).

GEOCOD	MUNICIPALITY	ROAD_DENSITY (km/km²)	WATER LOSS (%)	SEWAGE (m3/year/inhab)	SOLID WASTE PRODUCTION (Tm/year/inhab)	UNCONTROLLED RUBBISH TIP (Presence)
16002	Acebrón (El)	0,21	5	90,00	0,21	NO
16010	Alcázar del Rey	0,18	5	111,54	0,25	NO
16016	Almendros	0,30	8	99,83	0,23	YES
16018	Almonacid del Marquesado	0,21	5	84,80	0,20	YES
16032	Belinchón	0,16	7	97,15	0,22	NO
16086	Fuente de Pedro Naharro	0,10	25	91,56	0,21	YES
16087	Fuentelespino de Haro	0,24	10	114,65	0,26	NO
16101	Hito (El)	0,13	10	132,86	0,29	NO
16106	Horcajo de Santiago	0,17	15	92,86	0,22	YES
16108	Huelves	0,42	10	226,91	0,48	YES
16129	Montalbanejo	0,16	5	126,28	0,28	YES
16130	Montalbo	0,29	30	101,46	0,23	YES
16148	Palomares del Campo	0,34	10	115,01	0,26	NO
16151	Paredes	0,20	12	90,76	0,21	YES
16167	Pozorrubio	0,09	10	105,30	0,24	YES
16172	Puebla de Almenara	0,22	3	96,39	0,22	YES
16181	Rozalén del Monte	0,18	3	116,53	0,26	NO
16186	Saelices	0,43	20	105,68	0,24	NO
16203	Tarancón	0,23	50	86,22	0,20	NO
16212	Torrubia del Campo	0,17	20	110,43	0,25	NO
16217	Tribaldos	0,18	20	155,15	0,34	NO
16218	Uclés	0,08	10	144,85	0,32	YES
16253	Villar de Cañas	0,27	10	117,89	0,26	YES
16264	Villarejo de Fuentes	0,27	15	119,14	0,27	YES
16269	Villares del Saz	0,25	20	105,59	0,24	YES
16270	Villarrubio	0,43	20	91,52	0,21	NO
16277	Zafra de Záncara	0,27	40	147,59	0,33	NO
16279	Zarza de Tajo	0,37	10	97,06	0,22	NO
16901	Campos del Paraíso	0,32	9	116,69	0,26	YES

Table 1: Fragment of an Iconographic Comprehensive Matrix (Source: Survey of Infrastructures and Facilities, Spanish Ministry of Publics Administrations)

4.2 GIS

The regional GIS seeks to fulfil three purposes: definition of the present territorial situation; monitoring of their environmental conditions and evaluation of the impacts of environmental policies.

The GIS describes the geographical space in a dual way: directly, by means of their attributes, capturing the data coming from satellite images and Digital Elevations Models (DEM), and indirectly, from the elements or parts described by their attributes and relationships. For the capture of the data it has been used a CAD of general purpose (Microstation) and a relational GIS (Microstation GIS Environment, MGE), due to its simplicity and flexibility (Newell and Theriault, 1989). However, for the future installation of the GIS in the inter-municipal net it is foreseen the use of ARC-GIS, given its easy handling. To facilitate the exchange of formats it is used GEOMEDIA (Intergraph).

- Sources of information:

- *Geographical Service of the Spanish Army:* numeric cartographic base (NCB50), scale 1/50.000, format * dgn.

- *National Meteorological Institute:* climatic database

- *Ministry of Agriculture:* facilitated the map of the present uses, including crops, in digital format.

- *Ministry of Environment:* list of Sites of Community Importance (SCI), proposed by the regional government to become part of the Natura 2000 Network.

- First GIS product:

- *Regional DigitalElevations Model:* to analyze environmental aspects starting from the levels contour and the enclosed points of the NCB50, from which other maps derives (hypsometric, of slopes and aspects).

4.3 Social responses: the value of the technical information

The information produced by IEG acquired a high value, so much for the 120 people that compose the Environmental Forum facing the definition of the LA21. The improvement of the territorial knowledge in terms of sustainability is an already reached objective.

As a result of the successful social movement organized around the Environmental Forum, the Government of the Autonomous Community of La Mancha – that participates in the project as an observer – it is considering this experience as an example to be followed. If the results are positive, the Government is willingly to impel the application of the same methodology to the rest of the rural territories of the region.

5 PENDING TASKS

While ADIMMAC is elaborating its proposals for the LA21, the activities of the IEG are centred in completing the remaining tasks: completion of the GIS; organization of the ADDIMAC Local Net, and definition of the contents for education and training.

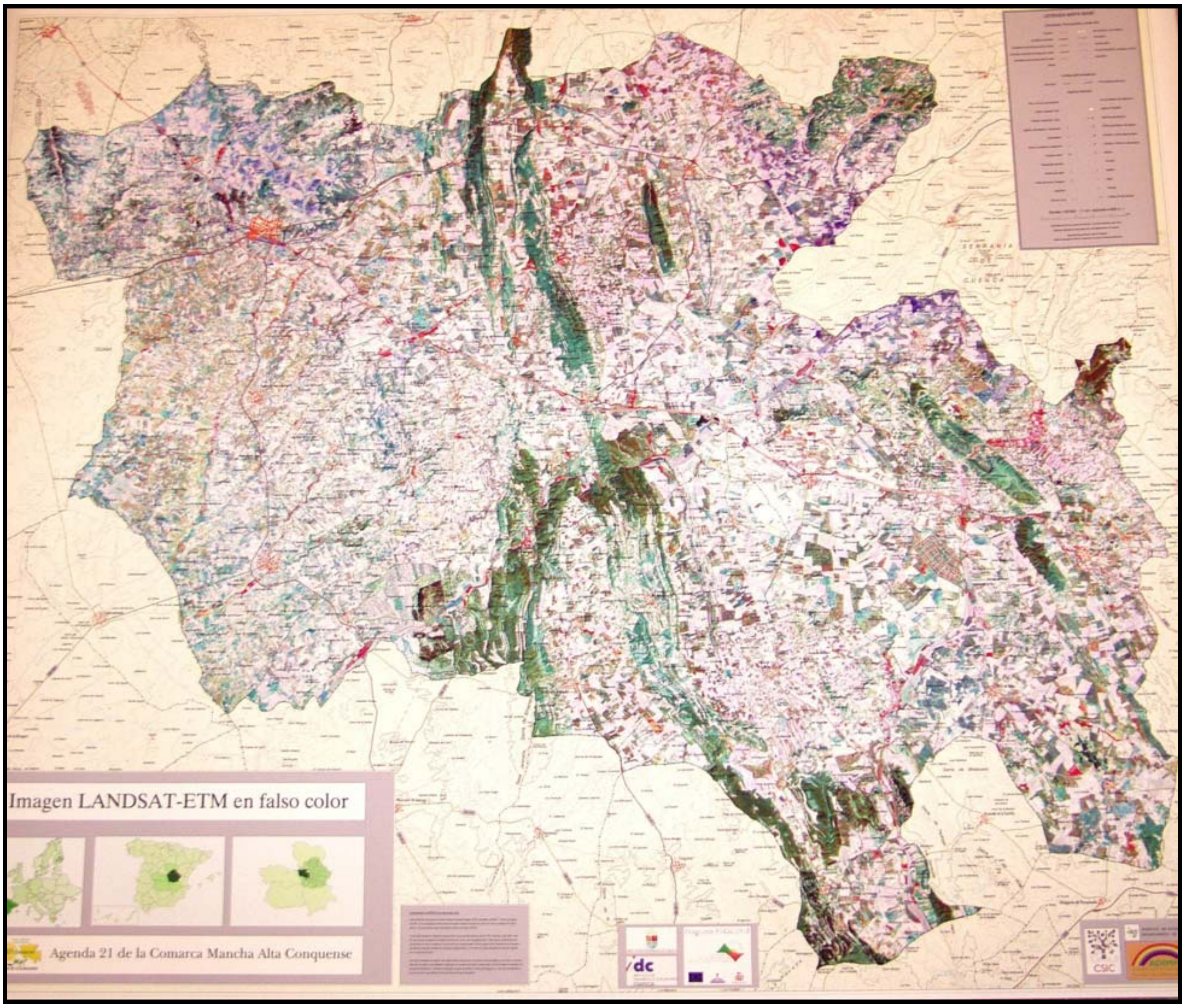
5.1 GIS completion

The Spanish Geological Institute will provide the geological map, scale 1/50.000 in digital support, to get information of underground aquifers and hydrographical basins, using the DEM. The climatic data, correlated with the DEM and with data of latitude and longitude, will allow modelling outstanding biophysical variables to be included in models of agricultural capacity of soils and erosion. For the upgrading of the map of land uses is interpreting visually, by means of digitization on screen, a scene Landsat ETM+ of August 5 2002 (Graph 4) with the support of digital blank and black aerial photographs**,** of 1 m of spatial resolution.

Their comparison will allow to know the structure of the changes taken place in the land uses and to formulate patterns of change, tendencies and to apply indexes of ecology of the landscape using FRAGSTAT, for example. On the other hand, the use of the land is a strategic variable to derive studies of the visual quality and fragility of the landscape and to assign protection levels to habitats and fauna species. Also, they will be able to simulate future scenarios, by means of cellular automata, introducing diverse conditions of change (Lavalle et al., 2002). Finally, it is working to incorporate the running planning instruments and a tourist map in which specific routes for eco- tourism and the most interesting points of geologic, natural and patrimonial interest are pointed out.

5.2 ADIMMAC Local Net installation

For the purpose to improve the capacity of the municipal administrations in the decision taking process using the GIS, it will be defined a protocol to connect terminal nodes in each municipality served by an administrator of the system located in ADIMMAC headquarters. To reach these objectives, GIS is a key piece: it should integrate the whole information in a standard structure and very well documented (Metadata). The server will provide to the end users maps using web mapping technology, and will have an interface that facilitates the consultation, the visualization and the analysis of the information integrated in the GIS.



Graph 4: LANDSAT ETM+ image of La Mancha Alta Conquense (Source: Microstation GIS Environment)

5.3 Education and training for end users.

To reach conditions of success it is indispensable that the end users commit to participate in a formation program and technological training that qualifies them in their handling, as a way to extract the maximum possibilities to the GIS. The project expects to contribute in the modernization of the municipal administration. The formation should be organized at several levels: seminars and workshops for users of terminal nodes and advanced courses for the system administrator.

6 THE NTS, THE MARGINAL RURAL AREAS AND THE CONDITIONS OF SUCCESS

1. *The leaders:* it is of great importance the presence of enthusiastic local leaders capable of dynamizing the social and economic life of marginal rural regions, especially those affected by a selective emigration of the most dynamic groups. It is also fundamental the existence of local attitudes towards change, and the willingness of being involved in the processes of recycling of knowledge.
2. *Scientific institutions:* it is also essential that research organizations centered in applied investigation contribute to solving concrete problems of the society, especially those ones involved in the use of New Technologies.
3. *Finance:* in economic terms, these rural territories must have a minimum of economic base - reinforced for initiatives such us Leader or Proder - to promote new investments and to open new perspectives.
4. *Public participation:* a local community that supports the initiatives of the leaders is essential to promote a process of change. Without a civic participation it is not possible a sucsessfull LA 21.
5. *NT Infraestructure:* it is indispensable for the marginal rural communities to have a minimum level of this kind of infrastructure. The access to the broadband communications in these regions is a challenge governments should face. New technological conditions opens the possibility to reduce economic and social differences among urban and rural areas.

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The Use of Information Technologies in the Urban Redevelopment Process in The City of Baltimore, USA

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1 ABSTRACT

In the summer of 2003, The Reinvestment Fund (TRF) and Baltimoreans United In Leadership Development (B.U.I.L.D.) prepared an Assessment and Redevelopment Plan for the Oliver neighborhood in the City of Baltimore funded by the Annie E. Casey Foundation. Oliver is neighborhood with high levels of urban deterioration and poverty. Property vacancy is over 44 percent, Aids and Hepatitis C cases are the highest in the City and drug abuse is one of the highest in the nation. Ironically, the John Hopkins Hospital is located a few blocks from Oliver (Figure 1, center). Over the last decades, this world renowned institution has expanded its campus significantly displacing low-income residents to other distressed parts of the City.

In order to create a seamless redevelopment process in which land acquisition is closely interrelated to physical design actions, TRF developed a methodology in which each parcel was evaluated and categorized by redevelopment activity (encapsulation, demolition or rehabilitation). The result of the process was a “Feasibility for Redevelopment” map used to guide physical planning actions. GIS and non-GIS databases were provided by the City of Baltimore’s Office of Information Technology and other public agencies. Additional data was created by TRF by surveying over 2,400 properties. The process included the development of a 3D-GIS model for trend analysis; the creation of a spatial contiguity analysis and a cluster analysis to determine the extent to which investment should occur; and the preparation of a physical master plan including implementation strategies.

This paper is an overview of the process utilized in the creation of the Redevelopment Plan. It focuses on the use of information and its relationship to the planning and design process, and it does not provide for specifics on the planning and physical design strategies developed for the plan.

Figure 1: Left: Baltimore Inner Harbor (1.6 km from Oliver); Center: Oliver’s neighbor, Johns Hopkins Hospital; Right: Oliver

2 INTRODUCTION

The redevelopment planning process for the Oliver neighborhood consisted of a two-phased effort: an Assessment Phase and a Redevelopment Phase. During the Assessment Phase, the neighborhood was studied and analyzed and included the following tasks:

- Existing Conditions Analysis: During this phase the demographic, economic, social and development analysis was performed at three levels: the larger region, the city, and the study area. This phase included the involvement of the Department of Public Works, the Housing Authority, the Planning Department, the Office of Information Technology, East Baltimore Development Inc. (E.B.D.I.), CitiStats, Baltimore Neighborhoods Indicators Alliance (B.N.I.A.), and the Department of Recreation.

- Parcel Surveys: Two surveys were administered during the assessment phase. The first survey provided information on the overall condition of the neighborhood’s physical infrastructure. The second survey was disseminated to community leaders to ascertain a vision for the future of the neighborhood.

- Community Workshop: A community workshop including Oliver’s block leaders and several residents was held to gather information about the neighborhood and the needs of its residents.

- Feasibility for Redevelopment Analysis: This analysis was based on gathered information from the tasks described above and the result of this effort was used to guide the design of the physical interventions in the neighborhood.

Using the result of the Assessment Phase, TRF prepared the Redevelopment Plan for Oliver. The Redevelopment Plan is a roadmap of physical interventions for future development efforts. The plan builds on local and regional strengths and, wherever possible, incorporates existing and planned initiatives in the surrounding area.

2.1 Context and Oliver

The City of Baltimore is an older industrial city with a large working class population and strong neighborhoods. The Inner Harbor (Figure 1, left) and North Baltimore are examples of established areas that are appreciating as the years progress. The fact still remains that the city has seen decades of population loss that have shaped the demographics of the entire region. The region can be described as the presence of a strong inner core, an adjacent inner ring of distressed neighborhoods, and an outer ring of stronger neighborhoods (Figure 2). Within the City of Baltimore, large areas of East and West Baltimore have been the most changed by the loss of population to the suburbs. This trend is not unique to Baltimore, but prevalent throughout older industrial American cities.

Figure 3 shows a map of a Neighborhood Condition Analysis prepared the City of Baltimore. As previously mentioned, the City generally presents a strong inner core (Inner Harbor) surrounded by an area in need of Investment and Redevelopment activities (East and West Baltimore). Finally, these areas, generally characterized by significant levels of distressed, are surrounded by stable neighborhoods (North Baltimore).

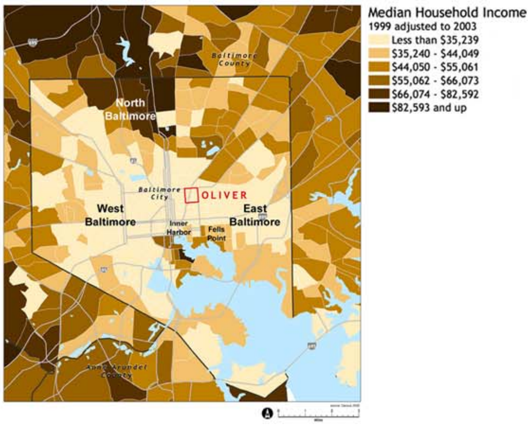

Figure 2: Baltimore County Median Household Income

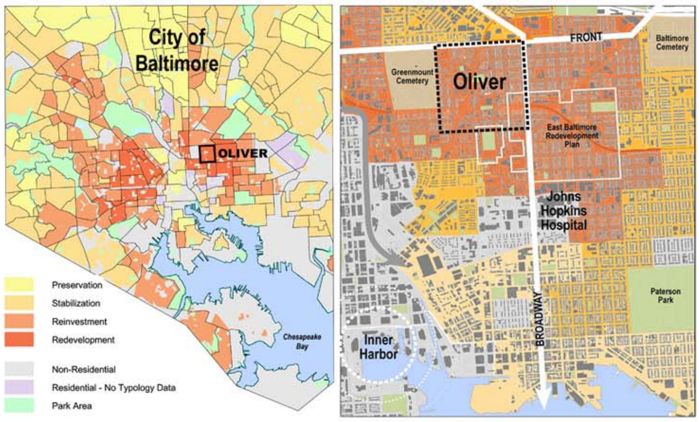

Figure 3: The City of Baltimore and East Baltimore Neighborhood Condition Analysis

3 ASSESSMENT PHASE

The Assessment Phase consisted of the analysis of existing conditions, the creation of property and community surveys, and the preparation of a feasibility for redevelopment mMap.

3.1.1 <u>Analysis of Existing Conditions</u>

Oliver is a 42 block area (160 acres/65 hectares) bounded by two major citywide corridors, North Avenue to the north and Broadway Avenue to the east. Broadway is a north-south corridor connecting Oliver and Johns Hopkins Hospital to appreciating areas east of the Inner Harbor (Figure 3, right). The study area was defined to include several blocks outside of the Oliver boundaries. This allowed initiatives in adjacent neighborhoods to factor into the overall redevelopment strategy for Oliver. The study area extends south to include the EBDI, currently creating a Biotech Center and redeveloping the neighboring community, and Johns Hopkins Hospital. GIS and non-GIS data was gathered from different public agencies or private entities including: income, poverty, aid cases, drug abuse, lead contamination, and rehabilitation activity. Figure 4 shows selected indicators for The City of Baltimore including acute poverty, number of drug treatment client, and number of aids cases.

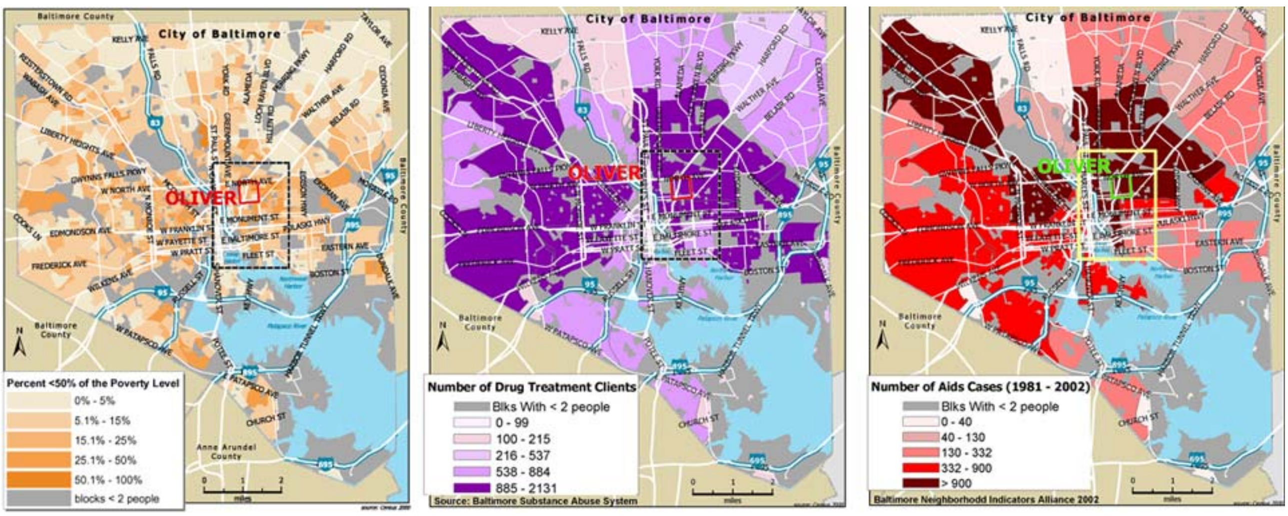

Figure 4: Acute poverty, Number of People Entering Drug Treatment, and Number of Aids Cases

3.1.2 Property Survey

The property survey was designed to gather information regarding the physical condition of Oliver and surrounding areas while other information, such as taxation, property use, and ownership, was collected from the City's Tax Assessor Office. Accurate information about the physical condition of the study area guided the selection of the redevelopment strategies in different areas of the neighborhood. Parcels were primarily categorized by the following indicators: Type of property, occupancy, evidence of recent improvements, number of stories, and architectural significance. The surveys were disseminated to community leaders who then went parcel by parcel scoring the indicators for every building within Oliver. After the survey was completed and results reviewed by the TRF, the information was linked to the GIS parcel data. Other datasets complemented the survey and included: addition and rehabilitation improvements permits, 2000-2003 sales values, assessment value, public ownership, and drug activity nodes.

Once the parcel information was collected, TRF was able to understand the pattern of distressed of those areas that were largely vacant and posed undesirable blighting influences. The survey results also revealed those areas that had stronger housing conditions and higher occupancy rates. Selected results are shown in Figures 5 and 6 below.

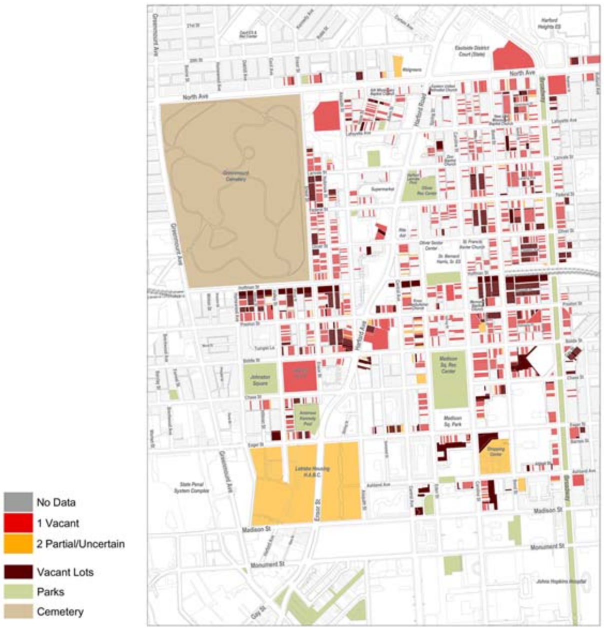

Figure 5: Vacancy Results

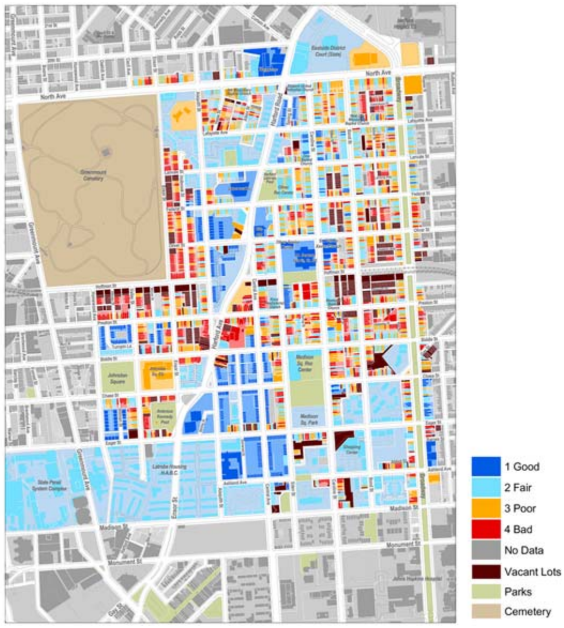

Figure 6: Property Condition Results

A good indicator of a neighborhood's level of distressed is the Vacancy. Results of the survey revealed that vacancies were much higher than expected by neighbors and City officials. Some of the vacancy outcomes are summarized below. :

• Total Structures in Oliver	2,309	100.0%
o Residential	2,223	96.3%
o Non-residential	86	3.7%
• Total Vacant Structures	782	100.0%
o Residential	762	97.4%
o Non-residential	20	2.6%
• Total Vacant Parcels	372	
Vacant Parcels + Vacant Structures	*1,154*	*43.8%*

3.1.3 Workshop

The objective of the community workshop was to learn what residents of Oliver wanted to see integrated into their neighborhood plan. In order to accomplish this task, a questionnaire was developed and administered to 80 Oliver's community leaders. After completing the survey, attendants formed into small groups (of 7-9 people) to formulate physical and policy remedies to the issues identified in the survey.

3.1.4 Assessment Results: Feasibility for Redevelopment Analysis

The Feasibility for Redevelopment Map is the result of a cluster analysis of spatial and non-spatial variables. The result of this analysis is an assigned score by property that allowed TRF to understand the potential of different redevelopment activities throughout the neighborhood. These redevelopment activities included: Demolition, Encapsulation, Rehabilitation, and New Construction. Basically, this model allows determining the extent to which one should invest additional money for encapsulation or write off a building and demolish it. This model is not a predictive model, as there is no way of measuring success or calibrating it. Rather, it is a model focused on decision-making at the parcel level done as an interactive exercise as we needed to determine how the different variables played out. All the variables utilized were critical to the analysis as they often play a significant role on determining physical distress.

The non-spatial variables utilized in this model included:

- Density of Vacant Parcels
- Owner-Occupancy
- Assessment Value
- Occupancy
- Publicly Owned Properties
- Building Condition

The spatial variables utilized in this model included:

- Distance to Johns Hopkins Hospital and Areas of Recent Investment
- Distance to Transportation Corridor
- Inverse Distance to Negative Assets
- Distance to Vacant Parcels

The analysis of the spatial variables was developed using the spatial analyst component of Arc-View. A density of vacancies analysis was performed first generating a score by parcel (Figure 7). A contiguity analysis was then prepared in order to understand the impact of vacant parcels on adjacent buildings. After the spatial indicators were completed, a cluster analysis using SPSS was performed. The cluster analysis combined the results of the spatial and non-spatial variables for each property. The final result was the creation of a Feasibility for Redevelopment Map (Figure 8) in which each property was assigned a score from 1 to 6. This information was then used to determine the different redevelopment activities by property. Properties with scores 1 and 2 represented new buildings or buildings in need of minor rehabilitation activity. Properties with scores 3 and 4 represented buildings in need of major non-structural rehabilitation activity. Properties assigned a score of 5 represented buildings in need of significant structural, non-structural rehabilitation activity, and/or demolition. This category represented the majority of the building stock in the neighborhood therefore showing the consistently poor urban condition. Properties assigned a score of 6 represented buildings in immediate need of demolition.

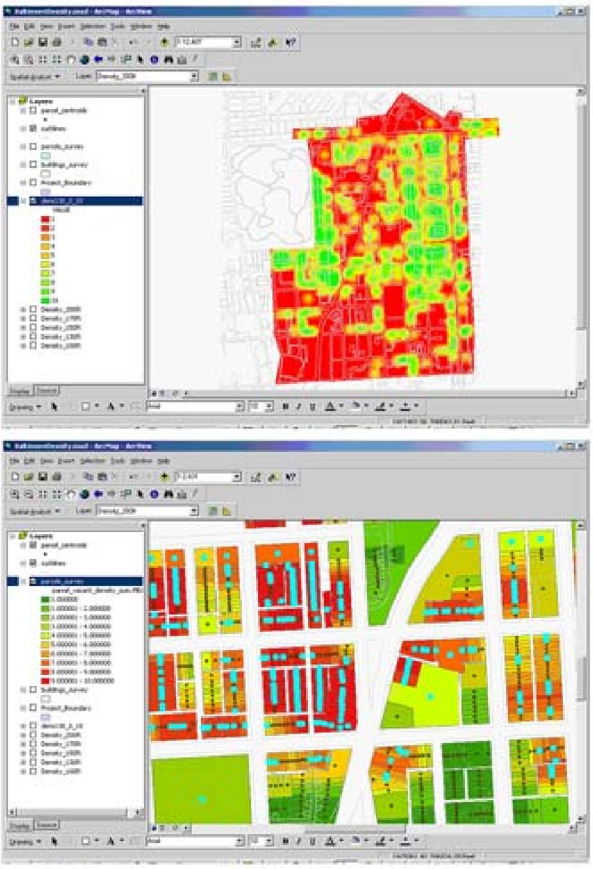

Figure 7: Analysis of spatial variables (Avencia, Inc)

Figure 8: Feasibility for Redevelopment Map (spatial + non-spatial indicators)

Once the Feasibility for Redevelopment Map was completed, a three-dimensional analysis was performed using 3D-analyst. This analysis was developed to determine the potential future of the existing housing stock if no redevelopment action was taken. The sequence of 3-D images shown in Figure 10 represents the existing built environment (left), the form of the neighborhood after the demolition of crumbing and dangerous structured (center), and the future of the remaining structures if no action is taken (right).

Figure 9: Left, Oliver and surrounding areas today; Center, neighborhood after the demolition of dangerous structures (5 yrs.); Right, future of the neighborhood if no redevelopment action is taken (over 5yrs).

3.2 Redevelopment Plan

The Assessment Phase was prepared to inform planners and designers of the issues and opportunities for action in the neighborhood. Based on the analyzed information, a set of ideas was developed to address urban stabilization in the neighborhood. In Oliver, urban stabilization can be achieved by strategically upgrading the housing stock and urban infrastructure; connecting Oliver to areas of recent investment in East Baltimore; reducing health related issues and improving safety related to the physical environment; creating a new image for Oliver that reflects the residents hope for change; and building on local strengths: Institutional, Physical, and Neighboring appreciating areas.

Figure 10: Left, Oliver Redevelopment Plan.

Figure 11: Photo-simulation of a proposed redevelopment idea.

Based on these core ideas, the following are the principles that guided the development of the physical plan (Figure 10 and 11):

- Develop a multi-center planning strategy
    a. Improving existing commercial properties
    b. Improving programs in existing recreational centers
    c. Creating new institutional uses

- Create redevelopment areas of critical mass by reconfiguring the existing urban structure.
- Create an open space strategy that resolves issues of vacancies and residual properties from recent subdivisions.
- Provide for a wide range of housing types for all income levels.
- Create strong connections and gateways to neighboring East Baltimore communities.

The core principals allowed TRF to prepare an Urban Design Strategy, a Multi-center Planning Strategy, a Housing Strategy, and an Open Space Strategy. The Redevelopment Plan proposes the following program:

- Total Proposed SF Units 1,242
  - Total New Units 1,030
  - Total Rehabilitated Units 212

- Total Demolished Units 1,252
  - Units in Bad and Poor Condition 1,130
  - Units in Fair and Good Condition 122
- Total Occupied Demolished Units 541
  - Units in Bad and Poor Condition 419
  - Units in Fair and Good Condition 122

- Total New SF High-density Units 420
- Total New SF Low-density Units 610
- Total New Multifamily Units 130
- Total Other Uses in Sq. Ft. (Institutional, retail) 61,800

- Existing Typical Block Density (dwelling units/acre) 34
- Proposed Typical Block density (dwelling units/acre) 25
- De-densification percentage -26%

3.2.1 Phasing

The Assessment Phase was a fundamental piece of the redevelopment process that provided accurate information on each property in order to create a seamless planning-design-redevelopment process. This information has assisted in the creation of the Redevelopment Plan principles, has allowed TRF to start planning the financing piece of the plan, and has accurately informed planners and stakeholders on the best way to approach phasing. Due to the large amount of properties targeted for redevelopment, a phasing plan (Figure 12) was created that builds on current rehabilitation activity around EBDI, neighborhood strengths and potential funding available. The concept behind the redevelopment phasing strategy is described below:

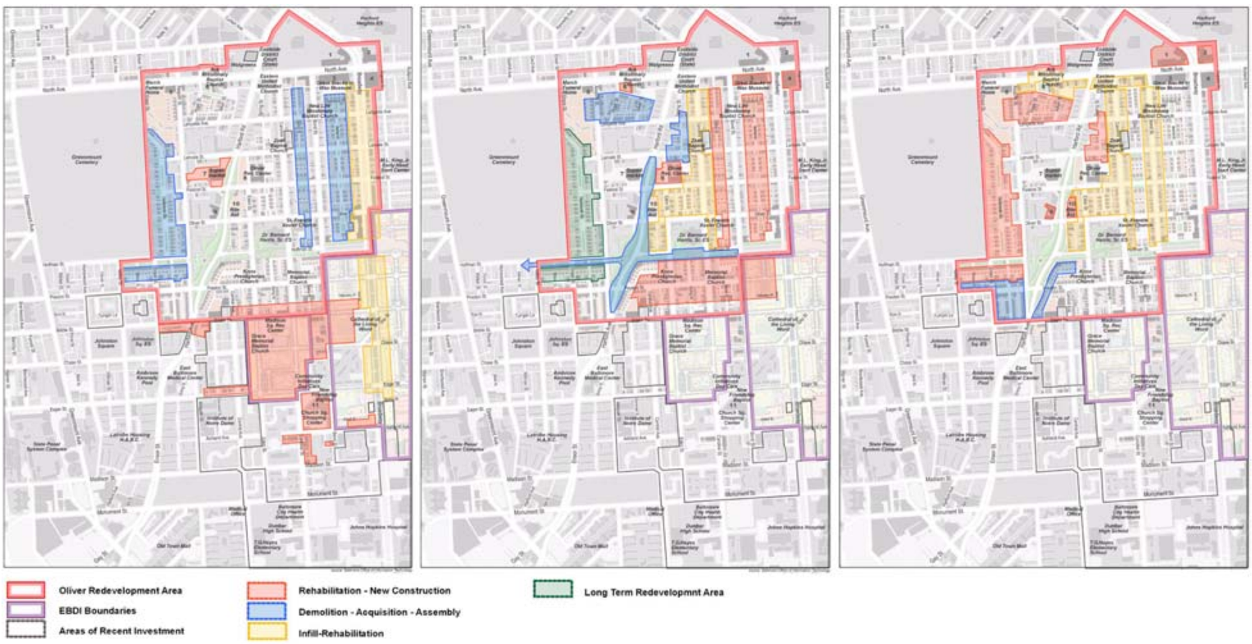

Figure 12: Left, Phase 1; Center, Phase 2; Right, Phase 3

<u>Phase 1 - Building the Bridge:</u> Phase 1 concentrates revitalization activities on the consolidation of key fringe areas within the study area. Therefore, the strategy of the first phase will be, in essence, to build a bridge from those adjacent strong areas to the borders of the redevelopment area. Other activities will concentrate on the preparation of redevelopable land in key areas within Oliver.

<u>Phase 2 – Seeding the Core:</u> The investment efforts in Phase 2 will focus much more on building strength within core areas of the neighborhood. The inner blocks' assembled and cleared land prepared during phase I will pave the way for the redevelopment activities of Phase 2.

<u>Phase 3 – Core Revitalization:</u> Phase 3 is the final phase that caps off the transformation of the neighborhood. Investment efforts in this phase will focus almost entirely in the core areas of the neighborhood and along the neighborhood's north.

3.3 Conclusions

The Oliver Redevelopment Plan builds on the core ideas in TRF's neighborhood investment work: public investment decisions should be driven by good information and the capacity to track market outcomes; investments should be organized around the recovery of self-sustaining markets; and distressed cities such as Baltimore require attention to equity and growth, such as market rate housing and the construction of new urban choices for middle income families. Based on these ideas, Oliver has the necessary assets that make it poised for a successful transformation. The assets include a significant social capital asset, large amounts of vacancies that allow critical mass redevelopment, and proximity to assets (Hopkins, areas of recent investment, public transportation, proximity to Inner Harbor). However, taking advantage of these assets requires good knowledge of the urban structure from both a physical and a real estate perspective. The ability to use and manipulate information to assist the redevelopment process in Baltimore has been critical to the creation of a plan that is already showing signs of a positive change.

The use of information technologies in the planning process in Baltimore offered an alternative to the often disjointed planning and design practices related to their actual implementation. The seamless coordination of analysis, planning, urban design, phasing and financing is critical to the creation of a framework in which investment opportunities can occur while a coherent and desirable physical development is attained.

4 ACKNOLEDGEMENTS

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Chris Scott, Planner, The Reinvestment Fund
Toby Snyder, Planner and GIS Analyst, The Reinvestment Fund

Internet based tool for assessing regional location factors

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1 ABSTRACT

The internet based assessment tool presented in this paper is being developed within the framework of the EU-financed research project ‚AsPIRE', which investigates the importance of so-called 'soft' location factors like social capital or regional governance for rural economic development. After conducting case studies in selected regions followed by a statistical analysis of development patterns across Europe, the assessment tool is designed to present scientific results for a particular region, to enable regional actors to give their own assessments and thus to facilitate policy decision-making.

2 THE AsPIRE PROJECT

The objectives of the project 'Aspatial Peripherality, Innovation and the Rural Economy' (AsPIRE) of the 5th RTD Framework of the European Union are (i) to establish the concept of 'aspatial peripherality', (ii) to provide a methodology for measuring/mapping it through regional indicators and (iii) to generate best-practice and policy evaluation guidelines. 'Aspatial peripherality' is a term devised by the project team to describe a range of processes which are increasingly emerging to compound or distort the handicaps conventionally associated with remote locations. AsPIRE is a co-operation of seven partners from Finland, Germany, Greece, Ireland, Scotland and Spain under the leadership of the Rural Policy Group of the Scottish Agricultural College in Aberdeen. The assessment tool is being developed by IRPUD and Spiekermann & Wegener as the German partners.

3 REQUIREMENTS AND CONCEPT

The AsP-assessment tool is being designed as a user-friendly set of tools and procedures to allow regional agencies to assess the components of AsP (Aspatial Peripherality) in their region and to suggest appropriate forms of intervention. There are numerous options for setting up such a tool ranging from solely quantitative analysis to completely qualitative assessment entirely based on user input. The Dortmund AsPIRE team decided to link these two scenarios and create a tool that encompasses user input as well as 'hard' statistical data from the AsPIRE database. The application to be developed should be accessible by everyone interested or involved in rural development policy-making. This encompasses regional politicians as well as decision makers in regional planning agencies. Thus it seemed to be reasonable to develop the tool as a server based application, accessible via the internet. The spatial range of regions to be assessed covers all rural regions of the present EU member states.

Because of the wide range of potential users the tool's usage has to be simple and intuitive. To collect the necessary information and to maintain the user's interest the tool has to interact with user input and has to generate 'intelligent' results to gain the user's trust. The presentation of the tool's questions should encourage the user to complete the whole assessment and to avoid early abortion by the user. The presentation of the results should be distinctive and valuable for all users. These results should form a regional profile in regard to the ASP-Themes combining user inputs and results queried from the AsPIRE database. Finally to avoid any frustration using the tool the user should know his exact 'position' or progress within the overall assessment process.

4 IMPLEMENTATION

Since the tool should be developed as an internet based application an appropriate software environment had to be utilised providing the developer with all the features potentially needed. This concerns server operating system, webserver and database software as well as certain components needed which are provided by the scripting language utilised. Each and every part of the assessment process will make use of these features to provide the user with the appropriate functions.

4.1 Software environment

Three criteria guided the choice of an appropriate software environment. First it should be state of the art, secondly it should meet all requirements concerning the features needed and finally it should be open source in order not to consume too much of the project's funds.

The popular 'LAMP' combination has been chosen as the basic software environment. 'LAMP' stands for 'LINUX, APACHE, MySQL, PHP' and represents a combination of software very popular in use for the implementation of webservers. Taken together these programmes allow user interaction and dynamic content generation with database integration. The operating system LINUX offers a stable, secure and cheap solution for the implementation of public webservers. The APACHE webserver is a widespread, very capable piece of software and available for many different operating systems. Netcraft finds that the present market share of webservers using APACHE software products amounts to about 66 % (over all current domains) (cp. Netcraft, http://news.netcraft.com/archives/2003/12/02/december_2003_web_server_survey.html).

To provide the tool with the data needed for the assessment process MySQL is used since it is a very popular open source database software which offers very good integration with the server scripting language PHP. The scripting language is needed to implement the actual application. It offers the ability to enhance webpages with program code which is processed by the server when a site is requested. The results are then sent back to the client, usually in form of HTML-documents. This allows the processing of user inputs and dynamic content generation. PHP offers almost all functionality needed for building the AsP Assessment application.

4.2 Selected components used

Following the requirements identified there were several components which seemed useful and thus had to be provided by the scripting language employed. As mentioned above PHP meets all these requirements like built-in session management and the ability to generate dynamic graphics to name just a few.

4.2.1 Session management

From the beginning of the development it was clear that the application would have to collect information from the user. In order to grant full functionality to all users it was decided to avoid the use of cookies. To still be able to have all the necessary information present during the entire assessment session it became obvious that a server sided solution to store this information was needed. It was then decided to use the built-in session management which is part of the PHP distribution since version 4. This means that a session is assigned to every user at the start of the assessment process. This session is identified by an unique session id. During the assessment process all information and user inputs are stored server sided referring to this session id. This enables the tool to keep track of all user inputs and actions and finally enables the development of a process-like application. When the user finishes or cancels his assessment the session and all related data are erased.

4.2.2 Dynamic graphics generation

In order to be able to present assessment results along with statistical data in an adequate way it was decided to use charts for visualisation. But since these charts had to make use of user ratings and the tool should cover all rural regions within the present EU member states it seemed inevitable to implement a solution which is able to generate the graphics needed on the fly. The “GD” library which ships as an extension included in the recent PHP-distribution is the suitable solution for this task. It offers many useful image creation and manipulation functions as well as text integration. The most popular file formats currently supported by “GD” are JPEG and PNG. The latter one was chosen for use with the assessment tool because it offers fair compression rates without any loss of quality comparable to the popular GIF format which is not supported by “GD” anymore due to licensing related issues. The output produced by the assessment tool are image files which visualise user assessment results as well as statistical data queried from the database in the form of appropriate charts. These are part of the assessment result pages.

4.3 The online assessment process

Since the application has to collect different types of information from user input before presenting any results the whole application is designed as a process to be passed through. Each step either provides the user with important information or acquires information needed from the user. Only after all necessary user input has been given the tool is able to present the assessment results. This is why the user guidance became an important issue in order to have a fully functional application which motivates the user to complete the whole process. The most important steps are the selection of the basic user interface language, the selection of the country and region the user wants to assess, the completion of the region related user input forms and finally the assessment result pages.

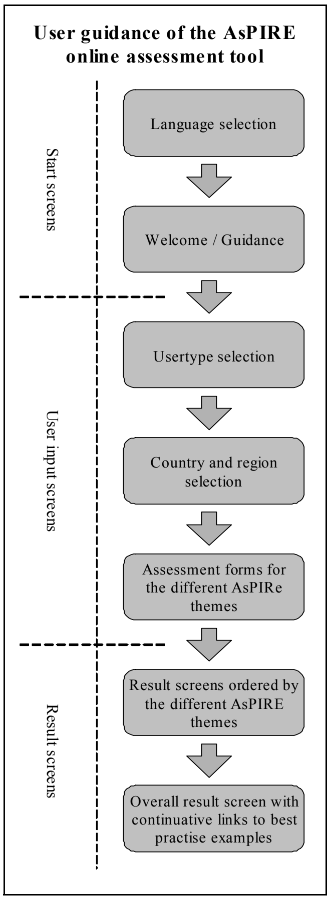

Abb. 1: User guidance (scheme)

4.3.1 General user guidance

The very first stage of the assessment process is the selection of the user interface language. This screen will be displayed no matter which document has been requested by the user because this is the basic information to be given right from the start of the assessment process. In general the user will not be able to request advanced stages of the assessment process until having completed preceding ones. After an appropriate language has been selected the ‘Welcome’-screen will be displayed saluting the user in the language chosen and giving general information on the background of the assessment tool and the assessment process. When the user proceeds to the next step he needs to choose a predefined user type giving general information about his institutional background. This is currently only used for internal statistical purposes but it is well imaginable that the result pages could incorporate this information e.g. for more actor-specific recommendations. The fourth step is the selection of the country respectively the region the user wants to assess. After giving this basic input the actual assessment procedure begins. The application presents forms for the 5 different AsPIRE themes ICT, business networks, social capital, governance and tourism plus some basic input concerning economy and accessibility. After having completed the user assessment section the result screens will be displayed illustrating the user assessment and assessments derived from the AsPIRE statistical database in the form of charts plus short explanations. The final result screen containing the overall results for the region combines all user and AsPIRE assessments to a 'regional profile' and gives a short text on strengths and weaknesses of the region regarding AsP. Furthermore some links to advanced information and/or best practice examples for compensating weaknesses and/or taking more advantages of the region’s strength are offered to the user. This is the final stage of the assessment tool.

4.3.2 Language modules / Dynamic user interface

When requesting the assessment tool's URL via an internet browser the language selection screen will be displayed. The language selection is done by a simple drop-down menu box with 'English' as the language preselected by default. The available languages displayed are results of a database query, where all available languages are registered. All textual elements presented on the screen are taken from the appropriate language module which is processed at the time of document generation through PHP according to the language chosen before. The text files used for the different languages can be translated into other languages with reasonable efforts.

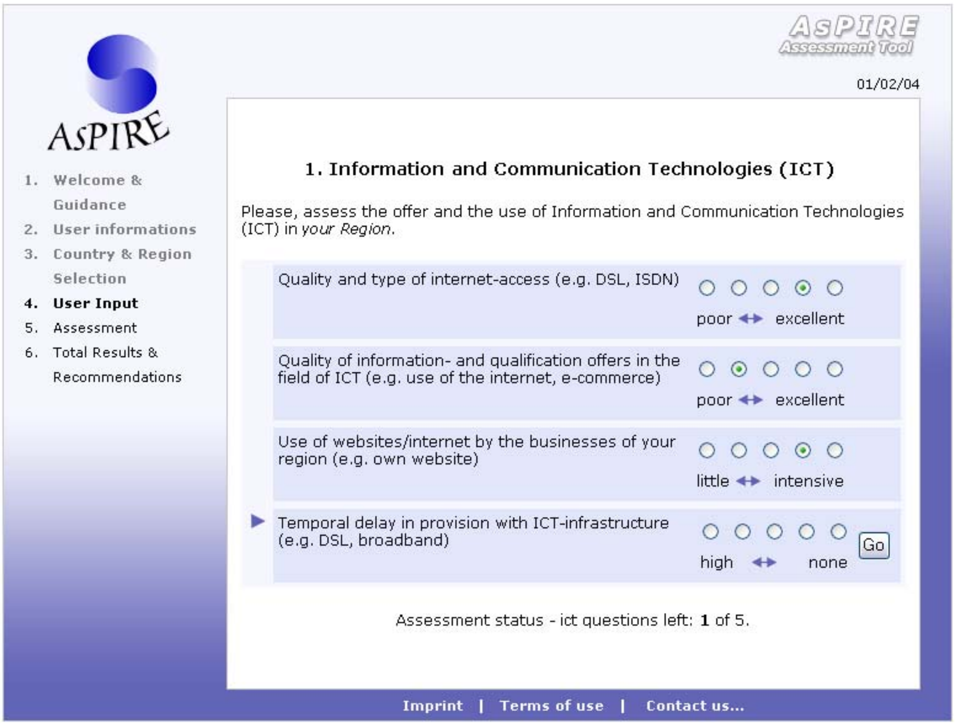

Abb. 2: User interface (displaying an assessment form)

The tool's user interface has been designed to guide the user through the assessment process. Therefore it always presents the assessment progress status in the left 'menu' bar. This is dynamically generated and lists all steps to be performed by the user, marks the current step in bold letters and the steps already performed in a slightly faded colour. In order to force the user to go through the process step by step only the steps already completed are linked to the corresponding web pages. Thus the application enables the user to go back if he wishes to check or modify previous inputs. At the top of the user interface the current date is always displayed formatted according to the language chosen. The bottom of the screen contains three links ('Imprint', 'Terms of use', 'Contact') which are not directly related to the actual assessment. Finally the main part of the screen displays the current page content providing the user with a clear screen layout.

4.3.3 Country and region selection

Since the assessment has a spatial reference the user must be able to choose which region he wants to do his assessment for. As stated before the tool is designed to assess regions classified as rural by the AsPIRE project since rurality related issues are the project's main focus. For a more comfortable region selection the user at first has to choose the country the region belongs to. Therefore a drop-down box is used containing all available countries queried from the database. After the country selection a second drop-down box is displayed containing all regions belonging to the country chosen before. Alternatively the user can choose country and region via a map displayed in a pop-up window when requested.

4.3.4 Assessment forms

The actual user assessment for the region chosen before is done through the already mentioned assessment forms. Each of these forms contains five questions related to one of the five different AsPIRE themes. In order to make the user concentrate on each question separately the subsequent questions are not displayed. Since all previous questions remain visible all five questions along with the assessments made are displayed at the final question of each theme before continuing to the next theme. A status line at the bottom of the form keeps track of the present assessment status giving the user information on the amount of questions left in order to avoid frustration with seemingly endless question sessions. Each question asks the user to assess his region with respect to the issue in question using a scale of five values ranging between the two extreme feature characteristics.

4.3.5 Results display

After completing all assessment forms the assessment result screens are displayed. These are also ordered by the AsPIRE themes. Following the statements made in the concept section each result screen contains three main sections, the user's assessment, the AsPIRE assessment for that theme and a text box that summarises the main results of the AsPIRE project for the particular theme. The first two sections visualise the assessment results using the chart generation module mentioned above and give an overall rating of the particular AsPIRE theme in the form of a short sentence. In addition the user gets supplementary information on the relevance of each issue by a pop-up window when requested. The final overall result screen summarises all results of the previous screens in a generalised manner. Furthermore the user will be provided with links to further information e.g. best practice examples. Finally a print function at the end of the result screens offers the user the ability to request a printer-friendly version of the assessment results for local print-out.

5 OUTLOOK

Since the tool should be up and running at the end of the project there is still some work left to do concerning its implementation. In addition it is envisaged to develop an internet mapping solution for the country and region selection via an interactive map as well as for cartographic results presentation. For these functions it is considered to use the free UNM mapserver which seems to offer a very good integration with the GIS data formats and the PHP scripting language used by the project. After testing and final bug-fixing the application will be released for public use. Since it is currently only running on a development platform and not put on a machine accessible by the public the final URL is not specified yet. But it will of course be linked from the AsPIRE website (http://www.sac.ac.uk/management/External/Projects/AspireExternal/AspireDefault.htm).

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Community Design of a Light-Rail Transit Oriented Development using Casewise Visual Evaluation (CAVE)

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1 INTRODUCTION

The Transit Authority of River City (TARC) is in the preliminary engineering phases of developing a light-rail transit system running from downtown Louisville, Kentucky to the city's southern suburbs, a distance of approximately 15 miles [1]. In collaboration with the research team, TARC wished to test an innovative methodology for improving community participation in the design of a light rail transit-oriented development for the Smoketown/Shelby Park area. The Smoketown/Shelby Park neighborhood is a low-income area located to the south of the University of Louisville Medical Center. A suitable site for the station has been identified by TARC and its design partners, but no development has taken place yet. TARC has been conducting extensive outreach in this neighborhood over a span of several years and as a result the community is aware of the nature of the transit project, its purposes and benefits and has participated in the shaping of the route [2]. Given this context the primary purpose of the research was to assist community participants identify preferred design criteria for their local transit oriented area, defined as this particular transit station and a two-block radius around it. This paper sets forth the principles of a novel visual assessment methodology termed Casewise Visual Evaluation (CAVE), describes its application to this problem and summarizes the results.

2 VISUAL ASSESSMENT METHODOLOGIES

This project required an analytic method of ordering visual representations (*scenarios*) by preference [3]. This section examines two approaches developed by landscape architects and decision theorists to quantify public preferences for scenarios and their constituent elements.

Nelessen designed a methodology for comparative landscape evaluation termed the Visual Preference Survey or VPS [4]. The VPS undergirds the implementation of a popular form of urban and suburban landscape planning termed *New Urbanism*. The VPS is intended to allow participants to "rank images of places, spaces, and land uses." As Nelessen [4, p.83-84] says:

Images must reflect what people see when they move through the study area, along streets, sidewalks, and public spaces, all of the integral components of the public viewshed. They should illustrate such aspects as building form, density, a sense of enclosure, setback, scale, massing, spatial definition, architectural style, colors, textures, materials, landscaping, road types, streetscape elements, types of land use, level of human activity, and development density that occur both in the study area and elsewhere in the study region.

A basic assumption is that each visual representation is a complex assembly of different components, termed *design elements*. The VPS consists of a survey instrument based on an optical bubble score sheet and a questionnaire administered to community members. The assessment criterion is an integer scale of preference 1 through 10 points. Although widely used, the VPS methodology does not specify analytically the elemental contributions to public preference. Thus, although one complete design scenario can be compared with another, it is not possible to determine which design elements influence public preference or by how much they do so.

Decision theorists sometimes prefer to use pairwise comparison to build preference functions. This mode is used in Saaty's [5,6,7] Analytic Hierarchy Process (AHP), a multicriteria decision methodology that is widely used as a foundation for decision support systems. For optimal quality, exhaustive pairwise comparison is required between each possible pair of design options. This mode is particularly efficient in discriminating between closely matched options. Pairwise comparison has also been employed by Whitmore et. al. for landscape assessment at public meetings [8]. In their study landscapes were shown as slide pairs to participant groups and preference was solicited. Marginal discrimination was not considered reliable, so instead of using a VPS-type integer scoring, preferences were restricted to an ordinal system in which either the right or left slides were scored as "preferred." Participants had to be "discouraged from voting draws." Further to encourage rapid and positive selection, the visual stimulus was presented for very short periods (8-10 seconds). Whitmore et. al. [4, p.32] believed that this would "minimize the respondents' interjection of their personal experiences of the landscape and to help them focus on the landscape as a visual stimulus only." Using an approach of analytic decomposition, in which each scenario is comprised of members in the combination subset (elements), they define the *Combination Equation* that specifies the number of slide pairs required for a complete comparison:

$$ {}_nC_r = \frac{n!}{r!(n-r)!} \text{............[1]} $$

where n gives the number of landscape types and r = members in the combination subset. Clearly n and r do not need to be large before C exceeds 100. Whitmore et. al's study generated 406 scenarios, requiring months of public evaluation despite constrained voting procedures designed to accelerate meetings.

Faced with real constraints of arranging and scheduling forums for public input the research team decided the Whitmore et. al. approach was not feasible. However, the team did not believe that it was useful to restrict planners to very small numbers of design elements in order to permit an exhaustive set of pairwise comparisons. A reasonable, realistic number of design elements had to be considered. Therefore, a method was required that would generate the maximum useful information from a less than complete set of comparisons.

The approach chosen was based on an expert system paradigm, in which the meeting participants were regarded as possessing the requisite knowledge. Their liking, or *preference*, for visual scenarios had to be quantified and translated into liking for specific design elements. Further, the preference increment or decrement for specific changes in elemental properties needed to be specified. For example, in a given situation exactly how much would an increase in building height affect public satisfaction with the project? Relationships between every design element had to be defined and stored in a preference knowledge base (PKB) that could be queried by planners and engineers, subject to resource constraints, to maximize public satisfaction with the design. Further, by giving the participants a sense that their opinions and judgments were helping directly to shape real designs, this approach was intended to address the frustrations that stakeholder groups often feel when infrastructure developments are discussed [9].

In sum, then, the visual assessment methodology had to satisfy two objectives within two constraints. The first objective was to establish a direct visual preference ordering among specific design options. The second was to perform a quantitative preference analysis based on the design elements. The first constraint was the inevitability of partial knowledge. The second was that the relationships between preference response to changing design elements could not be assumed to be additive. Preferences are non-linear. For example, changing the building height is not likely to produce the same preference increment when the other design features are varied simultaneously. The selected methodology was required to handle this non-linearity. Since the voting process required participants to score each scenario in turn, using a 1 to 10 point integer scale of visual preference as their scoring criterion, the methodology was termed *Casewise Visual Evaluation*.

PRINCIPLES OF CASEWISE VISUAL EVALUATION (CAVE)

CAVE relies on a PKB that is designed and built using fuzzy set theory (FST). FST has a long history of effective use in engineering applications, particularly control system dynamics [10,11,12]. More recently, it has been applied to a variety of systems that share certain characteristics, such as Geographic Information System algorithms for spatial decision modeling, ecosystem modeling [13, 14, 15, 16, 17] and so forth. These systems all are difficult to model accurately because they are complex and non-linear. Not all relationships are known explicitly. Because our knowledge domain in these conditions is often small compared with the uncertainty, predictions based on “crisp” or “closed-form” system dynamic analyses exhibit a great instability and unpredictability. In some cases, even with perfect input data, mathematical solutions may not be defined. This is particularly true with higher-order ecological systems and socio-economic systems with multiple feedback mechanisms, such as the preferences under consideration. In this situation, traditional attempts at mathematical specification of each relationship would be at best impractical, if adequate input data could not be collected, and/or of questionable utility in the event of the lack of a crisp analytic solution.

In contrast FST possesses several critical advantages. First, it offers robustness, or ability to discriminate reliably despite a lack of information. This characteristic has proved useful in systems modeling in diverse disciplines. This methodology was applied successfully to a complex reef ecosystem in Curacao, generating a reef growth model with reliable predictive capacity based on local expert opinion and very limited data [18]. Second, FST’s categories very effectively capture verbal comparisons. This application of linguistic terminology facilitates extraction of useful information even without quantitative audit data [19,20]. For example, a participant might not know the numerical specification of building density but she may be able to identify distinct and useful categories (in her judgment, she may have a clear idea what constitutes “dense” as opposed to “sparse”). Where quantitative information is available, this can also be input directly into the model. Even in the worst case, where response data for a system is of very poor quality, or very difficult or expensive to obtain, comparisons based on the responses to these adverbial categories allow satisfaction-enhancing design strategies to be defined.

FST is entirely a quantitative methodology. Elemental membership in fuzzy sets is governed by a probability function and this function is numerically specified for every case. Set operations and data computations are governed by set theory identically to crisp sets. However, output takes the form of a probability function rather than a singular certainty [21,10,12]. The CAVE modeling process entails a transformation from numerical value to categorical value during fuzzy set input and PKB build and then from categorical value to numerical value when the PKB is queried. Using the *FuzzyKnowledgeBuilder*® software’s graphical output [22], when this PKB is interrogated with respect to two specific design elements, the shape (slope and height) of the preference surface provides designers with the information needed to maximize public satisfaction. At any point on the preference surface, if $z = f(x, y)$ and ∇F is a vector showing the response to unit changes in *i* and *j* where *i* and *j* represent unit changes in *x* and *y* in direction indicated, then the partial directional derivative with respect to the visible input dimensions *x* and *y* can be specified:

$$\nabla F = \frac{\partial f}{\partial x}.i + \frac{\partial f}{\partial y}.j \quad \text{...............[2]}$$

∇F gives the direction of the gradient, and $\| \nabla F \|$ yields the gradient. Reading the numerical values for each of the coordinates allows functions such as marginal cost for preference increments to be specified precisely. This analysis enables an optimal design strategy to be defined in terms of changes in the *x* and *y* variables under consideration.

3 DEFINITION OF THE DESIGN VOCABULARY: ELEMENTS AND CLASSES

The research team collaborated with the Urban Design Studio (UDS)[1] to determine which design elements architects considered significant when modeling buildings and how these could be classified along linear scales (Table 1). This step allows an image

[1] The UDS is a joint venture between the University of Kentucky College of Architecture, the University of Louisville Department of Urban and Public Affairs, and city government's Louisville Development Authority.

(scenario) to be classified in terms of its design properties. It is essential in formatting input for the fuzzy knowledge base and ensuring that the knowledge base can do useful work in real world applications.

Each element has a potential range, encompassing several categories. For example, Height was considered an important design variable, and in the case of the images surveyed the team decided to divide Height into five classes: Low; Low-Medium; Medium; Medium-High; and High. Each of the verbal categories was assigned a numerical equivalent. Low height was considered to be any structure less than 1.5 floors high. Each of the other variables was similarly defined and classified and numerical ranges were specified for each class. The complete set of these elements and their classifications was termed the *Design Vocabulary*. The UDS then assisted the research team in choosing a sample of 15 stock images of such transit-oriented developments, covering a range of the possible elemental variables. Figure 1 shows one stock image.

4 EVALUATION OF IMAGES

Public involvement consisted of a series of small focus group meetings held in accessible neighborhood locations, such as churches and middle school cafeterias. Each meeting followed the same format: the aims were explained, one by one the stock images were shown and a short period of facilitated discussion was encouraged, and then preference scores were gathered using the *SharpeDecisions®* electronic polling system [23].

Table 2 describes the properties of each image and shows mean preference. For input into the fuzzy logic modeling software, mean preference was classified into categories. Mean image preference ranged from 2.29 to 8.36 units. While there is no *a priori* justification for setting specific ranges, it is better to take advantage of the software's capacity to discriminate between small changes in the input criteria by using the extreme values to set the minimum and maximum preferences.

For the pilot model, insufficient data existed to model all six variables with total confidence. After some iteration the research team confirmed that a four variable model was robust. Accordingly the UDS team was consulted and the four most critical variables were chosen: Height, Typology, Density and Open Space. A four variable fuzzy-logic model was then built and examined in detail using the *FuzzyKnowledgeWalker* and the 3-D surface slice tools. Figure 2 shows a two-dimensional slice through this four-dimensional knowledge base. Preference (z-axis) response to Density and Height variation is shown, with the Typology and Open Space held constant. Typology (TYP) is given as 37 units, which represents a Typology of "Assembly" class, while Open Space is of 0 ("Sidewalk") type. Most of the surface area of this chart shows combinations that are colored green or blue (representing preference values from "OK" to "desirable"). The general pattern of preference change trending from left to right along the x-axis shows that moderately high density always shows high, while a preference "sinkhole" exists where density is moderately low in combination with medium height. Clearly, it is better to avoid this design combination if possible. The high point on this surface (color coded purple) occurs in a zone where density is moderately high and height is low. This can be thought of as a design "sweet spot." The lowest preference on this surface is given by the yellow color in the bottom of the sinkhole, however, this is not the lowest preference possible (color red). Imagine moving across the preference surface from the lowest point on the sinkhole to the highest point on the peak. This transect trends from medium high density to medium low density while the height reduces from about 4 stories to between 2 and 3. This tradeoff zone is the most sensitive in the four-element model.

Although Figure 2 shows one small slice through the four-dimensional knowledge base, there are many possible design permutations that cannot be seen here. However, the walker tool enables us to interrogate the knowledge base quickly. For example, if we want to see how preference changes in response to changing typology the input bars can be manipulated accordingly and corresponding changes in the output (preference) can be observed and documented.

The PKB is being interrogated by the architectural design team and engineering partners to evaluate highly preferred potential design combinations. Appendix 1 summarizes preliminary conclusions derived from visual inspection of the preference surfaces and use of the knowledge walker tool. These data are being used to build 3D models and to create Virtual Reality visualizations. So far, the results are encouraging. Public participants have commented favorably, noting that they "have not seen this level of public involvement before" in infrastructure planning projects [24]. They have also noted their appreciation of the direct connection between their preferences and the characteristics of the architectural models presented for their final inspection.

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GLOSSARY

AHP Analytic Hierarchy Process. A multicriteria decision methodology developed by Dr. Saaty of the Wharton School. AHP is widely used by government and commercial organizations for procurement analysis as well as researchers for decision modeling and policy evaluation.

CAVE Casewise Visual Evaluation. A visual assessment methodology developed by the author.

FST Fuzzy Set Theory. A set of principles that structure the relationships between mathematical sets where membership functions are non-Boolean (i.e. an element's degree of membership in a set is not given by zero or one, so elements are not either "in" or "out" of a set).

PKB Preference Knowledge Base. Describes the sum of the information stored when the fuzzy set theoretic modeling software defines rules and then forms a database around a small number of known preference points.

TARC Transit Authority of River City. Louisville's transit authority, a partner in this research.

Transit-IDEA T-33 Transit-Innovation Deserving Exploratory Analysis. Research grant originated by the Transportation Research Board.

UDS Urban Design Studio. A joint venture between the University of Kentucky College of Architecture, the University of Louisville Department of Urban and Public Affairs, and the city government's Louisville Development Authority.

VPS Visual Preference Survey. A visual assessment methodology designed by Dr. Anton Nelessen and widely used by consultants in the urban planning field.

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Table 1 Design Vocabulary

Element	Categorical Variation →				
Height	L	LM	M	MH	H
Typology	C	L	B	A	
Density	L	M	H		
Open Space	S	P	C		
Private Space	B	Y			
Parking	O	L	S		

Breakdown of Table 1 with named classes

Height: Low-rise, low-medium, mid-rise, medium-high, high-rise (L, LM, M, MH, H)
Typology: Courtyard, linear, block, assembly of parts (C, L, B, A)
Density: Low, medium, high (L, M, H)
Open space: Sidewalk, public plaza, central courtyard (S, P, C)
Private space: Balcony, yard (B, Y)
Parking: On-street, lot, none (O, L, N)

Table 2 Image Properties Matrix

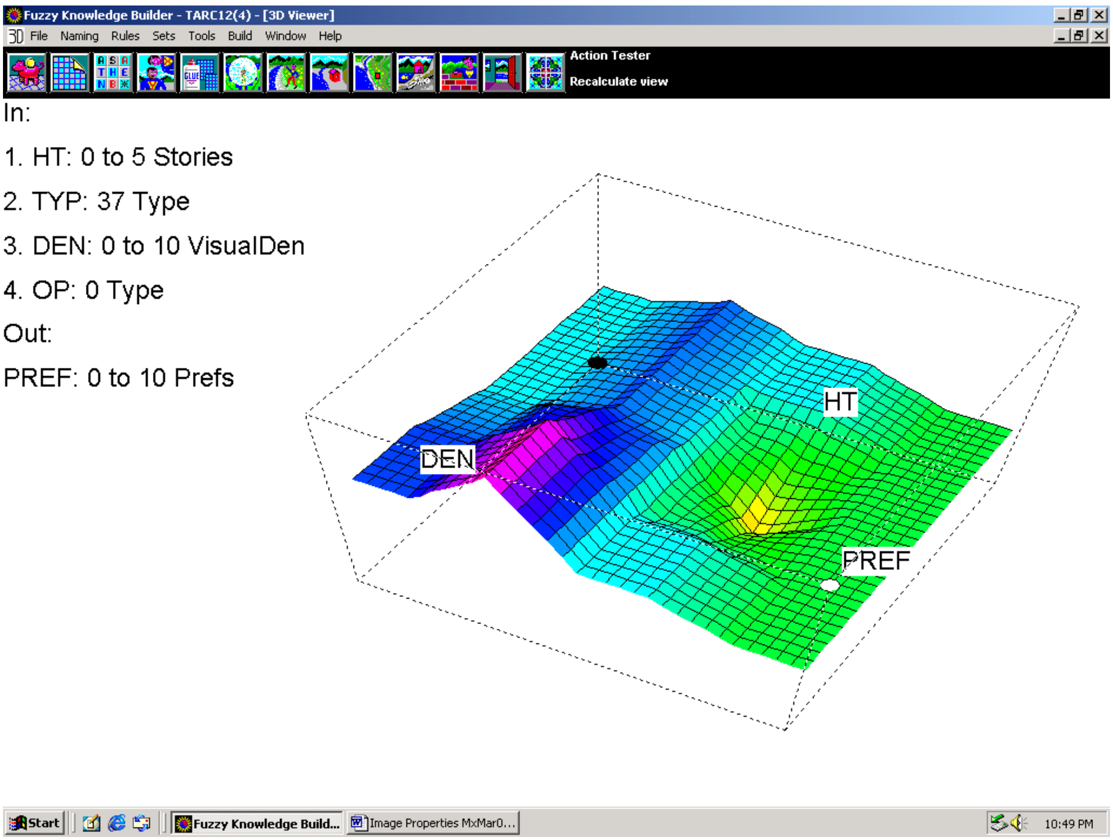
Image Name	Height	Typology	Density	Open Space	Private Space	Parking	Mean Score*
Philly	LM	A	H	S,P		O	8.36
TOD1	M	B	M	S	B	O	6.83
Little Italy	MH	A	M	S	B	O	2.90
PioneerSquare	LM	C	H	P, C	B		3.80
FruitvaleOakland	M	C	H	C	B		5.37
MtView (gazebo)	L	C	L	S,C	Y		4.85
SurfaceParking	L	C	M	C	B, Y	L	5.64
Hillsboro	L	A	M	S			4.84
Townhouseleft	M	L	M	S	Y	O	4.94
GoodSam	M	C	M	S	N	N	3.00
OrencoArch	LM	A	M	P	N	O	6.30
BoydHotel	LM	A	H	S	N	O	3.37
CalleH (Cuba)	M	L	M	S,P	B	O	4.00
Seattle	M	L	H	S	B	O	2.29
Orenco2	L	B	M	S,P	N	L	5.49

*Preference scoring categories used for PKB input:
Category Value (mean preference units)
Extremely low Less than 3.0
Very low 3.0-3.7
Somewhat low 3.71-4.60
OK 4.61-5.39
Somewhat high 5.40-6.30
Very high 6.31-7.00
Extremely high Greater than 7.00
Preference range 1-10 units.

Figure 1 Stock image of transit-oriented development

Image name “Philly” – see Table 2 for properties as defined in terms of the design vocabulary.

Figure 2 Example slice through preference knowledge base



Preference response shown for variation in Height and Density, with Typology and Open Space held constant.

Appendix 1: Summary of PKB interrogation for the four-variable model.

1. Variations with Height

At low heights, typology exerts a very powerful influence on preference. It is the dominant criterion. Very low heights are rarely preferred. A height between low and medium often shows highest preference. As height rises past medium, typology becomes relatively less significant and preference falls globally. This only applies while the Open Space and the Typology criteria are held constant. At maximum height, changing any of the other three variables from minimum to maximum only alters preference somewhere between 3 and 5 units.

2. Variations with Typology

Courtyard typology. Generally, low density is preferred. With height and density both low or with height low and density high, changing the open space makes no difference. However, if height is low and density is medium, preference reacts strongly to the kind of open space provided. Preference doubles from three to six units as we transition from Sidewalk through Plaza to Open Courtyard.

With Linear typology and low density, low heights are preferred. Preference falls slowly away from 5 to 3 units as height rises. With height set low, changing either the density or the open space makes no difference at all to preference: it remains at 5 units regardless. With low buildings, therefore, this typology is relatively insensitive to open space and density arrangements. However, preference is “OK.”

But if height is set at medium, with Plaza-type open space, a very different picture emerges. Preference responds very negatively to increasing density. At medium density, a preference “sinkhole” is encountered. Preference falls to the absolute minimum value recorded. However, with increasing density, preference recovers. This sinkhole should be a “no-go” design zone.

Linear typology. With linear typology, and low height, increasing the density slightly increases preference from 4 units to 5. Changing open space makes no difference under these conditions. At medium height, there is only a limited response to both Open Space and Density. If height is high, preference remains very low at 3 units and shows no response to either open space type or density.

Assembly typology. With this typology, under some circumstances there is great variation in response to the other variables (see Figure 2). Changing density from medium to high, and changing open space type from Plaza to Open Courtyard drops preference rapidly from as high as 8 units down to 3 units. This typology exhibits the most complex preference response function, suggesting that the design team must analyze and test such combinations with care.

Note: This listing is an abbreviated summary of conclusions presented in the team’s Phase I research report [24]. Many other design combinations were examined and described in the report; however, they are not discussed here owing to space constraints.

The use of OpenGIS in the public Sector by the example of the public-public-partnership - City of Munich and Chamber of Industry and Commerce for Munich and Upper Bavaria

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1 INTRODUCTION

The city of Munich, Department of Health and Environment (RGU) and the Chamber of Industry and Commerce (IHK) for Munich and Upper Bavaria use a lot of geo-relevant information for their work. Both institutions also have to use spatial datasets of administrational and private third party data suppliers. Originally this data was used only with special GIS-Software, but now it is offered in the form of map services by which the geodata, served by a Linux based Open Source mapserver, can be displayed using standard internet technology with any browser. Internet map services (IMS) are the graphical interface which supply basic GIS-functions in this case without active technologies and the need of plugins.

The geographical base data has to be bought from communal mapping agency of Munich or the Land Surveying Office Bavaria. When extending the spatial coverage of the Departments maps towards the greater Munich area, the usage of OGC-conformant web mapping services (WMS) will become the most important step in the development from a local to an integrated map service. Since the begin of the year 2002 the Department of Health and Environment runs its mapserver in cooperation with the Chamber of Industry and Commerce, making use of the University of Minnesota (UMN) MapServer which also supports WMS functionalities. These are tested in so called cascading mapservers where the every institution keeps her own geodata but can use reciprocal all geodata of the cooperation via WMS. In an extended phase of the OpenGIS-cooperation from middle 2003 within a project of the Technical University of Munich (Interoperability on the base of OpenGIS Web Services) the advantages and practical abilities were proofed with live geodata.

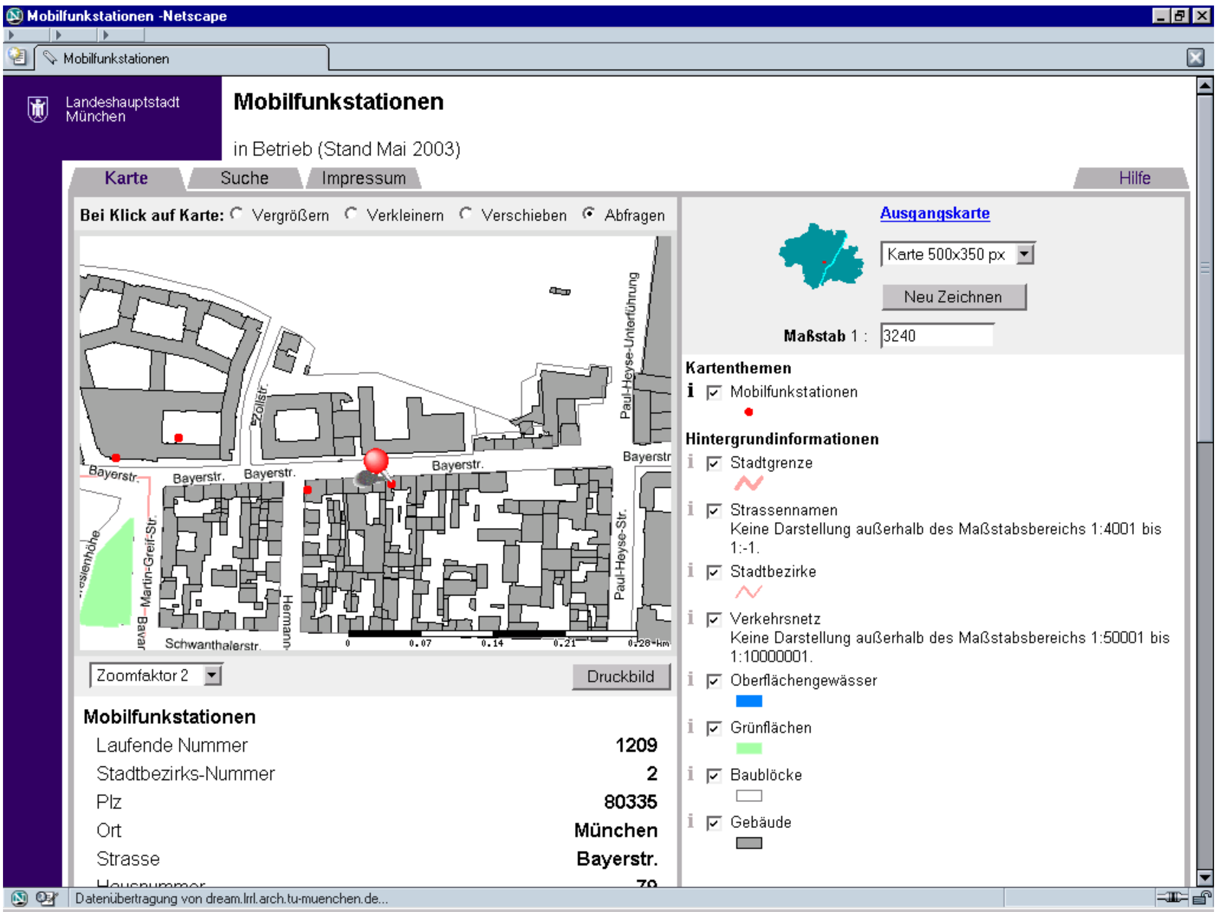

Figure 1: Internet-GIS-Viewer at the RGU, GSM transmitter stations

The RGU as part of the administration of the City of Munich is responsible for environment protection and planning as well as running the public health system with 5 municipal hospitals. The initially paper based environment atlas formed the starting point for the now internet based map services. These are used for internal information and quality control systems as well as public information. In the environment atlas over 100 maps of environmental themes are shown, health reporting adds another 15 maps, tendency growing. Within the European Union funded project MILES (Managing Information for Local Environment in Sri Lanka) the OpenGIS infrastructure will be adapted for the building of an environment and information system for Sri Lankan municipalities.

The IHK for Munich and Upper Bavaria is like any of the 82 Chambers of Industry and Commerce in Germany a self-administering body under public law for any individual company of industry, trade and services. Every company in Germany is member of a Chamber of Industry and Commerce, besides crafts enterprises, professionals and agricultural enterprises. The Chamber of Industry and Commerce represents, democratically authorized, every particular industrial sector independent from the size of the enterprise. The main tasks are the representation of interests concerning economy, sovereign functions and assistance for companies. Concerning GIS there are two major services at the IHK Munich.

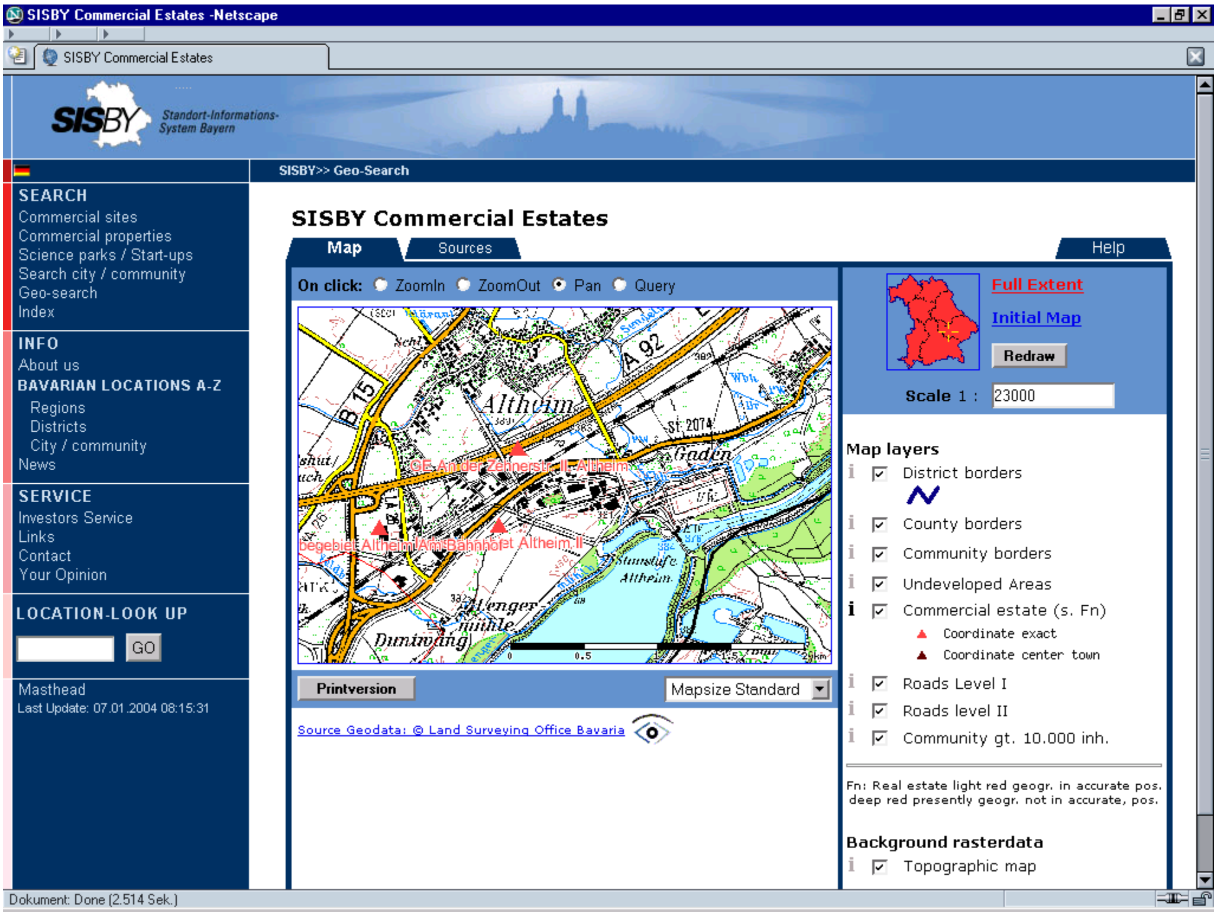

Figure 2: Internet-GIS-Viewer at SISBY

The Site Information System Bavaria (SISBY) is a marketing instrument for municipal industrial real estates in the Internet. The offered geodata covers the whole spatial extent of Bavaria (about 70.000 km²) with ATKIS 500.000 (Authoritative topographic cartographic information system) a vector dataset with the basic transportation system, estate structure and the administrative subdivision. The TK 50.000 (topographical map) is also available in the application with more than 40.000 stored tiles. GIS in SISBY is designed multilingual and supports German and English at present.

In addition the IHK Munich offers a special “Geoinfoservice” covering the district of upper Bavaria for enterprises and citizens with several maps based on official statistics like population, employees, apprentices/trainees, commuters, trade and real estate tax etc.

The RGU and the IHK Munich do a inter institutional cooperation with the objective of development and testing mapserver-tools and -functions to promote the usage of geographic data by means of local distributed mapservers. Only by the use of Open Source Software in combination with the Public-Public-Partnership the expenses for development and to run an IMS could be realized.

2 STATE OF THE ART IN SERVING MAPS AND THE WMS FUTURE

Up to now there has been as strict and clear division between geodata suppliers and geodata users as well as among the geodata suppliers themselves: The supply side had "their" geographical data in files or databases and used a bundle of (mostly proprietary) map servers to bring the data to the users.

Portal and Clearinghouse techniques will leverage the problems of finding and accessing the data. Whereas organizational and legal hindrances still wait for european harmonization, the Open Source community already provides powerful technical tools for a major task of a geo portal:

- The delivery of views of geodata of a broad variety of projections and data sources.

But modern open source technology already offers far more than this: By following the OpenGIS specifications, the UMN mapserver can combine different datasets and thus is a powerful tool even for the less experienced user: by a on-the-fly combination of maps from different sources offered through a portal, a sophisticated and problem oriented ad-hoc solution for many cartographic problems becomes handy.

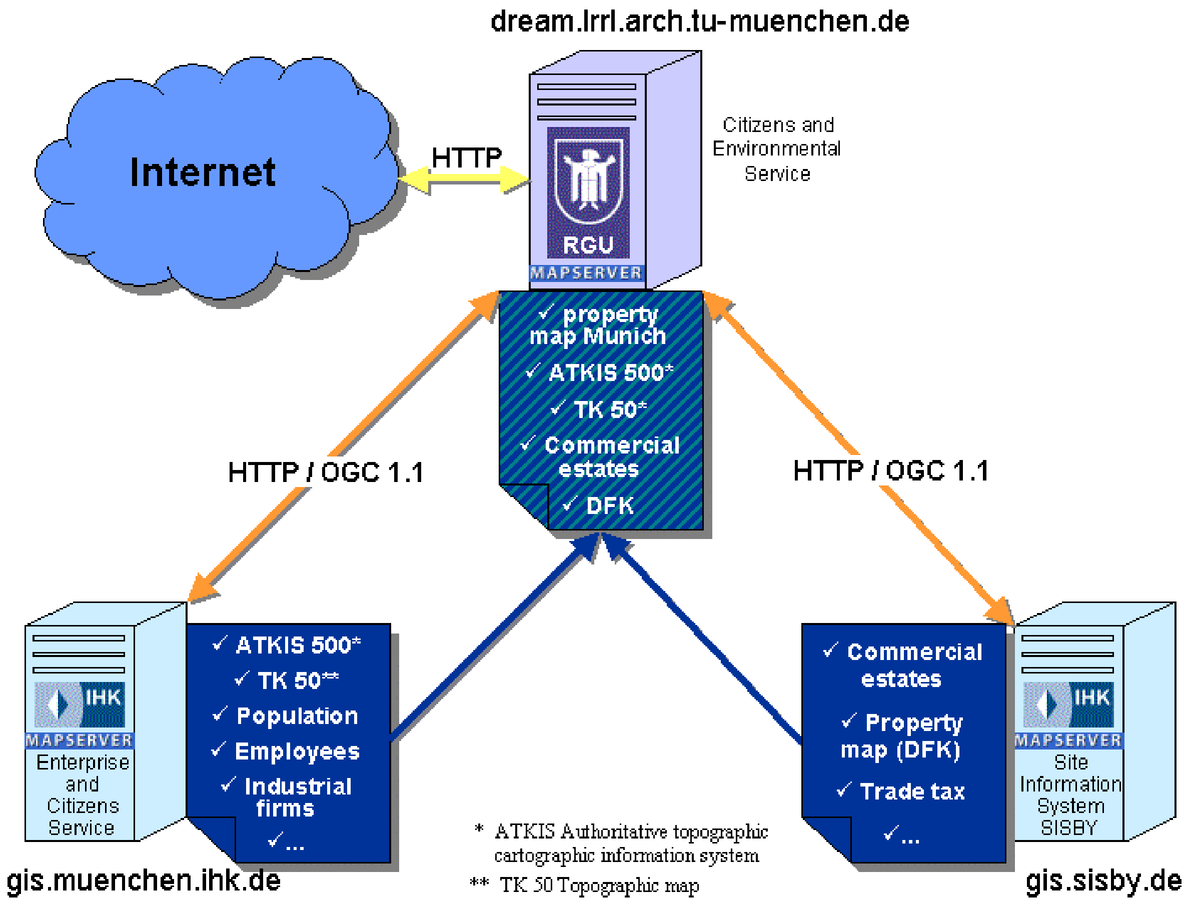

Figure 3: Schematic cascading mapserver combining geodata from two distinct mapservers

3 ENHANCING EXISTING MAPS AND OVERCOME ACCESSIBILITY BARRIERS

The main and seemingly concrete-made distinction between classical map providers and users is going to be wiped out, too: The OpenGIS WMS standards enables everyone being able to run a conformant mapserver (as the UMN mapserver, again) to get into value adding: Given there is a map service for the basic data, for example real estate agents as well as NGO's can publish their geographical information on the background of reference map sets. The painful experience in this pilot scheme with the property map (DFK) for the neighbouring community was that the offered data format (DXF) of the administrational suppliers is still very restricted and inefficient to work with. The conversion of the unsuitable and voluminous dataset produced a lot of manual labour so that the use on a grand scale is impossible at that time.

The practical problem in combining geodata is the de-facto absence of publicly available reference map servers. The European Union's INSPIRE initiative will leverage this problem by achieving legal and pricing security for map providers as well as users, but the sheer cost of data can and will be a major obstacle for spreading of the usage of geodata. As the e-Europe 2002 report and even more the presentation “Borders in Cyberspace” from Peter Weiss of NOAA state, open, unrestricted access to public sector information will yield in strong economic growth in this sector. The above outlined possibility of a shift from map consumers to map enhancers with all its positive economic and societal consequences will only have a chance to become reality if the costs of data can be cut to an absolute minimum.

4 CONCLUSIONS

The used UMN map server proved thereby due to its standard conformity and to its Cascading abilities as stabile and future-safe tool for the composition of geo information of different sources. A future goal of the IHK and the RGU Munich is it to demonstrate the efficiency of open SOURCE software and the efforts for the standardization of the open GIS Consortiums (OGC) for WMS by high-quality and practical application examples out of the co-operation.

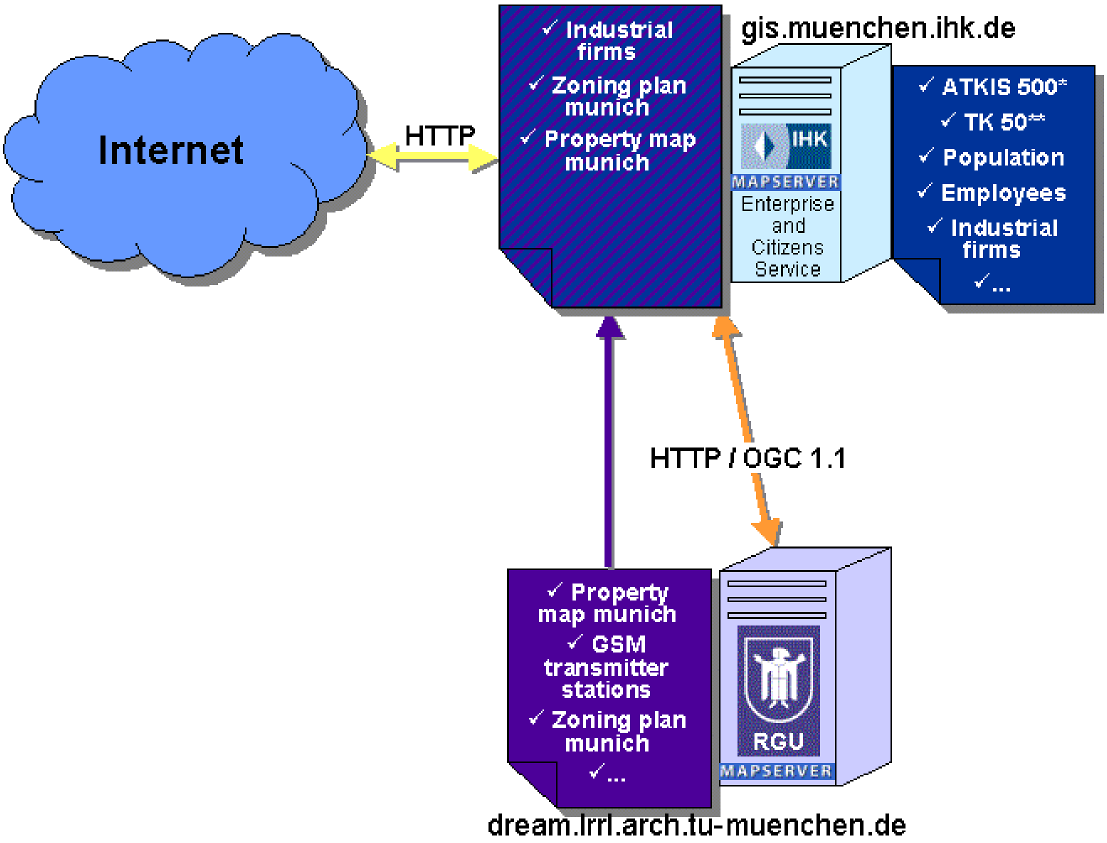

Figure 5: Schematic cascading mapserver enhancing foreign geodata with local layers

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Fritzsche, Andreas; Markus Spring (2001): Free-Software Lösung zur medienübergreifenden Präsentation von Raum- und Umweltinformationen mit WebMapping und XML - realisiert im Digitalen REgional Atlas München DREAM . In: CORP2001, Band 1. Wien, S. 83-86, ISBN 3-901673-06-7.

6 LINKS

Apache-Webserver: http://www.apache.org
Digitaler REgional Atlas München DREAM, http://dream.lrrl.arch.tu-muenchen.de
Digitaler Umweltatlas München, Referat für Gesundheit und Umwelt (RGU), Landeshauptstadt München, http://www.muenchen.de/referat/rgu/umweltdaten/index_html.php
Free GIS-software und geodata: http://www.freegis.org
Digital Chart of the world: http://www.maproom.psu.edu/dcw
Mapserver of the university of Minnesota: http://mapserver.gis.umn.edu
PostgreSQL Database: http://www.postgresql.org
PERL in the apache -Webserver: http://perl.apache.org
PERL programming language: http://www.perl.com
Site-Information-System Bavaria (SISBY): http://www.sisby.de

Valuation of open source for governments

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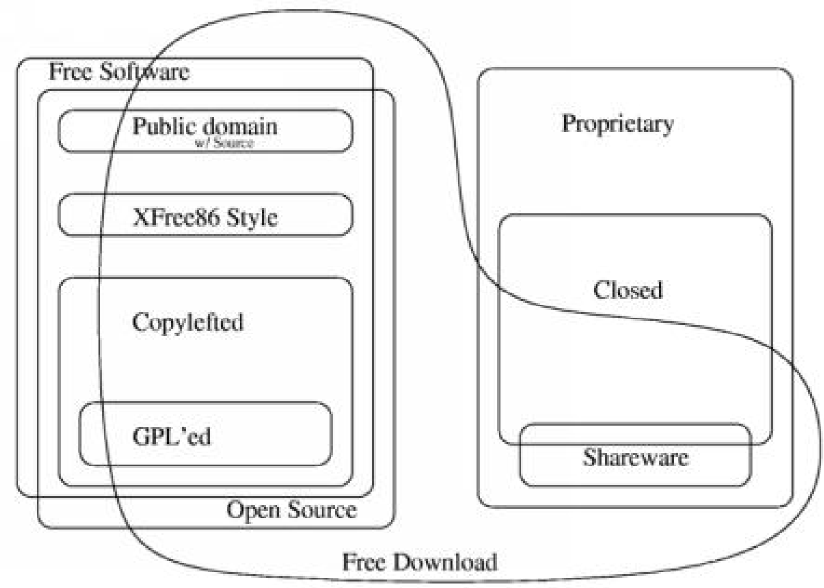
1 ABSTRACT

Keywords: open source, government, strategy consideration

Worldwide many governments recognized and occupied the power and advantage of open source software and nowadays the number of these governments is growing. Open source is a viable alternative against proprietary software products. Time is over the theological controversy and the market proved that in many fields open source software were equal or better than commercial software products. Free and open source software gives the user the freedom to use, copy, distribute, examine, change and improve the software.Free /open source software has already a long history, that is still unknown to many people.This paper shows what kind of benefits can gain the governments from using open source software and why is it so attractive for the governments.

2 THE KEY TERMS OF OPEN SOURCE AND FREE SOFTWARE

In the first instance is important to clarify some of the key terminology used in the free and open source environment. [1],[2],[3],[4] What are the differences between Free Software and Open Source Software? The Free Software movement and the Open Source movement are like two political camps within the free software community. Richard Stallman says that "The fundamental difference between the two movements is in their values, their ways of looking at the world". The difference between them lies in the motivations that are emphasised. The term "Free Software" stresses freedom from control by another. "Free software" is a matter of liberty, not price. To understand the concept, one should think of "free" as in "free speech", not as in "free beer". The term "open source" software is used by some people to mean more or less the same thing as free software and it is often used by people who wish to stress aspects such as high reliability and flexibility of the resulting program as the primary motivation for developing such software.



Graph 1: Category of software products, Source: http://www.gnu.org/philosophy/categories.htm

Free software[1] is a matter of the users' freedom to run, copy, distribute, study, change and improve the software. More precisely, it refers to four kinds of freedom, for the users of the software:

- The freedom to run the program, for any purpose.
- The freedom to study how the program works, and adapt it to your needs. Access to the source code is a precondition for this.
- The freedom to redistribute copies so you can help your neighbour.
- The freedom to improve the program, and release your improvements to the public, so that the whole community benefits. Access to the source code is a precondition for this.

The Open Source Definition[2]

Open source doesn't just mean access to the source code. The distribution terms of open-source software must comply with the following criteria:

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1 http://www.gnu.org/philosophy/free-sw.html

2 http://www.opensource.org/docs/definition.php

- **Free Redistribution** The license shall not restrict any party from selling or giving away the software as a component of an aggregate software distribution containing programs from several different sources. The license shall not require a royalty or other fee for such sale.
- **Source Code** The program must include source code, and must allow distribution in source code as well as compiled form. Where some form of a product is not distributed with source code, there must be a well-publicized means of obtaining the source code for no more than a reasonable reproduction cost preferably, downloading via the Internet without charge. The source code must be the preferred form in which a programmer would modify the program. Deliberately obfuscated source code is not allowed. Intermediate forms such as the output of a preprocessor or translator are not allowed.
- **Derived Works** The license must allow modifications and derived works, and must allow them to be distributed under the same terms as the license of the original software.
- **Integrity of The Author's Source Code** The license may restrict source-code from being distributed in modified form only if the license allows the distribution of "patch files" with the source code for the purpose of modifying the program at build time. The license must explicitly permit distribution of software built from modified source code. The license may require derived works to carry a different name or version number from the original software.
- **No Discrimination Against Persons or Groups** The license must not discriminate against any person or group of persons.
- **No Discrimination Against Fields of Endeavor** The license must not restrict anyone from making use of the program in a specific field of endeavor. For example, it may not restrict the program from being used in a business, or from being used for genetic research.
- **Distribution of License** The rights attached to the program must apply to all to whom the program is redistributed without the need for execution of an additional license by those parties.
- **License Must Not Be Specific to a Product** The rights attached to the program must not depend on the program's being part of a particular software distribution. If the program is extracted from that distribution and used or distributed within the terms of the program's license, all parties to whom the program is redistributed should have the same rights as those that are granted in conjunction with the original software distribution.
- **License Must Not Restrict Other Software** The license must not place restrictions on other software that is distributed along with the licensed software. For example, the license must not insist that all other programs distributed on the same medium must be open-source software.
- **License Must Be Technology-Neutral** No provision of the license may be predicated on any individual technology or style of interface.

In the rest of the document, both (FS and OSS) will be referred to as F/OSS.

2.1 Copyright and intellectual property

The copyright automatically and implicitly protects all intellectual creation, including computer software. „The issues related to intellectual property are quite important for open source software. Among the four mechanisms that international legislation provide for protecting intellectual propriety, only three (copyright, patents and trademarks) could be suitable for software. The fourth one, trade secret, is obviously not adequate for open source software, since it requires obscurity (by not having access to source code, in the case of software) or restraint on modifications or resell and redistribution of derived works. None of these requirements are possible with open source software."[5],[6]

Copyright is the most usual method of protection for software products. In fact, open source licenses are enforceable because they use, in one form or another, copyright law. Most open source licenses were designed according to the United States law. Just recently some research has been done about the applicability of some of them in particular countries. [6]

2.2 F/OSS licenses

„The copyright law, by default, do not allow for redistribution (nor even use) of software. The only way that redistribution can be done is by granting specific permission in a license." [5] The license is the contract between the User and the Licensor.

Open Source licenses[3] are more permitted than Free Software licenses[4]. F/OSS licenses have two types, non-permissive and permissive. The Free Software licenses do not allow "closing" the source code while the permissive licenses permit the creation of proprietary development. "There are dozens of OSS/FS licenses, but nearly all OSS/FS software uses one of the four major licenses: the GNU General Public License (GPL), the GNU Lesser (or Library) General Public License (LGPL), the MIT (aka X11) license, and the BSD-new license. Indeed the Open Source Initiative refers to these four licenses as the classic open source licenses. The GPL and LGPL are termed "copylefting" licenses, that is, these licenses are designed to prevent the code from becoming proprietary."

[3] http://www.opensource.org/licenses/index.php

[4] http://www.fsf.org/licenses/license-list.html

2.2.1 Copyleft

Copyleft is just a specific way to apply copyright. As the FSF declares, “Proprietary software developers use copyright to take away the users' freedom; we use copyright to guarantee their freedom. That's why we reverse the name, changing “copyright” into “copyleft”.” The major impact of copylefting is the prevention of changes to the license terms.

	GPL	LGPL	BSD&MIT	Apache	Public Domain	Microsoft MIT[4] EULA
a. Can be stored on disk with other license types	✓	✓	✓	✓	✓	(bans FOSS)[5]
b. Can be executed in parallel with other license types	✓	✓	✓	✓	✓	(bans FOSS)[5]
c. Can be executed on top of other license types	✓	✓	✓	✓	✓	(bans FOSS)[5]
d. Can be executed underneath other license types	✓[1]	✓	✓	✓	✓	(bans FOSS)[5]
e. Source can be integrated with other license types	✓	✓	✓	✓	✓	(bans FOSS)[5]
f. User decides if and when to publish derived code	✓[2]	✓	✓	✓	✓	✓
g. Software can be sold for a profit	✓	✓	✓	✓	✓	✓
h. Binary code can be replicated by users as desired	✓	✓	✓	✓	✓	
i. Binary code can be redistributed as desired	✓[3]	✓	✓	✓	✓	
j. Binary code can be used as desired by users	✓	✓	✓	✓	✓	
k. New users always receive source code of derived works	✓	✓[6]				
l. New users receive full source modification rights for derived works	✓	✓[6]				
m. New users receive full redistribution rights for derived works	✓	✓[6]				
n. Binary code can be released without source code			✓	✓	✓	✓
o. Derived code can have a different type of license		[7]			✓	
p. Original source can be incorporated into closed source products					✓	

[1] Provided that both programs are fully and independently usable in other unrelated contexts.
[2] Provided that the binary code has not been previously released to the public.
[3] Provided that source code is always redistributed along with the binary code.
[4] The proprietary Microsoft MIT EULA is not related to the similarly named MIT (X/MIT) license.
[5] Specifically bans use of: GPL, LGPL, Artistic, Perl, Mozilla, Netscape, Sun Community, and Sun Industry Standards.
[6] The rights granted by LGPL do not necessarily extend to the applications linked into an LGPL library.
[7] The LGPL does permit re-licensing under GPL as a special case, but not re-licensing under any other license type.

License Acronyms:

GPL –GNU General Public License (Microsoft)	BSD –Berkeley Software Distribution
MIT –Mobile Internet Toolkit	EULA –End-User License Agreement
LGPL –GNU Lesser General Public License	MPL –Mozilla Public License
(X/MIT) MIT –Massachusetts Institute of Technology	FOSS –Free and Open-Source Software

Table 1: A Comparison of F/OSS and Related Licenses, Source: MITRE http://www.egovos.org/dodfoss.pdf

3. ADVANTAGES OF F/OSS SOFTWARE

It is as recent as the last two years that the public sector in Europe has become interested in free and open source software. The European Commission has released several reports and open source software has been the subject of interest in many different ways. In Europe, Germany is the country that has the highest rate of open source software usage. Many governments have encountered budgetary tightening and principally in the developing countries they can save money. But in the developed world the hardware have been changed more often and this change usually accompanies with software upgrade. This cost can be decreased by using open source software in every case. The licensing questions are in close connection with the financial consideration. (Usually) there is no fee for every single license; this makes easy the inventory of software registration and of course it is a much cheaper way for software procurement.

3.1. Economical impacts

The existence of F/OSS software has a complex and important impact on the economy. Recent years the information technology has become part of our daily life. Daily activities are unthinkable without services of information technology. Many-many new hardware have been developed, but the hardware could be operational by software. Software costs can result high amount of bills. These are some reasons for governments to support the dissemination of open source software. Software costs can be cut, instead of government jobs. Replacing some proprietary software products with F/OSS software would eliminate the licensing costs of those products. Many good examples exist around the world, where the primary aspect were the cost cut.

New products, new services can develop on open source basis. Another important imapct is the job creation while moving government systems to open source software model that means there will be more local, high-paying IT jobs for integrators and consultants, that has a spin-off economic multiplier effect. Spread of F/OSS software would make stronger the local IT sector, the number of small and medium size enterprises could growing. This resulting higher rate of employment.

In specific fields, such as education using F/OSS software and open source development model work out some problem, such as the cost of software and interoperability, reduce the total cost of ownership.

The reality of the macro-economic effects is well-documented, their quantification, and their comparison is not possible today, because of the lack of adequate detailed statistical data on free and open source usage and its detailed links with economical and non-economical activities.

3.1. Total Cost of Ownership (TCO)

Total cost of ownership (TCO) is an important measure. TCO is extremely sensitive to the set of assumptions. It contains "hidden" costs, such as administration costs, upgrade costs, technical support, end-user operation costs etc. F/OSS software has many cost advantages in various categories that result the smallest TCO in many cases.

3.1.1. Acquire

F/OSS is not cost-free, but costs far less to acquire than propriatary software. F/OSS programs has initially less cost at the purchase or usually it can be download from the Internet withot any fee. The most users in some cases prefer the printed manual, support and they are ready to pay a small fee to a distributor for an integrated package with CD-ROMs, documentation, and support. There are cost for documentation, support, training, system administration etc just as in case of proprietary systems.

3.1.2. Upgrade/maintenance costs

Long-term upgrade costs are far less for F/OSS systems. F/OSS systems can be (free) downloaded, or simply re-purchased and the single upgrade be used on every system. This does not include technical support, but the technical support can be also purchased and it can be competed because there are more than one supplier (not in case in proprietary software), and you can switch among them. While upgrading a Microsoft system will typically cost around half the original purchase. This factor was that made the Munich public administration move towards open source software.

3.1.3. License management costs

In case of using F/OSS software there is no license management cost, in contrast proprietary software vendors make money from the sale of licenses and the charge the license management to customers. This means later the customers have to prove that it was paid for every installed software. Who cannot later prove that it was paid for every installed copy of proprietary software risk stiff penalties. Organizations must keep careful track of license purchases that prevent any legal actions by proprietary software vendors (or the organisation that represents their members interest, such as Business Software Alliance). It demands huge efforts from customers both in time and in cost.

3.1.4. Other factors

OSS/FS can often use older hardware more efficiently than proprietary systems, yielding smaller hardware costs and sometimes eliminating the need for new hardware.

3.2. Security

Computing is crucial to the infrastructure of advanced countries.The F/OSS software are efficient and secure, however quantitatively measuring security is very difficult. The F/OSS software advantages are based on software standard (e.g. W3C, ISO) more than proprietary software products so they meet demand to build real interoperability sytems. The Europen Commision working paper [7] advises the open source software for governments to build their own e-government services.

Examining the government information system the most important and relevant question is the security. In case of open source development the comprehensive audit is assured by the members of open source community and the patch for security vulnerability is usually improved faster. The user can be sure that this software has not got any backdoor and other malicious and unwanted codes, from where unauthorized and unwanted persons can gain sensitive data. There are good examples for this development and trend in USA the National Security Agency [8] (that developed the Security Enhanced Linux) and Department of Defense (that advocates the open source programs in security environment). [9]

Another issue that have to discuss about is computer viruses. "Most of the world's computers run Microsoft's operating systems, thus most of the world's computers are vulnerable to the same viruses and worms at the same time." [10] The viruses are more and more dangerous and illegal attacks' number is also growing. Viruses can disable large organisation and also governmental offices. Last year was a good example when could be seen some viruses during hours spreaded around the world. The viruses make major impact for the economy. Data loss, interrupted economical processes, etc. These incidents could be usually preventable even using proprietary software products, but it requires consideration by users. F/OSS software have less vulnerability and the viruses have not impact on them, yet.

3.3. Dependency

In case of using proprietary software the user usually can not choose a supplier or software vendor. Best example is the operating system market where Microsoft increasingly threatens to dominate market share. The strongest potential rival to its dominance is no longer its traditional commercial rivals, but the F/OSS software vendors. In case F/OSS the users have not only the mentioned freedom as in Free Software, but they have the freedom of the choice of software vendors. That is why more and more governments choose the F/OSS software, beyond the security consideration.

The European Commission IDA programme made and published the “Open Source Migration Guidelines” [11] that helps the public administration migration to F/OSS software.

3.4. Other factors

3.4.1. Healthcare

Healthcare is one of the most costly segment within the governmental “services” around the world. The F/OSS software is occupied comprehensive spectrum in the healthcare not even more the cost consideration. During the therapy is important the protection, conttroll and utiliozation of patient’s data because their life can depend on it. The F/OSS softwares ensure the patients’ privacy.

The F/OSS software can improve the performance of the healthcare services, while they ensure the interoperability and patients’ privacy.

3.4.2. Education

In educational system there are two major expenses on software: in case of proprietary software the school has to buy every single computer a license that want to use the software, on the other hand the school has to ensure the possibility to use these software the students after the class. At present in most cases (no matter what side of the Earth) the informatics education cover up lower grade knowledge of the proprietary software products. Because of that the students leaving school do not have knowledge on standards and they do not know more software product. This also serves using the pirated programs, because the students usually do not get a legal copy their own computer. In education sector is a most significant development that can be seen.[5]

3.4.3. Research and Development

Nowadays the innovation is more important than earlier. From R&D must not missing the software. Every R&D project is supported by software and more R&D software are based on open source basis. This can support best way of the projects because this software can customize, usually without any legal violation. F/OSS support the share of the scientific results and disseminations.

4. CONCLUSION

No software is perfect. Both proprietary and F/OSS software made by people. The most relevant differences are between them, that F/OSS is developing and assured by group of users and the source code is available for everybody. This makes this software so desirable for governments and government agencies. The source code is verifiable and modifiable so it is secure. Recent years the governments tasks expand to build Information Society and e-government services. The secure and trustworthy services must be based on reliable software systems. Since the proprietary software can not be verified according to unavailable closed source code by security, these conditions can be accomplished only by F/OSS software. In the public sector many software handle and forward the citizens’ personal data because in this case 100% security is needed to prevent citizens’ privacy.

Governments have special obligations to protect the integrity, confidentiality and accessibility of public information throughout time like no other entity in society. Therefore, storing and retrieving government data through secret and proprietary data formats tied to a single provider is especially problematic. The trends show that many governments choose the F/OSS software different strategy consideration. F/OSS software can be considered both a great opportunity and an important resource. F/OSS software has already started to modify the rules in the information technology industry, which will produce enormous changes in further years. Europe is in a good position to take early advantage of open source, and can also help the open source movement to get stronger, that explain many government moving towards of open source last year.

Michel Sapin, the Minister of Public Services in France, stated, “Next generation e-Government has two requirements: interoperability and transparency. These are the two strengths of open source software.”

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Open Source and Free Software: More than Saving Money!

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1 INTRODUCTION

Save Money. Currently this catch line is being (mis)used a lot to get legitimate the use of Free Software. This is also what most people first think when they come into contact with the concepts of Open Source and Free Software. Instead we want to show that there are a host of arguments beyond the cost which make Open Source and Free Software a viable and fast growing alternative concept. These arguments in our humble opinion by far outweigh the rather disrespectful reduction of this software to the buzzword „free-of-cost“.

The topic of Free Software and Open Source Software (F/OSS[1]) has a long tradition and splits into several categories and branches. If you misunderstand Freeware and Free Software to be the same then the following differentiation should get you going. To understand all the implications of Free Software and Open Source it takes more than this short introduction.

1.1 Open Source

The human readable part of a software is the source code. In traditional software development the source code usually has to be compiled to a binary file which then is readable for machines and can be executed on a computer. The term Open Source describes a software where the source code is readable and freely distributed. Proprietary software developers (and companies) in most cases treat source code like a secret (or even mystery) and the most important and only good they have to compete against competitors.

Nonetheless with fairly simple tools any software can be decompiled (something like reverse compiling) and studied to depth. As in most cases you have to get a copy of the software in order to use it – it is very hard or even impossible to technically really keep it a secret. Therefore proprietary software licenses are very strict about the use and handling of software and contain collections of barriers restricting the use.

The term Open Source explicitly specifies that the sources of a software have to be accessible. The Open Source Initiative (OSI) explicitly extends the openness to other areas, most of which can also be found in the Free Software movement. Open Source is a precondition of Free Software.

1.2 Free Software

The concept of Free Software, initiated by Richard Stallman in 1984, additionally touches rather more philosophical and theoretical questions about copyright, copyleft and users' rights. Initially it was spawned from the simple need for a free UNIX-style operating system, it was named with the acronym GNU (GNU is not UNIX).

Some may think, that "Free" in the context of Free Software is to be understood as in free beer. But you should rather understand "Free" as used in the phrase "free speech" or "freedom". Free Software is a matter of the users' freedom to run, copy, distribute, study, change and improve the software. More precisely, it refers to four kinds of freedom, for the users of the software:

- The freedom to run the program, for any purpose (freedom 0).
- The freedom to study how the program works, and adapt it to your needs (freedom 1). Access to the source code is a precondition for this.
- The freedom to redistribute copies (freedom 2).
- The freedom to improve the program, and release your improvements to the public, so that the whole community benefits (freedom 3). Access to the source code is a precondition (Free Software Foundation / Definition).

For a software to be free in this sense its source code has to be accessible without restrictions.

1.3 Open Source / Free Software

For ease of use we will refer to the term Open Source / Free Software or in short OS/FS when we talk about Free Software and Open Source Software.

For most users the economical aspects are currently the most obvious appealing advantages. Besides supporting very modern and highly accepted software development models, OS/FS can be extended into social and market dimensions.

In the opinion of the oekonux-project[2] the high quality potential of OS/FS is due to the lack of interference of marketing considerations of a company or the influences of a market of commercially available programmers. The focus rather lies on the quality of the software. In the end it is this quality which helps leverage Free Software in the long run – it is definitely not the absence of license fees (Frankfurter Rundschau / Spaß am Programmieren).

The users attitude towards FS in general typically changes the longer it is being used. This is not only true for the viewpoint of customers but also for companies and software producer. In the beginning (and this is what currently is also conveyed to the public)

For the distinction of the words Free Software (FS) and Open Source Software (OSS) please see at the websites of the Free Software Foundation (http://www.fsf.org/philosophy/free-software-for-freedom.html) and the Open Source Initiative http://www.opensource.org/docs/definition.php. In this article both words are used as synonyms or put together in the acronym F/OSS.

In this project economical and political characteristics of Free Software are studied and discussed using different methods (http://www.oekonux.org/ from 2003-12-17).

monetary arguments clearly dominated the decision processes favoring OS/FS. Only when users start using those concepts seriously they start to appreciate the aspects of high quality, security and constant further development.

1.4 Adoption of OS/FS concepts by software user

The adoption of Free / Open Source Software has been initiated by software specialists who had the need to access source codes in order to adopt it for their special purposes. A colorful community communicating via Internet developed. This community did not rely on centralized institutions but lived the concept of multiplying knowledge by sharing it.

Surprisingly FS and OSS have also become a dominant issue in government administrations recently – even although it can be seen as the incarnation of decentralized and deregulated development. Germany for example is deploying Linux and the Open Source model at the federal, state and community levels. Secretary Siegmar Mosdorf argues that OS improves software security (Heise / Wirtschaftsminister). The german Minister of the Interior Otto Schilly explains that Germany is lowering dependence on a single supplier, while creating more diversity in the computer field..

In December 2003 the European Commission (Directorate General Information Society) launched a new sections on their websites providing information on activities conducted within European programs and initiatives related to Free Software and Open Source . The Open Source Observatory (OSO), launched by the Enterprise DG and funded under the IDA Program, aims ultimately to provide a comprehensive overview of Open Source Software activities in current and future EU Member States[3].

1.5 The LINUX grassroot movement

High tribute has to be payed to the Linux movement for propagating OS/FS concepts. The initial slow development and adoption of Free Software has been accelerated considerably because of the ubiquitous presence of Linux and their developers all over the world. It has also brought about some changes which unltimately led to a separation into the movements „Free Software“ and „Open Source“ (see above) which together foster the further development of F/OSS in their own ways (Raymond / Cathedral).

1.6 Not everything boasting the term „open“ is OS/FS

As happens with all successful terms now the prefix „open“ can be found indistinctly combined in whichever combination the marketing whim currently toys around with. So a whole lot of new „openness“ plasters glossy advertisements. Therefore it is important to clearly distinguish between Open Source, Free Software and whichever else good things might be meant.

2 SOFT(WARE) SKILLS – ARGUMENTS BEYOND SAVING MONEY

In the following section we want to light up some of the more important arguments for Free Software and Open Source.

2.1 Collaboration as a basis of all OS/FS concepts improves software development

The opportunity to access the source code not only opens the possibility of greater creativity but also helps to reduce cost and time of development. The synergetic effects of both aspects can be accounted for immediately. These ideas offend against the traditional calculation of software development where all factors are predisposed.

This concept also only sustains if there are enough programmers and interest in the OSS project to solve all technical problems. Without the participation of enough competent programmers a project may not be further developed and will fail, and many do. That is also part of the OS/FS concept – a somewhat more evolutionary approach, only the strong survive, but not in the sense of strong market presence or financial power but simply in the sense of stronger, better software.

Therefore an enormous potential for FS concepts lies in public administrations due to the possibilities of combining efforts to deal with questions and problems in a large knowledge community. This is especially true to GIS environments, because their aim is to make geographic data accessible.

2.2 Lack of complicated, intransparent and constricting licensing models

Licenses which follow OS/FS models (GPL-, Artistic-, BSD-like etc.), have the user/costumer pay only for the work which is really done. Proprietary licensing “protects” (in a short-sighted economic sense) the development from the real world and encapsulates the programmer as a segregate group within the software producers management which is driven by economical directives. Some licensing models from proprietary software producers are difficult to understand, complicated, subject to frequent unannounced changes, what can result in an incomprehensible and unreproducible mess.

Because of the four freedoms which are inherent in FS the license management for the users is much easier. Users can install any number of copies - there is no risk of illegal copies or license audits, and there are no anti-piracy measures (e.g. CD keys, product activation). Current users praise this freedom from licensing burden, but OS/FS doesn't eliminate software management, customers still have to track versions. The quality of any program, especially for security, depends on patches and other updates. Again the responsibility is shifting – away from the software producer and into the domain of the user where it belongs (NETC / management).

2.3 OS/FS is more empowering

Open Source empowers users instead of restricting their rights as proprietary software does. Any user can fix bugs or add the features that matter most to them (or hire someone, or collaborate with others). Software companies may decide a bug or feature isn't critically important to most of their users (or their sales) and ignore the users request. Open Source at least offers the users the

The pages can be found at the following URLs:
Informations Society: http://europa.eu.int/information_society/activities/opensource/text_en.htm

opportunity to decide for themselves and either solve the problem on their own, hire a specialist or align with others who face the same problem.

This argument – becoming (more) independent from the pricing and licensing policies of software companies – is one of the mayor aspects pointed out in the FLOSS study[4]. This is also a major point emphasised by the proponents of OSS in the public administration as the recent discussion in Germany has shown. With budgets tight, previous software versions becoming unsupported and new licensing schemes coming up, which are considered to lead to higher software expenditures, establishments wish to become less dependent from pricing and licensing policies of big software companies (FLOSS Study / p. 20).

Even if the software producer goes out of business (for whatever reason), the community still disposes of the source code and may decide to further develop it. This independence also means "end of life" decisions or undesirable new features can't be forced on the users. Customers aren't caged into a single vendors development model or support department. The original software producer or company may offer the best support, but since the software is open anyone can try to improve or support it. Everybody can choose the best solution now with the freedom to change in the future. Nobody has to rely on a single software company for all aspects of the solution.

2.4 Attitudes and relationships between the "user" and "producer" changes

Due to the disclosure of the source code, the user earns the possibility to get an insight view of the software. It helps to emancipate the user from the dictate of the software producer – not speaking in monetary terms but in a technical sense. The possibility to get to know the software better also improves the chances to influence further development of the software. Additionally the user knows that he receives imperfect software, it is no secret that software never is perfect. This is one of the greater problems for traditional proprietary producers, because in advertising campaigns they have produced the expectance that their software is the ultimately and only true best solution. One of the great advantages of FS is that all users automatically also comprise the test team. No single software producer will ever be capable of recruiting as many beta-tester as users, if following the traditional concept of treating software testing as a separate, closed task within the closed development process.

In proprietary concepts there is a fairly strong antagonism between the user claiming a clearly defined value for his money and the producer who never seems to be able to deliver exactly what is needed. This happens for several reasons:

1. One problem roots in the marketing concepts common within proprietary software development which are in most cases driven by financial considerations and market analysis, but are not user centered. Most producers explicitly proclame thinking and acting in a user centered way – but who really believes them if they are a multinational behemoth?
1. Software development is always based on existing software, which itself also underlies changes. Best example are operating systems, which form the most basic platform for any software. In traditional proprietary development a new operating system is kept secret as long as possible to have a head start on the competitors. The result is that the operating system will not work correctly because it has never before seen the diversity of problems in the real world.
2. New releases invariably contain errors, which provokes the saying: „The banana [software] ripes at the customer's". If that is the case anyway – why should we ignore this fact and deceit users into believing that they receive perfect software?

The result of these contradictions is that users become more and more demanding because they know that they will receive less than promised anyway. Being part of the development **and** user community reduces this antagonism to an open challenge where all protagonists have the same rights. Users can directly influence the software development, either by programming themselves, contributing to discussion and user lists or directly investing money into a special features.

Large software enterprises like Microsoft have silently over the past years adopted many of these concepts (frequent intermediate releases (bug fixes), public user lists, open forums, etc.) but not changed the politics of closed source. This is now turning out to be a larger problem than suspected.

3 TECHNICAL ARGUMENTS FOR OS/FS CONCEPTS

In the following section some background on the technical advantages Free Software projects can provide are pointed out.

3.1 Life cycles and development cycles

Open Source software tends to have very short development cycles before new releases are published. Beware! This does not mean that the life cycle is short. OS/FS fosters shorter development cycles and a higher transparency of the development, having a much bigger and immediate impact on software development concepts than economic factors. The concept to "publish early and release often" is not defined as a flaw but a conscious decision to speed up development and improve quality.

As Torvald says: „If 10 people work one hour a day for a project and share their results, than everybody gets 9 hours out. That is what Linux makes that good: the work which is put in by a person is multiplied." And: "...there is a kind of automatically quality control, because everything is all the time observed by other programmers." (die Zeit / Open Source).

The life cycle of a typical OS/FS project end when nobody supports it anymore and that will happen either if there is a better alternative or the problem no longer exists. Never will economic reckoning lead to the death of a software (end of the life cycle) as regularly happens in the proprietary world.

IDA / OSO: http://europa.eu.int/ISPO/ida/jsps/index.jsp?fuseAction=showDocument&parent=news&documentID=1809
FLOSS Study: http://floss.infonomics.nl/report/index.htm or FLOSS-US http://www.stanford.edu/group/floss-us/report/FLOSS-US-Report.pdf

3.2 Reliability

OS/FS may be more reliable than proprietary. We explicitly use the term “may” because for sure there are hundreds of vastly unreliable software fragments bobbing in the Open Source surge currently flooding the software markets. It may not make as many errors or crash as often (e.g. Linux is famous for not crashing). Due to the access to the source code programmers can find and fix bugs, software may be repaired and improved more quickly. Not every initial program may be more reliable than a proprietary alternative, but it may mature faster as a lot of programmers correct mistakes and add features. Eric Raymond calls this Linus' Law: "Given enough eyeballs, all bugs are shallow." (Raymond / Cathedral). Some may think of this as permanent beta testing which is not wrong at all, the Open Source community can endlessly troubleshoot and improve software as needed or desired.

As mentioned in the beginning, the advantage of improving a software depends on the participation of enough competent programmers. Just like proprietary software, the reliability of an Open Source program depends on clear feedback after rigorous use in a variety of environments. Without enduring, sufficient, talented interest, an OS/FS project fails, and many do. In contrast, proprietary software companies may create and support necessary programs that no one would enjoy working on. Some companies are starting to blend the best of both models, by employing a core group of programmers while attracting volunteers from the open source community (NETC / reliable).

3.3 Better security and quality of Free Software due to the free access to the source code.

There are different studies stating that OS/FS products often reach a higher software quality compared to proprietary (closed source) products.[5] Mainly the high transparency causes the high quality of OS/FS projects. Linus's Law describes parallel debugging: multiple programmers independently finding and fixing the same program to discover the best solution. Security threats like viruses and worms exploit software bugs to damage computers. One of the advantage of parallel debugging is the pace of finding and fixing bugs much faster than the traditional way.

For both Free and proprietary software, effective security depends on thoughtful deployment, regular monitoring, and timely upgrades or other modifications. Some proprietary solutions offer potentially robust security, but Linux leads the industry in defensive design. This is one critical reason why business and government are interested in OS/FS. For example, Linux and most FS isolates users from the code viruses and worms need. These threats need unchecked access to execute, replicate, and deliver a payload (e.g. delete all files). In a properly configured Linux environment, an email attachment in a user's inbox can't spread destruction to the whole system (NETC / secure).

The most obvious argument proposing the security of software can be improved due to the availability of the sources is that OS projects constantly underlie the scrutiny of a vast number of users.

3.4 Transparency – everybody can see everything

Sometimes transparency is misinterpreted as a critical security threat. However, the OS model brings a community of programmers to maintain and improve security. This collective benefit seems to outweigh the danger of transparency. Also, the security of a system depends much more on careful deployment and maintenance. For example, the source code for Linux is publicly available. But any good system administrator will deploy a Linux server only with secure passwords, firewalls, additional software, and other defences. Thus, transparency in the "virgin" source code is usually a trivial concern.

If software is transparent, any programmer can see what happens and why. Proprietary software is not transparent and most computer users are familiar with the strange error messages that appear when a program fails. Often, these messages use special codes to express the problem. These codes point to secrets without actually revealing what went wrong. Only someone who knows the secrets can understand the codes. It's the suspicion of such errors that causes people to distrust proprietary programs. Some countries are suspicious of proprietary software because it could contain spyware or other security threats.

OS/FS programs in contrast aren't trying to protect themselves as secrets. Therefore they can offer more exact information about an error. With this information any programmer can start to identify and fix problems. This does not have negative effects on the security of Open Source and Free Software.

3.5 Better networking and customisation with OS/FS

A lot of the popularity of OS/FS comes from its performance on the Internet and lesser networks. Open Source software is often very networkable. For example, more than half the World Wide Web runs on Apache, an OS solution. Apple built its OS X on BSD, an Open Source operating system. The critical reason is the Internet: Some proprietary companies recognize that they can't privately innovate Internet functionality as well or as fast as the Free Software community. Furthermore most of the FS networking solutions are compatible with proprietary software, due to norms and standards. One of the reasons, that the OS/FS movement is getting so strong can partly be explained as a response to incompatibility in proprietary software. Due to a earnest commitment to open formats OS/FS programs are generally better at working together.

By its very nature, OS software allows users with enough expertise to tailor the software to their needs. The diversity of free based server-system (Linux) distributions reflects this flexibility. Each distribution offers a customized operating system targeting a specific market. On the back end, the open, modular nature of open source solutions allows advanced users extraordinary power to customize any aspect of a network (e.g. firewalls, spam filtering, email filtering) (NETC / customized).

3.6 Open formats and Standards

Open formats make integration of different systems and data much easier. The term “open” in this context does not refer to the OS/FS software development models and should therefore not be mixed up with them (see above). Nonetheless they very much improve the acceptance of any software package, especially in the context of GIS where the OGC (Open GIS Consortium) specifications and ISO standards help to integrate software from both concepts and offer a nearly seamless blending of existing data architectures. Especially in the field of geographical questions it is important to integrate different data into a system. (The data is by far much more valuable than the software package, no matter how expensive it might have been.) For example, suppose different cities in the same district have different database programs, and each program has a proprietary format. To integrate the data of all cities, the district would have to select a program that licenses all those formats, or convert to the data to the new format, or abandon some data. Using open formats forecloses on these problems and may curb opportunity costs.

Integrating any two programs is often difficult. It may also be tricky to integrate Open Source and proprietary solutions. This can also happen because proprietary companies prefer their customers to exclusively use their software for most or all of their needs. In contrast, the TMTOWTDI ("There's More Than One Way To Do It") philosophy[6] of most OS/FS projects promotes integration. In the beginning FS was a minority solution, so it's designed to integrate as smoothly as possible with proprietary solutions. For example, a Linux lab can be nested in a Microsoft network using Samba.

Most newer OS/FS projects in the GIS field implement open formats and standards because the chance that the software is accepted by users is a lot higher. This is especially true for German administrations where the interoperability of systems and data are always a primary goal for larger infrastructures.

3.7 Necessary expertise – Application of OS/FS is good investment

For any software solution whether Free/Open or proprietary expertise is needed to deploy, secure and maintain. In the past, most OS/FS was technically tricky and required considerable know-how. Today, OSS can be just as easy be set up as proprietary alternatives. Solutions like OpenOffice.org are designed for entry- or mid-level user expertise, offering installers with graphical interfaces and suggested configurations.

As everybody knows, using software always includes a learning curve. People want computers to work like appliances. But neither the proprietary nor the OS/FS model have produced many solutions as reliable and user friendly as toasters. For better or worse, most users are more familiar and more comfortable with proprietary software, especially Microsoft Windows. However, many OS solutions are somehow cloning proprietary interfaces and environments. For example, anyone familiar with Microsoft Office will probably find it easy to use OpenOffice.org for simple productivity.

But which are the barriers to using OS/FS? Mindshare and comfort are perhaps most influential among users working with front end solutions. In contrast, most of the back end users (e.g. server technicians) are already familiar with Open Source solutions or may adjust more readily. But even proprietary software may change from version to version, causing mindshare dissonance and user discomfort. Customers using front end solutions may have very legitimate reasons to resist migration to OS/FS. They may have projects working and dependent on specific proprietary software. They may not have the time or energy to learn new software. Notably, some advanced users prefer the freedom of Free Software since they feel proprietary software caters to the lowest common denominator. As users grow more comfortable with Free and Open Source solutions they may be pleasantly surprised, especially if they're only ever used a single proprietary solution. OS/FS may not offer certain or more features as proprietary software, but it's not necessarily more difficult to deploy. Therefore Open Source and Free Software can also be called a disruptive technology.[7]

3.8 Service, Support and other costs

Any software solution requires some service and support. For both Free and proprietary software, experts and costumers can find help on email lists and community Web sites as well as in contracted support. As mentioned before the difference is that in OS/FS paradigm by default every user can be a tester whereas in proprietary development a software has to be tested **before** it is shipped to the end user – resulting in unstable releases.

The quality and availability of help is proportional to the interest and use, especially in OSS. If there is only some small group of developers, usually the costs for niche solutions are high – just the same as with proprietary products. On the back end, OS/FS is common so the community of developers is large and helpful.

As Open Source software usually is more modular than proprietary alternatives, customers can decides which of the modules they need for their questions. Modular software means each program is a discrete piece of a solution. If the user finds a better program, it can be swapped in without replacing the whole solution. OS/FS often offers several interchangeable, modular programs for various needs. This approach is summarized as "There's More Than One Way To Do It" (TMTOWTDI). Users can find the best components and then decide whether further development has to be financed. So Free Software solutions are usually scalable at little or no cost, while most proprietary solutions are incrementally more expensive with each new user or machine.

4 CONCLUSION

4.1 Open Source is community-driven & community-serving

As mentioned above the OS/FS movement exists because a large community of motivated, generous programmers work together. Not every programmer is a volunteer, some are corporate employees, but the movement succeeds through the participation of volunteers. Current users are often keen to help others solving their problems and give back to the community. Especially users without programming or other technical skills help by filing endless bug reports, writing documentation, or answering questions on

Further information: German Federal Office for Security in Information Technologies http://www.bsi.de or bundestux – http://www.bundestux.de

See: http://www.perldoc.com/perl5.8.0/pod/perlfaq1.html "Is Perl difficult to learn?"

After Christiansen disruptive technologies are simple and convenient-to-use innovations, which at the beginning have a marginal existence but then are continuously developed and start to capture the market (http://www.disruptivetechnologies.com/).

email lists thus exempting the real programmers to do their job. Current users report a sense of belonging and accomplishment by sharing and collaborating. This cooperation and focus on the common good accumulates in a new relationship between customers and consultants.

4.2 Open Source does not threaten intellectual property rights.

Opponents often argue that OS/FS is a menace to intellectual property rights. The CEO of Microsoft said, "Linux is a cancer that attaches itself in an intellectual property sense to everything it touches." (Linux / interview Ballmer). This argument refers to the most radical OS/FS license – the GNU GPL, and only points out the fact that source code released under the GPL can't be included in closed, proprietary software. The GNU GPL has been designed to protect its software from being looted by commercial interests – just as any software license in the world ever has. From the proprietary point of view this is the most normal thing that a software license would do.

Another argument against OS/FS is that governments should not invest into Open Source development because then this software cannot be used by commercial enterprises. This is simply not true as is impressively demonstrated by the constant growth of SuSE but also by giant companies like IBM, HP, SUN and many more smaller enterprises.

On another scale it is a legitimate question to ask where all the programmers who work for Microsoft have gone to school, high school and university? There is no return on investment for all the money which has been invested by parents and the government to build schools, universities and libraries – except to the benefit of the entrepreneur. Technology developed with OS/FS concepts potentially offers many advantages and challenges, but it's exagerated to compare it with the theft of intellectual property. New business models and social norms are developing, just as they have in the past (NETC / property).

4.3 OS/FS is a paradigm shift in information society – we are overnewsed but underinformed

Some old and new companies are quite successful using OS/FS. The movement represents a paradigm shift for the software technology, but it's not anti-business. Free Software may challenge some existing businesses, but doesn't competition inspirit the market? There's little reason to buy a proprietary program when a comparable Open Source alternative exists. The software industry is already converting from the product model to the service model for quite some time now, in Germany we comprehend ourselves as transforming into a "Dienstleistungsgesellschaft" - a service community. Companies like IBM are thriving with OS/FS because they offer quality service, other companies like SuSE sell OSS with added value, including service (Linux distributions).

Furthermore as shown in the previous chapters FS can protect users against paternalism and constraints of their civil freedoms. Important in this issue is the basic understanding about information: Is it permitted to deprive the public arbitrarily of some information or does the public have the right on special information? Some distinct information "wants" to be free of structure and arrangement and free of usage restrictions.

The idea of free information is a cultural perception known for hundreds of years. OS/FS is not a communist or anarchical movement. The concept behind the disclosure is one of the basic modules of our culture since the renaissance. Like libraries ensure and protect public available knowledge, our academic culture is based on the principle of the disclosure of sources (e.g. references, citations or documentations of experiments) (Buchholz / Argumente).

4.4 Standardization as conciliation between proprietary and open development models

Especially in the context of GIS software the use of standard interfaces, for example the OGC WMS specification and ISO norms also helps integrating Free and Open Source Software with other normed software which can also be proprietary. This opens the possibility to select the adequate software to solve a problem and not having to follow the largely commercial (and thus intransparent) interests of one software producer. Therefore standardization (hopefully) helps to reduce the currently growing antagonism between proprietary and Open Source development and business models.

In the GIS arena, Open Source and Free Software solutions are maturing and finding their place in a crowded commercial marketplace. There is no explicit need for proprietary software but there is also no reason not to adopt and integrate both concepts.

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Sustainability in European Union through the Free Market: The effects on the physiognomy of the cities

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1 INTRODUCTION

Humanity has become obsessed with the assimilation and exploitation of new technology and novel scientific data which are presented through everyday research. This obsession is accompanied by a permanent anxiety of each society so that they are not left behind in this attempt. In our days, the orientations of a society are alternated rapidly. The consequence of this is that there is not enough time to study the impacts that these changes have on human life and surroundings.

The European Union with the Agreement of 1992 has set the direction of Europe for the 21th century. The principles of the agreement articles are materialized with the preparation and performing of “side” policies which the European countries have considered in a first attempt in 1996 at Intergovernmental Conference for the future of Europe.

According to the conclusions of Intergovernmental Conference the top priorities are the policy of Free Market and labor, the protection of society and the financial coherence in Europe. Undoubtedly these policies affect a wide range of activities not only of European Governments but also of any European citizen on individual level. The question that comes up is if these alternations that accompany certain political activities have an effect on solid characteristics in the European social life. Under this approach it is very interesting to study the impact certain developments have on the physiognomy of the European Urban Surroundings.

We are all aware that the “European city” is the core of the development of the European and Western civilization. It is certain that throughout its historic route, the city, as if it is an alive organism, has gone through a lot of changes. However, the creation of its physiognomy and identity is a product of significant works in natural and human level. Preserving the physiognomy of the city is vital for the mental balance and the normal personality development of human beings in a complex period of humanity.

2 THE FINANCIAL MAP OF THE EUROPEAN UNION AND THE POLITICAL ORIENTATIONS

After the European Union Agreement, one of the top priorities was balance in financial and social development in an international competition frame and the rise of global financial demands. The E.U. has thus decided to strengthen every geographical region for the successful confrontation of the new financial conditions. In 1995, it was realized that the state members of the Union appear to have some competition drawbacks in the international scene, part of which is the weakness of organizing “land - planning”. Further more, it is a necessity to carry on the activities which aim at the abolition of the boundaries so as to facilitate the attempt of the unification. In this frame it is essential to accelerate the construction of the global European nets of transport, energy, telecommunications and information so that even the most remote part of the E.U. will become accessible and financially turned to advantage.

Furthermore, the White Book has defined the financial development of the E.U. countries in geographical level. This development presupposes the homogeneity in financial status in the E.U. In this way the E.U. encourages the establishment of corporations in any country or region as long as certain conditions exist for infrastructure development and their function. The result of this policy will be the creation of working positions at any geographical spot of the E.U. and also the capability of any area to profit from the predicted benefit that is offered by the successful union of the common market. The promotion of this policy will insure competitiveness among the different areas independently and individually.

In this direction and with an orientation towards creating a global free market and the creation of the E.U. common market, the E.U. decided to free the state-member-markets, especially the monopoly of the telecommunications and transport which up to recently had a prime position. It has also been realized that it is essential to conserve the development of interior dynamics and to make the most of the multiformity of the cultural elements traditions and the residents’ “technology awareness”.

Many of the activities of the E.U. proved inefficient as it is obvious that the general directions, the possibility of taking advantage of the working force and the effects of the transport network and telecommunications, deteriorated the unbalance of the E.U. areas. The big urban centers having better infrastructure and organization have attracted the placement of central services and undertaken decision centers and at the same time the gathering of “technology awareness”. Consequently, the big cities have become even bigger and the small, smaller. Furthermore, more services have been created like banks, schools, “cultural infrastructures”, athletic centers and other more or less important services. All the above have maximized the big urban centers which have attracted with growing pace, a huge amount of population who abandoned the rural areas.

Through the policy of the E.U. towards the enhancing of the outer district and the expansion of local authorities, the cities are exposed to more immediate global changes compared to the past. Today it has been realized that there are serious risks underlying because a significant part of investments take place in big cities. This is in accordance to specialized services like banks which have mostly been established in London, in Frankfurt and Amsterdam, but also with the establishment of the headquarters of huge international corporations like in Brussels, Paris, London and Amsterdam. A characteristic example is the Japanese corporation in Dusseldorf. Furthermore, the area around Amsterdam has become basic spot of distribution centers in European scale. On the other hand Spain, Portugal and Ireland have accepted a big part of investing flow after the creation of the common market. This situation indicates the excellent financial status of Madrid and generally of the big urban districts of the East coast of Spain and the steady development of Lisbon.

During the 80's, the gathering of the population at specific urban regions was realized and at the same time the decrease of diaspora to other regions. So, serious problems were created like the congestion of some areas and the desertion of others. Obviously, there is great danger for the European vision which depends on the citizens' equality and opportunities.

3 THE IN-HOMOGENEITY OF FINANCIAL DEVELOPMENT - THE PROBLEM OF UNEMPLOYMENT

We should point out that, as anyone would expect, after the unification of the Union market, greater movement of the E.U. citizens would be noticed at the general European level due to the financial activities and occupation opportunities. Finally though, this movement was remarked at local level, in state scale. So the inhabitants of rural areas gather to big urban centers. The phenomenon of recycling of occupational positions appeared due to technological progress which has created new occupations and has abolished old ones. Of course, it is an exception the inflow of immigrants from other countries out of the European Union.

A significant parameter is the fact that nowadays the development of technology has minimized distance while telecommunications are greatly developed too (eg. Wireless, telephone, fax, Internet etc.). So commuting time is much less. Thus people considered it easier to stay far from their work even though they would be obliged to cover daily a big distance when commuting. The increase in commuting has caused a deteriorating situation at the city centers as traffic jams have become worse and contribute more to air pollution especially at rush hours. So it is not accidental that the above problems are a special element of the physiognomy of some cities. (Rome, Athens).

The phenomenon of the "Shift" in occupations through technological progress - occupations becoming obsolete and being substituted by others - had as a result the gathering of the population in big urban centers where it is easier to find work. This phenomenon has makes them even more densely populated. We can observe a tendency to establish more productive co-operations at more favorable spots. By this we refer to spots that offer better public services, have more specialized working force or those which offer the possibility to be established in the national and international market. All the above, however, have as a result the reinforcement of regional inequalities in terms of regional planning separation and the differences in income. Poor regions lose a significant amount of their "active" inhabitants because they lack in financial progress. Those areas are thus unable to offer working positions and are lead to decline.

At this point we should mention the serious problem of unemployment faced by the E.U. The number of the unemployed is dramatically increasing and has become one of the biggest problems of the Union. Even though there have been numerous attempts in the direction of tackling the problem, there is a weakness in providing opportunities to an increasingly large number of people in need of work. Steps had already been taken in the Amsterdam Agreement to deal with the face occupation and the unemployment problem as well as attempts for co-operation between state members. (3rd pylon). In addition, the announcement of the E.U. with title "A European Strategy for the encouragement of local initiative development and occupation" has looked into new opportunities for the creation of occupation opportunities in the public and private sector (for example domestic and social services, local-public transport, social security, housing sector, local trade, tourism and cultural heritage). At the same time the political aims of the E.U. are:

- *The financial support aiming at prosperity and occupation in cities:*

The Committee has emphasized the importance of financial support of urban areas through funding from organic funds based on local programs. The role of the cities will be re-enforced with the financial development and the development of initiative will be also encouraged.

- *The measuring of social data in urban areas:*

The state members have to focus on co-operating against predisposition and social exclusion. The European Commission have already suggested:

- Financing through organic funds with complete social, cultural, environmental etc. programs for the renewal of the downgraded areas.
- Supporting the links of urban areas so as to avoid their separation and alienation.
- Programs for the education of citizens.

Aiming at a successful outcome, the Commission have encouraged the exchange of experiences (know- how) and also activities between the state-members. The 5th Frame of Support for the Research and Technological development contributed drastically towards this direction. The same and the 6th.

We should finally point out that important political programs are being formed for the solution of the problems of occupation and unemployment whose effects on urban life and on the shape of the modern E.U. city, we will be able to evaluate the forthcoming years.

4 THE ENHANCING OF THE SUB-STRUCTURE OF MEDIUM AND SMALL SIZED CITIES

Taking as a fact that the E.U. regions appear to be heterogeneous in terms of shape development and sub-structure and with the imminent danger of a decline in the medium and small sized cities, directions have been given for actions followed to insure the convergence of the different areas. In this way, these areas will hopefully become viable and competitive in European and global level. These actions focus on:

- The nets for provisions of energy and transport in areas that need to become more accessible

- The organizing of a society of information promoting the construction of tele-communication nets so as to be organized in a “settled” frame which will guarantee the total provision of services and the funding of the applications and local nets through the substructure funds. This will allow the less prosperous regions to exploit the new technology of information and communication.
- The substructure of educational issues occupation specialization and differentiating activities throughout the Union.

To sum up, we can conclude that the Policy of Competitiveness and Occupation has dramatic spatial effects since only the cities have the sub-structure to offer high-level services and manage to attract investments and new establishments. The following phenomenon appears:

- huge cities taking monstrous proportions
- the weakening and desertion of the already small and medium cities.

The cost of the adoption of small and medium cities is great while it also seems impossible for them to keep up with the rapid pace of development and competitiveness as imposed by the modern European Union. The spatial differentiation and the increase of inequality among the regions can become obvious in European and state-member level. Undoubtedly, a substantial factor of financial success, is the ability to innovate. Particular urban regions in the E.U. like London, Amsterdam, Paris, Frankfurt, Munich etc. are organized in a high technical and research level combined with a business mentality orientated towards innovation. Almost half of the funds of the 2th and 3rd “frame-programs” have been given to regions of the above areas, which are European top-centers. So, cities which do not have the substructure needed are automatically put aside and gradually weakened. Inevitably, youngsters abandon these cities to seek a better future and thus small and medium cities become cities of over-aged people with all the serious consequences involved. The physiognomy is alternated and appears to have a dramatic lack in initiative and activities which create an appealing for the youngsters environment.

5 CONCLUSIONS

The measures taken by E.U. with an aim to improve competitiveness and the balanced financial development is natural to affect people’s life, their financial situation and the daily image of the cities. Eventhough these measures have not been completed, some of their consequences are already obvious in the cities

- We can remark that a lot of city centers which were once downgraded and the home of financially weak classes and immigrants, have undergone a number of renewal interventions. This had as a result a rice in the price of the land and the return of well - off citizens. Simultaneously mixed uses of land were attempted so that city centers which were used only for business purposes were reshaped into domestic spaces. That lead to the creation of shops that serve the new inhabitants and the development of businesses concerned with entertainment which gave a “night-life” look to the urban areas that used to look deserted in the night hours. (eg. Psyri, in the center of Athens).
- The improvement of net subtractions allows, even though in a rather slow pace, the establishment of businesses and the development of financial activities at small and middle-sized cities. The every day life of these cities changes due to citizens moving to those areas and demanding a superior way of life.
- The rapid development of new technology and telecommunication gives the opportunity to the big production units to the decentralize their activities. In addition, the daily physical presence of many executives is no longer necessary at the working environment. In this way a gradual reduction of city dwelling will be observed.
- The urban inhabitants’ demands related to health and quality of life have been increased and intensified. The total amount of changes at the urban environment need to include research and activities which will be compatible with the physical environment protection and the protection of health and life of the people.
- It is proved that financial development is parallel to an increasing interest for culture and art. This is proved by the examples of European cities which developed a great cultural and spiritual achievements at the same time with their financial development. The success of European programs has naturally led to the upgrading and elevation of the politistic and artistic view of the cities which, as it is known, is particularly interesting and an essential characteristic of the physiognomy of the European cities.
- The development of standards of living even in countries less developed like Greece, have lead to a demand for better quality life and has raised life-style standards in sections like housing. The chosen locations for housing are mainly non-developed rural, mountainous or coastal regions which are turned into domesticated areas which in spite of being rather disorganized, they have their very own local character.
- Historical or traditional areas which become popular among financially powerful classes and are chosen as suitable areas for the creation of a second or third residence.
- The above have lead to the development of two kinds of cities:

  a. The modern cities which are in harmony with the spirit of globalization and whose prominent features are not related to their local monuments but to modern buildings incorporated into a global financial-cultural network connecting the specific financial-center city to other key-cities worldwide.

  b. The cities and settlements with national, local and traditional character whose traditional qualities are the main attraction and the most profitable "Resource". Such cities in Europe (e.g. Greece) and generally countries with special character and outstanding cultural heritage will not badly influenced by globalization.

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Environmental Management Information System - a tool for urban planning in developing countries

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The first part of the paper will introduce the concept of environmental management information systems for supporting participatory decision making processes in urban planning. The Sustainable Cities Programme (UN-HABITAT/UNEP) originally developed the system. Further developments aim at the increased use of open source technology and the internet. The second part will present selected city case examples from Africa, Asia and Latin America which are applying and using an environmental management information system.

1 CONTEXT AND CONCEPT OF ENIRONMENTAL MANAGEMENT INFORMATION SYSTEM

During the 1970s, the city of Lagos built an express way through a wetland area. This route was chosen because the costs for the land in that area were low. This new road opened up access to a new whole area in the wetlands, leading to the spontaneous development of that area. Not only that one of the last nature reserves was destroyed, people in that area suffered from flooding and water-borne communicable diseases. The city needed to provide services to the new settlements but infrastructure was difficult, and therefore expensive, to build. When these expenses were added to the initial costs of building the new road, it became a rather expensive undertaking.

Urban managers of fast growing cities in developing countries are confronted with a number of recurrent questions on a regular basis: Which areas are available for city expansion? How can we revive certain parts of the city? How can we improve the health conditions for the citizens? How can flood-prone areas be controlled? How can we stop air pollution in various parts of the city? How could investors be attracted to the city? Where can service delivery be improved and expanded?

In many cases traditional master planning approaches, mostly introduced by former colonial administrations, have not been able to respond to the planning needs for fast growing cities in the developing countries. Those master plans were usually prepared by external experts in a highly sophisticated manner with the result that the insufficient financial and managerial capacities of municipal councils were not able to implement such plans.

Since the seventies the need for new planning approaches evolved with the aim to take people into the centre of strategy development and decision making. Environmental planning using participatory approaches was placed on the world agenda through the Brundtland Report which initiated the subsequent debate on sustainable development during the "Earth Summit" in 1992. With additional focus on urban governance and combating urban poverty, sustainable urban development is key to achieve the global Millennium Goals, further re-enforced during the Rio +10 Conference in Johannesburg.

Among a number of national and international programmes, which promote Local Agenda 21 processes, the UN-HABITAT/UNEP Sustainable Cities Programme started demonstrating a particular environmental planning and management approach in cities around the world in the early nineties. Each city level project was adapted to the particular needs, priorities and circumstances of that city. The approach is based on the following principles:

- Central focus on environment-development interactions;
- Broad-based participation by public, private and community sector groups;
- Concern for inter-sectoral and inter-organisational aspects;
- Reliance on bottom-up and demand driven responses;
- Focus on process: problem-solving and 'getting things done'; and
- Emphasis on local capacity building.

Carefully designed and tested management tools support urban decision makers in applying the individual steps of the environmental planning and management process in their city. They include tools (a) for determining an information base (Environmental Profile), (b) for kicking off a consultative process (City Consultation), (c) for establishing issue specific working groups, (d) for strategy development and action planning, and (e) for institutionalising the process in existing management structures.

Naturally, such a practical planning and management approach requires a solid and sound geographical information basis. In particular the members of the issue specific working groups base their discussions on concrete situations on the ground. Although most municipalities in developing countries have more or less sophisticated cartographic units, those units usually require support in supplying the appropriate information to those working groups. Traditionally, mapping units in municipal structures are highly sectorised and usually deal mostly with large-scale maps (utility maps, cadastral maps, etc.) - compatible to traditional master planning principles.

In order to respond to the new cross-sectoral and participatory planning and management processes, new mapping concepts needed to be developed which supply stakeholders with relevant spatial information. One of those tools, which the Sustainable Cities Programme uses for planning, is the Environmental Management Information System (EMIS). EMIS is a tool for collecting, organizing, and applying information relevant to urban environmental planning and management. It is designed to assist cities in clarifying issues, formulating strategies, implementing action plans, monitoring progress, and updating changes, using mapping and geographic information systems as essential components for presentation, analysis, and modelling.

Experiences from cities around the world have shown, that the use of GIS based environmental management information systems can help to improve transparent decision making in municipalities. However, sensitised high-level decision makers and adequate technical capacities are key to a meaningful implementation of such a sophisticated system. The EMIS approach responds to these capacity building needs and provides the necessary tools for implementation of such a system in municipal councils.

2 EMIS STEPS AND TOOLS

The EMIS is part of the environmental planning and management process and it is designed to support every phase of a Local Agenda 21 project cycle. It is, in itself, a tool for better urban governance, because it ensures that data is collected and analysed in a participatory and gender responsive way. The spatial scope of the EMIS can differ widely. It can cover the whole city, giving a more or less comprehensive picture of urban development. However, an EMIS, by its very nature, aims at connectivity rather than comprehensiveness. Therefore it is more often used to examine smaller 'pilot' areas or specific issues from a cross-cutting perspective. It can focus on specific management issues such as petty trading, or on specific locations, such as dealing with a lake within a city.

Although the EMIS does not attempt to be comprehensive, it must have a basic set of data which includes information on the natural setting of the city, land use, ongoing development activities and the state of the environment. The power of the EMIS lies in its outputs. Pinning large, colourful maps on the walls or presenting them effectively on the internet helps tremendously to deliver messages. Saving on outputs jeopardises the usefulness of the EMIS.

The EMIS cycle consists of nine standardised steps. Each step has concrete outputs which is basis for the following steps. The steps are supported by a number of practical tools which are part of a detailed training concept.

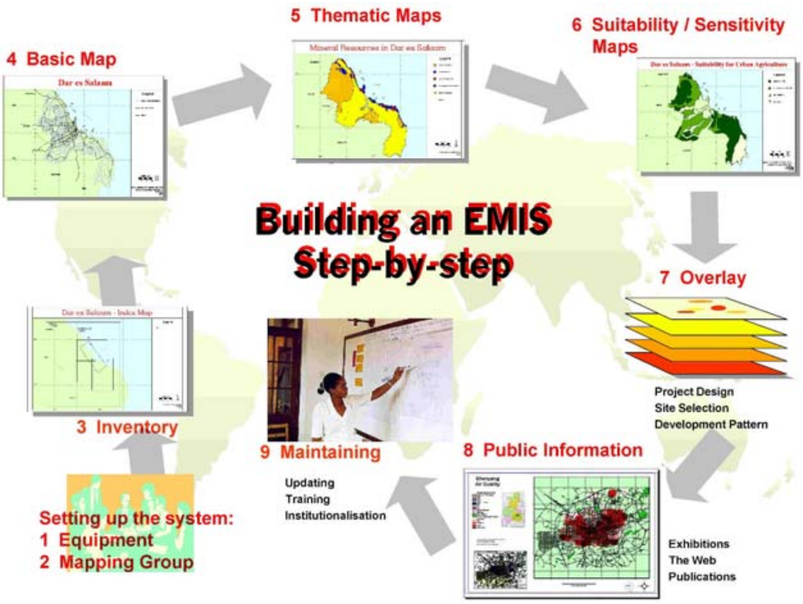

Abb.1: EMIS Steps

Step 1: Setting up the EMIS

Setting up an EMIS unit takes quite some resources, and must be supported by a high level commitment of key decision makers of the respective institution. Although an EMIS system can be built without technical equipment, it is much easier to use a Geographic Information System to handle the amount of data in the system. The sophistication of technical equipment relates to the scope of the expected work to be done and the necessary human and economic resources. The installation costs for an average system may mount up to EUR 50,000; the annual running cost may vary from EUR 20,000 up to EUR 100,000, depending on the size of the city and the amount of work to be done.

It is often underestimated that the physical location of highly attractive (and status related) computer equipment decides on the success of the system. Experience has shown that an EMIS function is placed in a cross-sectoral department or directly under the head of the institution/municipality.

Step 2: Mapping Group

To link the EMIS with the stakeholders and users of the system, it is very useful to establish a Mapping Group. The major task of such a group is to backstop the EMIS unit and to make sure minimum mapping standards are kept. This group has to solve problems and decide many things during the EMIS building exercise. In Step 1 they advise on purchasing equipment. For Step 3 they can provide information about existing maps and for Step 4 they can decide on the content and layout of the Basic Map. The Mapping Group facilitates the link between the issue specific working groups and the EMIS unit, and it is this group which discusses the needs of Thematic Maps, the mapping rationale for Suitability and Sensitivity Map, and the overlay procedures. Finally, the Mapping Group organises training during Step 9.

Step 3: The Inventory

The EMIS inventory stage covers finding existing data and maps, setting up a filing system for hardcopies, developing a filing system for the digital data, and establishing a database of all relevant maps and data.

Step 4: Basic Map

A Basic Map includes the main features of the city such as major rivers, main roads and basic landforms. These basic features should be used in each map created later on to give some guidance and orientation on the location. The layers of the Basic Map function as master layers, so rivers, roads or boundaries will never ever be digitised again unless they undergo physical change. When printing the first Basic Maps, it is essential to decide on a standard layout which can be used for all the EMIS maps.

Step 5: Thematic Maps

Thematic Maps contain factual information and show, for example, height of water table level in metres underneath the ground, soil eroded each year in centimetres, population density per hectare for each administrative sub-unit, and so on. The input for these Thematic Maps will come from existing maps, scientific reports or existing data, which can be found in different city departments, research institutions or which is generated by the issue specific working groups. The information in the Thematic Maps will be displayed as symbols (e.g. location of ground water wells), unique codes (e.g. administrative areas), class ranges (e.g. population density) or charts (e.g. content of chemical substances in water).

Step 6: Suitability and Sensitivity Maps

The Suitability and Sensitivity Maps are usually the main outputs of the issue specific working groups as regards mapping. The creation of a Suitability and Sensitivity Map includes the interpretation of factual data found in Thematic Maps and the evaluation of these findings. This focuses on drawing conclusions about conditions in specific areas and defining and applying certain rules stored in a database. The issue specific working groups will assign ranks to these ‘rules and conditions’ according to the environmental impact on development or the impact of development on the environment. A Sensitivity Map shows areas which are highly, moderately, less or not sensitive to an environmental issue, whereas a Suitability Map shows areas highly, moderately or less suitable for a development activity.

Step 7: Overlaying of fact and policy maps

Overlaying a variety of maps will simulate the interaction between environment and development issues, meaning the identification of crucial 'hotspots'. Meaningful combinations of overlays will generate the necessary outputs that are relevant for urban environmental management. Typical products include strategy maps, land use maps, zoning maps, and spatial management frameworks such as the Environmental Management Framework (EMF). These documents help to answer routine questions in urban environmental planning and management.

Step 8: Information Outreach

Public information outreach activities are an important part of the system. This brings new information into the system, and can be very effectively supported by the EMIS itself. Methods to promote the system include exhibitions, the world-wide-web, printed publications, and interactive map publication on CD-ROM.

Step 9: Maintaining the System

An EMIS is a learning system. Thus, even though the design of the system is completed, the data content will grow and change continuously over time. In order to maintain the system it is vital to anchor the system in the most appropriate department or institution, ensure public involvement and acquire a regular budget on a long-term basis. The anchoring department has to commit itself to continuously up-date the system (undertaking the costs involved) and must provide a continuous training programme for the EMIS users and operators.

3 PRACTICAL CASE EXAMPLES

Globally, about 35 cities are directly applying the EMIS steps and using the system for urban planning. Progress and results vary widely also the quality of the outputs. A number of cities built the EMIS function on top of their existing and well-functioning GIS units while newly established EMIS units in other cities got in contact with computers for the first time.

Experiences from those cities resulted in identifying following key challenges:

- Computer-aided mapping and GIS is still conceived as a 'black-box' for many decision makers and hence left to highly sectorised expert thinking rather than mainstreaming the use and production of maps to a wide range of stakeholders;
- Municipalities often make tremendous efforts to purchase a high-end equipment without considering the much higher operating and maintenance costs. Equipment then is used for basic office work and 'white elephants', such as expensive large scale scanners and digitisers left behind;
- Initial and continuous capacity building efforts in both, GIS techniques as well as integrating GIS in an participatory planning process are often underestimated which at some stage leaves a system idle behind;
- And most important: the control of spatial data is equivalent to power. Therefore, transparent processes involving sensitive information (such as the reclassification of land-use) are often not the priority of people having the control over data.

The following three case examples from three continents should give an insight in the practical implementation of a sophisticated environmental management information system.

Abb.2: Some 35 cities world wide are applying the EMIS concept

3.1 Managing the environment in Tanzanian municipalities

In the mid-nineties the Government of Tanzania had decided to adopt the use of the new Environmental Planning and Management process instead of the traditional master planning approach in the preparation of all urban development plans. This 'revolutionary' decision was based on the good results which the participatory working group approach of the Sustainable Dar es Salaam project could demonstrate. This decision had a much wider impact than just on Dar es Salaam. It affected the planning procedures for all Tanzanian municipalities which have, under guidance of the Ministry of Regional Administration and Local Government - Urban Authorities Support Unit, established 'environmental planning and management' units. The national University College for urban planners integrated this new approach in their curriculum which ensures the education of a new generation of planners.

In the course of the Sustainable Dar es Salaam project the desolate cartographic unit of the city had been successfully revitalised and the use of GIS technology had been introduced. The EMIS concept was used to prepare the Strategic Urban Development Plan (SUDP) - the guiding document for the future development of Dar es Salaam. After completing the preparation of the Draft SUDP, it was noted that there were several contentious issues pertaining to the said plan where different people had different understanding. Such issues included the following:

- What is strategic about SUDP and what implications does this have on its focus, thematic scope, geographical coverage, time horizon and detail?
- Does SUDP have/ need a legal basis?
- Is SUDP a stand alone plan type; does it replace other plans; how does it relate to other urban management instruments?
- In what detail should the SUDP address land use planning and development control issues and is a land use map mandatory?

The Urban Authorities Support Unit in collaboration with the City Commission organised workshop where the participants, drawing on their varying experiences and professions, deliberated upon these issues and came to a common understanding through a consensus based approach. As a result, EMIS units were established in all municipalities. Experience shows that a sustainable continuation of the unit depends strongly on the attitudes of municipal directors regarding the use of information technology in planning and management.

3.2 Planning the future of Bayamo, Cuba

Bayamo, capital of the Granma province is a typical example of a medium sized city with rich history but relatively slow development compared to similar cities in Latin America. More than half of the city’s population is living in neighbourhoods with unsatisfactory basic services and poor quality of urban space. The water quality of the Bayamo River is poor; the lifeline of the city is seriously polluted, affecting its use for human consumption, recreation, industry and urban agriculture. The solid waste management needs overhauling, while Bayamo’s urban transport is constrained by a lack of fuel and spare parts. This is due in part to conflicting views on the traditional horse carts as a central element in the public transport system.

Under the lead of the Institute of Physical Planning (IPP - Instituto de Planificacion Fisica) and the Programme for Human Development at the Local level (PDHL – Programma para el Desarollo Humano a nivel Local) a team of local experts had documented these topics through the participatory development of an Urban Environmental Profile, which served as the basis for the City Consultation. The consultation offered a forum for animated debate, reflecting the conflicting interests of key stakeholders. It also helped to broaden the ownership of the process and agreed on an Urban Pact. This pact envisions sustainable urbanization for Bayamo and sets out the tasks for thematic working groups whose composition reflects the key stakeholders concerned. These groups are developing project proposals to demonstrate how the issues can be addressed with tangible impact on the daily lives of urban residents. Particular focus is on resource mobilisation and institutional coordination. In parallel with the pilot project in Bayamo, a capacity building centre is being developed in the city of Santa Clara, in the centre of the country, as a mechanism to mainstream innovative urban planning and management concepts at the national level.

The physical planning department of Bayamo invested in a sophisticated GIS system in order to support the Local Agenda 21 process through producing municipal development plans. A well-trained local GIS expert co-ordinates a team of technicians who collect relevant information in the field for up-dating a central database on urban issues. The department has published an environmental profile containing map illustrations of high quality and relevance for the consequent planning process. Technical problems (for example software) or organisational problems (for example acquiring high-end equipment) are usually resolved through an excellent ability of improvisation. More problematic is the inter-institutional co-operation, particularly with the official mapping authority (under the military administration) in the exchange of data and information.

3.3 Strengthening institutions for municipal support in Sri Lanka

3.3.1 Environmental initiatives in Sri Lanka municipal authorities

Sri Lanka has a long history in supporting and promoting participatory planning approaches for environmental planning and management. In the early nineties the Worldbank/UNDP funded Metropolitan Environmental Improvement Programme (MEIP) identified through an environmental management strategy in Colombo priorities such as

- loss of natural resources,
- deteriorating quality of surface and ground water,
- flooding and stagnation of water courses,
- pollution from solid waste,
- deteriorating ambient air quality
- concentrated environmental problems in low-income areas, and
- traffic congestion.

These problems were attributed to inadequately planned urban infrastructure and inadequate institutional and financial capacity for management. Strategy and action planning first involved enumerating a set of principles for the sustainable development of Colombo. A full range of qualitative and quantitative environmental quality targets were prepared for priority sectors. A number of concrete activities emerged from this such as institutional development (with setting up a GIS unit to enhance pollution control enforcement), local level initiatives (community based environmental projects) and bankable investment projects (effluent treatment plants.

The UN-HABITAT/UNEP Sustainable Cities Programme introduced additional aspects of participatory planning and management and started the replication process to other municipal councils in the Western Province. The established EMIS unit, although equipped with highly sophisticated technology, did not survive the internal competition on competencies of the different departments of the Colombo Municipal Council.

3.3.2 MILES - technology transfer to support a national EMIS

In 2003, the City of Munich (Germany), the City of Vitoria (Spain) and the Sri Lanka Institute for Local Governance (SLILG) in its capacity as a national training centre for local governments started a European Union co-funded partnership to support the transfer of experiences and know-how in environmental management information systems. The project aims at improving the living conditions in the municipalities, in particular the poor in the low-income settlements as well as guiding investors, especially in emerging industrial areas where environmental permits are required before making investment decisions. The MILES initiative (Managing Information for Local Environment in Sri Lanka) is integrated in the national replication process of the Sustainable Cities Programme and technically supported by Rupprecht Consult GmbH.

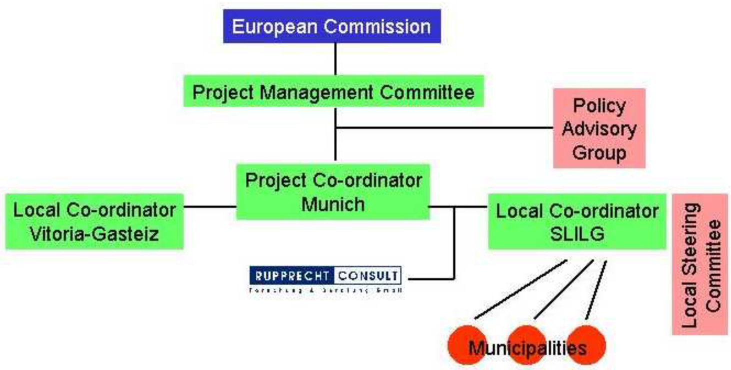

Abb.3: Organisational structure of the MILES project

The initiative adopts and transfers environmental and spatial information management concepts based on Open Source technology which is successfully used by the Health and Environment Department of the City of Munich. This project will integrate the EMIS concept with mapserver technology. Core of the initiative is to build the capacities of the SLILG for supporting and training municipal practitioners and community stakeholders in three municipal authorities in Sri Lanka (Kotte, Kandy and Batticaloa) in environmental planning, information management and spatial analysis.

The selected municipalities will use the EMIS cycle to update their mapping base, to provide spatial information to the environmental working groups and develop environmental management frameworks. The strategic exploitation and further take-up of project results will promote the project results with in the Asian region for further replication.

4 CONCLUSIONS

After analysing the successes and failures of introducing sophisticated spatial information systems to municipalities in developing countries, it becomes evident that attitudes and the political support are the key challenges for sustaining such a system. This requires a fundamental change in perceiving the introduction of such technology: it is not just about equipment, software and data - it is about the institutional integration and the transparent flow of information.

Change of Attitudes

GIS experts, training institutions and software developers continue to 'demystify' the use of computer technology for producing maps and mainstream spatial thinking beyond plot boundaries. The global exchange of experiences among municipal officers will help them to recognise that the free flow of information will benefit the urban development process and finally their own position.

Political support

The successful operation of a complex environmental management information system requires forward-thinking leaders with an attitude of supporting transparent planning processes. The EMIS tool is an appropriate instrument to actually demonstrate good urban governance. The recognition of the usefulness of such a system will ensure the financial commitment of an administration to maintain such as system. Political leaders need to receive continuous sensitisation and can be convinced through creative demonstrations of applications of the system.

Capacities

It is known that building capacities of municipal officers in information technology is prone to brain drain. Continuous efforts are necessary to keep a well-trained pool of experts available. Training is not only about complicated GIS operations. Training relates to the practical knowledge of participatory planning processes and how a tool, such as the EMIS, could support such a process.

Self-reliance

Particularly the experience of Dar es Salaam has shown, that the development of the Strategic Urban Development Plan through local knowledge and efforts contributed to the self-confidence of the municipal officers in producing such documents. Self-reliance contributes to a better implementation of such plans through effective convincing of decision makers. Using Open Source technology will enable local experts to lessen their dependency from expensive expertise and technology and create market opportunities for new services.

Networking

Last but not least - the exchange of practical lessons of experiences between practitioners is key to advancing knowledge and concepts. Internet technology allows technicians to communicate and to share information. However, the internet cannot substitute direct working contacts or technology transfers. Initiatives, such as the CORP, ensure the direct exchange and the mutual learning.

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Contemporary Tecnology-Enviromental Protection-Sustainable Development

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1 PREFACE

Environmental protection and sustainable development are the global aims of today. The "Rio Declaration" of the United Nations in 1992 and the Kyoto Protocol in 1997 laid the foundations for the achievement of this aim. Ten years after "Rio", in 2002, the International Conference of Johannesburg has not succeeded in giving a new prompting to this effort. The final adopted Action Plan has just maintained two basic principles of the initial Action Plan": common but differentiated responsibility and the protection principle.

Sustainable development is long-term visions for a more prosperous and fair society through a cleaner, safer and healthier environment [1].

The basic keystones towards the achievement of the sustainable development are:

- Environmental Protection
- Social Cohesion
- Financial Development

It is obvious that these keystones should co-exist in a medium-long-term basis. Furthermore, the ambitious visions of the future and Actions Schemes of the present must converge to this direction. Emphasis should be placed on a small amount of major problems, which should be carefully and constantly monitored by mechanisms and indexes.

Contemporary experience leads us to the conclusion that former political choices concerning technologies in production of electricity, land uses, substructure development and financial development, have only led to threatening for environment and sustainable development consequences.

The most significant threats for environment and sustainable development, as recorded today, are the following:

- Emission of Greenhouse gases leading to the rise of global temperature causing serious problems (climate change- extreme weather conditions- consequences on the nature, health, substructures).
- Social deprivation and poverty leading to numerous problems
- Rapid increase in transport resulting to pollution and decay of urban centers.
- Reduction of biodiversity.
- Constant increase of waste, which gets increased faster than the gross national product.

Undoubtedly, determining the priorities of environmental policies of the European Union until 2010 is extremely important for achieving sustainable development. This will be materialized through the "Sixth Action Scheme for the environment" for the period 2000 – 2010, which is the follow-up of the "Fifth Action Scheme" for the period 1992 – 2000.

Limited results in environmental protection during 1992-2000 are due to the fact that the EU Institutions expended excessively in mapping out the "European Policy" on environment and sustainable development and haven't emphasized in "materializing actions" on implementation measures and monitoring and policy mapping control. So inevitably, present decade is focusing on "materializing" and "implementation" of every "policy" that has been mapped out or is mapping out complementarily.

The attempt for controlling and reducing greenhouse gases will play a key role on Viable European Development achievement. This attempt is depended on the most significant factors of primary production and action as Energy, Industry, Transport, Urban Planning etc.

The present paper occupies with achieving Sustainable Development and Environmental Protection in the E.U. in the forthcoming decade with particular emphasis on the decisive part of the reduction of greenhouse gases and contemporary technological environmental protection growth and pollution reduction by emphasizing in producing electricity by Renewable Energy Sources.

2 THE EVOLUTION OF GREENHOUSE GAS EMMISIONS IN THE EU

According to W.W.F., the barbaric spoliation of earth's natural wealth during the last 30 years led the 1/3 of global natural wealth to destruction. [3]. Greenhouse phenomenon is an overshadowing threat for the environment, while the optimistic side concerns the ozone hole, since reduction has been noticed regarding its growth rates and full repair expected in 2070. The EU member-states' obligations concerning the greenhouse gases reduction until 2012 are presented in Figure 1. The greenhouse gases record a total reduction of 3,5% until the end of 2000 concerning the 1990's gas emissions. To this general environmental conjuncture, the reduction of forests plays unfortunately a negatively determinant role, since they are vital for the absorption of the basic greenhouse gas by 12% globally from 1970 to 2002.

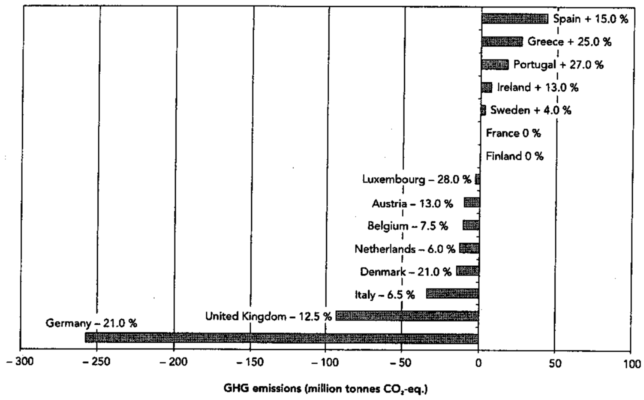

Figure 1

The 10 new EU member states' obligations are shown in Figure 2 (accession of 9 member states is already done).

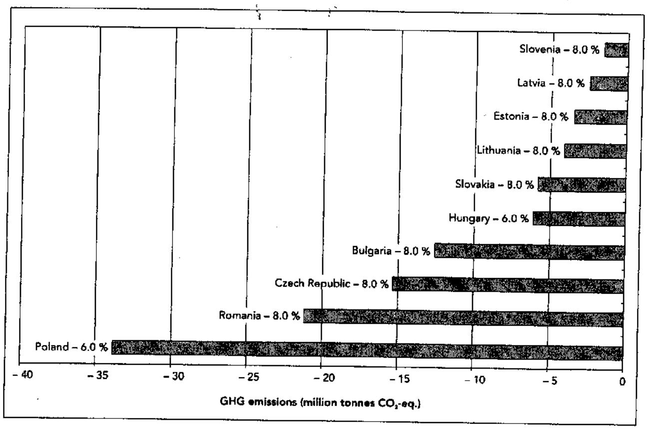

Figure 2

It should be noted that Kyoto Protocol will be in force after the ratification of the Treaty by 55 states, including developed countries in which at least 55% CO2 is emitted in 1990 values. In practice, Russia's approval is a prerequisite for the Protocol to be in force. The 15 EU member-states had ratificated the Protocol by November 2002. Japan and 8 EU new members have also approved it.

The true evolution progress concerning the reduction of greenhouse gases in E.U. is shown in Figure 3 emphasizing in the CO2 course.

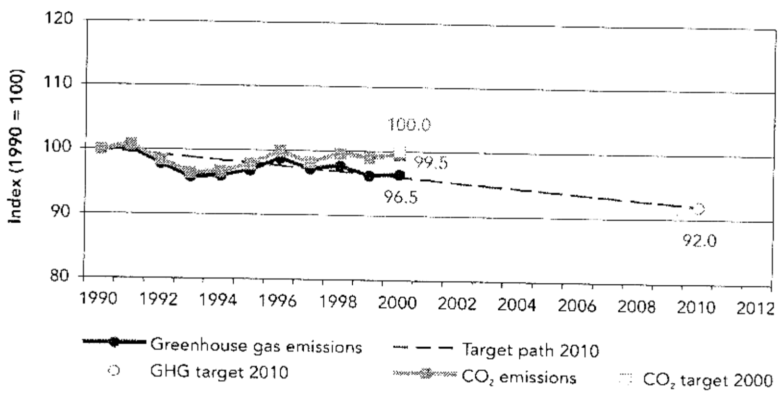

Figure 3

It should be noted that according to Kyoto Protocol, reduction is mentioned at six greenhouse gases, which are: Carbon Dioxide (CO2), Methane (CH4), Nitrous Oxide (N2O), Hydro fluorocarbons (HFCs), per fluorocarbons (PFCs) and Sulphur Hexafluoride (SF6). It should also be mentioned that CO2 is the primary greenhouse gas with a percentage of 82% among the total of emissions recorded in 2000. [5], while methane (CH4) and Nitrous Oxide (N2O) have a percentage of 8% each. The remaining 2% is emitted by the rest fluoric gases. The deviation per each EU member-state from Kyoto's objection in 2000 concerning the 8% reduction of gas emissions starting from 1990, is presented in Figure 4.

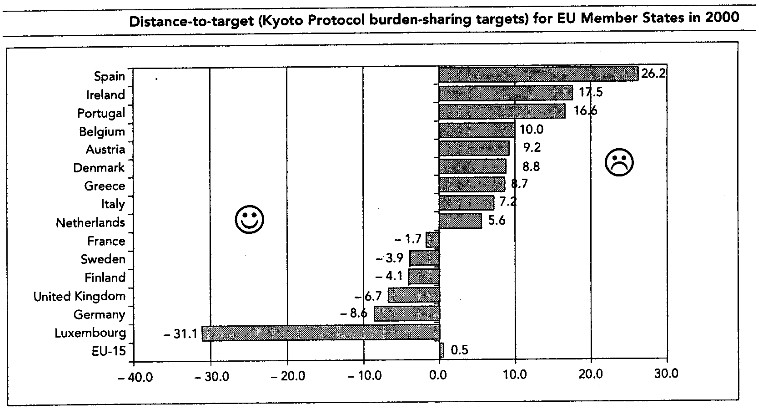

Figure 4

The total EU deviation is 0,5% granted that the succeeded reduction is 3,5%. Emissions from greenhouse gases per sector are showed in Figure 5.

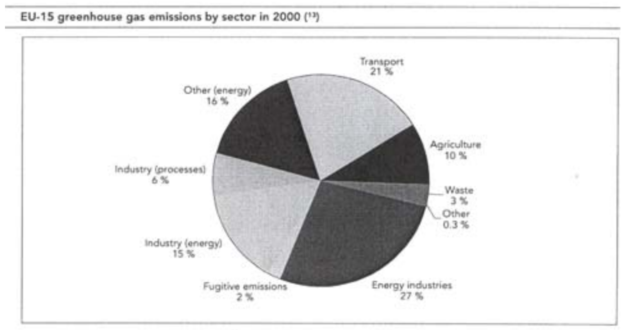

Figure 5

The two higher pollution sources are energy with 27% and transportation with 21%. Finally, the increase in emissions from greenhouse gases per sector is shown in Figure 6**.**

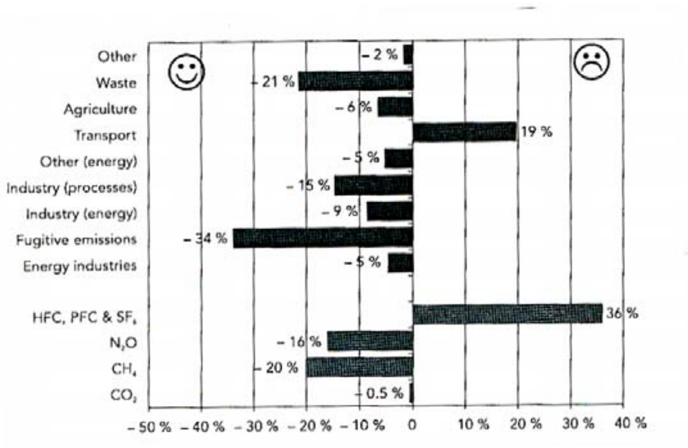

Figure 6

Unfortunately, there is a rapid increase in transport (19%) and there is no optimistic prospect for the future.

At this point it should be noticed that the 36% increase in fluoride gases, (HFCs, PFCs, SF6) used for refrigeration machines, air-conditions, fire-extinguishers and sprays, led Mrs Margot Valstrom, Member of the Commission in charge, in publishing a new directive on 12/8/2003 [6] on reducing specific gases methods which have high heat energy (23.900 times higher than CO2 and long time duration) although they are just the 2% of greenhouse gases. Specific gases emissions are expected to reach 98 million ton in 2010 from 65 million ton in 1995 unless strict measures are taken mostly on car air conditions which are the basic emissions sources (they will reach 20 million ton in 2010 from 1,5 million ton in 1995 unless measures are taken). So, car industries are suggested by EU to stop using the specific gases and gain of course the return benefits.

3 EXPECTATIONS TOWARDS KYOTO OBJECTIVE FOR 2012

The adopted policy and the measures taken by EU member states do not allow optimistic expectations on materialization of Kyoto objective – in 2010 at EU. Although a 3,5% reduce has been achieved at the end of 2000, the present estimation is that in 2010, the final reduction in emission from greenhouse gases will be at 4,7%. [7].

Towards this outlook the 15 EU member states have taken additional measures, in order to accomplish further reduction in the emission of greenhouse gases. This policy implementation might lead 2010 to a final reduction of 12,4% in gases emission comparing to 1990 levels. In this way, Kyoto's objective will be topped by 4,4% comparing to the initial 8%. Such differences concern also the EU member states as showed in Figure 7 in which the improvement accomplished due to the additional measures is obvious**.**

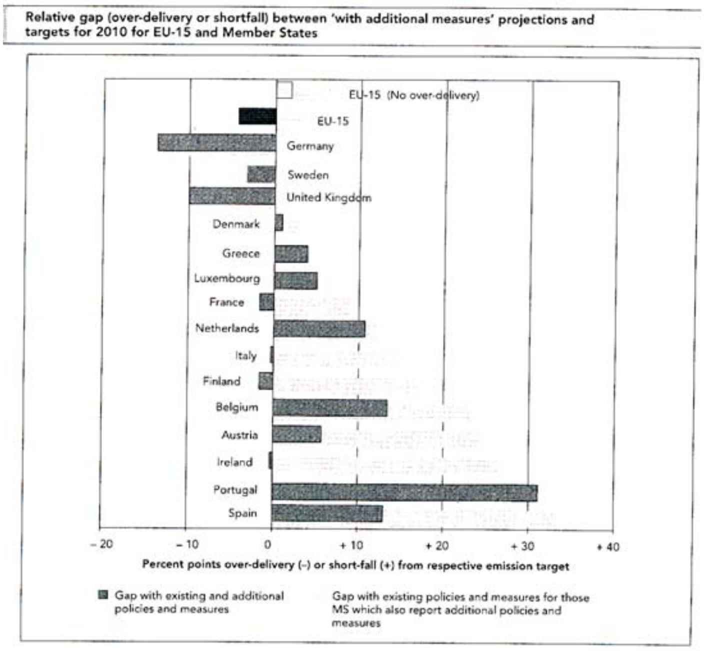

Figure 7

Energy (production and use) and transport are the basic pollution sources on which the global efforts are focused**.**

3.1 Energy (production – use)

Emissions from greenhouse gases by energy sector will be reduced in 2010 in E.U by 16% comparing to 1990. Additional measures taking can lead to 20% reduction.

Energy sector gases reduction at the end of 2010 due to the political steps and to the implementation of new measures in 10 EU member states which have given the relevant data, .is shown in figure 8.

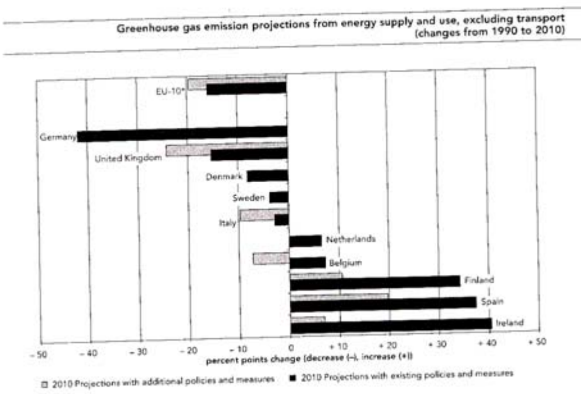

Figure 8

Renewable Energy Sources development, CO2 reduction in production of electricity and in Industry and CO2 reduction in "use" implementation are the objection bases for total gases reduction by 20%.

3.2 Transport

Transport plays a critical role in gas emission globally. It's not just a coincidence that the whole contemporary technology moves towards the following directions:

Improvement of the fuels in use as far as it concerns the gas emissions.

Use of new ecological fuels (e.g. H2).

Other energy type use (e.g. electricity) in order to reduce the vehicle gas emissions.

Unfortunately several improvements (Pb-N2O etc) have been eliminated due to the rapid progress in transportat and private vehicles resulting the increase in the emission of greenhouse gases by transport for 2010 outlook, based on 10 EU member states' data – 15 members states have not given any data: Austria – Luxembourg – Portugal – France – Greece). Taking additional measures will lead to reduction of the emissions. Figure 9 shows in detail the first estimation for the above 10 EU member states.

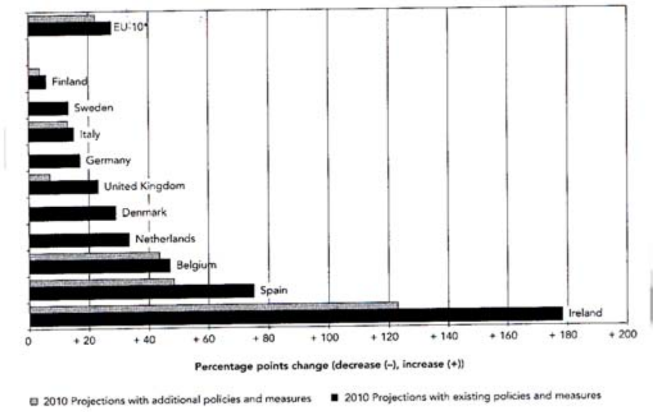

Figure 9

The reduction of CO2 emissions in private vehicles is the basic factor towards this direction aiming at their limitation in 120 g CO2/vehicle-klm, until 2010, from being 172 g at the end of 2000.

The taken measures and the potential ones that can be taken by EU 15 member-states can be showed in Figure 10.

Types of policies and measures by Member States for transport

	Economic		Fiscal		Voluntary/ negotiated		Regulatory		Information		Education		Research		Other	
	Imp	Add	Imp	Add	Imp	Add	Imp	Add	Imp	Add	Imp	Add	Imp	Add	Imp	Add
Austria			✓	✓	✓		✓	✓	✓✓	✓	✓	✓	✓			
Belgium			✓	✓✓✓	✓✓	✓		✓			✓✓✓	✓			✓✓✓	✓✓
Denmark				✓			✓		✓	✓						
Finland	✓	✓✓	✓	✓	✓✓	✓			✓	✓✓	✓	✓✓				
France	✓	✓	✓	✓	✓	✓	✓✓	✓			✓	✓			✓✓	✓
Germany	✓✓		✓		✓✓✓		✓		✓							
Greece			✓				✓									
Ireland				✓		✓		✓				✓				
Italy		✓		✓		✓✓		✓		✓						✓
Luxembourg				✓												✓
Netherlands			✓		✓✓		✓				✓				✓	
Portugal																
Spain	✓		✓		✓		✓	✓	✓		✓					
Sweden					✓								✓		✓✓	
UK			✓	✓		✓✓										

Notes: Imp = implemented (existing); Add = additional.

Figure 10

4 WIND POWER: CONTEMPORARY TECHNOLOGY IN PRODUCTION OF ELECTRICITY AND ENVIRONMENTAL PROTECTION

On May the 10th 2000, European Commission adopted a strategic goal proposal on significant increase in electricity coming from Renewable Energy Sources. [9]

Since 1997, the objective of the White Paper on R.E.S. was the doubling of R.E.S. share in E.U. energy balance from 6% to 12% until 2010. Big hydroelectric schemes are not included in this percentage.

In 2010 electricity produced by R.E.S. aims on 22,1% for the total production of electricity in E.U. including big hydroelectric schemes (>10MW).

Former percentages of produced Electricity in Greece at the end of 2000 per fuel are shown in Figure 11. [11]

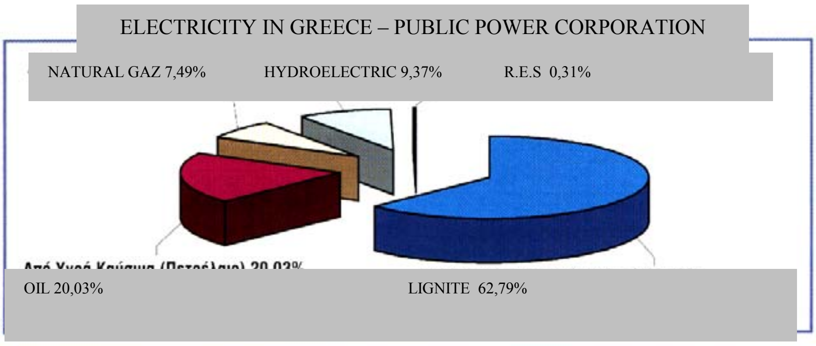

Figure 11

Lignite is still the first by 62,79% while total energy's part is only 0,31%.

Electricity gets increased globally by 1-2%

The increase in Greece during the last years was 4,5% respectively. Prospect for 2010 is 3,5%.

Producing electricity by wind power promotes the basic objectives towards the following directions. [12]

- Energy dependence reduction.
- Decentralization of electricity production.
- Increase of available electrical power.
- CO2 emissions reduction.
- Added value increase in national level.
- Economic activities support and employment increase in suburb.

Today, E.U. energy dependence on external sources comes to 50% for imported products. This growing tendency leads to the estimation than at 2030 the percentage will be 70% unless substantial measures are taken. According to this turn it is obvious how precarious would the E.U. position be within international economy.

At this point it should be noted that energy consumption in 2002 at E.U. was the 15% of global consumption, when demographically, E.U. is just the 6% of global population.

Under these circumstances wind power development plays a significant role both in energy balance and gases emissions reduction, especially CO2.

In 2001 installed wind power was 24.000 MW, 17.319 of them were available in E.U. [13] (Figure 12)

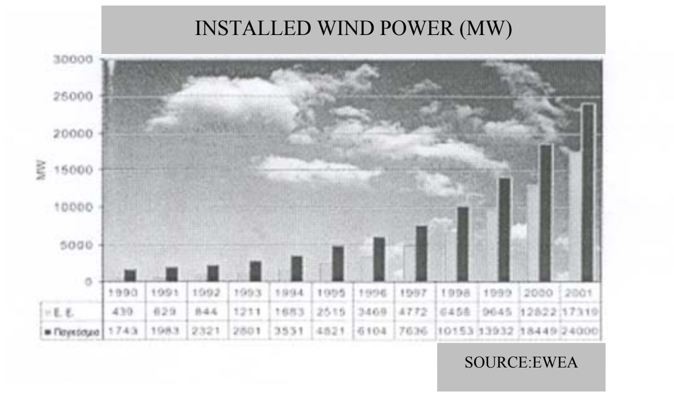

Figure 12

At the end of 2002 this amount reached 31.000 MW [14], while during last year a global increase in installed power is noticed per 32% annually.

Wind power covers today 0,4% of global energy demand.

In Greece installed wind power course is shown in Figure 13. [15]

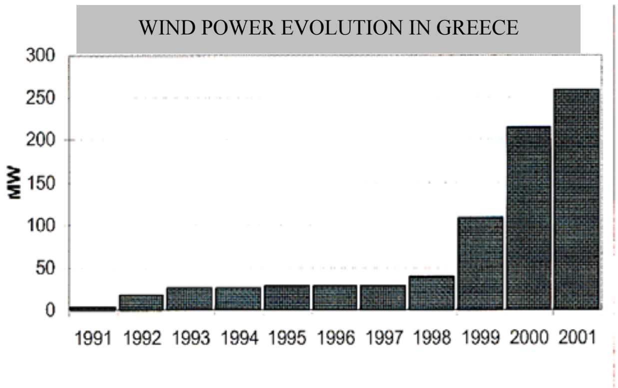

Figure 13

According to present data [16], installed power of R.E.S. in Greece will be 3.500 MW in 2010, 90% of which will be wind power. They will produce electricity 8.800GWh, out of a total of 76.000 GWh in Greece as it is estimated for the total production for 2010 (percentage 11,6%).

Considering that big hydroelectric schemes will produce in 2010 the same amount of electricity (today 9,27%, 7-8% in 2010 respectively) and adding the small percentage of the rest R.E.S., Greece will almost reach E.U. objection for 2010 that means 22,1% production from R.E.S. and big hydroelectric schemes.

5 CONCLUSIONS

It's a common belief today that Contemporary Technology, Sustainable Development and Environmental Protection are a common objective, common action course, and complementary policies and measures implementation. During the last two decades focusing has been made on environmental problems due to predatory use of the environment, while in the last decade global European and National policies have been mapped out without being materialized.

Materialization of these policies will be made during 2000-2010 since the negative consequences in not taking measures are so obvious as the positive results after specific measures implementation in international and national level.

Towards this direction, contemporary technology evolution will play the main part, and will give the first but not last priority to transport and production of electricity.

It is obvious that emission of greenhouse gases evolution will play a key role on environmental protection evolution, on climate changes, on Sustainable Development. Unfortunately, since Kyoto Protocol has not yet been into force the evolution is negative at this point.

Substantial activation of E.U.–25 in drastic reduction of CO2 in energy (production – use) and in the vital sector of transport is an auspicious prospect. It is a fact that global scientific community efforts have been focused on transport as far as it concerns the direction of new ecological fuel implementation (e.g. H2) and the improvement of the fuels in use. It's also a fact that rapid progress in transport and in private vehicles is opposed to this serious effort.

Therefore same emphasis should be given on the technological evolution in this sector as on transport management sector in order to eliminate every vehicle use.

Eventually, emphasis on I.E. is a vital priority since it is the "cleaner solution" as far as it concerns energy. Present high cost will surely be depressed after their wide use and the evolution of technology. Therefore we can hope that during the following period until 2010 the negative course of environment will be changed and Sustainable development by using technological evolution will be reached.

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Pedestrian Navigation System in Mixed Indoor/Outdoor Environment – The NAVIO Project

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1 ABSTRACT

Pedestrians have often ways in unfamiliar urban environment or in complex buildings. In these cases they need guidance to reach their targets, for example a specific room in a local authorities' building, a counter, or an institute at an university. The goal of location-based mobile services is to provide such guidance on demand (anywhere, anytime), individually tailored to the actual information needs and presented in preferred forms. This project is focusing on the information aspect of location-based services, i.e., on the user's task at hand and the support of the user's decisions by information provided by such a service. Specifying a task ontology will yield context-dependent conceptualizations, activities, and references to directions from the user's perspective. These specifications will allow to:

- select appropriate sensor data and to integrate data when and where needed;
- propose context-dependent routes, fitting to partly conflicting interests and goals;
- select appropriate communication method in terms of supporting the user guiding by various multimedia cartography forms.

To test and to demonstrate the approach and results this project takes a use case scenario – guiding visitors to institutes of the Technical University Vienna – and develops a prototype.

2 MOBILE POSITIONING

2.1 Problems and State of the Art in Mobile Positioning

Pedestrian navigation has to work under any environmental condition in mixed indoor and outdoor areas as well as urban environments. Therefore challenging tasks that are dealt with in the project NAVIO are:

- the capability to track the movements of a pedestrian in real-time using different suitable location sensors and to obtain an optimal estimate of the current user's position,
- the possibility to locate the user in 3 dimensions with high precision (that includes to be able to determine the correct floor of user in a building), and
- the capability to achieve a seamless transition for continuous positioning determination between indoor and outdoor areas.

Thereby a navigation support must be able to provide location, orientation and movement of the user as well as related geographic information matching well with the real world situation experienced by pedestrians. Other challenging issues relating to the privacy and security of information about the current user's position, however, will not be addressed.

Nowadays for outdoor navigation, most commonly satellite-positioning technologies (GPS) are employed. Then the achievable positioning accuracies of the navigation system depend mainly on GPS, which provides accuracies on the few meters to 10 m level in standalone mode or sub-meter to a few meter level in differential mode (DGPS). If an insufficient number of satellites is available for a short period of time due to obstructions, then in a conventional approach observations of additional sensors are employed to bridge the loss of lock of satellite signals. For pedestrian navigation, sensors such as a low-cost attitude sensor (digital compass) giving the orientation and heading of the person being navigated and a digital step counter or accelerometers for travel distance measurements can be employed. Using these sensors, however, only relative position determination from a known start position (also referred as Dead Reckoning DR) is possible and the achievable accuracy depends on the type of movement tracking sensors used and the position prediction algorithms adopted.

For indoor positioning different techniques have been developed recently. They offer either absolute or relative positioning capabilities. Some of them are based on short-range or mid-range technologies (see e.g. Klinec and Volz, 2000) using sensors such as transponders or beacons installed in the building. An example are the so-called Local Positioning Systems (LPS) that have an operation principle similar to GPS. The LPS systems claim to achieve of about 0.3 to 1 m distance measurement accuracy (see e.g. Werb and Lanz, 2000; Sypniewski, 2000), but no details are given on the test results and the achievable accuracy on position fixing. Other indoor positioning systems currently under development include so-called Active Badge or Active Bats Systems (Hightower and Boriello, 2001). These systems are mainly employed for the location of people and finding things in buildings. Also Bluetooth, which has been originally developed for short range wireless communication, can be employed for locating mobile devices in a certain cell area that is represented by the range of the device. It can be employed for location determination using active landmarks. Locating the user on the correct floor of a multistory building is another challenging task. For more accurate determination of the user's position in vertical dimension an improvement might be achieved employing a barometric pressure sensor or digital altimeter additionally (Retscher and Skolaut, 2003).

As an alternative, mobile positioning services using cellular phones can be employed in both environments. Apart from describing the location of the user using the cell of the wireless network, more advanced positioning methods are under development. Most of them are based on classical terrestrial navigation methods where at least two observations are required to obtain a 2-D position fix (see e.g. Balbach, 2000; CPS, 2001; Drane et al., 1998; Hein et al., 2000; Retscher, 2002). The achievable positioning accuracy thereby depends mainly on the method and type of wireless network where accuracies are expected to be much lower in the current GSM[1] networks as in the future UMTS[2] networks. First manufacturer tests showed that a standard deviation of 50 m for 2-D position determination can be achieved using advanced methods in an ideal case. Further investigation on new developments and performance test results is especially required in this field.

2.2 Integrated positioning

For guidance of a pedestrian in 3-D space and updating of his route, continuous position determination is required with positioning accuracies on the few meter level or even higher, especially for navigation in buildings in vertical dimension (height) as the user must be located on the correct floor. The specialized research hypothesis of this work package in the project NAVIO is that a mathematical model for integrated positioning can be developed that provides the user with a continuous navigation support. Therefore appropriate location sensors have to be combined and integrated in a new multi-sensor fusion model.

Selection and test of appropriate location sensors

Newly developed sensors are available on the market which can provide various level of accuracy for position determination in navigation applications (see e.g. Ellum and El-Sheimy, 2000). Due to the obstructions of satellite signals in urban environment (Mok et al., 2000), a methodology has to be developed for position estimation under insufficient satellite availability condition. Besides a GPS or DGPS (Differential GPS) receiver other low-cost navigation sensors have to be integrated into the system design. It is proposed that at least the following relative dead reckoning (DR) sensors should be included: an attitude sensor (i.e. a digital compass) giving the orientation and heading of the person being navigated in combination with an inertial tracking sensor (e.g. a low-cost Inertial Measurement Unit IMU) including a three-axis accelerometer also employed for travel distance measurements as well as a digital barometer (i.e., barometric pressure sensor) for height determination (Retscher and Skolaut, 2003). Their performance and suitability has to be analyzed in detail.

For indoor positioning various technologies are currently being developed or in the development stage (see e.g. Hightower and Boriello, 2001). Further investigation concerning their suitability, accuracy potential and error budget is yet not addressed in detail. In addition, mobile phone location services should be employed. Depending on their availability a comparison with other technologies is required and further investigation on their suitability, reliability and accuracy potential is necessary.

Development of a Multi-sensor Fusion Model

A Kalman filter approach is particular suited for the integration and sensor fusion in real-time. Extending basic filter approaches, a centralized Kalman filter approach which integrates all observations from the different sensors will be developed. The model must be able to make full use of all available single observations of the sensors at a certain time to obtain an optimal estimate of the current user state (i.e., position, orientation and motion).

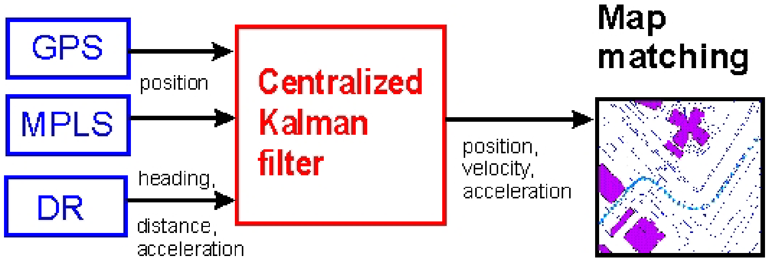

Figure 1: Centralized Kalman filter approach (after Retscher and Mok, 2003)

Figure 1 shows the concept of an approach for the integration of observations of sensors using a centralized Kalman filter. The concept has been introduced by Retscher and Mok (2001) for the integration and combined position determination of observations of

[1] GSM stands for Global System for Mobile Communication.

[2] UMTS stands for Universal Mobile Telecommunication Service.

GPS, mobile phone location services (MPLS) and dead reckoning (DR) sensors employed in vehicle navigation systems. An analysis based on simulations performed by Siegele (2001) has proven that this model is suitable for integration of different sensors in mobile positioning. Apart from the last step, i.e., matching of the positions obtained from the filter to a digital road map, the approach can also be employed in pedestrian navigation. A simulation study for the guidance of visitors of our University performed by Skolaut (2002) showed promising results for the adaptation of the filter model for pedestrian navigation. The algorithm is also open for the integration of other sensors than shown in Figure 1 and for further modification.

An improvement of the accuracy and reliability for position determination should be achieved in the model by integrating all single sensor observations available at a certain time (epoch). It is suggested to derive an extended filter model capable to calculate the user state from all available measurement data, also in the case, if only incomplete observations from a single sensor are available (e.g. if insufficient numbers of satellites for GPS positioning are available due to obstructions). Any single observation can then contribute to improve the previous state of a tracked user by updating the prediction in the filter model. This approach would provide the advantage to estimate the user state recursively also, if an individual positioning method would fail by refining the estimate of the solution using single observations (i.e., GPS pseudoranges, attitude parameters, traveled distance, velocity or acceleration and height difference) together with the observations of other sensors (e.g. in the case of availability range measurements to pseudolits[3], transponders, beacons or base transmitter stations of wireless phone networks). Such an extended Kalman filter approach has been firstly introduced by Welch and Bishop (1997) for an individual positioning method (i.e., an optoelectronic 3-D tracking system) and can be further adapted and modified for our application.

The proposed multi-sensor fusion model will be developed in a way that it is open for the integration of future developed sensors. It has to be implemented in a software package and will be analyzed and tested in detail using simulations and real observations from the senor tests. The model is capable to provide continuous information about the user's position required for the route modelling and updating.

3 PEDESTRIAN ROUTE MODELLING

3.1 Problem and State of the Art of Route Modelling

Existing navigation services are based on technical feasibility instead on user´s needs. They are difficult to use, do not meet the pedestrian's expectations, and can fail supporting human navigation (Chewar and McCrickard 2002, Geldof and Dale 2002). Mostly they optimize single search criteria or even use arbitrarily predefined routes.

An user-centered design approach will exploit the literature on pedestrian wayfinding behaviour and human route communication from disciplines like cognitive science (Freundschuh et al. 1990; Couclelis 1996), psychology (Lovelace et al. 1999), and linguistics (Herrmann and Schweizer 1998). For instance, Werner et al. summarize research for navigation strategies based on route graphs (2000). Denis et al. report on human subject testing for route communication (1999). Similar is done by Fontaine and Denis for complex built environments, especially in the vertical dimension (1999). People use landmarks in mental representations of space (Siegel and White 1975) and in the communication of route directions (Werner et al. 2000, Maaß and Schmauks 1998, Lovelace et al. 1999). Studies show that landmarks are selected for route directions preferably at decision points (Habel 1988, Michon and Denis 2001).

Davies et al. report from experiences with a catalog of route selection criteria in a tour guide (2001). A pedestrian is interested primarily in the shortest route (Golledge 1995). If alternative routes exist that are not too much longer, but show other qualities (e.g., safer, easier, or more interesting), groups of pedestrians prefer to be guided the other routes. The relevant selection criteria of pedestrians need to be identified (Golledge et al. 1998), and their combination in optimal route algorithms needs to be solved. Multi-criteria optimization, as investigated in Operations Research (Martins 1984; Ehrgott 2000), will be investigated for this problem.

There is a lack of a formal model of the diverse results of this literature. Such a formal model would provide a task ontology (Guarino 1998; Smith 1999) of pedestrians (Timpf 2001), or, in this context, of pedestrians navigating in unfamiliar urban environment to a desired destination. The restriction to specific tasks reduces the complexity of modelling the real world and possible users' intentions in this world. A formal ontology (Gruber 1993; Guarino 1995), represented in a functional language, can be checked for consistency and completeness, and can be used to simulate test cases for cognitive relevance and plausibility (Frank 1997; Raubal 2001).

Data provided by data warehouses were not collected for support of pedestrian navigation. It is structured for the physical large-scale space but not for the every-day space (Freundschuh and Egenhofer 1997; Golledge et al. 1998) or city-size spaces (Downs and Stea 1982). If the categorization of the real world into objects is task dependent (Frank 1997; Fonseca et al. 2000), and changes with the task, e.g., from a pedestrian's perception to the perception of a user of public transport (Timpf 2001), then mappings are needed between objects of different ontologies. Moreover, the different tasks of navigation – planning, instructing, moving – require

[3] Pseudolits (short for "pseudo-satellites") are ground-based transmitters at known location which transmit GPS signals.

different models of space (Timpf et al. 1992; Kuipers 2001). The resulting model will be useful to improve (pedestrian) navigation services. Moreover, with a formal approach based on ontology research we pioneer a new approach to modelling services and small GIS in general.

3.2 Route Modelling Ontology

The overall goal of the ontology is a model of pedestrian route modelling, based on the informal and unstructured findings in the research literature on human wayfinding: how do people select and represent routes? The model shall simulate the reported behaviour. The approach is formal ontology design. A formal ontology will identify and define formally the criteria, the actions, and the reference objects used by pedestrians in their reasoning for routes.

The research hypothesis of this work package is based on the idea that pedestrian route selection behaviour and route representation can be simulated successfully. We call a simulation successful if the 'behavior' of the specified model is acceptable for most users, and can easily be realized. The formal ontology, written in a formal language, can be executed and thus, tested for metric and cognitive plausibility. Plausibility of generated routes will be cross-checked with test persons in our use case scenario.

The ontology of pedestrian route selection will identify and define criteria to combine a route. We will develop qualitative and quantitative measures for the criteria that flow into multi-criteria optimization. Partly this work can profit from experience of modelling the generation of hiking trips (Cziferszky 2002, Winter 2002a). Another part of the ontology is the identification and definition of actions in pedestrian movements. This part will be developed by investigating the verbs in human route descriptions. Actions are related to functions and lead us to an algebraic specification of route directions (Frank 1999, Frank 2001). The third part of the ontology consists of the identification and definition of features pedestrians refer to in their mental representation or communication of routes. Here we will profit from our ongoing preparatory work on finding salient features in the urban environment (Raubal and Winter 2002, Nothegger 2002).

We expect that criteria, actions, and reference features will differ for outdoor and indoor navigation. Nevertheless, the commonalities of indoor and outdoor route selection and representation will motivate a hierarchic construction of the ontology. The more abstract level, derived from the common parts, is guiding towards a general ontology of navigation.

4 MULTIMEDIA CARTOGRAPHY ROUTE PRESENTATION

4.1 Problem and State of the Art of Multimedia Cartography Route Presentation

Guiding instructions for pedestrian navigation consist of spatially related information (Downs & Stea 1982). The main elements of guiding instructions for supporting pedestrian navigation are usually resulting from a general routing model (cp.1.2), where routing functions and, optionally, guiding functions along predefined routes can be executed. The main elements derivable from such routing models include starting point, target point, decision points, distances and route graphs (cp. FTW Project C1, 2001). In order to communicate the resulting elements they have to be combined and translated into "communicative guiding instructions". Such a translation has to be seen in the context of the problem of matching a guiding instruction with the reality by the guided person, which is dependent on various influencing parameters, including:

- the user´s task/situation;
- the skills of the guided person;
- the "quality" of the instruction in terms of semantic, geometrical, temporarily correctness or usability;
- the "potential" of the communication mode to transmit the information needed by the client; and
- the technical restrictions of output devices.

So far, such "translations" for the usage on wireless mobile devices are rarely based on user-centered approaches but on technical possibilities of existing mobile clients, using textual modes (Webraska 2001, Mogid 2000) or cartographical modes (EML 2001, WiGeoGIS 2001, Benefon 2001) only. The "validity" of the used modes (especially maps) and knowledge about different enhancements by using additional modes (e.g. images, VR-scenes, audio) or combined sets is aimed at in different projects, e.g. Lehto (2001), Hardy et. al. (2001), Wang et.al. (2001), Reichenbacher (2001), Sorrows & Hirtle (1999), Maaß (1996), Stocky (2002) and Davies et.al. (2001).

The FTW Project C1 - UMTS Application Development (FTW 2000, 2001; Brunner-Friedrich et. al. 2001, Uhlirz 2001), where the Department of Cartography of the Vienna University of Technology takes part in a research group (Forschungszentrum Telekommunikation Wien), has produced first results in this context. As a joined issue of the FTW-project, the development of a prototype of a location-based service for an UMTS environment is in progress. The application "LOL@", a guided tour through Vienna's 1st district, is meant as a service for foreign tourists. The user is guided along a pre-defined route or due to individual input to some of the most interesting places in Vienna's city center, where he can get multimedia (audio and visual) information about the tourist attractions via the Internet portal of the service. The application requires a wireless handheld as input/output device. In order to be able to develop a location based service in an UMTS environment, the project has to deal with four main parts: specifications of technical prerequisites as well as conceptual and method development for localization, positioning and routing, application development and application implementation (FTW 2000). The result (cp. Gartner & Uhlirz 2001, Pammer 2001 or http://www.ftw.at/projektC1_de.html) is based on the objective to develop a running prototype. The objectives defined in the NAVIO project have to be seen as closely adding on / taking advantage of the results of the project "Lol@". This is seen in the context of applying multimedia cartography methodology on the transmission of guiding instructions, which is based on the theory, e.g described in Cartwright et.al. (1999), Buziek (1997) or MacEachren (1995), that Multimedia cartography offers various methods and forms of communicating spatially related information with different potential of information transmission and user interactivity (Gartner 2000c).

4.2 Multimedia Cartography for Route Presentation

Telecommunication technologies developments (like GPRS, UMTS) are conceived to offer a wide range of new multimedia services to mobile users. The cartographic part of the NAVIO project aims at demonstrating the feasibility and efficiency of presenting space-related guiding instructions, derived from integrated positioning methods and pedestrian route models, to support pedestrians navigation by various methods of multimedia cartography. The research hypothesis to be investigated is: a multi-purpose defined selection of multimedia cartography presentations supports the wayfinding and navigation of pedestrians via a guidance system.

Within this hypothesis the evaluation of multimedia supported cartographic communication processes within the context of pedestrian navigation is guided by the idea, that the applying of multimedia on spatial communication processes is an improvement in terms of enabling individualization of interfaces and content presentations (Neuman et.al. 1999, Reichenbacher 2001, Bobrich & Otto 2002) and therefore increases the efficiency of information transmission.

In the context of pedestrian navigation the appropriate presentation form is dependent on the particular user situations and the specification of the user characteristics. It is assumed, that the appropriate form of communicating spatial guiding instructions will include primarily graphical coding and abstracting (maps, other forms), but also other kind of information transmission methods. An aim of the project is the investigation on a criteria catalogue of selecting the appropriate combinations of multimedia cartography presentations forms for particular user situations in the context of pedestrian navigation. A special focus is necessary on the role of active and/or passive landmarks and their derivation possibilities. A further aim is to investigate a suitable concept of deriving a metrical and semantic correct and feasible guiding instruction into different forms of multimedia cartography presentations.

In detail the objectives consist of:

- Identification of appropriate multimedia cartography presentation forms and various combinations
- Investigation of the range of applicability of presentations and/or presentations sets in the context of pedestrian navigation by defining characteristics and context/relation to guiding
- Analysis of range and methods of deriving and/or adapting guidance instructions into various communication forms including the role of determining input (user specifications) and output (device specifications) criterias
- Investigation of possible enhancements to the process of pedestrian guiding by embedding active and/or passive landmarks
- Testing of suitability

5 SUMMARY

The described project is aiming to analyze major aspects being important when concepting a pedestrian navigation service: integrated positioning, multi-criteria route planning, and multimedia route communication. As a result, a specific pedestrian navigation service as use case will derive the requirements on positioning, route planning, and communication. A prototype of the service will guide visitors to institutes and persons at the Technical University Vienna. This prototype will allow evaluating and demonstrating the usability of the service, and thus, prove the projects attempts. However, the focus of the NAVIO project is on developing the methodology such that the prove of the hypotheses, not on product development, is possible. Therefore, we will contribute to the integration of location sensors and seamless transition of positioning between indoor and outdoor areas; the ontological modelling of navigation tasks, deriving well founded criteria and optimization strategies in route selection; and models for context-dependent communication modes of route information; and, in general, to improvements in (pedestrian) navigation services.

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Automatic Vehicle Location Systems

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1 INTRODUCTION

Automatic Vehicle Location Systems are practically based on a combination of GPS, GIS and Telecommunications technologies. They provide vehicle location equipment as well as monitoring of the data transferred by AVL equipment through the telecommunications network (whether private or public).

AVL offers the automatic tracking of moving assets in real time, the display of their position on a digital map and the creation of statistical reports, based on the stored data concerning the location and status of a vehicle. At the same time they offer the display of digital maps (street level) combined with the real position of the 'vehicle' on a monitor within the 'vehicle', in order to assist the driver.

2 HOW DOES THE VEHICLE CALCULATE ITS POSITION?

G.P.S. consists of 30 satellites and 3 supplementary ones that constantly send radio signals containing the exact time and location in relation to the Earth. Knowing the position of three or four of them and by calculating the time gap between the transmitted radio signals, the GPS receiver is able to calculate its geographical position at any part of the Earth.

3 MODE OF OPERATION

The central unit of each vehicle receives signals from the satellites of the GPS system and calculates its position. Then, according to its programming, it sends the data through the telecommunications network to the AVL server, where it is processed and stored. This data is used by the workstations for the display of vehicles on a digital map, which originates from GIS applications. Also, from each workstation it is possible to send data – orders to one or more vehicles, again using the infrastructure of the telecommunications network.

The vehicles and the route of each one are graphically presented on a GIS map. Vehicles can be monitored for any deviation from the assigned route or any suspicious stops or delays. In such cases, the AVL operator can send messages or activate an on-call information signal from any vehicle or pre-selected groups of vehicles or any combination of vehicles that may be of particular importance. "Street level" data are available to the driver, through the coloured touch screen display installed in the vehicle, in a way that does not obscure the driver's view. Reports are also available on a per vehicle basis or for the selected group. Historical data retrieval and graphical display, is also possible, at every AVL Operator Console.

Vehicle information is automatically updated for each vehicle being monitored. The information provided from the vehicle can be real time constantly transmitted upon predefined time intervals. The frequency of transmission can be selected in a way that non-critical information is not flowing over the network.

The architecture of AVL systems comprises of three core elements: the in-vehicle equipment, the AVL Operator Console and AVL Server.

4 IN VEHICLE EQUIPMENT

The in-vehicle equipment consists of:

- Communicator GPS unit
- GPS antenna (covert where applicable)
- Key-fob receiver
- Battery Back up System (included in the central unit)
- Colour Monitor Display
- Panic/Distress button
- Impact Sensor
- Installation Material
- User guide which covers installation instructions

The Communicator GPS unit is covertly installed so that it cannot be distinguished and damaged by any unauthorized personnel. The details of each respective driver are identified automatically and after any unauthorized movement, a movement alarm is transmitted to the operations centre. Other alert data is also transmitted when an alarm situation comes up (i.e. collision, activation of vehicle alarm system etc). An alarm button is also available in the vehicle and may be activated by the driver. The operator can also arm or disarm the vehicle's security system remotely, provided that the security system of the vehicle provides digital input/output for interfacing with the communicator unit. These services can be implemented, by connecting external triggers/sensors to the inputs of the in-vehicle unit. The inputs of the in vehicle unit can be connected to: the car alarm (if available in the car), the ignition of the vehicle, the Panic/Distress Button, the Impact Sensor, enabling the vehicle's status data to be transmitted to the operator. Two of the outputs of the unit, may be connected to the vehicle security system (if available in the car and provided that the necessary digital inputs are available), enabling the operator to arm or disarm it remotely.

5 AVL OPERATOR CONSOLE CAPABILITIES

The AVL Operator console presents information of vehicles that it is currently tracking, displayed in graphical form on a GIS map. The system is flexible, allowing the user to decide on the data to be displayed and the control of the data sent from every car (poll, get log, activate outputs).

The management of vehicles is done from any P/C, which has been installed with the usage software (AVL Operator Console). A username, an access password and an operational personal profile correspond to each user of the system. The profile includes details such as how many vehicles will be visible on the screen and which capabilities will be available (e.g. dispatching of a message to a vehicle, matching of driver to key fob, etc.). Upon logging into the workstation, the real picture of a vehicle's operations becomes available to the user. The capabilities provided by the system to the operators of the workstations are described directly below:

- Vehicle Status is used in order to present the current status and location of all vehicles controlled by the system. Each vehicle will be depicted with a particular graphic symbol and in a colour that represents its status at the time. This status can be one of the following (in motion, stopped, ignition on-stopped, alarm, over the speed limit, battery status). These statuses can be differentiated for each vehicle of a vehicle group (e.g. connection with siren). A window presents the data of those vehicles allocated to each user name and password. The screen appears like a table, presenting one row for each vehicle and in order for this data to change, new data will have to arrive. The vehicles may appear with different colours and this will depend on the reason for which each incident is reported.
- Discovery of a vehicle's location in real time: The vehicle automatically sends information at a predetermined time, which can vary. A suggested rate, which derives from equivalent systems and according to experience, for the predetermined time for data transmission is 2 min. The operator, in the case of an incident, can change this rate. Apart from the automatic transmission of the location and status of each vehicle, depending on the programming of the main unit it is fitted with, it is possible that the location and status are transmitted following an operator's request. In combination with the incidents reported by the vehicle, you can request the location of a vehicle at any time. It must be noted that the vehicle will respond only if its engine is on. If the ignition column indicates that the engine is 'OFF', then it is likely that you will not receive an answer from the vehicle. If you have requested the location of a vehicle and the vehicle's engine is off, then the message you have sent will be forwarded to the vehicle and will be stored. This way you will not have to request its position again. The vehicle will answer as soon as its engine is ignited. You can selectively request the location either of an individual vehicle or of a group of vehicles.
- Search on the digital map: Given that the GIS map provides the relevant information, the program provides the capability to search for streets, pharmacies, theatres, etc.
- Background report on a vehicle's itinerary in relation to the points of interest, which may be either predetermined on the GIS map, or defined by the user. In other words, it is possible to discover if a vehicle passed by a certain point on the map. The background feature is used in order to present the background of each vehicle. The window will only present the vehicles corresponding to certain usernames. We select the vehicle, and right-click on the vehicle we want. By choosing current background we are able to view the background from one day to one week. By selecting background period we are able to view the background of the particular vehicle for the time period we desire. By selecting route representation on the map the following window appears:

By pressing PLAY the positions of the vehicle whose background was requested, along with the information concerning the time and date, start to appear on the GIS map.

- Time in motion, kilometres covered and duration of stops during the selected itinerary for the particular vehicle.
- Location of the vehicle closest to a selected point of interest.
- Location of the point of interest closest to a selected vehicle.
- Checking of a vehicle's status: in motion, stopped, ignition on – stopped, alarm, over the speed limit, battery status.
- Transmission of a text message to the vehicle appearing on the vehicle's terminal screen (e.g. VHF radio).
- Automatic briefing on important events (panic button, alarm, collision, non-authorised driver). In the case where such an incident is received, a pop-up window containing details about the incident informs the operator.
- Monitoring of a vehicle's itinerary with the use of a continuous line or of dots.
- Selection of vehicles that are to be displayed on the map (filtering per vehicle group – according to the groups that can be created during the system configuration phase).

Plate 1: Route Representation Window

6 GENERATION OF REPORTS

AVL produces detailed reports, which analyse vehicle activities. These reports are available to the workstation operators that have the necessary access rights.

The reports are produced for a specific vehicle or vehicle group. Following is a detailed list of the reports:

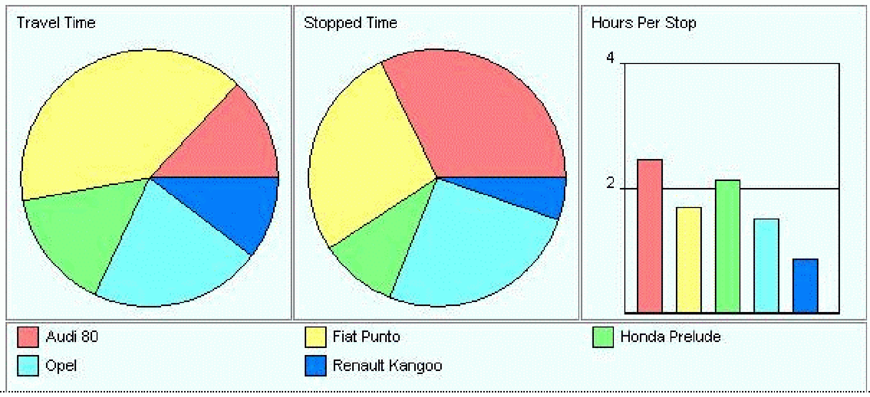
6.1 For vehicle groups

- Time Summary Reports
- In this particular report we can see:

Total travel hours
Total stopped hours
Total Hours
Total stops
First start time (Daily average)
Last stop time (Daily average)
Travel hours (Daily average)
Stopped hours (Daily average)
Total hours (Daily average)
Stops (Daily average)
Hours per stop (Daily average)

Plate 2: Time Summary Report Example

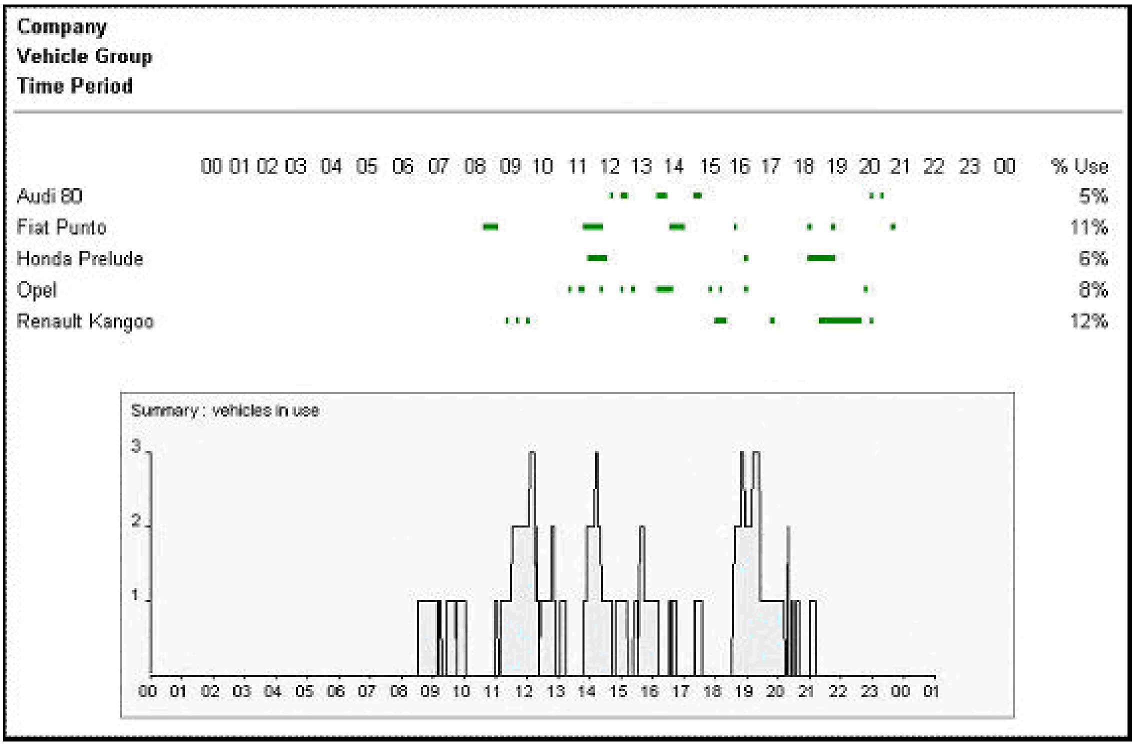
					Daily Average						
Mobile	Total Travel Hours	Total Stopped Hours	Total Hours	Total Stops	First Start Time	Last Stop Time	Travel Hours	Stopped Hours	Total Hours	Stops	Hours per Stop
Audi 80	7:39	86:48	94:28	41	08:27	21:56	01:05	12:23	13:28	5	02:28
Fiat Punto	23:31	72:39	96:10	46	07:24	21:57	03:21	10:22	13:43	6	01:43
Honda Prelude	8:55	25:58	34:54	14	10:18	19:02	02:13	06:29	08:42	3	02:09
Opel	12:44	69:17	82:01	46	08:34	21:54	02:32	13:51	16:23	9	01:32
Renault Kangoo	6:08	14:21	20:30	16	09:07	19:14	03:04	07:10	10:14	8	00:53
Total	**58:59**	**269:05**	**328:04**	**163**							
Average	**11:47**	**53:49**	**65:36**	**32**	**08:46**	**20:48**	**02:27**	**10:03**	**12:30**	**6**	**01:45**



- Fleet's Daily Usage Report

With the fleet report, by selecting a date, we can see the movement of all vehicles during those particular 24 hours.

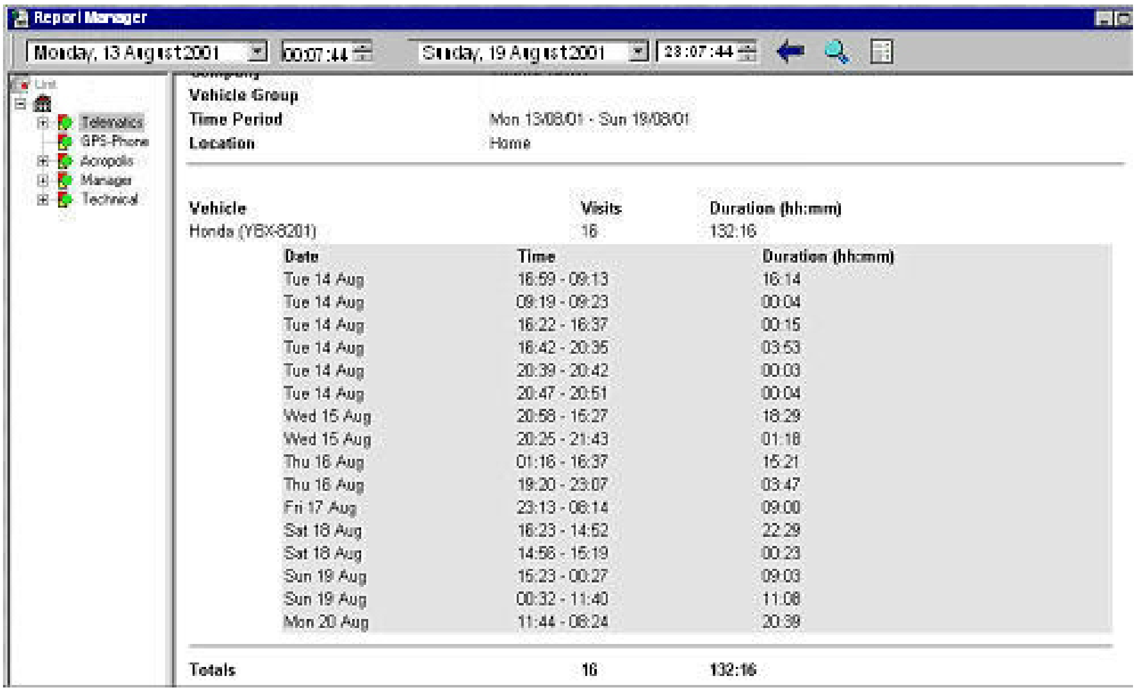
Plate 3: Fleet's Daily Usage Fleet Report Example



- Collective Weekly Work Report
- Visitability Report

By selecting FLEET VISIT we can see the visits made by the fleet to a point of interest.

Plate 4: Visitability Report Example



Vehicle Group
Time Period Mon 13/08/01 - Sun 19/08/01
Location Home

Vehicle	Visits	Duration (hh:mm)
Honda (YBX-8201)	16	132:16

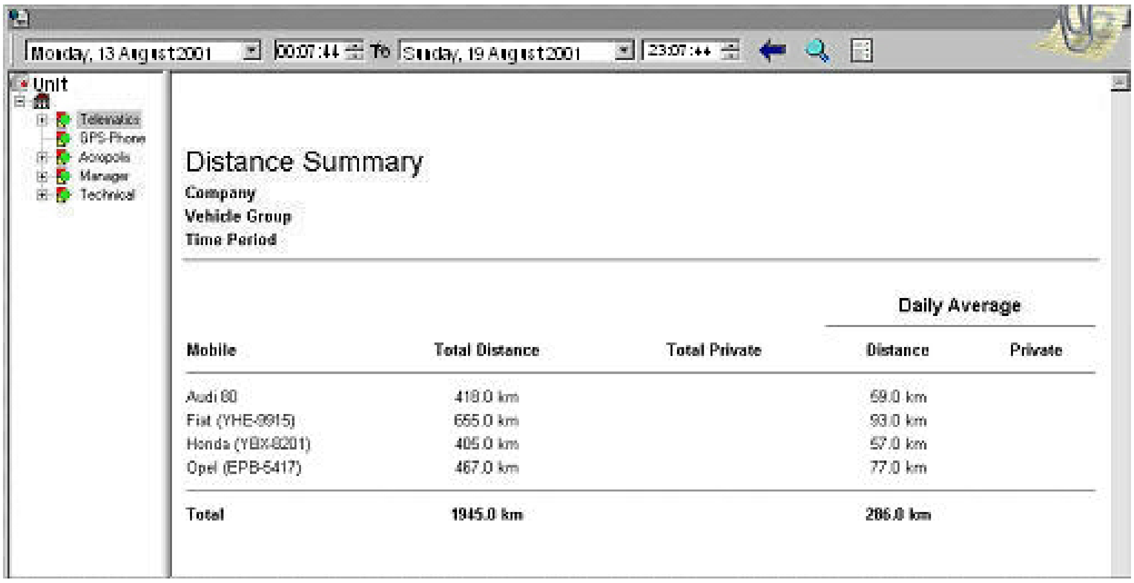
Date	Time	Duration (hh:mm)
Tue 14 Aug	16:59 - 09:13	16:14
Tue 14 Aug	09:19 - 09:23	00:04
Tue 14 Aug	16:22 - 16:37	00:15
Tue 14 Aug	16:42 - 20:35	03:53
Tue 14 Aug	20:39 - 20:42	00:03
Tue 14 Aug	20:47 - 20:51	00:04
Wed 15 Aug	20:58 - 15:27	18:29
Wed 15 Aug	20:25 - 21:43	01:18
Thu 16 Aug	01:16 - 16:37	15:21
Thu 16 Aug	19:20 - 23:07	03:47
Fri 17 Aug	23:13 - 08:14	09:00
Sat 18 Aug	16:23 - 14:52	22:29
Sat 18 Aug	14:56 - 15:19	00:23
Sun 19 Aug	15:23 - 00:27	09:03
Sun 19 Aug	00:32 - 11:40	11:08
Mon 20 Aug	11:44 - 08:24	20:39

Totals	16	132:16

- Weekly Report on Distance Travelled

By selecting DISTANCE SUMMARY REPORT we can see the total number of kilometres travelled by all vehicles in a week.

Plate 5: Distance Summary Report Example



Distance Summary
Company
Vehicle Group
Time Period

Mobile	Total Distance	Total Private	Daily Average Distance	Daily Average Private
Audi 80	418.0 km		59.0 km	
Fiat (YHE-9915)	655.0 km		93.0 km	
Honda (YBX-8201)	405.0 km		57.0 km	
Opel (EPB-5417)	467.0 km		77.0 km	
Total	1945.0 km		286.0 km	

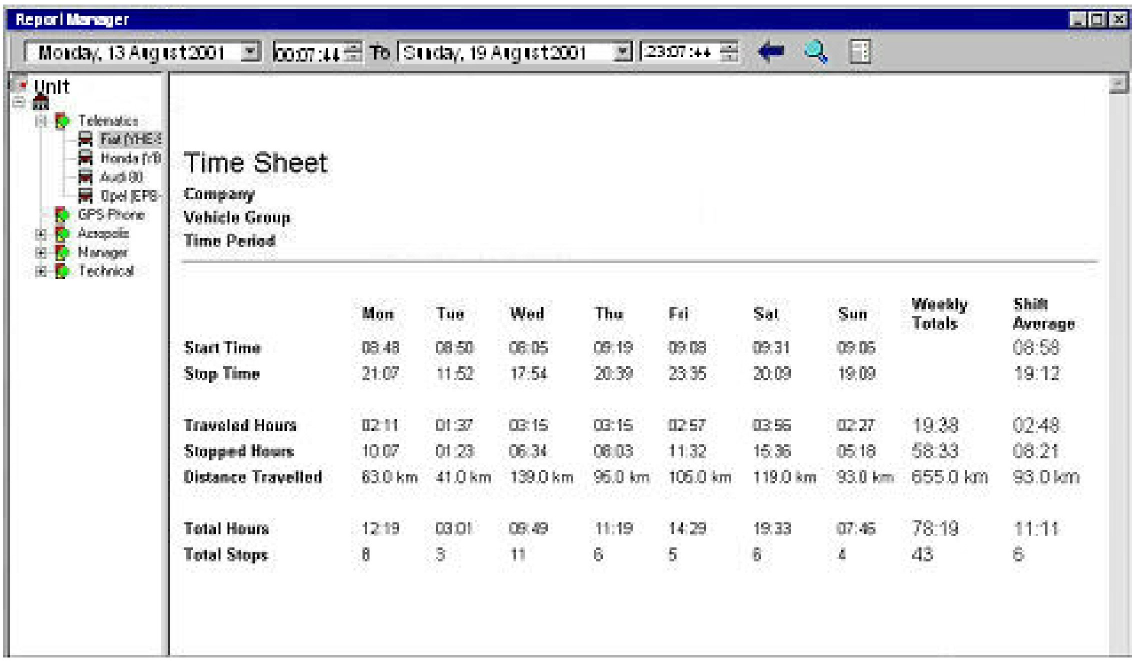
- Log on to the system Report

6.2 For a particular vehicle

- Time Sheet Report

By selecting a TIME SHEET REPORT we can see the schedule and kilometres travelled by a vehicle during a week.

Plate 6: Time Sheet Report Example



Time Sheet
Company
Vehicle Group
Time Period

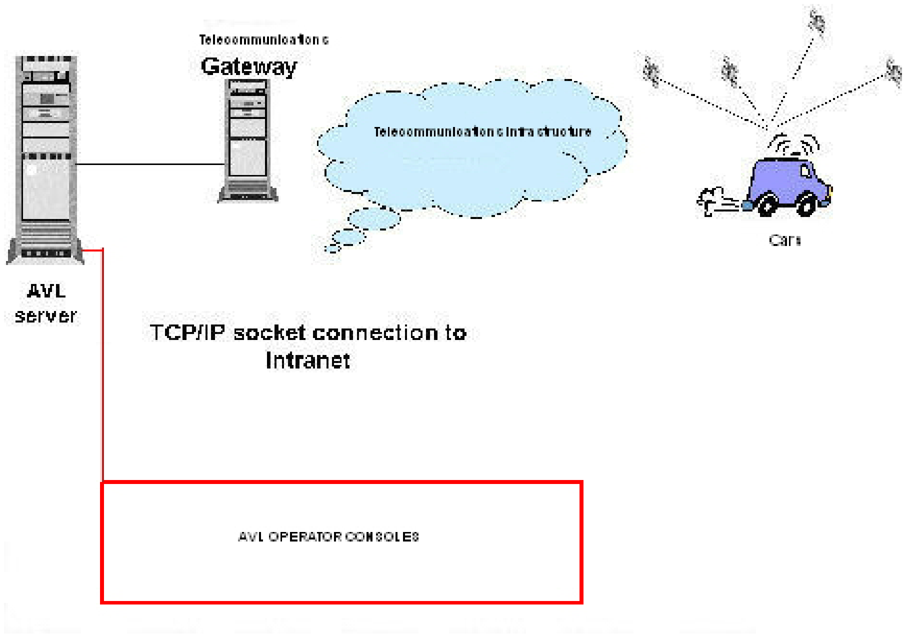
	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Weekly Totals	Shift Average
Start Time	08:48	08:50	08:05	09:19	09:08	09:31	09:06		08:58
Stop Time	21:07	11:52	17:54	20:39	23:35	20:09	19:09		19:12
Traveled Hours	02:11	01:37	03:15	03:15	02:57	03:56	02:27	19:38	02:48
Stopped Hours	10:07	01:23	06:34	08:03	11:32	15:36	05:18	58:33	08:21
Distance Travelled	63.0 km	41.0 km	139.0 km	96.0 km	106.0 km	119.0 km	93.0 km	655.0 km	93.0 km
Total Hours	12:19	03:01	09:49	11:19	14:29	19:33	07:46	78:19	11:11
Total Stops	8	3	11	6	5	6	4	43	6

- Stops Report
- Activity Report
- Geographical Points of Interest Report

7 AVL SERVER

The AVL server can be connected to the telecommunications network through a TCP/IP protocol connection. The server and data storage system are responsible for parsing information from the vehicles and distributing it to the AVL Operator console.

Plate 7: AVL System Structure



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Presenting a Potential Bus Rapid Transit Line with GIS, Analytical Models and 3D Visualization

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ABSTRACT

Cincinnati is a typical American city where private automobiles are the primary means of transportation. It is not hard to envision the future of serious traffic tie-ups. Adequate mobility is a key factor for improving the residents' life quality and consequently the prospects for economic development. The two options are 1) adding more highways and 2) improving mass transit. Within this context, this paper presents a study that uses information technologies to help explore if a mass transit can be a valid alternative for Cincinnati. In particular, the research team explores the effect of a potential Bus Rapid Transit (BRT). Although BRT has been implemented in many cities around the world, it has not been proposed in this region. To help people understand the impact of a BRT the research team uses a combination of Geographic Information Systems (GIS), simulation models (SM) and 3-dimensional visualization (VIS) to present the current and future scenarios related to a potential BRT along a previously proposed bus line in terms of traffic flow and air pollution related to automobile emissions. The value of such a system as an information communication tool in planning processes is discussed from its spatial, temporal and visual realistic aspects.

1. INTRODUCTION

As the concept of sustainable development and the need for public involvement in planning of diverse groups become more widely accepted among politicians, policy-makers and the general public, it is critical to incorporate impact assessment and analysis into the planning and decision-making process. During such a process, all stakeholders in a region, including public/private organizations and residents should work together to analyze, compare, contrast and prioritize different development alternatives for a sustainable future (Smith, Blake, & Davies, 2000; Wang, 2001). Planners, in particular, have the responsibility of accurately and realistically presenting future consequences of proposed actions to all stakeholders. The ability of selecting and presenting information to support decision-making is an integral part of such a process (Halls, 2001). Applying information technology will enable planners to collect and analyze data to effectively design, simulate and present future scenarios using computers before the building phase. Such presentations are important to enable people to envision the future consequences of a proposed development in order to build a consensus among stakeholders and to formulate appropriate proactive measures. This paper presents an effort toward the integrated use of three specific components of information technology – Geographic Information Systems, simulation models and computer visualization to support this planning process. The goal is to enable policy makers, planners and citizens to better understand the impact of a potential Bus Rapid Transit. Visualization features of such a system can present scenes of the present and future. The work reported here demonstrates the advantage of the integration and challenges faced in such integration through a prototype application.

GIS applications have been used to quickly and reliably process spatially referenced data as a decision support tool (Badard & Richard, 2001; Dangermond, 1989; Lee, 1990; Worrall, 1990). Many research projects have explored the potential of using GIS to store spatial data, to perform interactive spatial analysis, to sketch a city and to display data and modeling results through maps and tables (Singh, 1999; Shamsi, 1996; Grossmann & Eberhardt, 1993; Wang,1997; Batty et al., 1999; Gahegan & Lee, 2000; Bailey & Gatrell, 1995).

Various simulation models have been used in planning practices. For example, surface and subsurface water models are used to address resource and environmental issues (Darbar et al., 1995; Cowen et.al., 1995; Merchant, 1994; Smith & Vidmar, 1994; Warwick & Haness, 1994; Tim & Jolly, 1994). Another set of models commonly used in planning simulates the interactions between land use and transport to connect economic activities in space with accessibility and; demands and supply for flows (Barra, 2001). In general, simulation models provide the information necessary for analysis and evaluation between planning alternatives (Putman & Chan, 2001).

The importance of computer visualization for planning practice lies in its potential for improving the quality of decision-making. The physical nature of planning practice demands that three-dimensional images should be used to evaluate the effects of planning that takes place in space. Recent efforts demonstrate that 3D models can be used to visualize and quantify abstract policy and planning simulations (Kwartler & Bernard, 2001; Batty et al., 1999, Ranzinger & Gleixner, 1997). A visual representation should help to avoid misunderstandings of the consequence of development (Hall, 1993). In other words, the future can be presented graphically and evaluated as the base for discussing different planning alternatives. Martin and Higgs (1997) suggest two areas of visualization applications in planning: representations of physical environment and the abstract statistical relationships. In both cases, the use of 3-dimensional (3D) models provides certain degree of realism that can help viewers link data to a particular physical setting.

Although planners use GIS, simulation models and 3D visualization in various projects, the development of each has been primarily independent and integrative uses are still at an early stage. Langendorf (2001) argues that it is necessary to analyze the world from multiple viewpoints in order to understand any subject of consequence. In the following sections, current approaches to integrate GIS, simulation models and visualization are first reviewed, then a prototype of such integration, using traffic impact analysis as an example is presented. Lastly, the needs, benefits and challenges for such an integrated system are discussed.

2. STUDY AREA

After a decade long effort for a light rail system in Greater Cincinnati, a proposal to raise a half-cent sales tax to help pay for a $2.7 billion transportation plan was put on the Hamilton County ballot, known as Issue 7. It would be used for a network of five light rail lines, expansion of its bus system, construction of 30 transit hubs, addition of 13 neighborhood shuttles running from those hubs, streetcar lines along the downtown riverfront, direct bus routes to the University of Cincinnati and the medical complexes around it. Issue 7 encountered sharp, well-organized opposition, which resulted in a defeat by a ratio of more than 2-to-1. The centerpiece of the cause of most of the controversy was a 60-mile, $2.6 billion light-rail system. Transit officials expected the sales-tax hike to raise about $60 million and pay for about 25 percent of the plan. The plan then called for the federal government to cover half the cost and the state to cover 25 percent. One of the major concerns was about the lack of a binding commitment to roll back the sales tax if the light rail portion doesn't win adequate state or federal funding.

Many believed that the only thing keeping light rail from coming to the area was the lack of a local funding source. The last proposal to the federal government for a light-rail line along Interstate 71 received a passing grade on all aspects of the plan except local funding from the Federal Transit Administration. That forced the agency to give a "not recommended" rating overall.

Rejecting Issue 7 does not solve the need for a better public transit in Cincinnati. It is not hard to envision the future of serious traffic tie-ups - the fact that a rainy day can double the commuting time ought to give people an idea of what lies ahead. Adequate mobility is still a key factor for improving the quality of life of residents and consequently the prospects for economic development.

One alternative is to add more highway lanes and more highways. Expanding the highways is expensive and will pave over a lot of real estate that homeowners, business owners, etc., would be loathe to give up. Furthermore, experience in other cities has shown that it may not work. Atlanta tried to build its way out of traffic jams with highways. It didn't work.

The other alternative is to reconsider the mass transit option. People predict that the defeat of Issue 7 will put mass transit planning on ice for several years in Cincinnati. Cincinnati will remain one of the largest cities in the world without a single mile of any form of rail transit. This study will help to explore if a mass transit without light rail can even be a better alternative for Cincinnati.

3. THE MODELING AND VISUALIZATION STUDY

An effective planning support system can significantly enhance the collaboration among stakeholders and facilitate agreement on the most appropriate alternatives. To achieve these goals, such a system ought to be used by stakeholders with diverse backgrounds, interests, and knowledge to analyze and evaluate, both effectively and accurately, development alternatives. The integration of GIS, simulation modeling, and visualization is expected to greatly enhance the analytical capabilities of GIS-based spatial decision-making through a three dimensional format. The net effect will be to improve both the decision-making process and communication among planners, decision-makers and the various groups comprising the public; as well as to encourage citizen participation through graphical presentations that are familiar and easy to understand.

Mitigating congestion and estimating pollution emission are always primary issues faced by transportation planners. Understanding traffic conditions and pollution levels from different scenarios is indispensable in the traffic planning and decision making process. The significance of an integrated traffic impact analysis system is related to using best available technologies to analyze spatial data and predict and present future scenarios and changes. Planning alternatives are to be evaluated and presented using various methods, including numerical data tables, two- and three-dimensional maps and images, and three-dimensional animations.

Two analytical transportation models were used in this study to predict the traffic conditions and hourly Carbon Monoxide (CO) concentration levels. Both models are applied to street segments called free flow links. A free flow link used in travel demand modeling is defined as a straight segment of roadway having a constant width, height, traffic volume, travel speed and vehicle emission factor. The coordinates of the two end nodes, (X1, Y1) and (X2, Y2) determine the location of a free flow link. Data used in this study, provided by the Ohio Kentucky Indiana Council of Governments (OKI), included street link-based traffic count data for 2002 in the Greater Cincinnati Metropolitan Area.

One of the most widely used models to predict link-based travel speed, the standard BPR curve model (Dowling, 1997), was coded with Visual Basic Application as part of the ArcMap application. From the model output, the time taken for a car to pass a street link is calculated from the link length and travel speed. Multiplying the time and volume will get the number of cars per link.

The concentrations of Carbon Monoxide along streets are calculated with CAL3QHC model (Version 2.0), developed by the U.S. Environmental Protection Agency (USEPA, 1995). The inputs for CAL3QHC include roadway geometries, receptor locations, meteorological conditions and vehicular emission rates, among which meteorological variables are assumed to be spatially constant over the entire study area. Vehicles are assumed to be traveling without delay along free flow links. The link speed represents the speed of a vehicle traveling along the link. The CO concentrations are measured at receptors specified in X, Y and Z coordinates. A vehicle Emission Factor table was obtained from OKI that contains emission factors for nine vehicle types and a Composite Emission Factor (CEF) for all vehicle types at different travel speeds.

GIS was used to manage a digital database and to connect to visualization and simulation models. Several GIS operations were performed with ArcGIS 8.3, product of the Environmental Systems Research Institute (ESRI, Redlands, CA). In order to represent the geometry of streets more accurately than the straight-line roadway links used in the simulation model, street data were acquired from CAGIS, a local organization maintaining high quality data. Receptor locations were created as a point coverage.

The source codes of the CAL3QHC program downloaded from the USEPA website was in Fortran language. The codes were translated into Visual Basic for Applications (VBA), in the format of a Class Module, which can be used in ArcMap directly. Several improvements were made to the original model.

- The Fortran model can only calculate a fixed maximum number of 120 links and 60 receptors. To remove this limitation, we introduce the dynamical memory allocation in the program. With this approach, we are able to model a much larger number of street links and receptors. The model analyzes 100 receptors at a time, during which the program collects all information for the 100 receptors and generates an XML file of "in.xml", which provides all data needed by the model. Then the Class Module will read this XML file and export another XML file of "out.xml", as well as a text file of "out.txt". "out.xml" provides the same information as the output text file in the old version of model. "out.txt" gives a comma-separated table of receptor ID, coordinates, and CO values. At the end of each run, the "out.xml" and "out.txt" will be appended in specific XML and text files respectively.

- To operate the original model, a user must prepare an input file, which is a text file using the punch card style of data lines. To make the data preparation more efficient and user friendly, we develop a toolbar of the air quality model in ArcMap for user input control. After clicking a button, a user sees a User Data Entry Form whic is the main interface of the program (Figure 1). From the form, a user can set the input parameters. The original model only can run one set of receptor height, the modified model has the option of running many different heights, as specified the lowest and highest height and the elevation increment. For the wind direction, a user may choose to calculate for one wind direction or calculate the 360 degrees with a specified direction increment. In addition, a user may specify the unit for distance, the pollutant type. All output files are saved under the folder named by the user.

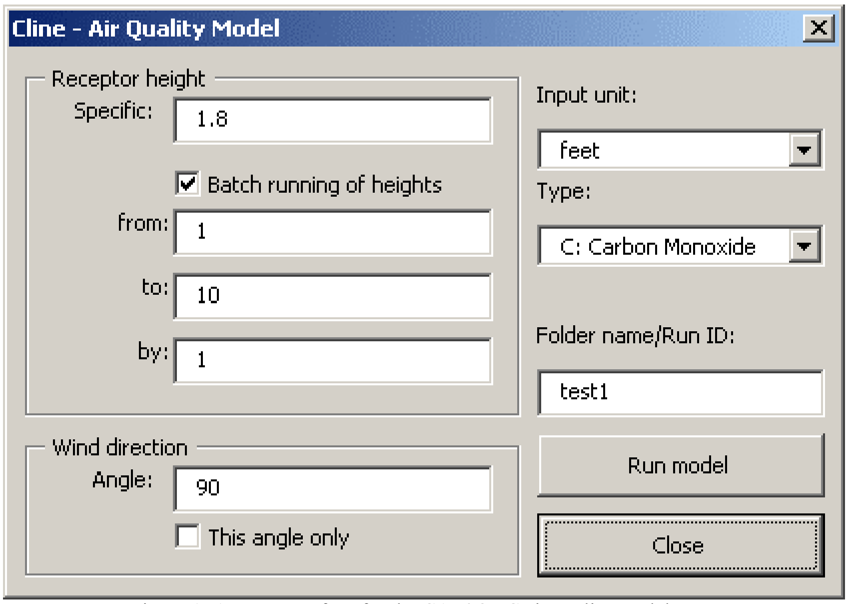

Figure 1: A User Interface for the CAL3QHC air quality model

Normally, the automobile generated carbon monoxide (CO) concentrations would be displayed as a color thematic map, such as color coded mesh points or concentration isolines. Using the simulated receptor CO concentration as the z value, we created a 3D surface with the GIS 3D surface construction function for each modeling output. Figure 2 displays such a concentration surface created from a CO concentration model output. The z value of the surface is replaced with Carbon Monoxide concentrations. Street segments that are experiencing high level of CO concentration can be identified and highlighted, which allows the system's users toquickly prioritize their problem-solving effort in searching for alternatives to minimize air quality degradation.

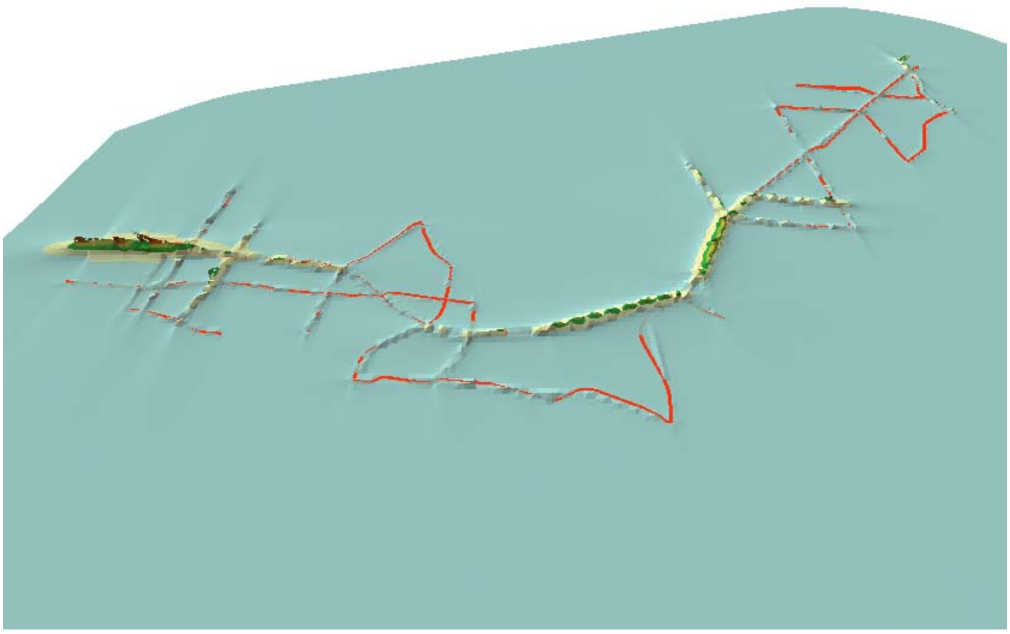

Figure 2: Surface of carbon monoxide concentration

Following Shiffer's (1999) idea of using digital video clips taken at various Level of Service (LOS) conditions to represent traffic at a given LOS, we created a series of animations based link-based automobile density and travel speed produced by the simulation model. Figure 3 shows an example of the animations for the entire BRT line, which is about 8 kilometers. We used the aerial photos as the background, the potential BRT line was highlighted as the red line. The yellow line indicates the half of a mile distance from the bus line. The buses are shown as gloring points. The brighter points represent the rapid buses traveling at both directions. The buses travel at predetermined speeds to represent different scenarios. We have identified 12 bus stops along the BRT line. The buses stop for 1 minute at each bus stop.

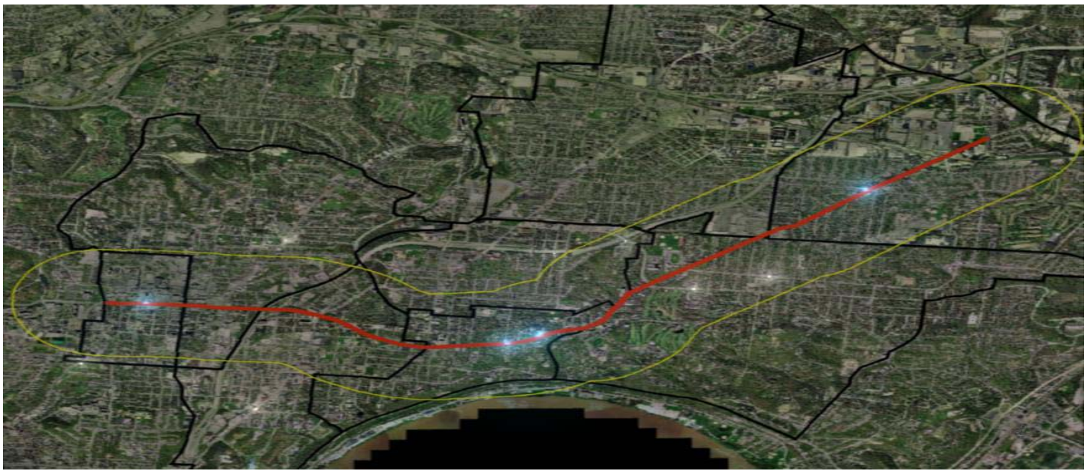

Figure 3: The animation of a potential Bus Rapid Transit line

Figure 4 is an example of the animation of as a bird view of a few blocks. From such animation, the rapid buses and other automobiles are animated to demonstrate the traffic conditions. A viewer can use animations at this scale to examine a segment of the bus line in order to understant the traffic conditions at different scenarios.

The third type of animation takes a viewer to the block or intersection level. At this level, detailed models of the background, such as buildings, streets and trees are created as 3D models. The automobiles are also shown with details (Figure 5). Viewers are more likely to tie the scene with their real life traffic experience.

These animations represent an effort to widen audiences and support space-time analysis (MacEachren et al., 1994; Openshaw et al., 1994). The significance of these animations is that one can easily see how does a BRT line interact with other transit lines and private automobiles and contrust and compare traffic conditions at different scenerios.

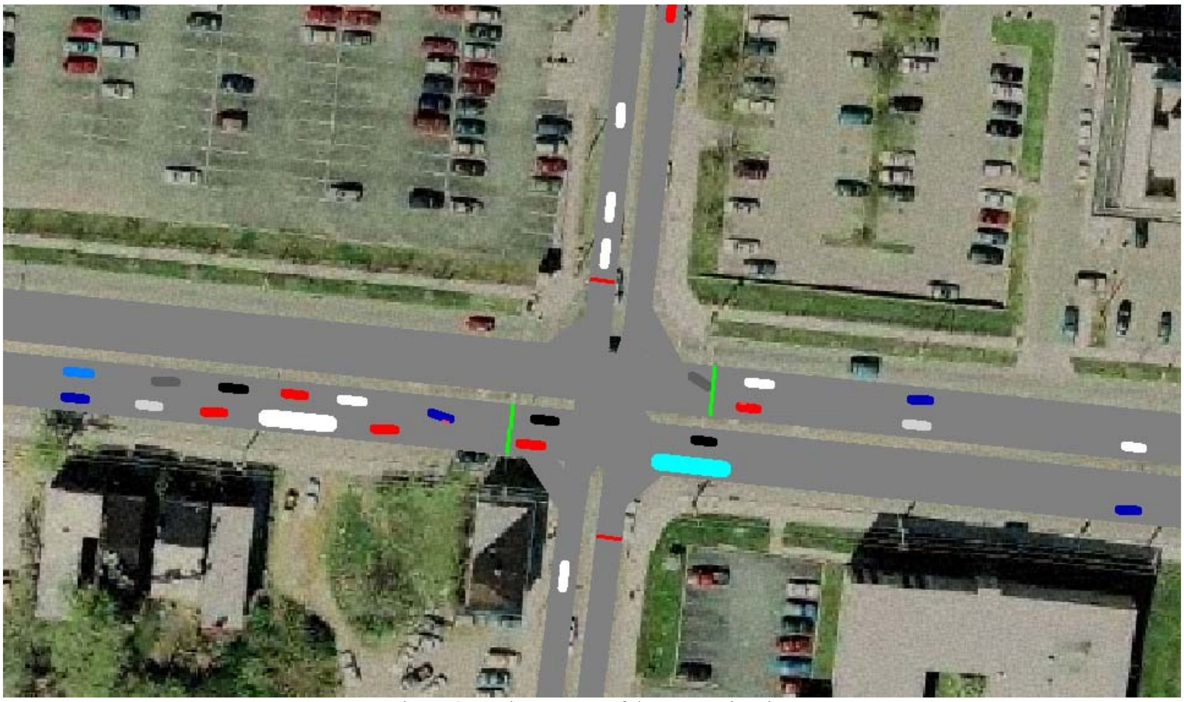

Figure 4: A closer scene of the BRT animation

4. DISCUSSION

Actions that modify the built environment often lead to significant and irreversible impacts, therefore it is crucial for people to understand the anticipated consequences of proposed changes before a decision can be made. The most important purpose of integrating GIS, simulation models and visualization is to support such decision-making processes.

This study presents an effort to integrate GIS, simulation modeling, and visualization in order to help the planning and decision-making process. Simulaiton models – the BPR traffic model and the CAL3QHC model are implemented as part of the GIS platform through a customized user interface. The visualization functions provided with GIS software were also used to construct CO concentration surfaces,. We also used GIS functions to create the points representing receptors with specified distance intervals and to establish node-line topology for roadway links. We created 3D models of highway segments and buildings with Maya, a software application widely used in the visualization industry (Alias Wavefront, Toronto, Canada) and Vissim, a traffic annimation software (Innovative Transportation Concepts, Corvallis, OR, USA), based on GIS data and field observations. To reflect traffic flows, animations were created manually based on the BPR model output, using the MEL scripting language in Maya.

Figure 5: A street level anamination

Although technologies have provided a solid foundation for such integration, none of the off-the-shelf commercial software alone has sufficient functions across all three areas. Moreover, they are often prohibitively expensive and require a significant investment in time to master. This is not currently as easily achievable as we might anticipate. The types of smoother integration and closer coupling that would improve accessibility and uptake still requires more effort from researchers and software vendors, in all three fields.

The most challenging effort is to integrate simulation models and visualization within a GIS platform. There is still no commercial software available for such integration. Some are capable of converting a GIS data file into a format that can be visualized. Geometry is the only thing can be retained during the process. As a result, analysis and presentation are operated separately. This is the case presented in this paper. In the analysis component, GIS, simulation modeling, and visualization are collectively used to prepare outcomes of planning scenarios. The presentation component combines GIS and visualization features to link maps, modeling results, and 3D images and animations. This two-phase design provides a practical tool to planners since current technology is not ready for preparing real time simulation and animation. To use this system as a planning decision support tool, an analyst would prepare maps, images, and animations for different planning scenarios. Any stakeholders can operate the presentation system to assist their decision-making.

Built upon Martin and Higgs' (1997) classification of visualizing physical characteristics and abstract statistics, researchers have tried to bring these two together. The study presented here provides one of such examples. This study has been primarily designed to illustrate the potential and importance of the integrated system that saves the simulation model output into a GIS database and displays the results with visualization tools. The outcome from such study can be an interactive tool for planners and decision makers to review the modeling outputs and GIS data with maps and 3D scenes.

5. CONCLUDING REMARKS

A review of the literature reveals that while there is a long history of using GIS, simulation models and visualization in various planning related research and practice projects, integrated applications are a more recent phenomenon. In addition, such integration is often between any two of the three, such as GIS-simulation modeling, GIS-visualization, or simulation modeling-visualization integration. Recently, with the advance of computer technologies, especially the dramatic improvement of computer hardware and software, GIS, simulation models and visualization have become more accessible to planners. However, a true three-way integration is still elusive.

An integration of all three technologies will provide solid support for planning and decision-making. When simulation modeling results are displayed by a combination of maps, images and animations, with geographical data in addition to tables, more people may be able to understand the consequences of plan and design alternatives. In addition, 3D visualization may enable the detection of potential errors of simulation results which are hard to achieve with tables and 2D maps.

The objective of study presented here is part of a long-term goal that applies information technology in planning. Such an objective is achieved by developing a system that is able to utilize the current data collected by planning agencies and various government agencies to evaluate highway projects with computers before the building phase. In a city with a controversial light rail alternative, the model simulations and 2- or 3-D presentations and animations of traffic conditions, with or without a BRT, can provide a contrasting view that residents and policy makers need to see before they can take a stand on the issue. With such a system, people will be able to actually evaluate traffic conditions and related CO concentrations from the simulations. It will give planners and citizens a better understanding of how a major construction project will impact their community. This will, hopefully, foster a sense of collaboration between stakeholders.

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Civic Networks of the Srem District – Overcoming or Indicating the Digital Divide?

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1 INTRODUCTION

The phenomenon of digital divide has been examined recent years from many different viewpoints. There is still a variety of definitions and a range of propositions for its examination and measuring. According to the OECD reports: "digital divide refers to the gap between individuals, households, business and geographic areas at different socio-economic levels with regard both to their opportunities to access information and communication technologies and to their use of the Internet for a wide variety of activities". Civic networks are regarded as one of such activities, where the Internet has been used to reflect civic life of the particular region.

Measuring the digital divide is mainly based on comparative statistics, primarily in an international context. In this paper, results of qualitative observations of the civic networks are considered as a possible indicator of the digital divide overcome in a regional context.

2 STATISTICAL INDICATORS OF DIGITAL DIVIDE IN SERBIA

In Serbia, it is still not possible to measure more precisely the effects like digital divide because of a lack of relevant detailed statistical information, but there are some observations, data and estimations published out of official statistical institutions:

Fixed plus mobile telecommunication paths - There is 2 700 000 fixed telephone lines in Serbia and 1.5 million users of the mobile telephony. Considering the fact that there are 10 million inhabitants in Serbia this gives about 23 fixed and mobile access paths per 100 inhabitants. Compared with the OECD countries (Figure 1) it is one third of the OECD average and three times more than Non-OECD average.

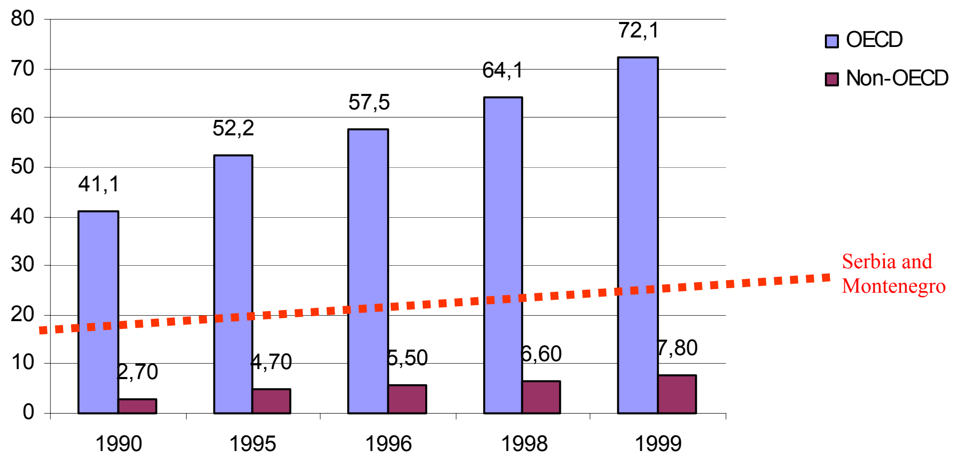

Figure 1 Fixed plus mobile telecommunication access paths per 100 inhabitants in Serbia and Montenegro compared with OECD and non-OECD countries (source OECD, 2002)

Internet access – Serbia and Montenegro has been (re)connected to the Internet in February 1996 via the academic links. In next couple of years, numerous providers appeared offering different Internet based services. "The history of Internet in Yugoslavia begins in 1996 when the Yugoslav Academic Network was connected to the Internet through the provider BeoTelNet. All Internet services became available to users in Yugoslavia, but the user population was confined to academic circles (faculty and scientific institute associates). That very year, first national providers operating on a commercial basis started working, making Internet available to non-academic users as well. As early as 1997, the first scientific conference on Internet was held (SITJ, 1997). By 2002, the number of Internet providers had risen to 60. The major ones are Eunet (http://www.EUnet.yu, capacity of terrestrial link – 34Mbs, capacity of satellite link – 45Mbs), in private ownership, and PTT Srbija NET (http://www.ptt.yu, capacity – 16Mbs), in state ownership (Figure 3, left). Seventeen magazines oriented towards computer and Web users are being published (the best one is *Svet kompjutera*, http://www.sk.co.yu), some ten odd search engines are in operation (most thorough, most popular and most efficient being Krstarica, http://www.krstarica.com.yu), while the number of registered domains rose to 13 thousand in April 2002. In relation to the size of its population, according to the aforesaid index, Yugoslavia lags behind Slovenia and Croatia, is slightly ahead of Macedonia and considerably ahead of Bosnia and Herzegovina (http://www.yutrend.com, 2002)." (Bacevic, 2003).

At the moment the Internet is accessible via modem connections from any place equipped with phone lines. Individual users of the Internet are charged approximately 0,3 € per hour plus phone call prices, which is still quite expensive comparing with average incomes. For a limited number of users in certain urban areas (Berlgrade) the Internet is accessible via cable connections and some experimental wireless services are started to appear as well.

According to some recent estimations, **number of the Internet users** in Serbia ranges from 300 000 (Jovanovic, 2002) to 500 000 (Jokanovic, 2002), where more of a half uses the Serbian Academic network.

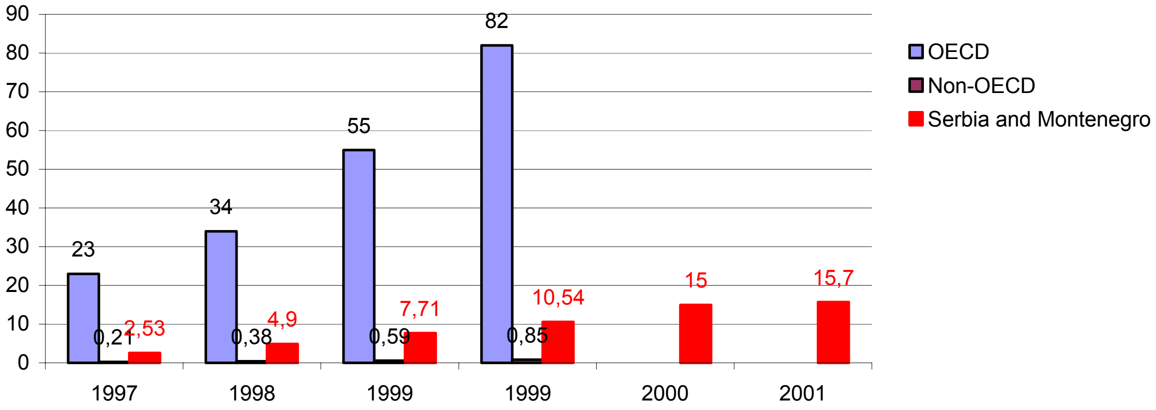

Figure 2 Internet hosts per 1000 inhabitants in Serbia and Montenegro (source World Resources Institute, 2003) compared with OECD and non-OECD countries (source OECD, 2002)

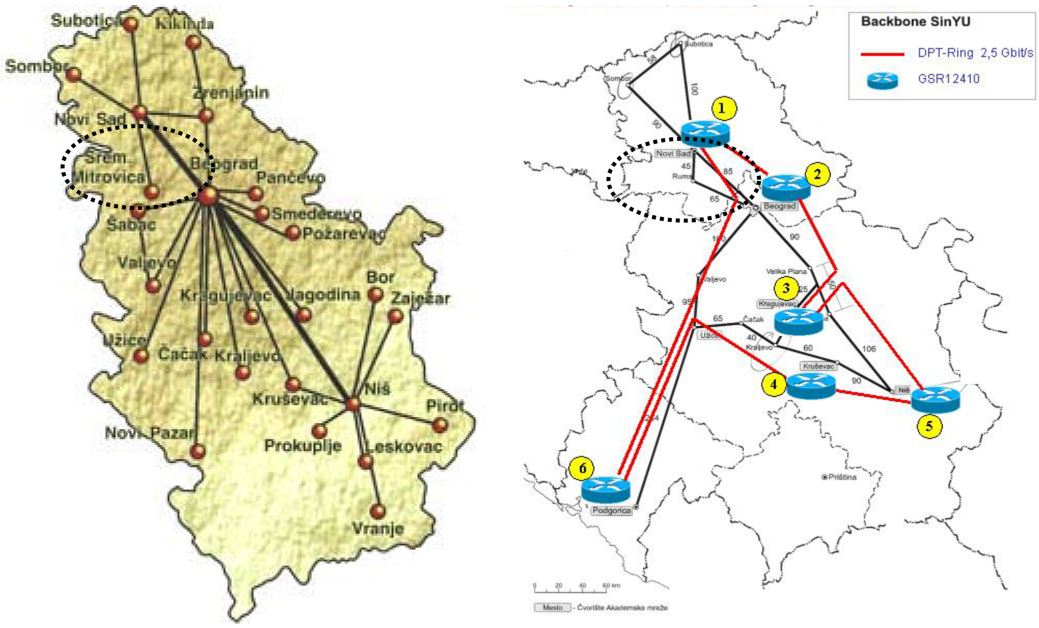

Figure 3 Topology of the Internet access nodes of the PTT YU provider (left) and the new academic SinYU Backbone (right), with the Srem region highlighted

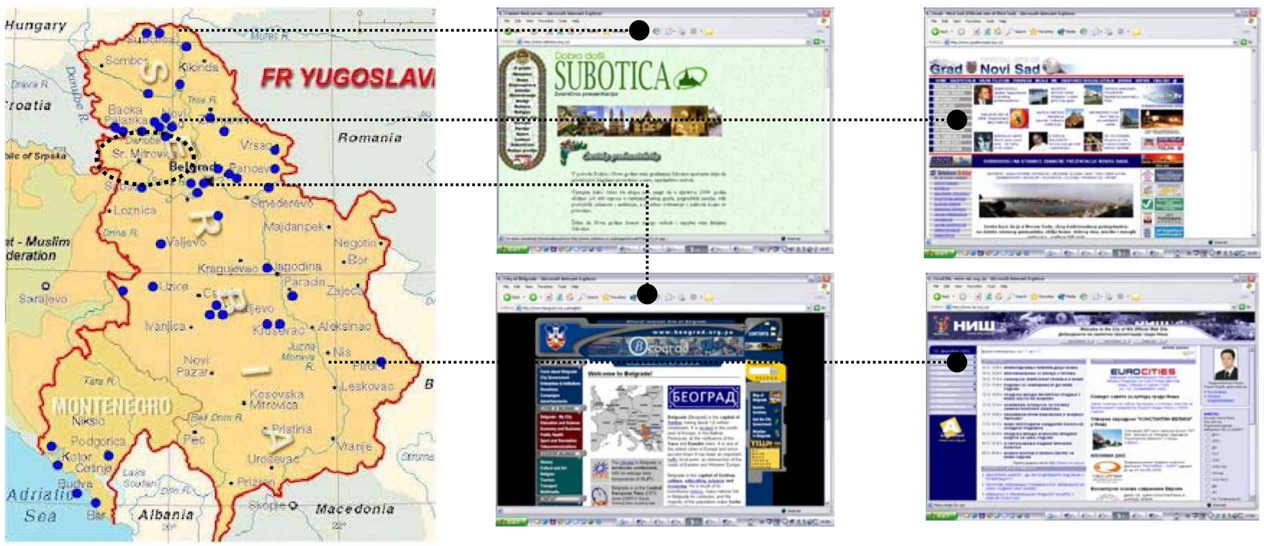

Figure 4 Civic networks of Serbia and Montenegro in 2000 (source Bajic Brkovic, Milovanovic 2000) and actual entry pages of the civic networks of Belgrade, Novi Sad, Subotica and Niš

3 CIVIC NETWORKS OF THE SREM DISTRICT

The Srem district is part of Vojvodina region (Serbia and Montenegro). It is situated at the northeast part of the country, between two branches of the Pan-European communication corridor X, tangenting two important nodes, Belgrade (the capital of the country) and Novi Sad (the capital of the Vojvodina region). The district is administratively divided into seven municipalities – Sremska Mitrovica, Stara Pazova, Ruma, Indjija, Sid, Pecinci and Irig (Figure 5).

Figure 5 Map of the Srem District (source Camber of Economy of Srem - http://www.rpksrem.co.yu/index_eng.php) with indicators of civic networks

The detailed statistics relevant for the digital divide examination (number of the Internet hosts, number of households and individuals with the Internet access, level of the Internet using, etc.) are not available on the regional level. Certain statistics, however, like the one indicating the percent of inhabitants living in agricultural households (Figure 6, right), could be taken as an indicator of the digital divide on the regional level.

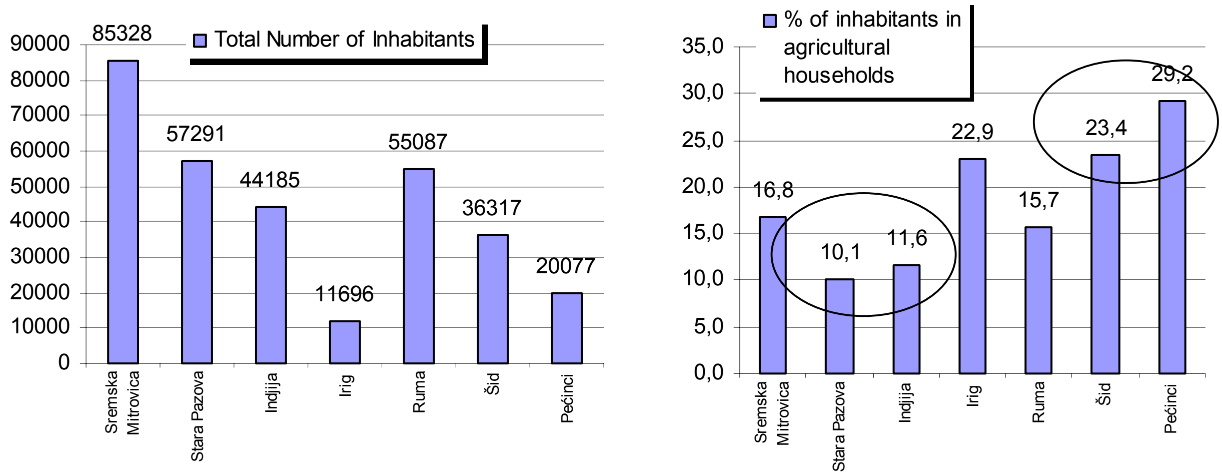

Figure 6 Total number of inhabitants in the Srem District municipalities and the percentage of inhabitants living in agricultural households

A topography of civic networks in Serbia and Montenegro in 2000 (Figure 4, left, according to Bajic Brkovic, Milovanovic 2000) show a significant concentration of civic networks in the region of Vojvodina and metropolitan area of Belgrade. In terms of the civic network development, the Srem district, remain isolated until 2001 when a considerable number of civic network initiations grew up (Figure 9).

3.1 Background

All civic networks in the Srem district appeared after 2000, four years from the country reconnection to the Internet. An observation of the Srem district civic networks started in 2002, when there were eight cases of civic networks (in six towns and two villages) and one newsgroup operating since 1999. Their appearance was a promising indication of an activity towards overcoming the digital divide. At the end of 2003, however, it was surprise to find out that some of analyzed civic networks disappeared (Šid, Novi Banovci). Reasons for that we could find in a lack of foundings, a low interest of local communities and a low level of usage of information technologies in the region.

3.2 Cases

In the table below (Table 1) an overview of all civic networks that ever appeared in the Srem district is given. Among the civic networks founders, the most important role certainly play enthusiastic individuals, either working independently (Irig, Vojka, Beška) or affiliated with local institutions (local radio/newspaper (Stara Pazova), city council (Novi Banovci). A very important influence have local Internet providers, launching presentations independently (Sremska Mitrovica) or in collaboration with city councils (Ruma). The latest cases show intentions of city councils to engage specialized institutions to develop information systems fully serving citizens in their quotidian communication with official bodies (Indjija).

Municipality	Founder				Year
	Internet provider, IT consulting firm	Local radio / newspaper	Individual	City council	
Sremska Mitrovica	http://www.mirtovica.co.yu				2001 - now
Stara Pazova		http://www.stara-pazova.org.yu/			2000 - now
Vojka			http://utenti.lycos.it/vojka1416/prva.htm		
Novi Banovci			http://www.banovci.co.yu*		2002 - 2003
Indjija				http://www.indjija.net	2002 - now
Beska			http://www.beska.net		1999 - now
Ruma	http://www.ruma.co.yu				2001 - now
Irig			http://www.yumreza.org.yu/irig		2001 - now
Šid	http://www.sid.co.yu*				2001 - 2003
Pecinci	-				

*not available anymore

Table 1 Civic Networks of the Srem District

Sremska Mitrovica – The official presentation of Sremska Mitrovica, the biggest city and a sort of capital of the Srem district, hardly belongs to the civic network category. It is a “city postcard” type of presentation with a strong orientation towards historical and cultural subjects. It is designed and maintained by the regional Internet provider Net022.

Stara Pazova – This is the first civic network of the Srem district. It appeared in 2000, after its founder attended a seminar titled Management and the Internet. Although not fully institutionalized yet, a significant part of this civic network maintenance is going on within the local informative centre (local radio station). It is still more oriented towards information delivery, than to an interaction on the civic level. The network offers access to all forms and instructions important for communication with the city council, but an electronic submission of documents and requests is still not available.

Within the municipality of Stara Pazova two villages appeared on the Internet independently of the official web site.

Vojka – Web site of the Vojka village is a presentation containing just couple of pages, offering basic information related to this old settlement and its history, as well as some specific information like index of family names or virtual gallery of paintings. This presentation is based on an individual initiative and it is hosted on the Italian free Lycos server, so it shows up a bar with the Lycos advertisements.

Novi Banovci – The civic network of Novi Banovci is not available anymore. The most important part of this presentation was quite well conceptualized public forum with a range of important local topics offered for the public discussion.

Indjija - There was a trial to establish a civic network in 2001, and an entry (only) page of this old trial is still available on the Net (http://www.indjija.com). The current system (http://www.indjija.net) is the second version of the civic network funded by the actual city council of Indjija. This is the last in the range of civic networks of the Srem region, launched in 2002, and the only one that appeared on the direct request of the city officials.

Beška – The Beška Group is a special case in this study. It is actually a news group, based on the Yahoo e-Groups system, gathering networked citizens of Beška and the ex-citizens of this village currently residing around the world. It is founded in 1999. The dynamics of information exchange varied over the time, but it never stopped, so the system remains active five years. The most intensive communication, according to the Group statistics (Figure 7), is registered during the NATO bombing of Yugoslavia, from March to June 1999.

Description — **Category:** Yugoslavia (Serbia and Montenegro)

Grupa Bescana iz zemlje i inostranstva. Ako zivite, ziveli ste ili poznajete nekoga u Beski, ovo je prava grupa za vas.

Most Recent Messages

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2003	44	61	28	7	9	27	1	24	3	3	6	
2002	51	69	169	45	35	72	50	15	104	26	102	70
2001	78	31	80	33	38	38	21	40	96	80	70	82
2000	83	130	115	87	74	108	63	15	49	52	84	95
1999		32	119	209	117	115	99	153	42	123	243	198

Group Email Addresses

For more information: www.beska.net

Figure 7 The amount of messages exchanged since 1999 within the Beška group

Ruma – A similar case as Sremska Mitrovica, the civic network of Ruma is created by the local IT consulting firm, but all information is copyrighted by the Municipality of Ruma. Another "postcard like" presentation with a small amount of information dedicated to the citizens with no tools for a real interaction.

Irig – The case of Irig is an exception in this study. A town presentation with just a few attributes of civic network, sustained for more than two years as a result of the effort of an IT literate individual being originally from Irig but residing elsewhere.

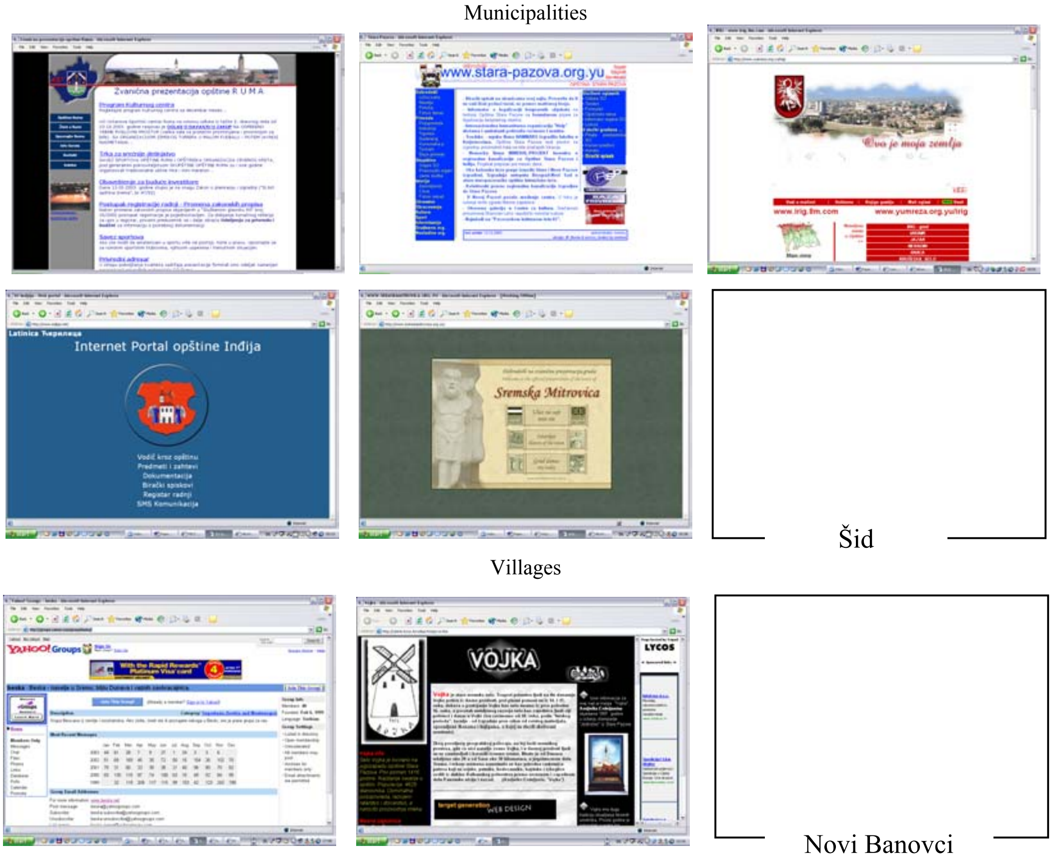

Figure 8 Entry pages of the Srem district civic networks (the empty fields belong to the civic networks that existed but disappeared in the meantime)

The entry pages of the Srem district civic networks (Figure 8) compared with the ones of Belgrade and Novi Sad (Figure 4, right), indicate a lower dynamics of information exchange, less sophisticated interfaces and a general absence of professional, methodological approach to the civic network creation and maintaining.

Next systematization (Table 2) has been done according to the following five criteria for evaluation of civic networks (Bajic Brkovic, Milovanovic 2000): areas and topics they cover, their internal structure, types and quality of communication (internal and external) they provide, population groups they serve, and level (if any) of interactiveness that is built in.

	The Entry Page	Particular areas and topics	Internal Structure	Communication	Target Groups	Interactions
Sremska Mitrovica	 static	 An interactive gallery of the city photographs	**News**, **Forum** **Municipality**, City, Economy, Education, Culture Religion, Tourism Health, Sport, Media	"City postcard" Info broadcast.	Visitors Citizens	 Forum
Stara Pazova	 dynamic (update)	 Map of industrial zone - investment opportunities	**Citizen service** Welcome (**news**) **Municipality** History, Health, Education, Culture, Sport, Media, NGOs, **Business Database**	Info broadcast. Citizen service	Visitors Citizens Investors Business	-
Vojka (village)	 static	-	A single page presentation - Important phone numbers, Index of family names, Gallery	"Village postcard"	Visitors	-
Indjija	 static	 Municipality news (updated)	**Municipality guide, Communication with Municipality official bodies, SMS ommunication Business Database**	Citizen service	Citizens Visitors Business	 Personalized access to the communication area
Beska (village)	 dinamic (news group)	-	-	-	Ex-citizens Citizens	The system is based on interaction among a group of members interested in issues related to the village
Ruma	 dynamic (old news)	 Interactive map	About the City; Economy, Culture and Sport; **Citizen info**; Contacts; Site index	"City postcard" Citizen service	Visitors Citizens	-
Irig	 static	 Local advertisements	**News**; **Advertisements** Settlements; History; Inhabitants; Economy; Events; Geography; Other	"City postcard" Citizen service	Visitors Citizens	 Message pinup board

Table 2 – Main characteristics of the Srem district civic networks

3.3 Civic Networks of the Srem District as Indicator of Digital Divide

In the case of the Srem district, the civic networks indicate an early development stage, with the contents progressing slowly and inefficiently. Majority of them belong to the category of city presentations, with rare functionalities of civic networks. A perspective for their continuity and further development is uncertain. A lack of funding and general support caused interrupting of the activity of two civic networks (Šid and Novi Banovci) while one municipality within the district (Pećinci) has never been presented on the Internet (Figure 9).

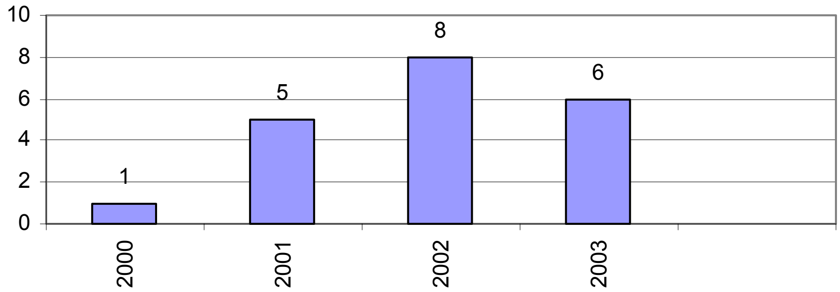

Figure 9 Number of Civic Networks of the Srem District

Behind a majority of civic network initiatives of the Srem district, there is activity of enthusiastic individuals having a sort of natural need to present their towns on the Internet. Depending on their IT skills, professional affiliations and ability to sustain with their activities for a critical amount of time, the initial city presentations develop and acquire attributes of civic networks. Collaboration with city councils is an important step in the city networks progress.

There is no clear evidence of the civic networks usage, like daily/monthly access, the most frequently visited contents, etc.

More than 90% of all contents represent a one-way communication, i.e. information delivery. A significant part of information is static, and has not been changed for a couple of months, in some cases since the civic network establishment. Participation of citizens in the electronic civic life is modest and limited to the topics of general importance rather than to the particular local problems.

4 CONCLUSION

In the case of the Srem district that has been observed for two years, there seems to be a correlation between some statistical data indicating the level of digital divide (Figure 6), and development of civic networks on the regional level. Municipalities with a high percent of agricultural households (Pecinci – 23,4 and Šid – 29,2) are the ones where civic networks never existed or disappeared during the time. On the other hand, municipalities with the lower percent of agricultural households (Indjija – 11,6 and Stara Pazova – 10,1) develop the most promising civic networks. This correlation needs to be examined further once the other statistics are available (number of the Internet hosts, number of PCs, the Internet usage, etc.) in this and other districts of the region, with aim to find out whether a development of civic networks could be a certain indicator of the digital divide overcome.

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Bridges.org – http://www.bridges.org

Camber of Economy of Srem - http://www.rpksrem.co.yu/index_eng.php

World Resources Institute - http://earthtrends.wri.org

Virtual Heart of Central Europe

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1 ABSTRACT - INTRODUCTION

We present a cultural heritage oriented EC project for documentation, digital preservation, and on-line dissemination of selected towers, wells, and rarities in Prague, Graz, Maribor, and Bratislava. We overview the methodology, technology, and digital content including digital storytelling. The results contribute to semantic web and digital libraries European Research Area priorities, as well. We discuss current state and prospective future work.

Our EC Culture 2000 project starts with the 3D reconstruction of top European added value places in Central Europe. Philosophically, we plan to approximate the phenomenon of *genius loci* [Norb00]. In four cities we create the ontology using mainly verticals in cultural cross-road cities – towers, wells, and places of highest added value (as identified by the UNESCO World Cultural Heritage). We enable sharing these values in wide public and Internet global village population. Thus we create the true bridge between the past and the future. The results contribute to semantic web by the jewel seeds from Prague, Graz, Maribor, and Bratislava. Additionally, we have developed the methodology for future completing this network of cultural heritage highlights in Central Europe. All in one.

The purpose of the project is to reconstruct the most valuable towers and wells and rarities in Prague, Graz, Maribor and Bratislava. The idea meets all Culture 2000 priorities - address citizens, new media aided creativity, tradition and innovation, link the past and the future. The portal entry point is at **http://www.dcgip.fmph.uniba.sk/~projects/virtual-heart.**

In mid April 2004, we will publish the 3D models and digital stories at a, hopefully, beautiful site **Virtual Heart of Central Europe**. Project logo and look-and-feel created Jozef Martinka. This is a project, whose purpose is to promote cultural understanding throughout the world and protecting outstanding universal value.

From the point of view of the target group, our intention is to enable Europeans to be consciously (and interactively) proud of their contribution to the World Cultural Heritage. Up to now this is neither done nor started! (There are remarkable single-site projects like Virtual Pompei or Sagalassos, but we wish to contribute to the future 3D on-line heritage network.) We hope that our model of cooperation, our workflow, and project results might inspire future European initiatives within the arising knowledge-based society.

At the CORP 2004 conference we present a subfinal version of the solution. The paper is structured as follows. We introduce the methodology and technology first. Second, we present the brief stories of selected places in four cities. Third, we conclude and discuss the future work.

2 GENIUS LOCI

Our approach is based mainly on an influential book on Heidegger-phenomenology of architecture - ***Genius Loci*** by Christian Norberg-Schulz [Norb00]. The book came in the time of disgust from modern architecture (1980s). The author provided the deeper (phenomenological) understanding of ***genius loci*** or ***spiritus loci.*** This ancient (Latin) notion denotes the local spirit of the place. Pre-christian people believed that each ***place*** - house or nameable outdoor location - has some spiritual being associated. Today the unique harmony of the given interior or exterior is meant by this. In contrast to artificially created uniform urban solutions, the spiritus loci arises - in a valuable ***place*** - from the dialogue of multiple cultural and historical influences.

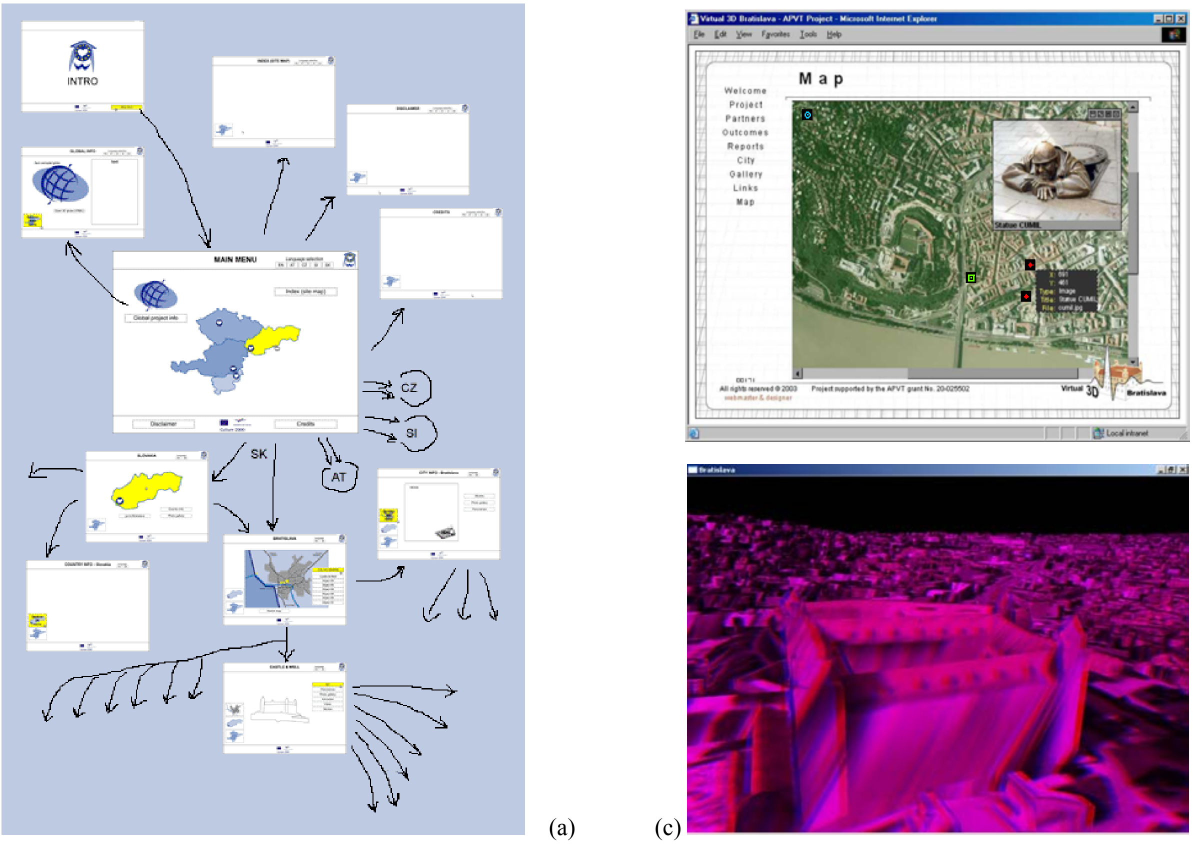
The city has, among other places (squares, riversides, streets, quarters), the ***city verticals***, given by towers, memorials, silhouettes, rivers and wells (old water sources). The oldest known ancient algorithm for founding a new city has been preserved in Latin books. The founders of Rome were the Etruscans – "engineers" invited by the rural Romans who had no knowledge in the field. The Etruscans computed the city location, ploughed the city border around, erected the city tower to transcend the city to the sky and – nearby – they have dug a ***mundus***. The mundus was not necessarily a well. It was the root of the city, transcending the city downwards, into the earth and into the depth. (One can see in erecting and rooting the male and female principles.) The Etruscan language, being isolated from Indo-European languages, has been not preserved up to now. Despite the fact that we do not know the language, we have two fundamental Etruscan words in the international language – ***urbs*** (the city) and ***mundus*** (the world, the meaning was changed by the Latin users).

Thus, the city verticals today both resemble the oldest known urbanisation algorithm and define the vertical extent of the ***place*** or city. This gives us physical and mental borders and they are very important because of prominent stories. "The urban physiognomy faithfully tells the story of its historic development" – says UNESCO evaluation and appreciation of Graz historic centre. From practical point of view, the city verticals can be reconstructed more easily than the large city blocks. Additionally, there are rarities, the most popular places in our cities. Cities can be understood as processes in time and space [Fers02]. Our idea is to provide the procesuality using stories.

3 METHODOLOGY AND TECHNOLOGY

Our general project decisions can be summarised in the following steps. We start with the ***UNESCO's World Cultural and Natural Heritage List*** to identify the global priorities in cultural and natural values in Central Europe. As there are four capable research teams to run the initial phase of the strategic mission, we have adopted the practical and pragmatic (minimum cost) restriction to start with global values in crossroad-cities ***Graz, Prague, Bratislava, and Maribor***. Second, we select the representative ***city verticals*** and embed them into the ***virtual old cities***, modelled at the reasonable level of precision. Third, we add some very special local rarities to preserve and publish the top quality attractions. Fourth, we will create the 3D reconstructions, models, and ***virtual environments***. So far, the creations are static and having no inhabitants. Therefore, the creation of ***virtual habitat*** follows – navigation, exploration, and on-line co-operation support. Interactive communication with the environment and with the virtual inhabitants – avatars. There are virtual environments with avatars and without avatars. ***Avatars, Digital Storytelling*** and tools for ***Immersive Experiments*** are the final phases of creating the successful reconstruction shared by many visitors. To our best knowledge, there is only one systematic theory of virtual environments which consistently explains the spectrum ranging from Matrix movie dystopic ideas to really working useful applications. The unique know-how is accumulated in 3 books - 1. Virtual Interaction, 2. Virtual Space, and 3. Production Methods: Behind the Scenes of Virtual Inhabited 3D Worlds [Qvor01], [Qvor02a], and [Qvor02b]. We have found a lot of inspiration in these books. Not surprising, they fit with the Genius Loci book ideas in using the same phenomenologic approach.

According to Konrad Karner et al. [Karn02] we proceed in the 3D reconstruction as follows. A set of calibrated high-precision images is processed using MetropoGIS [Baue03] to obtain dense façade point clouds. For very special input we create 3D models manually (3D Studio Max, PhotoModeller, Maya). An alternative of high precision panoramas has been proposed and developed by Mario Sormann et al. [Sorm04]. Another low-cost work-flow has [Ftac04]. Output formats include VRML, QTVR, video, digital stories, animations, and even computer games. Sometimes, there are virtual guides as emphatic avatars [Stan03]. The complete look and feel is designed in Flash and we compose the various data formats using XML and the fruitful idea of data containers.



(a) (c)

Figure 1: (a) Central Web Pages Navigation Scheme Designed by Jozef Martinka, (b) A Screenshot from Virtual Bratislava Navigation Tool by Stanislav Stanek. Aerial Photo Courtesy Eurosense Slovakia. Terrestrial Photos by Matej Zeman. (c) Strereoscopic View Created by Peter Borovsky.

4 PRAGUE

Prague is known as "The city with one hundred towers". That fact corresponds perfectly with the subtitle of the project (Towers, Wells, and Rarities) and offers to choose historical and cultural jewels from a large set of candidates. Naturally, we have selected the most well-known and interesting towers representing unique and outstanding solitaires on the old-time Royal Route used on the occasion of Czech kings coronation [Poche85].

Powder Tower (Prasna brana) used to be the opening point for coronation processions. The gothic tower (built in 1475) was a part of Old Town's fortification and served as a gunpowder store. A number of ornamental decorations have been added to the tower during neo-gothic reconstruction in the 19th century.

Old Town Hall and Old Town Tower (Staromestska radnice) belong to the places that are a *must* for every visitor of Prague. Those buildings together with the Old Town Square played exceptional role throughout the whole Czech history including royal weddings, election of the King George of Podebrady (1458), tragic execution of 27 leaders of anti Habsburg rebellion (1621), and many others. Old Town Square represents one of many genius loci in mysterious old Prague. A European rarity, astronomical clock (Orloj) from 1410 is a dominant part of Old Town Tower. Every hour during the day, a strong bell attracts crowds to watch a parade of twelve apostles appearing in two tiny windows, and four mechanical figures of Vanity, Greed, Death, and Turk.

Towers of Charles Bridge (Mostecke veze) are gothic end points of Charles Bridge built by king and emperor Charles IV in the 14th century. Monumental bridge decorated by 30 statues was built using a special technology. The legend talks about thousands of eggs that were added to mortar to improve a solidity and durability of the bridge construction. Actually, eggs did not stop couple of arch crashes during the life of the bridge. Some damages were mystic, of course, including arch collapse at the place from which Saint John of Nepomuk was thrown down [Peti95]. Then a devil's help was necessary to rebuild the arch again.

Both bridge towers, **Old Town Bridge Tower** and **Lesser Town Bridge Tower** allow passing through as well as viewing from them to wonderful panorama of Prague Castle (Hradcany) and Vltava river. Old Town Bridge Tower is nicely decorated including a sculpture of kingfisher bird in a bath towel ring, a symbol of king Wenceslaus IV, reminding king's escape from a jail and his cleaning from the prison dirt.

Singing Fountain (Zpivajici fontana) built in front of Queen Anne Summer Palace is a kind of historical rarity. This bronze solitaire (1564) contains two basins. Water drops falling from upper basin down to the lower one make sound similar to music.

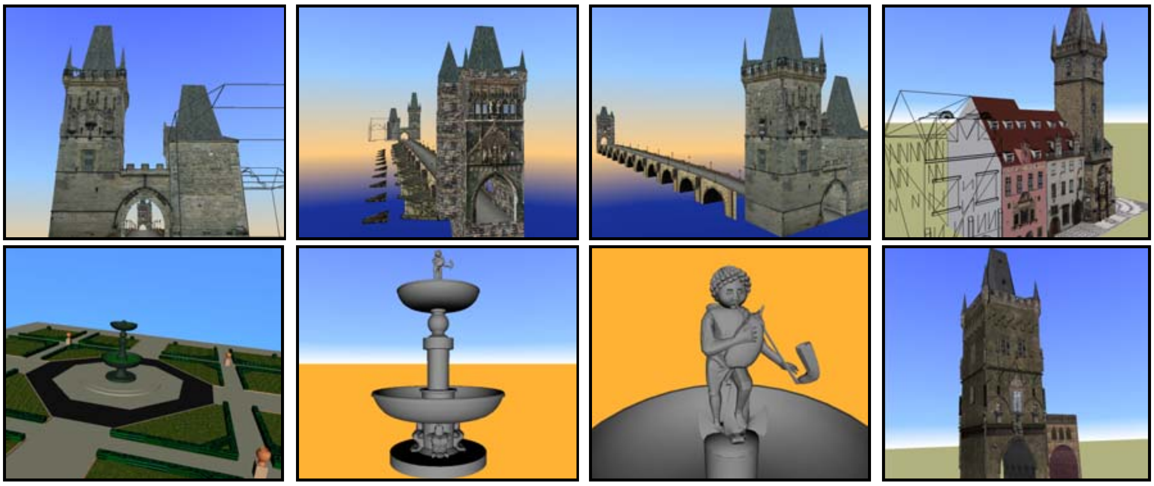


Figure 2: Preliminary versions of 3D models. First row: (a) Lesser Town Tower Bridge, (b) Old Town Tower Bridge, (c) arches of Charles Bridge, (d) Old Town Hall with Old Town Tower. Second row: (e) park layout around the Singing Fountain, (f) Singing Fountain itself, (g) detail of a musician on top of Singing Fountain, (h) Powder Tower.

Carefully selected towers and other buildings from Prague are digitally reconstructed and presented as individual jewels in the current project [Zara03]. The future work will be oriented towards complex creation of the Royal Route presented in a form of a virtual walk through, since such an approach gives a deeper and more intensive feeling of a city and its specific genius loci [Zara02].

5 GRAZ - CULTURAL CAPITAL OF EUROPE 2003

Figure 3: 3D-Model of Province Hall (Landhaus) facade.

Graz - capital city of the province of Styria is Austria's second largest city, with 250.000 inhabitants. Graz has many tales to tell. To start with, the tale of its history which starts some 900 years ago and which tells of the city in its heyday as the residence of the Habsburg monarchy in medieval and Renaissance times. As one of the best preserved historic cities in Europe, the Old Town was designated a World Cultural Heritage Site by UNESCO in 1999. And finally a tale of contrasts: classical music and jazz, tradition and modernism, literature and festivals [Graz03].

The current ***City Hall (Rathaus)*** is the third one that has stood on this spot at the southern end of the main square. Moreover the city hall was first built in the 1806 and fully reconstructed in the years 1888 to 1893. The ***Kaiser Mausoleum*** was built between 1614 and 1633 by Italian architect Pietro de Pomis. The imperial mausoleum houses the tomb of Emperor Ferdindand II. The sarcophagus of Ferdinand´s parents Karl II and Maria can also be found here and is very impressive. The famous City of Graz landmark, the ***Clock Tower (Uhrturm)***, is at the same time considered among its oldest construction works. The core may stem from the 13th century, because the land register chronicle from the time of the reign by the Bohemian King Ottokar over Styria even mentions the tower around 1265. The octagonal, 34m high ***Bell Tower (Glockenturm)*** with its renaissance style double windows, was built in 1588 under the orders of Archduke Karl II of Inner Austria. The 2 highest floors and the cellar vault, also known as "Bassgeige" due to its shape, earlier served as prisons. Near the top of Sporgasse you may notice a ***Turkish Warrior*** brandishing a sabre at you from an upper window of Palais Saurau. He spent his early career as a target for charging cavalrymen, but seems to be enjoying his retirement as a house mascot. Another famous object, the ***Turkish Well (Türkenbrunnen)*** can be found on the castle hill. This well was built in the years 1553 to 1558 and is almost 94m deep. On the 11 January 1558 the groundwater table was reached, thus at this moment the water supply on the castle hill was secured. Our last selected cultural object illustrates another well, the so called ***Province Hall Well (Landhausbrunnen)***. This well is a part of the famous Province Hall which was built in the 16th century by the fortress builder Domenico dell' Allio.

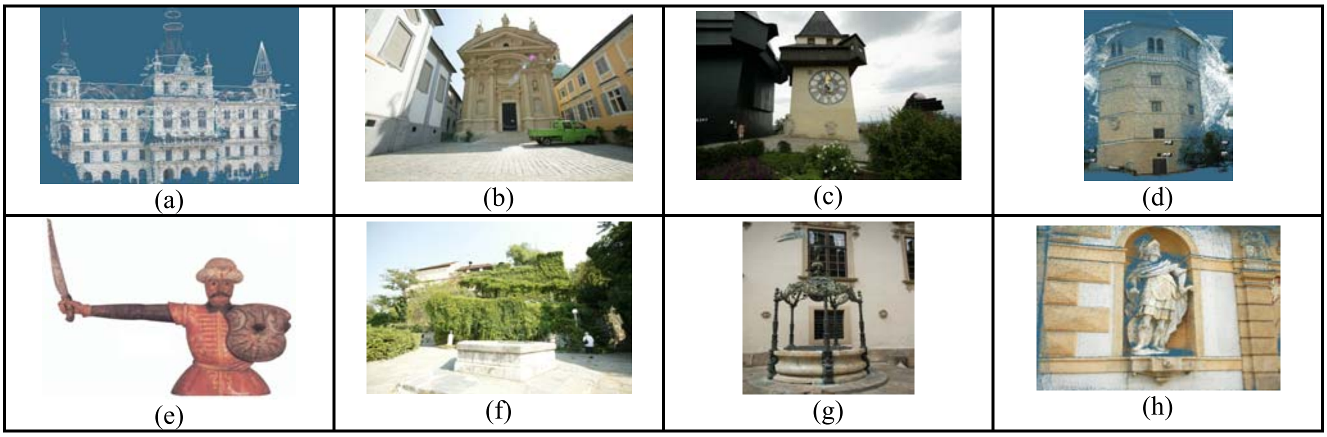


Figure 4: The selected cultural objects: (a) City Hall; (b) Kaiser Mausoleum; (c) Clock Tower; (d) Bell Tower; (e) Turkish Statue; (f) Turkish Well; (g) Province Hall Well; (h) Province Hall Statue.

6 MARIBOR

Historic Centre. Although Maribor as a town goes back to medieval times, very little of its medieval architecture remains - in most cases just the foundations of buildings in the very heart of the city center. On such remains either new buildings were erected, or old buildings totally renovated, so that their original appearance was lost, but there are still some buildings that show the basic layout of the old town. We will digitally reconstructed and presented the seven main historical attractions:

The oldest living wine (400 years): In Maribor next to the Drava River, a more than 400-year-old grapevine (*Modra kavčina*) still grows today and is probably the oldest fine grapevine in the world. Its venerable age was proved by Prof. Dr. Rihard Erker, a dendrologist. The grape harvest is a real annual city festival. It is protected as the natural monument of the Republic of Slovenia.

Water Tower: The Water tower was built in 1555 as additional fortification of the town walls because of increasing Turkish attacks. It is a renaissance architecture with five-sided ground plan and a cannon platform. Construction of the hydroelectric power station caused rise of water level in the river of Drava for 3 metres. For this reason, the building was lifted up in 1968. This has represented an extraordinary engineering work. Since 1989, the first Slovene wine store is located in the tower.

Plague sign: The plague sign was set up in the square in front of the town-hall in 1743 when it replaced the former Mary’s column. This column was set up by the citizens in thanks to termination of plague which murdered the third of all inhabitants. The plague sign consists of the column with the Immaculate, and statues of saints – intercessors against contagious diseases.

Castle in the centre of city: The Maribor castle was built during the Turkish invasion between 1478 and 1480 on order of the emperor Frederic III to fortify the city walls. Its main outlines are Gothic, completed by baroque the Loretic chapel, the Chivalric hall, and the rococo staircase). In 1878, it passed from the aristocratic into the middle-class hands. In 1933, it was bough by the town community, which arranged the regional museum in its interior some years later.

Slomsek square with catholic church of St. John the Baptist: The church was built in the 12th Century as a Roman-style building with a single nave. In the subsequent Century, it was devoted to St. John the Baptist, and two naves were added to the building. Today, the church shows mainly the Gothic appearance. A classicistic bell tower that became one of the town symbols stands in the west part. In 1859, the church became the cathedral when the bishop A. M. Slomšek moved the diocese from St. Andrew in Carinthia to Maribor.

Franciscan church: The church in style of a Roman basilica with three naves was built together with a cloister between 1892-1900. The plans were made by the Viennese architect Richard Jordan. The bells were exchanged several times because the former ones were carried away in both world wars. Below the church, there is a vaulted tomb, where the blessed bishop Anton Martin Slomšek was also buried for some period. On November 7th 1906, the pope Pius X. raised the church to basilica.

Synagogue: The Maribor synagogue was mentioned in 1429 already, when it became a periodic headquarters of the supreme rabbinate for Styria, Carinthia and Carniola. it is a simple building with straight wings. In its close vicinity, in the SE corner of the city walls, a town observation post was located first, and the town defensive tower (the Jewish tower) is placed there since 1465. After the persecution of the Jewry on order of the Austrian emperor in January 1497, all Jewish institutions have decayed. In 1501 The synagogue was rearranged into the church of All Saints. Nowadays, the synagogue and the Jewish tower serve for various cultural performances.

Town Hall in the Main Square: The town-hall has appeared gradually from two houses in 1513-15. It obtained its current Italian – renaissance appearance in years 1563-65. Building works were completed in the 19. Century. The building lost its function of the town-hall in 1967. Since then, the art gallery and headquarters of several cultural institutions are located there.

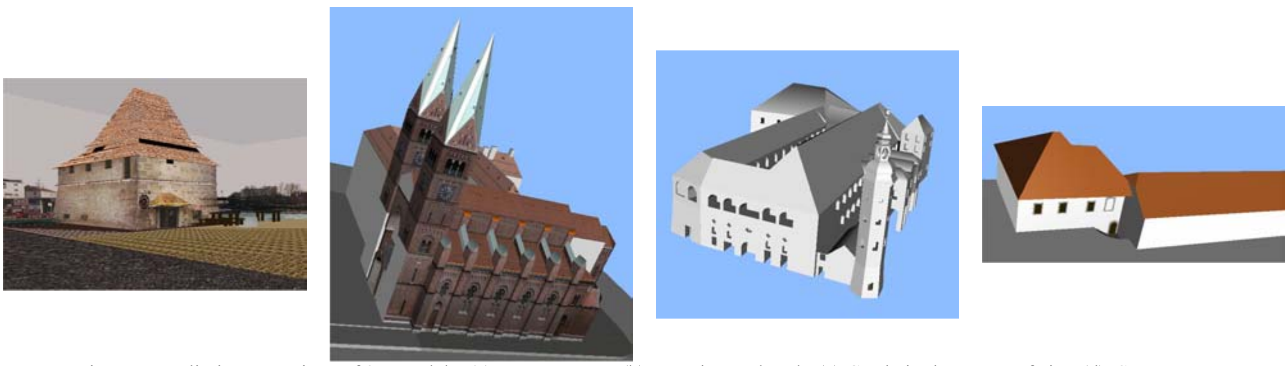


Figure 5: Preliminary versions of 3D models: (a) Water Tower, (b) Franciscan church, (c) Castle in the centre of city, (d) Synagogue

7 BRATISLAVA

Figure 6: Bratislava Towers Painted in 18th Century, http://www.bratislava.sk/.

We present Slovakia and its capital Bratislava for the sake of urban and cultural context for the following six places:

Chatam Sofer (1732-1839) was the most famous Jewish spiritual leader of his century. Nowadays, his grave is a prominent part of a unique burried cemetery (23 graves and 41 thombstones). Unbelievably, one part of the cemetery has been allowed to be preserved by a concrite cover. **Chatam Sofer Mausoleum** is a property of Jewish religious community and it has been proposed to be a part of UNESCO World Cultural Heritage in 1999.

Dom sv. Martina (St. Martin's Cathedral) is a three-ships gothic church where 11 kings and 8 queens (including Maria Theresia) were crowned in 1563-1830. The first try to use parachute took place here. Professor Fustus Verancic jumped down from the tower in 1603. The top of the tower is decorated by a golded copy of Hungarian royal crown.

Bratislava Castle is a National Cultural Monument and the well-known landmark of Bratislava. Originally, it was a fortress in 9-th century when Great Moravia was the first state of old Slovaks. Later on, it served as border post and residence of kings (Maria Theresia). In the courtyyard, there is a famous well connected with many ledengs. Nowadays, the palace with Rennaissance and Baroque additions is both a museum and the top representative place. E. g. the creation of free democratic Slovakia has been celebrated here (January 1, 1993). The famous ancient – and pretty fat - sex idol, Moravany Venus, made from mammooth bone, can be seen among other treasuries.

In the beautiful and remarkable position above the confluence of the Danube and Morava rivers, there is a wonderful little tower. It is said that here happened the most famous legend among Bratislava ones. It is a story on prohibited love, similar to Romeo and Juliet. When the wedding was already held, the Devin Castle has been attacked by the bad uncle of the bride. Her lover was killed and she jumped into the muddy Danube river. This is why people name this place a **Virgin Tower**.

St. Michael's Gate and Tower is the only preserved part of the Gothic fortification. At the top of the tower there is a statue of a hero, killing a dragon. One part of this place includes the oldest bridge in Bratislava. People believe that the separate gate entry should be avoided, especially by students before final exams. Nowadays the tower serves as museum and as an endpoint of installation of a popular laser show.

City Well gives a unique genius loci to Primatial square next to City Hall. The new reconstruction of the old square incorporated the well, discovered by archeologists in 1977. The well has been decorated by an artwork with the motif of Bratislava sign. Here is the place where tourists throw little coins to ensure that they will luckilly come back. The water level is about 126 m, aligned with the Danube river level. This is the deepest visible point of Bratislava.

The Old Townhall (Stara radnica) is the most important secular building in the downtown. Bratislava had the first free elections in Centraleuropean Middle Age as the city was very multiethnic. The original part of the rennaissance building is the gothic tower from 13th century. Today, there is the municipal museum. The wall paintings and many lovely details make from this place one of the most favourite ones, especially suitable for summer therate performances, tower brass concertos and folk art and craft exhibitions. The tower bell is said to contain the diamond from the ring of a bad city mayor. The painting above the entry was painted by the devil, says one of the legends.

For two of Bratislava towers there are legend or historical evidence about the jumping down. We have designed two simple physically based games to illustrate this. Additionally, several prominent legends are published on-line by courtesy of famous authors like Maria Durickova.

Figure 7: Preliminary versions of 3D models: (a), (b) St. Martin – typical and non-standard views, reconstructed by Marek Zimanyi, (c) Castle reconstruction with the kind help of Eurosense Slovakia, provided by Peter Borovsky, (d) and the first MetropoGIS reconstructed façade by Stanislav Stanek.

Figure 8: The world oldest living wine in Maribor. Photo by Sebastian Krivograd.

8 CONCLUSIONS AND FUTURE WORK

In Central Europe, there are at least 30 unique and recognised sites in Austria, Czech Republic, Hungary, Slovakia, and Slovenia - within the former Austro-Hungarian area. Sorry to say, this **European added value is not added** to the Internet community, except some fractions in the tourism-oriented web pages, mixed together with other information, often of a different nature or focus. That is why we propose to start the systematic reconstruction of them as a specialised whole – Central Europe Cultural and Natural Heritage – Virtual Heart of Central Europe.

The following is the quote from UNESCO official site: *"With 721 cultural and natural sites already protected worldwide, the World Heritage Committee is working to make sure that future generations can inherit the treasures of the past. And yet, most sites face a variety of threats, particularly in today's environement. The preservation of this common heritage concerns us all."*

However, UNESCO recognised historical centres, e.g. Prague or Graz Historic Centres, represent too much data. Thereafter, it has been necessary to focus on some jewel parts of them first. Our initial reduction and selection idea is the ***cultural crossroad-city verticals – towers and wells*** – embedded into an existing city model.

Our intention is twofold. We intend to reconstruct, preserve and present the top values of the past. In addition, we will provide the people in Central Europe and Internet global village with the well-working and beautiful cyber sites. In other words, we shall bridge the best from the past with the prospective future using the hi-tech, as envisioned in EU strategic research directions like semantic web [Bern01] or digital libraries. The dissemination of results started with [Karn03] and will continue at [VHCE04], at least.

The future work is obvious – to continue in forming the network in Central Europe. That is why we have submitted a follow-up Culture 2000 project named ***3D Virtual Heart of Central Europe***. Our new partner country is Poland and we are looking forward to extend the number of countries, prominently with Hungary, in future years.

9 ACKNOWLEDGEMENTS

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Figure 9: Chatam Sofer Mausoleum interior reconstructed from photos taken by Marek Zimanyi and Matej Zeman. 3D reconstruction using floorplans and lighting scenario by Jan Krizik.

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GIS supports urban planning in Prague

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1 INTRODUCTION

The City Development Authority (URM)- the municipal planning department - has first integrated GIS into the common planning process 10 years ago. Since then, GIS becomes the powerful tool for exploration, analyses and presentations. Although in the core of GIS application at URM is the maintenance of the well structured and detailed City Master Plan 1:10000, the attention has been also drawn to development of the tools designed for more efficient and wider use of spatial information: intranet and internet map applications, metadata catalogue and other tools.

The paper sets the focus mainly on the technological systems and solutions towards supporting the various planning activities by delivering the customised and pre-processed land information and supporting metadata services.

2 INTRANET MAP SERVICES

GIS was traditionally used as a powerful tool for creating maps which served as the source of immediate information both in office daily routine and the 'outdoor' urban survey activities. However the reliable information on the land has always been the midpoint of the planners interest, the built up environment is at the same time the most dynamically changing type of Earth's surface. The necessity of production of up-to-date maps was the key reason for introducing the GIS into the planning sector.

It has been already stated, that simple map information look is the most frequent task people in the urban planning must go through when they deal with some practical question. What is the parcel number, which address, what is the zoning regulation, which type of ownership? Also, urban planning decision process need complex evaluation of various antagonistic aspects, moreover, aspects changing in time. To provide the information in the traditional way is therefore complicated and time consuming question even with use of desktop GIS.

The question of immediate delivery of the basic up-to-date land information and map to the wide range of users has been answered by the launch of the intranet map applications based on Map Server technologies (Map Services).

The philosophy of the Map Services implementation in the City Development Authority stands on three pillars: Simplicity, Flexibility and Reliability.

2.1 Simplicity

To compete the paper map information, the Map Services must be fast and as simple as possible. While desktop GIS application are mostly used by the trained professionals, Map Services must look friendly and attractive for also people for whose the computer is not the best friend. To achieve this, all the Map Services must be of the very similar GUI (design), must be based on the same map background datasets and must share the same limited set of important tools. The requested information must be possible to get by the minimum of steps, the 'intelligent' find and info tools are the key requirements. If searching by the zooming, the scale limit for switching the map layers is set in the way which gives the users the most typical and practical map composition (picture) for the particular scale. Also, the delivery time mostly for raster layers is optimised by use of pyramid layers architecture.

Talking about simplicity, the simplicity for the end-users is only the one side of the coin. Maintenance of the Map Services system must be also easy-to-perform in order to be able to provide flexible reaction to the comments and new requests. The clear development environment is essential also in respect of the maximal independence on the concrete developer staff.

2.2 Flexibility

The Map Services are designed in the way which enables to perform easily adjustments in the map and tools contents as well as the additional design or other changes in order to improve the functionality and intuitivity towards the most common users. Also, source data storage and administration system is designed in order to provide as easy as possible update of all the geographic or related tabelar datasets. In terms of administration, each Map Service application is being developed and maintained by the person responsible also for the regular update of the data contents. Despite it, the administrators must follow the agreed common design and functionality as well as the interoperability with other services.

2.3 Reliability

The bottleneck of every information system is the content and functional reliability. The practical experience clearly proved that if the information system should be really used by the non-IT specialists, it must behave according the user expectations (i.e. normally, without any occasional exceptional and confusing dialog messages) and must provide as up-to-date information as possible. Thanks to the previous good experience with the desktop GIS performance and its requirements and outputs, the majority of users has learned at least a glimpse of the various land data availability, limitation and the update cycles, so they are able to distinguish between system functionality and the data quality. The apprehension of two system components (data and the application) is, from the administrational point of view, very helpful when users requests the new functionality, new data or refers to the failure of the interface.

3 MAP SERVICES ARCHITECTURE

To be able to achieve all the above mentioned requirements, the architecture of the Map Services is based on the division of the core map server (image server) and the application system nutshell which serves as the interface between the user and the map server. The interface application system translate and deliver the requests from the user to the map server, which perform the map image generation and send it back to the application interface. Such division enables to tune use independent software systems for both different parts of the task and tune them to the maximum performance.

3.1 Software and Hardware

The core map server is the ESRI ArcIMS 4.0.1, which deliver the 8 and 24 bit PNG images. Running on the Internet Servers Apache Tomcat 4.1.12 and MS IIS 5.0. The application interface is the PHP 1.3.7 based system T-wist by T-mapy Hradec Králové. System runs on PIII 1,26 GHz, 1GB RAM.

Database agendas are stored in the MySQL 4.0.8 and the ORACLE database system (experimental). GIS data storage uses the ESRI shapefile system, the migration into the ESRI ArcSDE 8.2 (8.3), and Oracle 9i database is currently in preparation, installed on the 2xP4 Xeon 2GHz, 1GB RAM. The web browser software used for the client stations is MS IE 5.0 (the graphics is optimised for resolution 1024x768).

3.2 ArcIMS map services

As the T-wist system enables to combine the map images delivered by the map server, the ArcIMS map services are designed as the basic thematic map components which are combined according to the specific requirements of each Map service application. The main map services are the basic map background (ortophoto, parcels, address points) and the zoning regulation from the Master plan. In addition to this, other thematic map services are prepared (building permit service, price map service, some environmental data services, urban studies services, etc.). The configuration of the services functionality (AXL setting) is focused to the map content and the symbolisation only in order to minimise the map server delivery time and also because specific layer visibility setting (including the scale depending visibility) is better controlled by the T-wist application.

3.3 T-wist application system

T-wist system is composed by the set of PHP scripts and definition files which controls the GUI design and functionality, the communication with Map Server(s) and the communication with the external database systems. The GUI is, in T-wist terminology, called Map Client, derived from the fact that normally several types of GUI varying in the complexity of the tool and the specific design can be required for the different user classes working with the same Map Service (scalable architecture). The Map Client serves as a sort of GUI template for the application controlling the main common design features as the colour scheme, location and the size of the interface components (map frame, overview frame, toolbar, legend frame, query result frame, etc.). Common Map Client specification is the key tool for the ensuring the common look of all Map Services application.

However Map Client controls the design features of GUI, the functionality is set by the definition files specific independently for each Map Service application. These settings controls the availability and performance of each tool and command as well as the its GUI design properties as icon on the button, location in the toolbar, etc. Given that, maintenance of the same basic functionality of all Map Services Application, as e.g. navigation, finding places, basic info tool, etc. is not that easy as in case of the Map Client design specification. On the other hand, possibility to alter the common tools gives the chance to adjust the generally known tools for the specific needs of various thematic datasets, which increases the intuitive command and user acceptance. In fact, new Map Services are developed by copying and altering the verified and popular ones.

Third area which is controlled by the T-wist system is the connection to the database agendas. T-wist enables to store in the GIS source files only the information necessary for the spatial identification while the rest of the descriptive data is stored in the relational databases. Such approach is again effective in terms of use of system resources and resulted in best request delivery time. By analogy with the ArcIMS map services, T-wist enable to define basic connectors to the database agendas which are then used by the various Map Services. Thus, one Map Service normally uses several ArcIMS map services and also more database agendas. T-wist does not require to collect all the information into the huge source data warehouse, which lets the room for effective distribution of administration and content maintenance of the particular databases.

4 SHORT INTRODUCTION TO EXISTING MAP SERVICES

4.1 Common features

The standard environment consists of main map frame, active overview with zooming functionality, legend frame with map layer check boxes and the toolbar. Tools and functions used across all applications are mostly connected with navigation and database search. The core ones are: zoom in & zoom out, pan, measure and print tool, together with two tools for easy info and search. Both latter tools consist of a combo box with predefined roll-down menu and a button for performing the task. The menu offers the basic options as information on parcels, zoning regulation and the address.

4.2 Ortophoto

The oldest and most frequently used Map Service which combines the elegance and simplicity. The application was designed in order to provide quickly first essential information on the area: Cadastral boundaries, Parcel+parcel numbers, Street+addresses, Ortophoto aerial image, zoning regulation from the Master Plan and after the flood in August 2002 also extent of the Q 500 flood area.

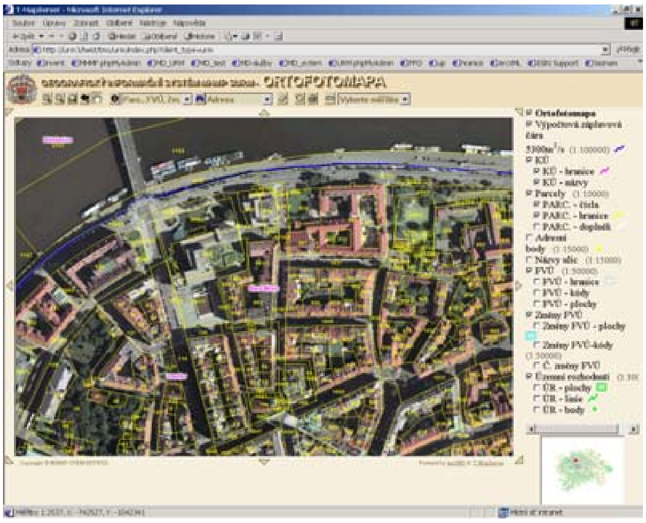

Fig. 1 Ortophoto Map service

4.3 Master Plan

The basic and essential application for exploring the map and textual information from the all 21 drawings of the Master Plan. The individual drawings are converted into the raster datasets and completed with the basic “navigation” layers as ortophoto, address points, etc. The description information on the selected map features (i.e. zoning regulation, etc.) are accessible through the hyperlink tools. Even though the map itself originates in the vector data model, there are many good reasons for using the raster image in the same resolution (scale) as the approved paper document is. First, the zoning regulation was prepared with some precision (1:10000) which determines the maximal detail which can be taken into consideration when working with some small area. Second, legal. According to the Czech legislation, the only legally binding document is the paper one, so that Map Service was designed in order to combine the official content with the strength of the search and related info functionality. Each drawing dataset is followed by the original image of the colour legend from the approved documentation.

4.4 Building Permits

Monitoring the interest in development activities in the area is easy to perform through use of the Building Regulation process monitoring. Every building activity since 1996 has been located into the map layers by point, polyline or polygon features and has been identified by the unique identifier. The identifier is then used for database referencing to the particular types of legal documents of Building Permits. From the administrational point of view the Map Service is the first which uses the interlink with the large database administered by the institutional body independent from the City Development Authority.

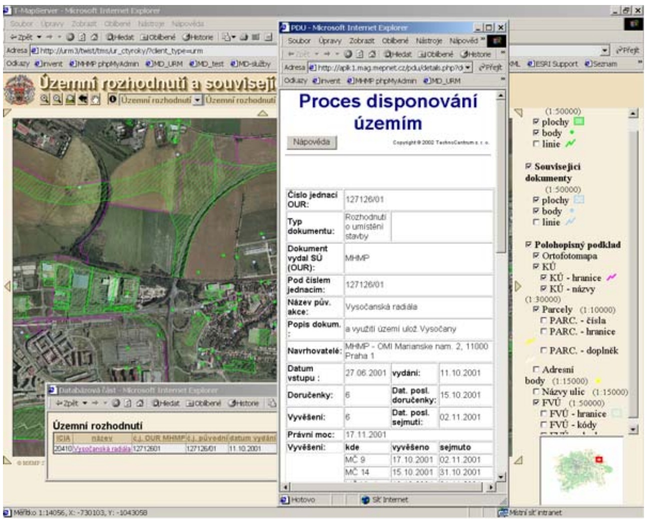

Fig. 2 Building Permit Map Service

4.5 Environmental applications

Information on various aspects of environment are accessible through two applications - Terrestrial System of Ecological Stability and Noise map. Terrestrial System of Ecological Stability (landscape network of green) is the important environmental limit for the land use anchored in the Czech law. The map of such landscape green patches and corridors followed by the database information of specific requirements on the type of the vegetation and other limits is the main information value of the Map Service.

Noise map displays the outputs from the noise model of Prague, the regularly updated source. Apart from isophone map representing the daily average noise levels in the whole Prague area, application contains also the layer of noise reception points – the points in the roadside location at the house facades with precisely calculated and calibrated daily average noise levels.

4.6 Urban development monitoring databases

Monitoring of development is provided individually for each segment of development according to its urban function – housing, retail, office, sport, etc. Currently, map applications for housing and sport are available, the application for retail facilities is under development.

All applications of such type are designed for detail description of development areas and larger development schemes. Thus the map presentation is simple and straightforward in order to show the extent and type of development, while the wealth of database, textual and image (photo, plans, etc.) are accessible through the hyperlink. All application are linked with the building permit database in order to be able to track the development from plan to realisation.

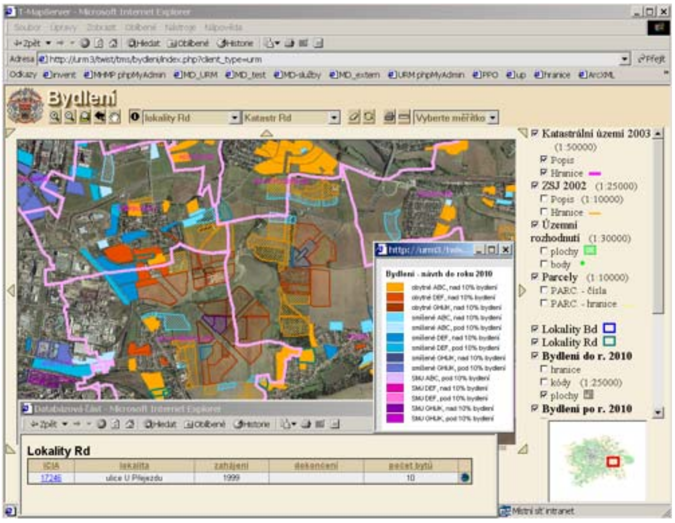

Fig. 3 Map application for housing

4.7 Floods 2003

Shortly after August 2003 floods orthofoto mosaic covering the whole flooded area in Prague was available. Together with calculated and calibrated flood contour line and 'normal' orthofoto and standard map background, the Map Service is valuated tool for discussion on the building regulation within the flood zones.

5 DAILY ROUTINE USE AND PROSPECTS TO THE FUTURE

When the first Orthofoto Map Service was launched in November 2002 it attracted soon attention of all planners as well as technical staff due to the comfortable and friendly option for obtaining fast the needed map information. Since then the majority of the staff use some Map Service every day, however, it was proved that the success of basic Ortophoto application can not be probably overcame in the close future. The log file analysis shows, that from some 100 employees which could potentially use the Map Services around 50 different access addresses connects to the Services. Normally there is roughly 20 clients running simultaneously.

The launch of Map Services meant also hard examination of the stability and performance of the office network system, which had to be tuned and adjusted for the increased data loads. On the other hands, the adjustments did not require to exchange the existing hardware and they were targeted mainly on the client internet access refinement.

In the near future new map services are to be developed, the Noise Map service and the Land Price Map service will be the next additions. Also, fine tuning of the current applications and changes towards increase of data store and speed of the system are expected as well.

In the same time, big step is going to happen, the opening the selected Map Services for the internet access. The project, named WebGIS Prague, brings together the leading GIS departments of Prague municipality in order to prepare new common municipal internet mapping and geoinformational website. City Development Authority will, within the framework of the project, develop on own internet map server technology the applications concerning Master plan and the urban planning documentation, as well as it will participate in the development of the other applications using cross-departmentally shared data administration, e.g. already mentioned Building Permit database system. According to the project plan, existing map services will be verified in terms of functionality and the legal conditions for the datasets use (contractual conditions for the presenting on the internet, etc.) and than refined in the necessary way. Technically, before website is officially open, hard stability and performance testing of the servers will be undertaken within the Authority.

6 METADATA SYSTEMS

6.1 Internal metadata system

Opening of the geodata to the broader audience and increasing need to provide and exchange the datasets led to the decisson to establish the metadata system based on the valid and currently negotiated metadata standards in order to stay compatible with the most possible numbers of the geodata providers and consumers. The starting point for the metadata architecture was Czech standard for the structure and exchange format of the geographic information sources metadata issued by the predecessor institute to the current Ministry of Informatics and based on the EU CEN P 12657. The implementation of the Standard was consulted with the authors of the standard and the GIS laboratory of the Technical University Ostrava where the national GIS metadata system MIDAS based on the Standard has been developed.

The Standard uses the well defined XML as the exchange metadata format. XML structures and the meaning and conditionality of each metadata field was the good base to build the own implementation. The main stress was put on the enabling the description of the dataset attributes and it’s domains, the tree hierarchical organisation of the Master Plan datasets as well as description of the use of the dataset layers in the particular drawing, colour legend symbolisation and other specific properties. Of course, such detail goes far beyond the Standard specification. On the other hand, many of that extended information are intended as internal, which allowed to design such database architecture which fully respects the requirements of the XML export format and is also capable to store the additional dataset characteristics. Thanks to the flexible architecture of the Standard, major part of extension was connected mostly by definition of new data classes in the class definition table and additions to the table of association types (definition of the possible relations between object classes). General metadata system architecture within the City Development Authority is based on the central database system accessed purely by the intranet application scalable system allowing to perform all operations connected to all administration of the system, database content maintenance and the end-user requirements.

Development of the metadata system started in October 2002. The system architecture was finished in November and the development of PHP application for the system administration has begun. Concurrently, the database was filled in the testing phase with the first set of Master plan data. Due to non-existing interface the database feeding was provided through direct database access using by MS Access standard application interface.

Up to now, the basic interface has been developed and the important part of the Master Plan dataset has been already entered into the system.

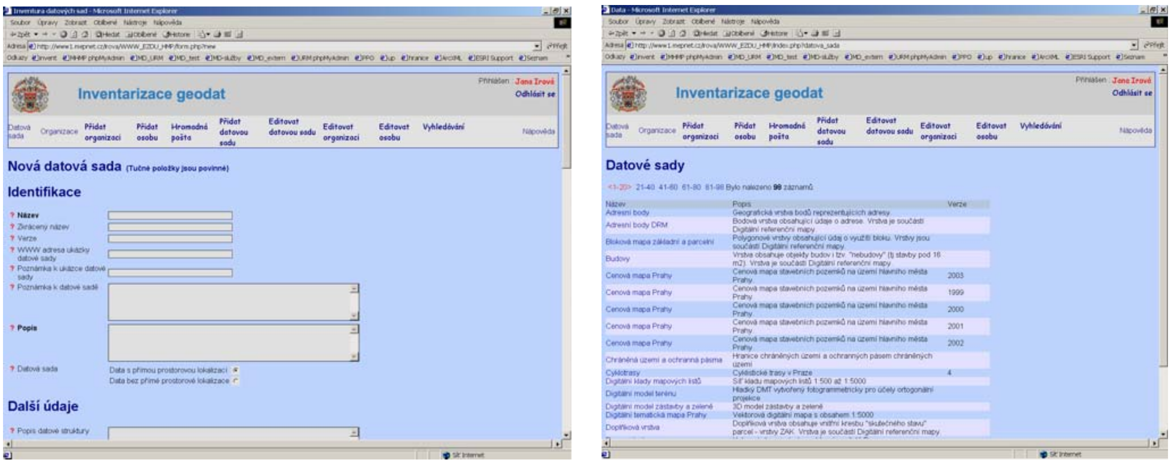

Fig. 4 Municipal geodata inventory interface

6.2 Municipal metadata project

Together with development of the municipal WebGIS project mentioned in the paragraph dedicated to the Map Services, the need to share the description metadata to the first presented datasets and all reliable geodatasets in the future appeared. The municipal metadata system must respect the distributed administration of the geographic data across the municipal departments and organisations as well as must take into account the different internal traditions and methods of dataset organisation and maintenance. The correspondence of the system to the national and international standards was also clearly expressed as essential.

Having that, the development of the system was designed in two steps. First, fast and lightweight inventory of the municipal datasets will be provided based on the simplified Czech metadata standard. The aim of the inventory is to raise the basic information on the geodata existence, quality and administration in Prague in order to be able to tailor the main metadata system in the most effective and productive way. The main co-ordinator of the geodata inventory phase, responsible for development of the inventory system, data input management and raised data exploitation is the City Development Authority.

After the inventory is evaluated, the main metadata system architecture will be developed. Even if detail technical solution is not ready now, the main features of the system has been already drafted. The system will be based on the principle of one central thin internet portal which will contain the basic list of dataset identification and the connection parameters to the metadata servers of each dataset administrator parties. The main task of the central portal is to serve as the ‘single address’ interface for the end users which will communicate with the local metadata servers. Local servers will wait for the request and return the complex information to display in the portal interface. Distribution of the main metadata content into the interlinked databases will allow all parties to maintain its metadata in internal well managed system and will avoid the ineffective dual metadata maintenance which will be the case if one central municipal metadatabase would be implemented. The communication between local metadatabase system and the portal will be based on Metadata Services principle and XML protocol, which assumes all parties equipped by the Internet Map Server will run the Internet Metadata Server within the system as well. The XML protocol must be compatible with the national and international metadata standards in order to be able to communicate in the future national geodata clearinghouse infrastructure.

6.3 Standards

As it has been stated above, proper definition of the rules for the metadata information content and exchange is the essential for any database architecture and the XML exchange format discussions. In this respect the development of both internal and municipal metadatabases is being disturbed by the unfinished Standard preparation in the Czech republic. In spite of publication of referred Standard based on CEN 12657 which is so far the only existing Czech official metadata document there is still missing standard which is expected to survive without considerable changes for more than two years. The reason is in the final stage of preparation new international ISO 19115 Standard, which is expected to serve as the base for new EU metadata standard as well as for the general redesign of the Czech document. The differences between current Czech and draft ISO standards are not only of the cosmetics nature. Even if comparison of the item (metadata entities) list and related mandatory/compulsory properties do not show too much real differences, the general database logic of both documentations can not be marked as compatible.

Unsettled situation in the field of standards has, of course, negative impact to the metadata systems preparation in Prague. It is clear, that after new Czech standard is published, existing metadata infrastructures will have to be adjusted to the new requirements. Therefore, development of some database parts (namely of internal City Development Authority system) was practically stopped until at least the draft of new standard is known. In order to be as close as possible to the process, the developers of both referred Prague metadata systems take the chance to participate in the discussions on the new ISO based standard.

7 CONCLUSION

GIS has become the essential part of the urban planners daily routine in Prague in the last decade. Implementation of internet information systems and namely Map Services into the common working environment brought positive change of perception of GIS among end users who no more see the GIS as the mysterious system for experts but as the common tool for everybody willing to learn and know. Positive feedback after launch of the first Map Service application was the impulse for boom of follower applications based on the common design and core functionality. Opening selected services for the internet user within the municipal WebGIS Prague project will be the next milestone on the way to the fulfilling the idea of the information society.

Promoting Sustainable Spatial Development by ICT

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1 INTRODUCTION

The development of the information / knowledge / network society has had and will have fundamental changes in economic and social life. It will also have spatial consequences by means of affecting the future of regional, urban and rural areas (e.g. Mitchell, 1999). The information and communication technology, ICT, is seen to be the main driving force in the formation of the information society (e.g. Bell, 1974; Masuda, 1981).

The spatial dimension has not been a common theme on the agenda in discussions about the development of the information society. The main interest has focused on the promotion of this development. This is understandable because the information society is still emerging. Its main driving force, ICT, is all the time evolving and the pace of the development of new products and applications is intense. The diffusion of the new important tools of ICT, like the Internet and mobile phone, among the large number of people and businesses in the developed world, has taken place during the last 15 years. It is thus natural that all possible spatial implications of these developments have not yet seen the light of day. There are some empirical evidences about new location tendencies, like the establishments of "back offices and call centres". Many scientists have described a vision of the future (e.g. Castells, 2001; Graham and Marvin, 2001; Kotkin, 2000; Mitchell, 1999; Moss and Townsend, 2000). Without any doubt one can predict that new spatial applications will be implemented when businesses and people have recognised new opportunities.

Spatial change is always both an opportunity and a threat for urban and regional planning. The emergence of the information society gives thus possibilities to guide spatial development according to the objectives of the planning area concerned, presuming that planners are aware about the impact of this development and especially ICT will have on the location factors of different businesses and on the behaviour of people.

This article will discuss possibilities to promote sustainable development in spatial planning by using the opportunities offered by the ICT applications. The findings and ideas are based on observations made in literature, on the results of my dissertation "Information and Communication Technology: A New Aspect in Urban and Regional Planning " (Talvitie, 2003a, published only in Finnish) and on the article "The Impact of the Information and Communication Technology on Urban and Regional Planning" I have written on the basis of the study (Talvitie, 2003b).

2 ICT AND SPATIAL DEVELOPMENT

In order to get a firm basis for the evaluation of the possibilities of ICT in the promotion of sustainable spatial development it is important to discuss at first the impact of ICT on spatial change in general terms. (More detailed analysis in my article.)

2.1 Principal characteristics of ICT affecting spatial change

The impact of ICT on spatial change can not be dealt with in isolation but as a part of the development of the information society and forces behind it. Webster (2002) distinguishes five definitions from the presented theories of the information society depending on their main criterion. These criteria are: technological, economic, occupational, spatial and cultural. The technological criterion refers to the development of information and communication technology and its effects on social development. The economic criterion refers to the development of new products and effects on industrial structures. The occupational criterion refers to the development of new types of work places and occupational restructuring. The spatial criterion refers to the development of different types of networks and effects on the organisation of time and space. The cultural criterion refers to the rapid increase in the information in social circulation. Webster´s analysis indicates well the different aspects in the development of the information society, which in real life all relevant and in all cases ICT plays a crucial role.

By simplifying and summarising the represented theories about the information society from the point of view of the impact of ICT on spatial change it is important to distinguish the following aspects:

- The information and communication technology enables the creation of new ways of working and reorganisation of the industrial, public and personal activities and structures. Globalisation will play an increasing role in these processes,
- the change in the meaning of space, place, distance and time as the determinants of location factors. (Probably the best known
- concept of the changing role of space, place, distance and time in the information age is suggested by Castells (1996/2002)
- when he introduces the concepts of "space of flows, space of places and timeless time"). As a result we will have a virtual
- world functioning at the same time with the conventional physical settings.

2.2 The changing meaning of space, place, time and distance as the determinants of location factors

Observations made about the changing meaning of space, place, distance and time mean that in many cases distance will no longer be a problem when one can transmit information via telecommunications networks. The same applies to time. All transmissions will take place at once. Wireless communications will allow the making of connections at any place at any time where the service is offered. In principle space and place are thus not any more affected by distance and time factors in the same way than before. At least in theory this could mean more freedom in the location of activities. This question has interested many scientists.

Mitchell (1999) argues that suggestions of the death of distance, the end of space and the virtualisation of everything will obscure the issue. He suggests it is more useful to recognise the opportunity to organise the inhabited space for multifarious human purposes. Kotkin (2000) suggests that when the freedom to choose the location will increase, companies and people will to locate to places where they will. Thus the peculiar attributes of locations will play an increasingly important role.

The way how the Finnish planners see the expected changing roles of the determinants of these location factors is shown in Figure 1.

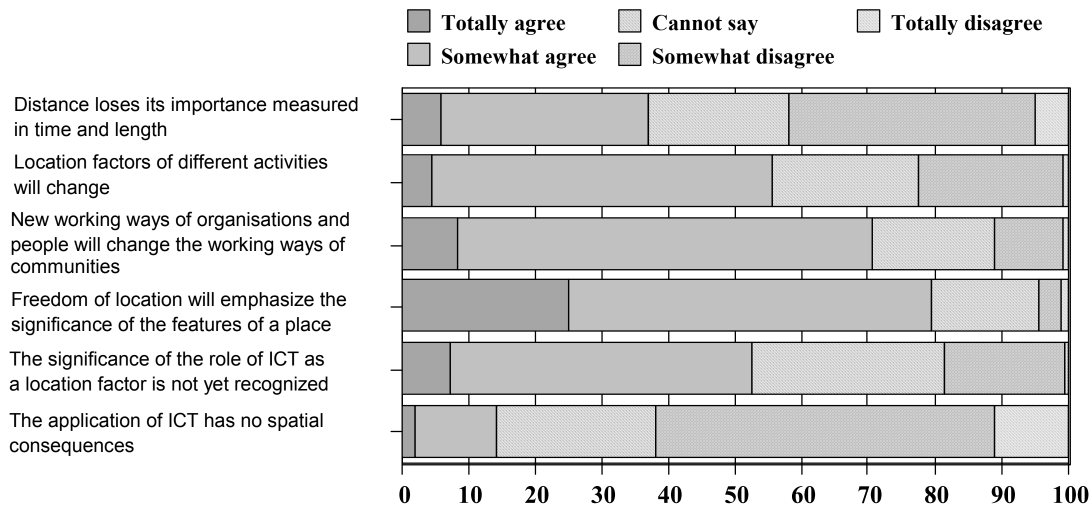

Figure 1. The opinions of Finnish planners on the statements about the impact of ICT on some principal location factors. (n=306-308). Sources: Talvitie, 2003a and 2003b.

We can notice that the majority of Finnish planners agree with most of the suggestions presented about the principal spatial effects of ICT. Opinions are split regarding the changing importance of distance as this is also the case among many scientists. Although some 55 % of the planners accept the statement that the location factors of different activities will change, there exists an interesting phenomenon in the opinions among planners of different planning tasks. The support for this statement grows when moving from the opinions of detailed land use planners (39 % totally and somewhat agree) to the opinions of master (71 %) and regional (82 %) planners. This result indicates, that the impact of ICT is easier to understand in overall than detailed planning. Over 50 % of the planners accept the statement that the role of ICT as a location factor is not yet recognised. Nearly 30 % hesitate to take stand on this statement. There were only a few who accepted the statement that the application of ICT has no spatial consequences.

2.3 New ways of working and reorganisation of activities

As mentioned earlier the consequences of the application of ICT in production and services will change the traditional ways of running businesses in industry, services and other organisations as well as in everyday life (e.g. Toffler, 1980; Mitchell, 1999; Castells, 2001 and 1996/2002). These developments form the basic driving force on spatial change and have been discussed by many scientists and futurologists.

The restructuring of industries when knowledge and skilled people are becoming the most important factors in production leads to new ways of working and reorganisation of activities. ICT has been used in the structural reforms of production. Mass production has often been replaced by customised production and enterprises are restructured into network companies (e.g. Castells, 1996/2002). This has led to the relocation of production to cheaper places. However, new technology has also provided new opportunities for old and small industries to compete by networking with other companies thus strengthening their positions. Marketing of products has also benefited from this new tool and in this sense a remote location is not a big problem.

The spatial impact of ICT on services is very diversified and developing fast. Electronic banking is a good example. Electronic commerce is mostly used by businesses. It is also becoming more common for ordinary people especially as regards buying and selling intangible products, like flight tickets, music, insurance etc (e.g. Mitchell, 1999). When buying goods you need to have a good delivery system.

Public services is an area where ICT provides limitless possibilities. In many countries central, regional and local authorities are now offering a lot of information about their services, and often online two-way communications are made available for citizens. Libraries offer online services, virtual education and telemedicine are developing fast etc. In many cases services provided via ICT will improve the service standard, especially in small communities and rural areas. It will also save time and travelling costs. The location of all services will not be as important as before.

How Finnish planners see some of the possible spatial consequences of these development trends is shown in Figure 2.

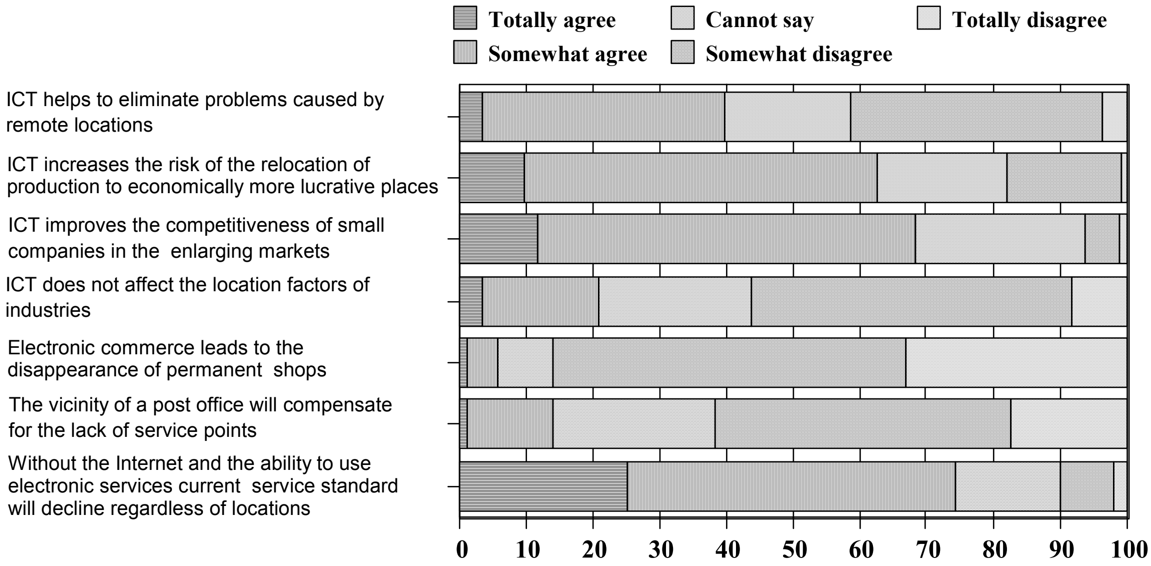

Figure 2. The opinions of Finnish planners on some proposed spatial impacts of ICT on industries and services. (n=302-307).
Sources: Talvitie, 2003a and 2003b.

The opinions of Finnish planners are split on the statement that ICT could help in eliminating the problems caused by distance. The result reflects the uncertainty we have about this matter. The majority agrees that there is the risk that ICT may cause the relocation of firms to cheaper places and with that, that ICT may help small companies to survive in a global world. Thus it is understandable that the majority rejects the statement that ICT does not affect the location of industries. The statements about the effects of electronic commerce on shops and the role of post offices as a delivery point of goods are rejected. Probably one reason for these opinions is that currently electronic shopping by ordinary people is still low in Finland, although growing.

The opinions about the importance of the Internet as a service provider indicate clearly that this possibility is essential in all places, not only in remote areas. This result is easy to understand at least in Finland, because a growing number of services are offered in the net and some service providers, like banks, are forcing customers to use the Internet; desk services are available, but more expensive.

The spatial dimension of new working practices is probably one of the most discussed topics in the evaluations of the spatial impact of the applications of ICT. Teleworking is now applied in different forms depending on the content and quality of work and naturally on the preferences of employees.

Traditionally employment has had a great impact on the decision of the housing area. Now the situation can change. People who can work by using telecommunications systems can locate anywhere. Pleasant climate and environment, sufficient service standard and others could be some criteria for good location. Naturally also a good service standard of ICT should be available. There are examples of these types of solutions and in most cases these places are famous resorts (e.g. Mitchell, 1999). Also other types of locations could be possible, depending on people´s preferences.

Those entrepreneurs whose customers are spread in a wide area could also have a great freedom in choosing their place of residence. An interesting aspect is the impact of the availability of skilled people on the locations of enterprises who need qualified labour. Kotkin (2000) expects that if enterprises want to safeguard this, they will have to locate to the vicinity of places where the well educated people like to live. Kotkin and DeVol (2001) have noticed that also the prices of houses and the changes in life styles have, in the USA, had an impact on the choice of residence. This development has also affected the location of enterprises.

It should be mentioned, as Mitchell (1999) argues, that digital revolution will bring home and work back together. Homes have to be planned to enable both housing and working functions (e.g. Mitchell 1999; Moss and Townsend 2000). The impact of ICT on housing is in many cases indirect. ICT enables people to implement some of their objectives which earlier has not been possible.

2.4 General overview of spatial development perspectives

Possible consequences caused by ICT in spatial development do indicate clear expected changes. The role of big cities and metropolitan areas is expected to remain important and even grow. On the other hand decentralisation within these areas is seen to take place. Activities will thus spread and form larger entities.

The future of small towns and rural areas has not been discussed very much. In principle these communities can also benefit from new development trends. New lifestyles and cheaper costs of living together with a pleasant environment could form a good combination as a driving force to promote the development of small communities and rural areas.

It is natural that we still have little empirical evidence about the development trends caused by the emergence of the information society and impact of ICT on spatial change. Only during the last 10 - 15 years has this technology been widely used in the developed world. Most of the expected changes are ahead. The pace of these spatial developments depends on the time people and organisations need to recognise new possibilities for locations of their activities. Remarkable changes in physical structures will also take place slowly, although the relocations of enterprises may happen nearly overnight. Therefore these findings discussed above are not the final word but just the beginning.

3 POSSIBILITES TO PROMOTE SUSTAINABLE DEVELOPMENT IN SPATIAL PLANNING

Despite the uncertainties about the future of spatial development, the expected spatial consequences of the emergence of the information society and the impact of ICT should be taken into account in all spatial planning (e.g. Talvitie, 2003b). Spatial planning is also a powerful tool in promoting sustainable development. An interesting item for discussion is now how in practical planning the objectives of sustainable development could be taken into account. Before discussing closer some of these possibilities it is important to make some general observations.

By simplification, the concept of sustainable development requires that all decisions are reconciled from the point of view of social, economic and environmental/ecological values and objectives. This means that there is no one common truth in solving a planning problem. Instead there might be different alternatives depending on the values and objectives of different actors involved in the planning process (e.g. Talvitie, 1994). Secondly it should be noted, as Barker (2001) has argued, that the same innovation and technology can be applied to different places in different ways depending on the goals of the target area. The impacts of these observations can only be dealt with in cases of practical planning situations are therefore not discussed in the following when dealing with some possible planning solutions.

3.1 ICT- infrastructure to be included in planning and plans

In order to promote sustainable development by ICT it is required that in a planning area there are possibilities to use ICT services. This need is general because for the future of all regions and communities including rural areas the most crucial thing is the kind of telecommunications infrastructure and service standard the area has. Most activities are nowadays dependent on these two factors. The ICT- infrastructure should be seen in regional and urban planning and in the content of plans as an equally important element as highways, streets, railways, airports and harbours. Good infrastructure with good services is an opportunity and the lack of them a big threat for an area.

3.2 Possibilities to diminish conventional traffic

Possibility to eliminate the need to travel is probably the best example to promote sustainable development by using ICT. Teleworking, e-commerce, services provided in the Internet, e-mail, changes in life style etc. are examples of new types of activities which will have impact on traffic.

Teleworking is applied in different forms. A common practice is to telework only a few days a week and keep contacts regularly to main office. The mixing of home and workplace has also lead to a situation when all work is done from home. If commuting between home and office will diminish by teleworking this practice may increase other type of traffic.

The use of electronic services will diminish the need to travel. Many things can be done at home, like banking, buying and selling intangible products, like flight tickets etc. Also to use of wireless communication tools can diminish the need to travel. These tools increase freedom in work and leisure. One can get many services when needed and on the road.

One possibility to diminish commuting is to locate workplaces closer to housing areas. Cheaper solutions, competition and activities with improved functionability are issues that may affect the relocation of current activities or decisions on new locations (e.g. Talvitie, 2003b). Call centres are examples of these types of solutions.

Changes is transport demand due to the use of ICT are difficult to predict. Very much will depend on how well people and businesses learn to benefit from the opportunities ICT offers. Spatial planning offers a tool to promote more sustainable solutions in these regards.

3.3 Possibilities to promote the development of the areas suffering from economic decline

Many small and remote communities and rural areas suffer from population decline and outflow of people. As a consequence service standard is decreasing and in general the future seems to be uncertain. In all cases this type of development is not sustainable. Abandoned buildings, underused infrastructure and high unemployment describe the situation very often. The use of ICT applications could at least soften the transition period and in some cases even give the future of these areas new opportunities. Some development means are listed below:

- the ability to use the growing number of services offered in the net will even improve the current service standard. Possible
- obstacles are related to the ICT service standard and people´s ability to use new technology,
- good ICT services offer possibilities to some businesses to be located in the area, like call centres and firms who could use the local workforce,
- existing businesses can benefit from good ICT services and thus have better possibilities to compete even in enlarged markets,
- good ICT services provide better possibilities for the reuse of abandoned buildings, like for call centres or new businesses.

Small and remote locations suffer very often from the lack of broadband connections. There are examples when local and regional authorities have addressed this problem and agreed to pay some of the costs for the service provider.

3.4 Development of new types of communities

The mixing of the home and workplaces and the location of firms and public and private organisations close to each others offer possibilities to create new types of communities, like old small towns when housing, working and services formed a close combination of different functions.

The idea may be seen as an illusion but there are facts which indicate that this type of sustainable development could be possible, at least in small scale. Many studies also argue that the development of new life styles emphasise quality of life factors where a good housing environment is playing a central role. The outcome depends on the will of local and regional authorities to develop these types of communities. It is possible that the competition among authorities will support the development of new types of living and working environments.

3.5 Urban and regional planning in general

As mentioned earlier many scientists (e.g. Castells, 2001) argues that the development of the information society will emphasise the development of big metropolises and large urban areas. Also smaller communities and rural areas will face changes. From the point of view of sustainable development it is thus important to understand how this development will be guided by spatial planning.

It is not possible to give a single piece of advice how to go about it. I have suggested (Talvitie, 2003b) that a systematic approach is needed to incorporate the impact of ICT into urban and regional planning and respective plans. It requires purposeful actions by those who are responsible for practical planning and who regulate and support the planning.

I would suggest at least the following actions to be taken by those who prepare the plans:

- a study of spatial impact of ICT should be included in the planning process,
- the development of ICT-infrastructure should be included as an essential part of the planning and the content of plans,
- the current planning principles should be updated and opportunities for gaining new insights into planning should be seen as a challenge for the planners.

To the support organisations I would recommend at least the following actions:

- the programmes of planning education and training should be updated,
- the research on spatial consequences of the development of the information society and the impact of ICT on this development
- should be intensified and new spatial and urban theories and planning methods and models developed,
- the content of planning legislation and guidelines should be updated.

The aspect of sustainable development should be natural part of all these processes.

4 CONCLUSION

Despite difficulties to see the future spatial development trends clearly, all indicators and also some empirical findings support the conclusion that in the developed world all urban and rural areas are facing big changes. Spatial structures will be restructured and the functions of all areas will have new forms. This is a big challenge for spatial development and planning activities. This challenge should be highlighted since until now the topic has been very seldom on the agenda of discussions about the development of the information society.

Sustainable development is a widely accepted common goal and the promotion of this development is also included in the planning legislation of many countries. It is always a danger that this aspect is neglected in decision making when the economic future of an area is threatened. Other things have more weight in the evaluations of different alternatives. In order to avoid this prospect it is important that in the development of new planning methods and models the needs of sustainable development are well taken into account. As the quality of life factors are becoming more important in the human values, the promotion living and working areas, where the aspects of sustainable development are well implemented, will be a good asset in the competition for inhabitants and businesses.

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IT Modeling Experience in Urban and Regional Development

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1 INTRO

Contemporary world increased dynamics forcing accordingly every human activity leaving none outside this never-ending race. Regional development is certainly strongly influenced by this trend challenging regional and urban planning techniques to cope with that. Acceleration of a working context and ambient accompanying with significant complexity are reasons, not only reasons however, for new evaluation and consequent advancement of current urban development planning methodologies. Shortage of a new appropriate techniques and methodology is apparent. Methodology that is able to respond quickly and efficiently to changes, independently from social and cultural context, toward to current development trends.

Current planning techniques are based on accustomed mixture of verbal and informal graphic and symbolic language. In the same time research substance if exceptionally complex, heterogeneous and substantial retaining numerous different parameters with rich relationships matrix, required to consider and study in order to fulfill the designated outcome through firmly defined set of activities. One of most difficult problems is spatial dynamics since it is hard to recognize and identify and accordingly difficult to describe and control.

Consequently, advancement of a planning methodology is essential to manage all listed inconsistence and weakness i.e. a new planning methodology is mandatory. This objective will certainly require a fundamental breach and change of current planning techniques demand and new interdisciplinary approach and research.

Similar complexity level, vast list of parameters with complex and heterogeneous structural and dynamic relationship scheme, may be found in information and telecommunication systems i.e. computer based systems. Information and Telecommunication Technology (ICT in further text) uses object oriented methodology, for analysis and design as well, (OO in further text) to cope with the complexity, scope and heterogeneity of a systems. Latest step in this direction is a Unified Modeling Language (UML in further text) as a cohesive graphic and formal language for system description. UML is adopt as an industry standard and today is almost inevitable in every even modest ICT project.

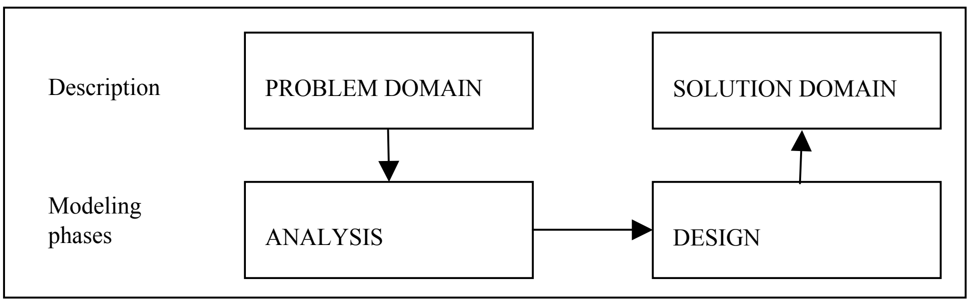
Paper illustrates basic building block of OO methodology and UML, and theirs many years of positive experience and encouraging results, intending to exploit this in an urban spatial planning domain. Higher perception and description level, enhanced knowledge and improved control over the urban development are main objective. However authors do not consider direct, as is, implementation of OO methodology and UML to the problem of urban and regional development. Localization and adjustment to the problem domain is advisory. This is already accomplished for several other vertical industries as joint effort of local experts and OO/UML professionals.

Main goal is to apply currently acquired OO/UML experience and knowledge to the urban and regional development problem domain. This interdisciplinary research will be, evidently, long, complex and expensive process but we believe that this direction promises a significant progress for urban planning. Urban ambient formal specification, founded on OO/UML modeling methodology, may accumulate experience and knowledge presenting it to the audience, introducing computer added urban planning and, may be in the future, urban ambient simulation.

2 MODELING

Firm understanding and knowledge about certain phenomenon is essential precondition for its control i.e. control of its development. ICT modeling is a good methodology for analysis i.e. comprehension and description of complex system structure and dynamics and this modeling could facilitate the same for spatial phenomenon's, conceived as complex systems, like city, region and others.

Modeling for analysis and design of a complex system is inevitable first step in modern engineering. Analysis is process of mapping of problem domain to the model i.e. its formal representation using techniques like abstraction, conceptualization, simplification, decomposition and similar. Design is process of mapping of analytic system representation, result of analysis, into the implementation model i.e. translation from problem to the solution domain. Implementation model is afterward used for real system component construction and consequently for system existing in a real world. However, either in case of analysis or design, modeling will result into a set of models, which are formal, simplified and conceptual representation of reality. This set of models is dividing in two subset named analysis model and design model (G1)



Graph 1: Modeling phases

 Ed. / Hg.: Manfred Schrenk, ISBN: 3-901673-11-2, www.corp.at

2.1 Modeling goals

Previously listed models, analysis and design models, are presenting structural, dynamic and other characteristics of targeted system. Analysis model will facilitate problem domain understanding and design model proposes the solution to implement to solve the problem. Anyhow, model describes the systems independently of its purpose. Accordingly, system modeling will have following objectives and goals:

- Description of system working context i.e. domain of system existence,
- Description of internal system dynamics and system dynamic interactions with working context,
- Description of internal system structure and system structural interactions with working context,
- Description and specification of system components and theirs structural and dynamics interconnection which is in ICT modeling named system architecture,
- Refined comprehension and detailed overview over the system as a whole and partially through its components from different aspects i.e. separate aspect for every previously identified and defined system actor,
- Formal, precise, complete and efficient communication among analysis and/or design modeling team members and
- Asynchronous, parallel and coordinated cooperation, through certain predefined activities, between analysis and design modeling team members.

Models are described with formal and consistent language, which is independent from domain, used verbal language and particular industry context. This establishes precise and efficient team member communication even between experts from different domains. This is of essential importance for overcoming over cultural and experience diversity, which are permanent source for misunderstanding especially in researches of complex phenomenons with heterogeneous and interdisciplinary teams.

Models are simplification of reality since they leave all unnecessary details out. This, of course, leaves possibility to discard valuable details of reality, may be not essential but important for a better solution and/or comprehension, resulting in incomplete model perception of a reality. Derived conclusions and designed solution will then have lesser chances for success. On the other side model may include elements, which are not required, elements that not contributing to the quality of proposed solution, making model redundant and additionally complex to understand and manage. Good model will include all valuable attributes of representing reality discarding all redundant for a given level of abstraction.

2.2 Benefits of Modeling

Modeling benefits could be derived from previous list i.e. list of objectives and goals however; we will list it once more because of its importance:

- **Abstraction and Simplification** leaving redundant and insignificant details out of a scope, classified as such by means of end modeling objective i.e. purpose of a system, enabling unambiguous focus on system important aspects,
- **Decomposition** unscrambling wide and complex system to a smaller and less complex subsystems, with firm and defined interface between them, allowing full attention to this simpler and easier to cope with parts which is basement for solving of complex problem and it is also natural approach for human intelligence,
- **Communication** using model as formal language independent from local context and experience, empowering firm vertical and horizontal team integration which is almost only successful approach for acceptable level of understanding for interdisciplinary teams,
- **Cooperation** since model defines and facilitates separation of responsibilities enabling proper coordination of conducted activities, **iteration** using model as a starting point for every subsequent step in problem solving and **accumulation** because model contains all previous iteration, therefore all collected knowledge and experience, that is all previous work on problem solving,
- **Unification and standardization** in view of the fact that is model specified with unified language, which does not have to be UML, imposing same principle i.e. use of standards and formal descriptions on the whole process level and to all team members and
- **Documenting** because model holds all significant facts about the system, working context, problem domain and problem solution serving to the every and all model users at any time, accordingly to hers/his role, required level of details and wanted aspect, as comprehensive knowledge base.

2.3 Main Modeling principles

Modeling, as engineering technique, have productive and long history and experience resulting in several basic principles positively evaluated through it. Although these principles are emerged from ICT problem solving process, we consider them easy applicable to any vertical industry because they are immanent to the modeling not to the ICT.

First is a **choice what to model** which have great influence to the solution shaping and designing. Consequently, right model will precisely and brightly reveal all essential aspects of a problem resulting in a quick and sub-optimal solution. Partially or fully incorrect model choice will postpone or even seriously obstruct solution of a problem. Consequently, right choice what to model is essential and has to be seriously considered at the beginning of system modeling.

Secondly, is that every model **specifies selected aspect** of a system **on appropriate level** of details. Ambition is to specify every system aspect on the level that is suitable for particular user i.e. model will contain only those elements that are interesting for particular user. Excellent model will offer all and any of its users to choose appropriate level of details accordingly to his/hers current team responsibilities

Model is always **simplification of reality** but has to **stay connected** to that reality meaning that model will have to specify what is simplified from reality in its specification together with the level of simplification,. This will enable constant check of ignored details re-evaluating theirs importance and value for defined system purpose. This will allow extension of a model, during its development, with previously ignored details if theirs re-evaluation classify them as valuable, improving accordingly, the quality of a system description and designed solution.

Complex and heterogeneous system are best described with **small set of independent or lightly dependent models** because it is hard and useless task to try to represent them with only one model. It is extremely confusing and hard to cope with numerous aspects, entities, relationships that are immanent to complex systems. Set of models are better, since every single one may try to highlight a particular aspect or system functionality. Those models are then connected through meta-model (See description below). Certain system will give preferentiality to certain models while others will use other approach depending on nature and scope of a modeling system.

3 OBJECT-ORIENTED MODELING

ICT modeling techniques and praxis recognizes two major type groups, of methodologies, based on theirs baseline approach i.e. algorithmic and object oriented. Object oriented methodologies are prevailing because theirs easy adoption to almost any problem domain and level of complexity. Moreover, transition from analysis to the design model is significantly easy and forthcoming overcoming strong boundaries between them. This is probably main reason for theirs attractiveness.

Basic entity of an OO modeling is an **object** and **class**. Object is real tangible thing existing in a reality and class as the formal specification and abstraction of an object set. Class will specify all common attributes, methods, relationships and semantics of selected object set. System domain is, in this first step, separated to the valuable objects, theirs structural and dynamic relationships and semantics for selected system behavior. This defines vocabulary of a system domain. Second step is abstraction and conceptualization of observed objects through theirs classification. Recognized classes will then establish relationships correspondingly to the relations between objects. These relations, in OO modeling theory, could be one of the following: classifications, generalizations/specializations, associations or aggregations/compositions.

Classification is a process of identification of a set of objects with common attributes, dynamics and semantic within the system domain. This identification strongly depends on a purpose of a system and it is, therefore, always domain specific. Results of a classification are classes. Object is than an **instance** of a certain **class**. Classification will establish relations between two sets i.e. a set of objects and a set of classes, defining for every object and every class if selected object belongs to the selected class. OO methodology does not recognize an object without belonging class although class may have none object instances.

Next level of model development is establishment of other relations between previously recognized classes and usually first on the list if building of the **class hierarchy**. OO modeling uses two complementary methods to establish class hierarchy named generalization and specialization. Generalization defines more abstract concepts i.e. deepens system conceptualization by abstracting the differences and forcing the commonality over particular set of selected classes. Result of a generalization is a new class, more general than starting set, comprising all common elements of started set. Resulting class is called **ancestor** or **parent** while all classes from starting set are **descendant** or **child**. Opposite method will extend selected class with more specialized attributes and/or semantics resulting in class that is more specialized. Resulting class inherits all attributes, methods and semantics from starting class adding ever more to it. Resulting class is descendant or child while starting class is named ancestor or parent. Those two methods will form a hierarchy tree where every descendant inherits everything from its ancestor. This configuration of a system domain facilitates efficient and precise conceptualization of it and it is standard practice in OO modeling. Classes from the top of this tree, classes without ancestors, are called power classes or **power types**. They are usually parts of a meta-model (see below about meta-model).

Complex system structure could not be defined and specified with only generalization/specialization relations. These relations are not sufficient to represent all aspects of class structural relations. **Aggregation**, as additional and important relation, is relation between part and a whole. Aggregation will arrange a new class from a set of classes. New class is a whole while used classes are parts. Aggregation reduces class complexity focusing to a whole and abstracting the details and complexity of its parts. Many of attributes and methods applicable to a whole are applicable to the parts too. Those who are not are **propagated** from a whole to every part for local interpretation. Aggregation is used wherever is useful to address a whole, instead every part, decreasing the complexity of a system representation. Description of a complex system will almost certainly include special kind of an aggregation named **composition**. Composition defines a whole as immutable configuration of parts i.e. configuration that could not be changed during object/class life cycle. Composition is often considered as aggregation that “contains” parts while usual aggregation is aggregation that “references” parts. OO modeling theory recognizes six aggregation types. Further info about the aggregation and attributes/methods propagation may be found in L2.

OO modeling recognizes relations, which are not listed above, but still significant and valuable for system understanding and control. Those relations are named simply **association** representing any structural and behavioral dependency between classes. One may define aggregations as a special kind of association since association set includes aggregation set. Moreover, class attributes are actually association of a class with other classes in a system domain.

Every, previously listed, relation will follow a set of constraints that are applied to them. OO modeling recognizes a wide set of applicable constraints but we will here define only a few. Reader may find others in L2, L3, and L8. First significant constraint is cardinality defining exact number of class instances allowed in a relation, which is defined by a range starting from none ending with many. Next important set o constraints are theirs mathematical characteristics that is relation may be reflexive, symmetric, asymmetric, transitive etc.

All previous defined building blocks will define system structure, although certain dynamic aspects may implicitly be included. Complete and precise system specification requires its behavior specification consequently additional elements for system dynamic description are required.

System behavior and dynamics may be precisely defined with set of states and transitions between them. System is, on the other side, composed from objects therefore system state is represented with state of every containing object. Object state is represented with current value of its attributes. If we recall previous definition of an object attributes as a set of association we will define an **object state** as current **set of its associations** with other objects. Association set will also classify an object to the class therefore **object state** is represented also with a **set of classes** to which is object classified. Object **state transition** is actually association/class set change. It is usually crucial, for complete and precise comprehension of a system, to specify all states and transitions that object may have within the system. That is object's **life cycle**. Model will contain life cycles only for important objects and set of objects. Same approach may be used for object, set of objects, subsystem or system in it entirety increasing the abstraction level accordingly. Life cycle is specified with **finite state machine** containing definition for both, states and transitions. System behavior may be additionally described with **objects collaborations** within particular system function and/or response or with resulting **sequence of events**. Object transition is result of a stimulus from outside of a system or inside i.e. result of a change of other object state. Object state is changed with object method. OO modeling recognizes methods as the only way for object state transition.

System specification is not complete with only structural and behavioral representations i.e. without specification of **domain specific rules**. Rules are specifying a particular politic conducted within the system during its functioning as well as its mandatory requirements. Every rule has to be valid at every time during system life cycle and under any circumstances. Rules may be defined as constraints and derived rules. **Constraints** are rules that establish boundaries over a set of selected objects that is over theirs behavior, structure, relationships etc. **Derived rules** are statements of type "if then" or "only if then" or formulas describing how to calculate or derive certain values or states. Although is this usual and standard classification of domain specific rules it is not the only one. Anyhow, rules should be defined using formal and defined language toward theirs computer processing, representation or application.

Before we switch to the UML, as one OO modeling language, we will describe three abstraction levels which are immanent in OO modeling and which are previously implicitly referenced. Those are **meta-model**, **model** and **object levels** of abstraction. Meta-model level includes definition of all object types and elements used on a model level. Meta-model is a model of a model. Entities like class, object, relation, attribute, generalization, specialization, association, aggregation, composition, basic data types etc are all fully defined on a meta-model level. Meta-model level is entirely abstract, representing the OO modeling methodology itself. Second level is a model level, which is previously presented. Model is an instance of a meta-model and model classes are instance of meta-model classes. Last level is object level, which was starting point for whole abstraction process. Object model, if exists, is an instance of a model and objects are instances of classes. Presented hierarchy is standard for contemporary CASE tools.

4 ELEMENTS OF UML

UML, Unified modeling language, is standardized object-oriented language for visualization, specification, construction and documenting or artifacts of computer based systems.

UML is a language for **visualization** of system entities and behavior resulting in graphic representation of concepts. This is baseline for communication between team members even with different domain origin and for enhanced and precise understanding of treated problem.

UML is a language for **specification** i.e. for precise, formal and complete definition and description of system elements and relations between them as well as rules which are valid on a system level.

UML is a language for **construction** because it is highly formal and it could be easily coupled with particular development environment as well as with specific domain techniques and activities conducted in the real world

UML is a language for **documenting** used for description of all system elements including its requirements, constraints, domain specific rules, system design, project plan, roles, responsibilities, system architecture and similar. All analysis/design artifacts are documented with UML and included into the model where every user may approach to them on a way and levels of details applicable to its role.

UML is a language and is therefore defined with vocabulary and, accompanying, semantic and syntax. UML Model is well formed if it conforms to proposed syntax. UML model is formal statement or set of statements about the system used for communication purposes. Modeling language is language with vocabulary and grammar adjusted to the description of modeling system conceptual and physical representation. Modeling objectives are reality abstraction, simplification and conceptualization as first step toward system comprehension. UML defines how to form well-formed model and how to read it. UML does not define what, when and how to model. It is defined in a modeling methodology, which is based on UML like for example Rational Unified Process, Catalyst or others.

UML is highly formal, extendible language, where extension will not decrease its formality, and also highly intuitive and therefore easy to learn and manage at least for reading. UML is defined with its conceptual model with three groups of major elements named: **basic building blocks** (nouns, verbs and semantics), **composition rules** for building blocks (language grammar) and **common mechanisms** that apply throughout the UML. UML vocabulary includes three kinds of building blocks called: **things**, **relationships** and **diagrams**. Things are basic object-oriented building blocks of UML including objects, classes, interfaces etc. Generally, things will include structural, behavioral, grouping and notational types. Relationships will include all previously described and few additional like realization. Diagrams are graphical representation of a selected set of elements used for system visualization from particular perspective establishing a projection into the system. Further details about the UML conceptual model and its elements may be found on L2.

UML's formality, simplicity and extensiveness is powerful driver, recognized by authors of this papers, for a shift of an UML scope from a domain of computer based systems to other specific problem domains including urban and regional planning as well. This will transfer all positive OO modeling experience to other complex domains of human interests and probably will improve level of knowledge accumulation and transfer, controllability, etc. Authors **do not** consider UML, as state of the art, to be directly applicable to urban and regional planning but rather suggest its adaptation to this specific domain. Definition of a regional and urban meta-model may be good first step.

5 PROSPECTIVE APPLICATION OF OO MODELING IN URBAN AND REGIONAL DEVELOPMENT

Main objective of this paper is to promote OO modeling methodology and accompanying positive experience for analysis and design of a domain of urban and regional development i.e. its modeling. OO Modeling will probably start with the analysis of urban space domain and its concepts identifying and specifying its basic entities and theirs relationships. This may end with valuable and practical taxonomy of an urban space. This taxonomy will be almost certainly incomplete and unfinished but it may be firm starting point for establishment of a corresponding UML meta-model. Current planning methodologies already implicitly use models and modeling approach but models and those techniques are not clearly stated and definitely are not unified. Moreover, planning process is already full of conceptualization and abstraction activities but they stay wasted in planners mind entering the real world only through informal and non-unified representations full of inconsistencies and localism. What we suggest here is to write down this mental modeling process directly to the customized UML models, customized to the problem domain, and to enable to the others direct approach to abstract concepts not to the vague presentation. This will not only overcome inevitable misunderstanding but also expose ideas to the public evaluation resulting almost certain in some improvement and enhancement. Moreover, models will continue to grow accumulating experience and knowledge and form exceptional knowledge base for coming generations.

Complex system requires formalized approach for powerful conceptualization and abstraction i.e. they require modeling approach to cope with complexity and volume. Modeling approach decomposes system to subsystems and then subsystems to components and so forth, concerning the interfaces between parts through this whole process. This will move analysis focus from whole system, difficult to manage, to less complex and manageable parts. Narrow focus leaves all unnecessary details out of scope enabling good conceptualization and abstraction. Modeling approach, opposite to other methodologies and techniques, emphasize relations between identified concepts and entities. On the other side urban and regional development is extremely complex and heterogeneous system with numerous and strong relations and mutual dependencies i.e. with numerous and complex relationships of different kind. Modeling approach with rich and precise vocabulary for all kinds of relations is therefore good starting point. Models, unlike GIS, will cover all functional relationships between entities, will describe all planning rules and suggestions, will describe global and local working context and therefore will represent full complexity of urban space from local and general point of view. Description of dynamic and behavior of a system, urban spatial structure, will facilitate anticipation of a development process and its phases ending with better control over it. Modeling of dynamics and behavior of urban spatial structure imply prosper establishment and use of dynamic regional and urban plans. This could facilitate better control and fine-tuning of development process based on acquired current state, defined planned state, by calculating the difference and offering corrective activities.

Applied OO/UML analysis will:

- identify basic concepts and entities of problem domain,
- establish classes and classification tree,
- identify and specify all valuable relationships between defined classes,
- identify and define system dynamics, states and transitions

In other word will establish complete system specification. Collected knowledge and generalizations will be later shifted on meta-model level as idiosyncratic knowledge about urban and regional development. This establishes particular abstract knowledge catalog used as design patterns.

Modeling will use proposed design patterns to model real world problem but will still stay on abstract level. Use of predefined, well-formed and described concepts will introduce at least less errors and mistakes in planning activities founded on accumulated knowledge and experience.

Last step is extraction of plans as instantiation of previously developed models targeting real world ambient and problem. Plans are like objects instantiated for particular real world and tangible things. Plans are customized re-description actual actors and actual ambient ready to use in a real world.

Meta-models, as it is explained above, are planners' knowledge base comprising all experience, knowledge, well techniques, even legislative rules specified as meta models entities. For proper definition of a meta-model, we will suggest iterative and incremental approach where every increment should include two steps:

- Extensive implementation and use of a meta-model through planning practice and
- Re-evaluation and enrichment of the meta-model based on a new acquired experience and evident important changes in the environment.

Meta-model is therefore never complete and it is always open to comply with the real world changes and requirements i.e. representing real world as much as it is required and applicable. Resulting meta-model should be considered as shared property and value of a whole industry and should be treated accordingly. On the same time, meta model must stay available and open to the audience treated as open source project, which is proven technique in modern world.

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Estimations Of Urban Land Use By Fractal And Cellular Automata Method

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1 INTRODUCTION

The article consists of five parts. After the introduction part the evolution of land use models and cellular automata based models are explained. Later, fractal and cellular automata concepts and running principles of a cellular automata system are expressed. In the other part the main properties of LUCAM model, the simulation of the model to Bursa city and conditions after this simulation are defined. In the last part after explaining the guidance effect of the model in planning studies suggestions are expressed.

2 EVOLUTION OF LAND USE MODELS AND CELLULAR AUTOMATA (CA) BASED LAND USE MODELS

In 1882, the ideas of Soria Y. Mata paved the way for new searches for replanning of settlements in accordance with certain principles. Following this there was a progress of development by means of Linear Urban Forms created by Tony Garnier, a French architect in 1917, by Milyutin in 1929, by Hilberseimer in 1941 and by J. Jose Sert in 1948. During these periods, there were a variety of arguments and models about not only Linear Urban Forms but also radiatic and radio concentric urban forms (Morris 1979). In 1919 it was Paul Wolf who developed radio concentric urban form to be used as an alternative for linear urban form. This study was followed by a model designed by A. Edwards in 1930s, which separated the functional areas by means of radiatic roads originating from the city center, and which kept the small working areas in the center whereas the big ones out of the settlement and which had radiatic as well as radioconcantric features. In 1946, S.E. Sanders and A.J. Rabuck developed a model, which was planned in a way to make the working areas, and their concerning settlement regions exist together in a concentric settlement. Following these models there were various approaches to settlement planning in different periods of time. All these searches that started with S. Mata's in 1882 were based upon accessability and the relationship between the function of work and that of housing due to the importance of production (Mumford 1961).

In the mid-1900s, although computers were not used in the models developed for estimations about the ways to use the locations, there were a considerable number of studies in which mathematical concepts were densely used. In the studies carried out by economists, the assumptions and models were rather made with sizes that could be taken as samples or by using calculators. However the common feature of them was that they were designed with scales taking the ability of the human factor into consideration. It was especially after 1980s that the studies about the models used to estimate the progress of land use increased because of the fact that computers were transformed into personal ones, became widespread and operations were fulfilled in a shorter period of time because of technological developments.

As computers were widely used in all kinds of disciplines, the data exchange between the discipline of City Planning and other disciplines (geography, photographmetry and environmental sciences) and as a result it was possible to combine the data of all these disciplines in a short time to make more proper estimations about land use. Towards the late 1980s, in the discipline of geography, computer programs, which were able to save the data swiftly, make input and output operations among the data, search and assess them according to the given target, were developed and by this way it was possible to make simulations concerning land use (Peuquet, Marble 1990; Archer v.d. 1961).

Before mentioning the CA based model used to make estimations about the land use (LUCAM), which is the main subject of this article, it is significant to present a historical trace back of the studies made so far, which will aid the reader to understand the relationships used in the method.

2.1 Models That Determine the Area of Effect

Since 1960s there have been efforts to apply various methods based on computers and urban simulations in order to estimate the growth processes and to set the orientations of the growth.

The first attempt in modelling studies carried out to estimate the land use was the studies done before 1960s to plan the transportation in metropolitan areas with the aid of computers. During the development processes of Detroit Urban Simulation Model, Metropolitan Area Transportation Model (1955-1956) and Transportation Model of Chicago, the modelling studies, which had been made before, were used to a great extent. The Urban Simulation Model developed by NBER (National Bureau of Economic Research) is a generalized model based on empirical researches about a great number of cities and it has had political influences. This model is known to be the first of the computer simulations on urban growth and development (Kain, 1975). The model was designed to simulate the main changes in urban special structure caused by the future effects of employment and population growth, income increase, changes in transportation technology (Gregory, Kain and Ginn, 1972). Another study carried out for Detroit is called Detroit Urban Transportation Planning. In this study it was accepted that the number of travels depends on the demands caused by land use whereas the future travels can be set in accordance with the demands stemming from estimations about land use. Taking the weaknesses of Detroit into consideration, a model that presented the relationship between land use and transportation was developed for Chicago later on. In this model called Chicago Area Transportation Study (CATS) it was found out that by using computers the speed of transportation increased in the metropolitan area and it took less time to travel from one place to another (Gregory, Kain, Ginn 1972).

2.2 Econometric Models

In 1960s, a prototype model based on linear programming was developed by Herbert-Stevens to estimate the growth of settlement areas. The use of this model in theoretical and empirical researches led to an innovation in urban economy-wise planning (Kain, 1975,1987). In the mid 1960s, within Boston Regional Transportation Study an empirical model was developed in order to describe the changes in the rates of income, population and employment. This model was used to estimate the distribution of population and employment in spaces. The model was applied to many settlements such as Atlanta, Denver and Washington.

2.3 Pull-Type Models

The pull-type models developed for the estimation of land use trace back to the study of Ira S. Lowry published with the title of "Lowry Model" in 1961. This model was widely used in Great Britain and other European countries. Since the main industrial area had already been located in a certain area, the model was designed for the purpose of making estimations about the possible residential areas of the population that would work in and serve for the concerning sector and the transportation network among the pertinent districts (Lowry 1964). Lowry model was used as the core study of several functional estimation studies i.e. "Time Oriented Metropolitan Model" (TOMM) by Crecine (1964), "Planned Land Use Model" (PLUM) by Goldner (1968) and that of Putman (1976).

Batty (1971), an English scientist, published studies that described the differences between the models with sub-region scales and those with urban scales. The Nottingham–Derbyshire model developed by Batty on the basis of these differences is accepted to be the first effort to estimate the pull-type models on a sub-region scale. Batty (1973) developed his first demand model by integrating a pull type model into a spatial distribution model and at the end created a housing market model. As a result of this study called Reading Model, Batty developed two new versions of simple demand model by making use of the data about the election of work places and settlements (Batty, 1976).

2.4 CA Based Land Use Simulation Models

In the studies made for urban systems many Cellular Automata based models have been developed. Tobler, who carried out a study in 1979, is the first person who used cellular approach in geographical planning and his studies were followed by the studies of Couclelis published in 1985, 1988, 1989, 1996 and the study of Takeyama made in 1996. The studies of Coucleis (1996) and Takeyama (1996) had a generalized modelling language enabling integrated, dynamic and spatial modelling on all kinds of scales, on the basis of GIS. Batty and Xie (1996) developed a CA based model for not only the land use samples but also the urban modelling with integrated transportation network (Kain, 1987).

Portugali ve Benenson made researches about the general organization principles of the city with the aid of CA models within the framework of the studies carried out in 1995 and 1997. The above-mentioned researches were based on the social structure of the city. In those studies emphasizing a model in which the characteristics of social structure in cellular location were described, the cellular space represented the individual housing parcels and the cellular conditions reflected the characteristics of the family who live in the cell as well as the criteria such as the value and the status of the residence (Portugali, Benenson, 1995).

The studies about the application of CA on urban structure made by Cecchini ve Viola in 1990 and 1992 and by Cecchini in 1996 included a model made by means of simple automata. Cecchini developed a model which comprised cellular-type of relations among neighbours and which was based on physical data including density in order to design the urban form and he used this model to simulate the growth of an urbanized area (Cecchini, Besussi, 1996).

In the researches on CA based urban models made by White and Ebgelen (1993, 1994, 1997) and by White (1997) and by Engelen (1997), C.A. based urban models, which combined the theoretical concepts with the ampirical facts, were developed (White R., Engelen G., 1997-b) In those C.A. based urban models founded upon high sensitivity analysis, it was agreed that the settlements had four main functions (trade, industrial, residential and empty areas) and that there is a pulling or pushing power among the cells that may vary according to distances. The objectives of the research were estimating and simulating the land use of the settlements according to the relationships among cells. The main difference between these models developed by White and Engelen and the models based on socio-economic events and transportation network is that White and Engelen's is a model based on land use (White, Engelen, 1993, 1994)

3 FRACTAL, CELLULAR AUTOMATA CONCEPTS AND THEIR RELATIONSHIP WITH URBAN PLANNING

When the development process of several events in natural, physical and social environment are examined, in differentations seen in initial and the next time interval, it's seen that initial position affects the next position much. Especially functional changes in existing texture (such as commerce, service functions) shows it's effects in a short time and cause differentations in texture. The dimension of this differentation changes according to the function's quality and effect. Mostly industrial enterprise occurs in a cell unit cause the development of other industrial enterprises, settlement areas, commerce and other service functions.

3.1 The Concept Of Fractal

So as to explain the relation between fractal structure and nature, several phenomena can be examined. Researces, which has done to explain the relation of natural phenomena with fractal method, show that distribution of earthquakes follows a special mathematical pattern and it constitutes similar properties with distribution with distribution of incomes per capita in a liberal economy. All the blood vessels from aorta to capillary vessels forming another type of continuous series can be examined. Vessels bifurcate and divide then again bifurcate and so on. The nature of the vessel's bifurcation is fractal. The fractal system can also be seen in the structure of a tree or bone system of a man or transportation system of a settlement. Golden ratio has been used for a long time by specialists like architects and city planners. In golden ratio by the iteration of rectangles in definite ratios a spiral similar to the initial rectangle occurs. Mathematical comment of infinite and self similar iterations occurs fractal geometry.

Methods using cellular automata mechanism for land use estimation depends on the fractal structure in settlements have been developed. The model suggested in the article is also a method, which developed through cellular automata (cellular transformation) rules. Urban land use estimation simulation model with cellular automata, which developed by G. Engelen, R. White contributed to the development of suggested model of the research.

3.2 Cellular Automata-Automation System-Rules

Sierpinski accepted cellular automata as the initial point of science. In a way Pascal triangle was the first cellular automata. Studies done by Konrad Zuse, Stonislaw Ulam, John Van newmann about cellular automata was related with the production of the first counting machines. Nowadays cellular automata has been used in so many science and technology from physic, chemistry, biology to countable liquid dynamics in aeroplane and ship design, from philosophy and sociology to geography and city planning as an important modelling and simulation means.

- A cellular automata is characterised by these main properties (Rietman, 1992).
- It forms from regular cell lattice.
- Development occurs in time steps.
- Every cell characterise with a situation.
- Every cell develops by the same rule only depend on the situation of the cell and neighbour cell number.
- Neighbour relationship is local and self similar.

Two main concepts and their relation is important in the running system of models depend on cellular automata. These concepts are induction and deduction approaches between real world (world of observed events-events to be modelled) and certain world (modelled events world) (Colonna, Stefano, Lombardo, Papini, Rabino, 1998).

A cellular automation system is modelled in three conditions.

Rest (0), Stimulate (2) and Back to normal (1). Cell development is characterized by rules as shown down. If a cell isn't stimulated by another neighbour cell, this cell will be in rest. If a cell is stimulated by at least one neighbour cell, this cell will be stimulated and named a "stimulated cell". A cell which is stimulated transform a normal cell after one step further. A cell which is transformed normal condition, transforms rest position.

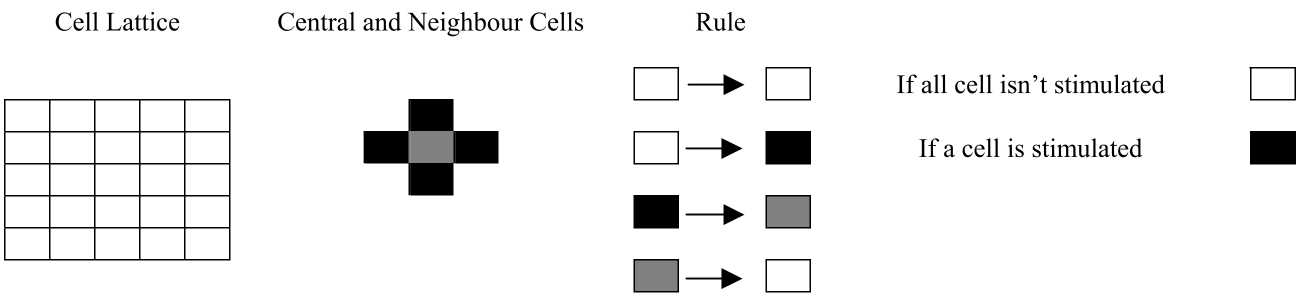

Figure 1: The Example Schema That Cellular Automata Rules are Applied (Weimar, 2000).

0->0 If a cell isn't stimulated by another neighbour cell, (kh≠2)
0->2 If a cell is stimulated by a neighbour cell (kh=2)
2->1; A cell which was stimulated, it transforms normal condition.
1->0; A cell, which is transformed normal condition, it is transform rest condition.

4 CELLULAR AUTOMATA BASED MODEL OF LUCAM

The objective of this model developed for estimations about land use in urban sites is to obtain the data, which will contribute to the formation of growth orientations, on the basis of the data about the land use and the wants of the user in the synthesis phase of planning studies. Development of this model (LUCAM) has been founded upon CA developed by G. Engelen and R. White and the simulation model for estimations about settlement land use (Engelen, White, Uljee, 1997; White, Engelen, 1997-a, White, Engelen, 1993-b). The main features and the fiction of the model is based on the method developed by Engelen and White. On the other hand original ways have been followed in data formation and assessment methods. This method has been employed to test the model in Bursa settlement and to evaluate the results. In this model each cell represents a kind of urban land use (residence, industry, trade, facility, vacant. The main features, the operation system and assessment system of this cellular automata based model are mentioned below.

4.1 The Operation System of the LUCAM Model

Operation System 1: The automation is divided into 100x100 m grilled shaped cells. Each cell must be in one of the pre-determined conditions i.e. Vacant (V), Residence (R), Industry (I), Trade (T), Facility (F) . The size of the grill changes according to the size of the settlement in which the model is tested. The area size can be accepted as about 1ha.

Operation System 2: The neighbour unit of a cell is defined as all the cells that remain in the 6 cell distance from the main cell. The total number of the cells that exist in the area between the core cell and the neighbour cells in the sixth zone is 168. As the cells are in a regular order, every cell in the neighbourhood is found in a 100 meter distance band (zone 1) or 848 meter distance band (zone 6).

Operation System 3: According to the area values and economic effects the hierarchy of the lowest and highest conditions in the land use model should be as follows:

In this hierarchy an empty cell can be transformed into any other function but an industrial cell can only be transformed into a trade or service function. As we acknowledge that the cities may grow, there can't be a transformation from the highest to the lowest condition (White, Engelen, 1993-a; White, Engelen, 1997-b; Yüzer 2001).

The lowest condition

↓

Vacant Areas

↓

Residential Areas

↓

Industrial Areas

↓

Commercial Areas

↓

Facility Areas

↓

The highest condition

Figure 2: Hierarchy of Urban Land Use Area (White, Engelen, 1994; Yüzer, 2001).

Operation System 4: In each turn, the transformation potentials are calculated for all possible transformations. For one cell the transformation potentials are calculated as a total (Formula 1).

The Calculation Method of the Cellular Transformation Potential

$$\mathbf{P_{ij} = (\Sigma_{k,d}\, m_{kd}) / \Sigma h} \quad (1)$$

$\mathbf{P_{ij}}$ **:** is the transition potential from state i to state j

$\mathbf{m_{kd}}$ **:** is the weighting parameter applied cells in state k in distance zone d

$\mathbf{\Sigma h}$ **:** is the some of central cell and neigbour cells

Empty cells have no weight and they directly contribute to the transformation potential. The facility areas exist in the settlements as unchanging function areas. These areas are for public use and they can not be transformed into functions such as residence, trade or industrial areas unless there is an extraordinary condition. On the other hand the transformation of facility areas take place if there is a need for another facility for public use. For this reason the cells defined as facility enter the model as they are, do not have any impacts on other cells and do not have any kinds of transformation.

Table 1 The Weighting Parameter to be Applied on Each Cell to Calculate the Transformation Potential (White, Engelen, 1994; Yüzer, 2001).

Distance to central cell (d)	Vacant ↓ Commerce				Vacant ↓ Industry				Vacant ↓ Housing			
	Commerce	Industry	Housing	Facility	Commerce	Industry	Housing	Facility	Commerce	Industry	Housing	Facility
1	0,8	0,0	0,3	-	0,0	0,8	0,0	-	0,0	0,0	0,3	-
2	0,8	0,0	0,3	-	0,0	0,8	0,0	-	0,0	0,0	0,3	-
3	0,8	0,0	0,3	-	0,0	0,8	0,0	-	0,0	0,0	0,3	-
4	0,6	0,0	0,2	-	0,0	0,6	0,1	-	0,1	0,02	0,2	-
5	0,6	0,0	0,2	-	0,0	0,6	0,2	-	0,2	0,03	0,2	-
6	0,4	0,0	0,1	-	0,0	0,4	0,3	-	0,3	0,05	0,1	-

Distance to central cell (d)	Industry ↓ Commerce				Industry ↓ Industry				Industry ↓ Housing			
	Commerce	Industry	Housing	Facility	Commerce	Industry	Housing	Facility	Commerce	Industry	Housing	Facility
1	0,2	0,0	0,0	-	0,0	0,0	0,0	-	0,0	0,0	0,0	-
2	0,1	0,0	0,0	-	0,0	0,0	0,0	-	0,0	0,0	0,0	-
3	0,1	0,0	0,0	-	0,0	0,0	0,0	-	0,0	0,0	0,0	-
4	0,5	0,0	0,02	-	0,0	0,0	0,0	-	0,0	0,0	0,0	-
5	0,5	0,0	0,03	-	0,0	0,0	0,0	-	0,0	0,0	0,0	-
6	0,2	0,0	0,05	-	0,0	0,0	0,0	-	0,0	0,0	0,0	-

Distance to central cell (d)	Housing ↓ Commerce				Housing ↓ Industry				Housing ↓ Housing			
	Commerce	Industry	Housing	Facility	Commerce	Industry	Housing	Facility	Commerce	Industry	Housing	Facility
1	0,1	0,0	0,05	-	0,0	0,05	0,0	-	0,0	0,0	0,0	-
2	0,1	0,0	0,05	-	0,0	0,05	0,0	-	0,0	0,0	0,0	-
3	0,1	0,0	0,02	-	0,0	0,04	0,0	-	0,0	0,0	0,0	-
4	0,05	0,0	0,02	-	0,0	0,03	0,01	-	0,0	0,0	0,0	-
5	0,02	0,0	0,01	-	0,01	0,02	0,02	-	0,0	0,0	0,0	-
6	0,02	0,0	0,01	-	0,02	0,01	0,05	-	0,0	0,0	0,0	-

In Table 1 each four-column block between the spaces comprise the parameters used in the model. In each block of the table, the first column illustrates the weights applied on trade cells at 1-6 zones, the second the weights applied on industrial cells, and the third the weights applied on residence cells.

In each turn a sufficient number of cells are transformed into all kinds of uses in accordance with the above given hierarchical order. The cell which tests all the statuses, is at the highest potential as long as the conditional hierarchy is suitable for such kind of a case. In other words the end-condition of the cell which tests all the statuses shows the highest possible potential of that cell. The operation is applied on all cells and by this way the scheme following transformation is drawn up. (White, Engelen, 1994). This scheme created by using transformation parameters is operated for the second time to form a basis for the model in case the projected population or the settlement capacity is not achieved. The model is operated until the set size is achieved.

5 CASE STUDY OF MODEL IN BURSA SETTLEMENT

Bursa (Turkey) was decided to be the sample area to test the model. It is one of the metropolitan cities of Turkey and it's population is 1.184.144 according to general census of 2000. Bursa is Turkey's fourth metropolitan city in population growth hierarchy. Within the scope of this research the projected population of Bursa in 2020 was estimated to be 2.813.394 (DIE, 1997, 2002). The primary sectors in Bursa settlement are agriculture, industry and service sectors. There is a rapid growth in the settlement due to the dynamics of development. Because of the rapid population growth in the settlement, there is a growing need for new areas.

In order to set the values of weighting parameters applied on the cells within the model, a research was made to determine the inclinations of the users in 10 different regions consisting of residence, industry and trade areas within Bursa central area and the achieved results were assessed (Yüzer 2001). The settlement was divided into 1 ha areas on the basis of land use to test the model in overall settlement of Bursa (BBBKBSDB 2000). Taking the weighted uses into account, each cell in the settlement divided into 1ha areas was formed according to 5 main functions (trade and service, residence, industry, facility and empty space) (Figure 3).

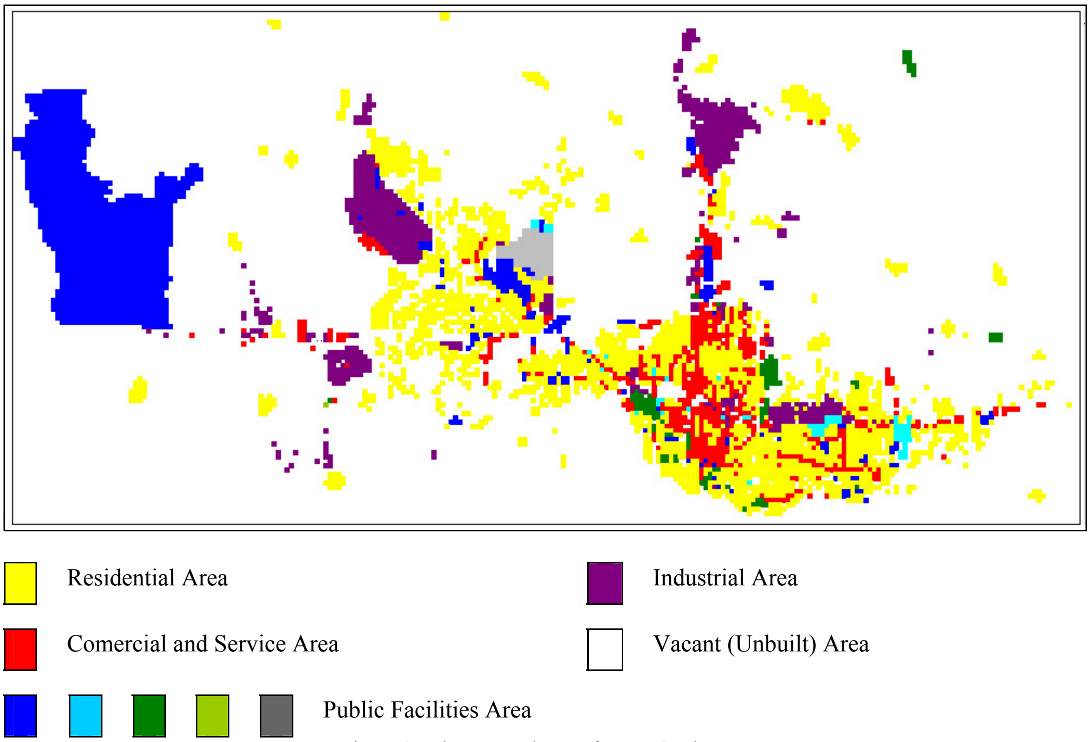

Figure 3 Existent Land Use of Bursa Settlement

According to existing data, functional areas and sizes are determined as follows in Bursa settlement area cellular land use schema (Table 2).

Table 2 Land Use of Bursa Settlement (Existing Situation) (DIE , 1997, 2002; BNİPR, 1995)

	Area (ha)	**(m^2/persan)**
Residential Area	2531	25.3
Comercial and Service Area	660	6.6
Industrial Area	749	7.5
Public Facility Area	1759	17.5
Overall Settlement Area	5699	56.9
Vacant Area	23447	234.4
Total Area (ha)	**29146**	**291.3**

Bursa Settlement After Transformation

The model was operated to find the area need of Bursa settlement for the year 2020 and the values in Table 3 were obtained as a result of the first transformation. In the first transformation process the number of residence cells increased 1.06 times and the end-size was 5228 ha. Moreover the trade cells increased 2.01 times and the industrial cells 2.14 times (Figure 4). Except the facility areas the ratio of the general increase in cells was 2.43 as a result of the first transformation and the end-size of the settlement was 9576 ha. In compliance with the principles of the model, the facility areas did not have transformations of any kind and their number and position remained the same (Yüzer 2001).

Table 3 Land Use of Bursa Settlement After First Transformation (DIE, 1997, 2002; BNİPR, 1995)

	Bursa Settlement Area Distribution After Transformation
Population (person)	2.813.394
Residential Area (ha)	5228
Commercial and Service Area (ha)	1993
Industrial Area (ha)	2355
Public Facility Area (ha)	1759
Overall Settlement Area (ha)	11335
Vacant Area (ha)	17811
Total Area (ha)	**29146**

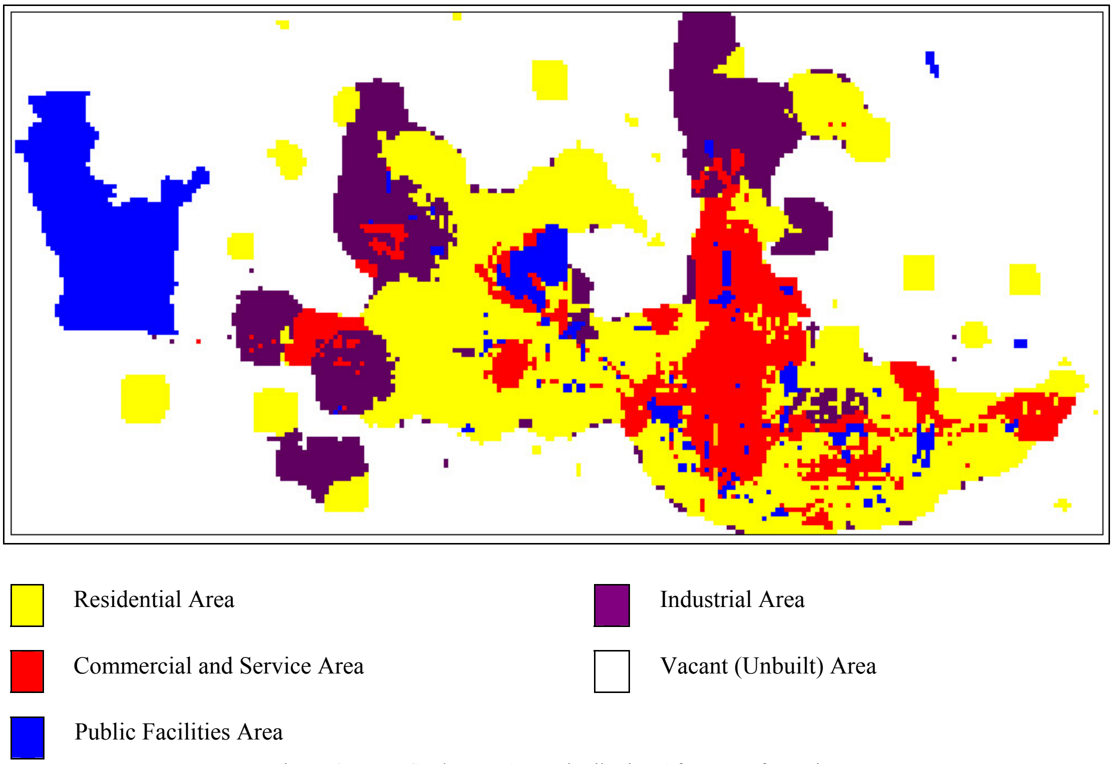

Figure 4. Bursa Settlement Area Distribution After Transformation

Accepting that all the function areas are adequate for Bursa settlement, it was found out that the required area size should be 15958 ha in 2020 on the basis of population growth. This refers to a 2,8 times increase. The difference between the size obtained after the transformation process and the required area size in 2020 was found to be 4622 ha. In this case the model could have been reoperated. However as it was agreed that there would be a growth in facility areas as well, one-stage operation of the model was deemed suitable.

6 CONCLUSION

Fractal and cellular automata based LUCAM Model which is explained in the article estimates land use transformations and new development regions in the settlements. As a result of the evaluations and the application of the model to Bursa it can be accepted that the model is an important guidance in urban planning studies. Easily application of the model to settlements, which are turned to fractal schema, strengthens spatial scale suggestions. Depend on the defined size of the settlement; the running of the model increases the sensibility of both the cell and the model. The model concludes peculiar to the settlement by using variation depend on the condition of the cell as the main rules of the cellular automata. With different rules and parameters put forward in the model enables the development of different versions of the model by different researchers. The model can be organized in different forms depend on local properties. By defining the user's tendencies, differentiations in rules used in the model and weight parameters can be occurred. Thus the model can be run special to that settlement depends on every settlement's property.

In this research, getting population projections did the simulation of Bursa settlement and land use data depend on user's tendencies. In another version of the model, the simulation of the settlement can be done by rules and acceptances determined after using natural data. The model intuitionally put forward logical results. With this characteristic, it guides zoning studies in classical planning techniques. The model enables the transfer of criteria determined in the settlement to cellular schema and getting schema of transformation in harmony with criteria. This model can be integrated with Urban Information System and Geographical Information System and data of these systems can be used in the model.

The model minimizes the calculation time with the software developed in the computer. Furthermore the variability of the matrix size determined depends on the settlement's size enables easy use of the model for every size of the settlement. In the model ownership was ignored. So the results should be compared with the ownership texture. In another version of the model, simulation can be done with data such as ownership texture and land values.

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The Information and Communication Technologies impact in Urban Process

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1 INTRO

The effect of Information and Communication technologies progressively covers the entire spectrum of the enterprising and administrative transactions that take place in the urban tissue and offer new innovative operational activities.

With the development of internet, digital technology and telecommunications

- most enterprising operations today tend to be electronic.
- geographical and temporal limits in operating an enterprise are diminished,
- new market forms are created,
- new hybrid products are created,

while, simultaneously,

- the nature of goods becomes, more and more, indistinguishable from services.
- changes in the hierarchies of importance of products.
- new dynamic relations developed between customers and companies.

The base of electronic activities is supported by the capability of:

- recognising and ordering products from distance,
- organised mass central assignment to the consumers of services, with direct impact to the reduction of transportation pressure and parking spaces.
- diversification of nature of products by material and immaterial, with disproportionate requirement of land and thus impact in the function of urban space.
- expansion of abilities of immaterial administrative solutions for material products.

The changes that take place in the structure of an enterprise activity, with the application of informative solutions, are drastic and interact with the exterior world in sectors as:

1) Supplies,

2) Sales,

3) Relations with customers and suppliers,

4) Management of relative information and negotiations,

and they expand in depth and width and acquire readiness and speed.

A) E-BUSINESS

A radical transformation is realised in the enterprising world.

- Electronic transactions,
- creation of electronic markets (e-markets), and
- electronic enterprising communities (networked business communities),

will bring down the traditional enterprising models.

The "Decapitalisation" of enterprises constitutes, potentially, the most important element of new enterprising model, as the enterprises create "external networks", diminishing considerably the corporate operations that are carried out inside them. This renders the entire urban tissue a place for operational activities when it does not exceed the government owned limits.

B) E-COMMERCE

It should be pointed out that real electronic trade is something more than simply selling products in web. Two basic categories of activation can be observed, which also create different enterprising processes.

a) To electronic trade addressed to the consumer,

b) The electronic trade extended to business resources and processes

C) E-PROCUREMENT.

The management of supplies via Internet is a basic component of electronic business. It provides important possibilities for reduction of expenses and offers new chances for profitability, both basic strategic elements for planning business in the New Economy.

D) E-GOVERNMENT

It changes the way that National and Local Governments serve the citizens. The era of electronic governing has already begun. Its simple expression concerns the use of technology so that the means of access and services to the citizens are enriched, as well as the enterprises in the frame of its operational way to a "client-central" approach.

E) E- MARKET PLACES.

The term e-marketplaces means electronic markets structured in order to serve B2B operational trades[1][3]

2 THE URBAN PROCESS TRANSFORMATION FACTORS.

The up today expressed theories of space explain land use distribution with reference to:

- distances from the markets,
- the available means of transports,
- simultaneous formulation of thematic and spatial hierarchies of services for the creation of markets, and the
- general functional aspect of space,

These allocation theories arise directly from the application of various types of economy (rural, industrial, services...) in space. This means that the allocation of the economic activities, in urban tissue, is mainly influenced by these functional factors.

Such elements, beyond political, social, and tax factors, are usually capabilities for:

- individuals transportation,
- communication,
- Information,
- products transportation,
- products distribution,
- goods storage,
- products processing,
- networks infrastructure e.t.c.

The spotting of type, place and function **of constitutive elements of urban structure** opens theoretically the way for the interpretation of nature and way cities operate. The basic constitutive elements concern mainly human activities taken place occasionally in urban tissue.

The differentiation of the **"human activities nature"** in the development of information and communication technologies (I.C.T.) has implications on the **"basic nature of cities"**. This differentiation is expressed initially in the function and in continuity in their form.

a) The classic factors of allocation of activities in the regional and urban space were up today mainly of **"material nature".** And more specifically:

- the accessibility,
- the cost of energy,
- the cost of labour,
- the markets place,
- the appropriateness of natural infrastructures etc

b) This consideration is progressively supplemented with corresponding allocation factors **"immaterial nature"**, as

- knowledge resources,
- culture resources,
- knowledge infrastructure,
- centres creation,
- information networks,
- communication technology.

These immaterial factors constitute the new genetic code of the old urban environment transformation and the new urban environment creation.

The new genetic code affects the urban process, acting additionally and simultaneously to the material nature factors, and results in **the activities territorial redistribution.**

It is important to investigate the way immaterial factors influence. This happens because their immaterial nature is reported mainly to the fact that these factors are "**independent from the space",** as they influence the urban process.

Thus while until today the cities process depended on the space and cost factors, the configuration of anthropogenic urban environment is, from now on, presented immaterial and consequently independent from the space and its' up to now active properties, because the e-networks creation disconnects the space and cost dimension**.**

Summarising we can consider that: "Information, Communication and Technology are main forces of development, in Urban agglomerations".

For the various hybrid immaterial activities completion and the diffusion inside and outside urban tissue "**Networks**" constitute the basic prerequisite.

The urban agglomerations environment, constitutes the ideal cradle of growth and convergence of networks, fact that constitutes their main attribute. This happens because the networks stretching out (gradually) in the urban planned space tend to unify, differentiate and improve, from a functional aspect, the space's three basic properties: ensure continuity, and blunt its anisomorphy and anisotropy.

The extension and spread of networks in the "men-made space" aims to render all places equally central active. The later recommends objective for the improvement of its functionalism.

Thus the developmental and cultural potential of a city is determined and depends upon the possibility, quality and speed of communications, that is to say the possibility of creating networks and their properties development which are:

- the comfort of integrating new elements and
- the possibility of networks combination.

3 THE SPACE TRANSFORMATION SEQUENCE.

These changes, emanated from activities evolution and the Market's transformation , affect the urban process, shaping:

a) Electronic way of function in all urban activities.

b) new spatial forms of growth for residence, productive activities and services sector,

c) modification in the way central places function because of alterations in their role, and the centricity's bluntness.

d) development of functions of scale (longer distance commuting, big commercial centres, road axes interconnections….)

e) development of allocation of scale, central regions extension with network form but also linear form on central axes.

f) intensification of land uses with consecutive increase in land prices.

The above new elements entail the Reconstruction of Urban regions by new functional forms, via

- 1)the development of nucleus with advanced – specialised functions,
- 2) interconnected with big supralocal axes and
- 3) growth of means of mass transport of constant orbit (underground, tram).

It should be clarified that the reported "**alteration of nature"** takes place in specific parts of cities that change mainly their functional nature. These changes take place initially in the "**functional part of the city**" that has maintained certain metabolic attributes and is extended in the "**inactive mass of the city**" occupying the necessary space.

It is namely "***an internal areal change***" characterized by ***thematic differentiation***.

4 THE BLUNTNESS OF CENTRICITY.

The Internet, stretched out in the urban tissue, renders the attributes of centricity approach-ability and accessibility property of all Urban regions. The notorious centricity based on the Urban functions hierarchy is blunted, since the nomenclatura of functions is transformed by the electronization of the old and the transformation of the new. The internet lends in all the regions, the central dimension from the point of information flow aspect.

It is noticed, at the same time, that the "**electronic control of supplies**" rationalises their management and decreases the transportation burden from their realisation. The same effect has, obviously, the legalization of electronic signatures. This fact ensures what has, for some years, realised by the double use of fax.

Similarly the final repercussion of electronic governing in operation of city is decisive, since up to now the citizen's movements via the road axes, from and to, various governmental buildings, is now carried out electronically, via the information boulevards.

These factors and influences shape in a new base the relations between

- allocation of production,
- transport cost,
- products and services places of disposal,

involving the total rearrangement and transformation of all parts, of production , disposal and the communications between them.

[1][3] B2B eMarketplaces

The unceasing phenomenon of enlargement brings, doubtlessly, the internal alteration. Thus new functional characteristics are shaped, that serve the objectives of each city which is extended continuously to a total multi-centric urban agglomeration.

Indeed, the cities, being developed under the effect of the already reported hybrid factors, are progressively converting to new "entities", that is to say in **"multi-centric urban agglomerations"** that can be determined as **"urbanised regions".**

The new possibilities of Information and Communication technologies (I.C.T.) exempt the individual consumer from the need to resort to these central places in order to obtain goods and services. Thus central position ceases of constituting essential attribute and advantage of places which henceforth are equally functional while simultaneously the complementarity of space is blunted progressively. Therefore new properties will be developed towards the allocation of activities, which will from now depend on Internet.

It is obvious that the activities electronization will not happen automatically, but will be developed progressively and step by step, depending on the possibility of each activity to become electronic.

This change in the way of operating individuals, services and enterprises in space, via the internet, which substantially constitutes new technology of information-communication but also action, differentiates progressively the man-made space nature. At least the nature we conceive.

This differentiation will begin with the progressive bluntness of centricity, and in **continuity with** the release of also local centres from this, in the degree that the new technologies of communication allow and determine.

The described above changes of nature and way businesses operate but also co-operate, show already a decisive effect in their way businesses act in space and co-act inside the city that accommodate it.

It is noticed, at the same time, that the electronic control of supplies rationalises their management and decreases the transportation burden for their run. The same effect has, obviously, the legalization of electronic signatures. This fact ensures what has, for some years, realised by the double use of fax.

The latest effect of electronic government in the function of a city is decisive, since the up to now transportation of citizens via the road axes from and to the various governmental buildings, has now been realised electronically, by the distribution of citizens and their administrative acts via information technology.

Factors and influences like these shape the relations between relocation of production activities, transport cost, and places for disposal of products and services. The latest are, obviously, influenced by every relevant technology that is available.

The VIRTUAL TRANSFER or the "Renaissance" of dramaturgy in Multimedia

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ABSTRACT

Since 1998 the Swiss National Museums are in a phase of reorganization and modernization. Part of this process will be the renovation of the first Swiss National Museum (Schweizerisches Landesmuseum) in Zurich. Founded more than a hundred years ago as a symbol of national identification in order to preserve the cultural inheritance, the museum in the 21st century is confronted with more extensive tasks, new challenges and goals. The New Swiss National Museum - the final reopening is planned for 2013 - will become an urban center linking the traditions of the past with the challenges of the future. These goals are reflected in the objectives of VIRTUAL TRANSFER MUSEE SUISSE, a vision of interaction and communication with our visitors and users. It aims to be a strategy for direct communication in 5 languages (German, French, Italian, Romansh and English) and works as a sort of "online agency" for the Musée Suisse Group. Unlike the flood of information in the web, the VIRTUAL TRANSFER offers the opportunity to rediscover the charm and charisma of the objects in the collections, their history and their impact on the viewer. The author Harald Kraemer - involved in the planning and realization of the VIRTUAL TRANSFER MUSEE SUISSE - will give valuable insights into the prototype on CD-ROM and the further development of this exceptional project on the web. The VIRTUAL TRANSFER MUSEE SUISSE is being set up on behalf of the MUSEE SUISSE Group by die *lockere* gesellschaft – TRANSFUSIONEN, a well-known company for innovative media in museums.

Keywords:

a New National Museum for Switzerland, Virtual Transfer instead of virtual museum, integrative museum, interactivity, knowledge transfer, creativity of visitors

Facing to existing mostly print-layout-oriented and data-oriented Museum Web-Sites the VIRTUAL TRANSFER occupies a special place in the museum worlds of cyberspace and virtual museums. The term *Virtual Museum* is used inflationary. Virtual Museums are "en vogue" nowadays and part of the strategy has been to keep distance to these flood, so the VIRTUAL TRANSFER was born. Why? A transfer is a process of transmission.[1] This can be a movement in real space (e.g. a bustransfer) or in virtual space (e.g. news on TV or using Google) or a symbolic transfer (e.g. money transfer) or an interspacial or intramondial transfer between the real world and the virtual world. No transfer exists without transformation and transfers between the virtual world and the real world are a process of transformation. By crossing the different transfer-levels we are growing on our defiances. And this is the best condition to learn and discover our specific relationship to the world we are living in. A Museum is untold in its wealth of collected experiences of life.[2]

But to communicate this richness to the visitor, especially the user, a leaded navigation is necessary. Interactivity are the multiple choices of digital one way streets and in the most cases interactivity is more interpassive than interactive. The secret is to understand that real interactivity grows out of the actuality of an action.[3] It is the productivity that leads us to the creation of reality and the meaning of perception. Not the navigation is responsible for my choice. My preferences, my associations and last not least my own history lead me through the contents. Only a manyfolded dramaturgy which allows different levels of deepening for the different usergroups. Not all of these contents are for everyone, but everybody has the chance to find something for him or herself. The navigation should be content and this means: Using interactivity in Multimedia is the way to control the creativity of your user.

The strategy of the VIRTUAL TRANSFER has been developed by the experiences of two formerly projects. In 1998, "VIENNA WALK DEMO", the prototype of an interactive film on DVD-ROM produced by Science Wonder Productions, was a futuristic vision of real interactivity and an intelligent knowledge transfer in the field of cultural heritage-tourism-ecommerce.[4] VIENNA WALK has shown that the relationship between navigation and information has changed. An intelligent navigation can lead through the world of ….. and can be part of the content at the same time. In another project, the CD-ROM "ART AND INDUSTRY" produced 2000 by Transfusionen this synergetic effect between content, navigation and communication with the visitor has been tested successfully on the kiosk systems in an exhibition show about the founding of the Museum of applied Arts in Vienna.[5] Combining the architecture of the building, the artifacts and the Multimedia kiosk systems, the visitors has been confronted with different levels of interactivity supporting an innovative transfer of knowledge about the cultural heritage of the pluralism of styles and the age of Historicism. Starting with the Great Show in London 1851 and ending with the "Halbzeit der Moderne" 1910 the navigation-line of the main story is in a chronological order following the story of the formerly "Museum for Art and Industry" and allow via sub-lines the deepening through single topics (e.g. The influence of oriental style, Vienna – center and suburbs). The second main part about Historicism and the pluralism of styles and has a different navigation. Concerning the democratic pantheon of the different styles (e.g. neogothic, japonism) the navigation shows them all, so that no style comes into prominence. So the user learns through the navigation that you can understand history linear and chronological in a single-line order, following event by event as well as a complex network of reciprocal influences co-existing at the same time.

The VIRTUAL TRANSFER is not a digital collection, not a portal, not a virtual museum, but a vision of interaction and communication with the museum visitors and users. It aims to be a strategy for direct communication in 5 languages (German, French, Italian, Romansh and English) and will work from Spring 2004 on as a sort of "online agency" for the Musée Suisse Group.[6] Unlike the flood of information in the WWW, the VIRTUAL TRANSFER offers the opportunity to rediscover the charm and charisma of the objects in the collections, their history and their impact on the viewer. Places and stories that can be explored interactively, a choice selection of objects, highly personalized forms of address, successful dramatic scenes presented in multimedia form, all give the users a strong stimulus, bring them inspiration and in this way activate their own creativity. And it is not a virtual substitute for the Swiss National Museum. It will help in developing experimental strategies for interactive transfer, and as effective publicity will attract ongoing interest and a high degree of awareness during the planning phase of the New National Museum.

So the Virtual Transfer is a labyrinth of experiences, an inspiration ahead of information, a rediscovery of the charm and charisma. The objects of the museum collections became the narrators and the stories the have to tell are part of our own life. This impact on the viewer allow the interactivity to activate his own creativity. Facing to the danger of art historian gibberish in exhibition catalogues or the accumulation of boring facts the dramaturgy of the Virtual Transfer has been planned to be humorous, intelligent, thrilling, inspiring, many-sided and full of marvelous stories and wonderful journeys.

Fig. 1: VIRTUAL TRANSFER, Introduction

Fig. 2: VIRTUAL TRANSFER, Sitemap

The architecture of the VIRTUAL TRANSFER MUSEE SUISSE contains:

chamber of marvels

The chamber of marvels include *masterpieces*, *favorite items* and *curiosities* and allow us to use different strategies and dramaturgies in the presentation of the object. This can be an inner monologue spoken by a female voice from the off reflecting her mood facing to an object (e.g. the Neolithic Gynaecomorph container). Or following an inner dialogue of the two halfs of a person discussing the positive and negative aspects of his future with himself (e.g. Langobardic foil cross). An invitation for a discovery or contradicting a message (e.g. “Death is not of long duration.”) or an alienation (e.g. the facts about a mail carriage shown as a second hand car advert) are some of our other strategies.

combinations

Every word is linked with an object, but the combination between two or three different words help to create new associations:

1. game = horse with wheels

1. game + 2. costume = chess game in the style of Louis XIV.

1. game + 2. costume + 3. automate = musical mechanism of a tennis play around 1900

picture albums

The picture album (e.g. "Dragons, mermaids and other strange beasts") is a collection in the collection, an exhibition on a meta-level and allows us to combine interesting and curious objects from all the different collections. The 60 objects are described by categories (mermaids, dragons, daemons, griffins etc) and attributes (Which beasts have their origin in Christian mythology? Who is a good teacher? Who is strong and powerful?).

anecdotes

These are audio adventures and a visualization of screenplays, fairy-tales or poems. In the module "Join Mark Twain in storming the peak of the Rigi and send us a happy end from there" we have illustrated a mountain climbing anecdote of the famous American Mississippi pilot by using historic photographs of the early alpine tourism period. Or a graphical animation by using unusual objects like forks and bells in the famous screenplay “Herakles and the stable of Augias” by Friedrich Dürrenmatt.

learning course

To find out the difference between ideal and reality we used an Playmobil medieval jousting tournament and complain it with the real medieval objects and the Codex Manesse. The combination of the well known Playmobil knights and the relics of the Middle Ages create a special atmosphere of fascination and invite the user to discover more about that time, the culture and the behaviour of the people. Especially the “MINNE love affair”, a rendezvous between a knight and a maid, read and spoken in Middle High German language with subtitles in our recent language is most impressing for children and adults.

quiz and game shows

Both are helpful tools to support the different modules. In the Web Preview Edition on CD-ROM we have combined the quiz about the learning course with a fight between two knights.

online exhibitions and research projects

are also part of the activities of the VIRTUAL TRANSFER. Virtual limited-duration *online exhibitions* on inter-disciplinary and abstract topics make it possible to discuss current problems and to achieve a high level of attention from the public, as well as offering scope for cooperation with colleges, academies and universities. The basis for *research* is provided by actual research projects such as those being carried out by the Department for Conservation Research. This module aims to give visitors an insight over a longer period of time into the progress of scientific research. This may be the restoration of a painting as Hans Ernis famous 90 m long and 5 m high wall painting “Die Schweiz, das Ferienland der Völker” from 1939 or an archaeological excavation, the reconstruction of the meaning of an excavation, or an introduction into specific museum activities such as making an inventory. Collaboration with the research departments of universities will be allowed for, as will getting schools involved. Both will mention relevant literature and show selected links relating to the questions raised.

witnesses

Witnesses are observers in time and space. This module gives reports by historic, fictive and living eyewitnesses:

The story of the invention of the historic *Notzimmer* (knockdown furniture with 4 chairs, 2 beds, 1 table, 1 wardrobe, dishes and cutlery in case of need) is told by the daughter of Mauritius Ehrlich and visualized by a newsreel from 1945 and two trick films. Thinking about his own fate – Ehrlich had to leave Vienna 1938 as a Jewish refugee – he constructed this famous Notzimmer to help others. The interview with his daughter ends with an appeal to help. With this personal background the user will get more information about the Swiss asylum policy in the years 1933-1945 and as well as web links to the Refugee Agency of the United Nations (UNHCR).[7]

Fig. 3: VIRTUAL TRANSFER, Witnesses: The Notzimmer of Mauritius Ehrlich, trick film No. 1

Or as a second example: the fictive eyewitness on *Memento Mori*. 550 years after his death (1456) the formerly mayor of the city of Berne in Switzerland, Rudolf von Ringoltingen, is talking in our days why he has spent a lot of money to shorten his time in the purgatory.

Fig. 4: VIRTUAL TRANSFER, Witnesses: Rudolf von Ringoltingen is speaking about his time in purgatory.

Or the last witnesses are reflecting about the *Trottinett*, a Swiss kickboard prototype. Seven youngsters – professional kickboard-hell drivers – give us an introduction in the fascination of their daily life. It may look funny in our days, but don't forget that these constructions in some years will be documents of our time concerning objects of the Swiss National Museum collection.

Fig. 5: VIRTUAL TRANSFER, Witnesses: A young kickboard driver is speaking about his passion.

The ***archives*** of the VIRTUAL TRANSFER serve as an instrument for documentation, a listing of developing activities, and as indexes. They are organized as follows:

- - systematically following the modules of the VIRTUAL TRANSFER
- - by languages, with versions in German, French, Italian, Romansh and English.

The VIRTUAL TRANSFER is not a Virtual Museum or just an information gateway. It is more like a lens filtering the essence as well as the stimulating value of these objects and understands itself as a powerful strategy for high-quality knowledge transfer. By realizing the project the museum team will be able to learn a lot about the real needs of their visitors, the real ones and the virtual ones. The keywords to establish a homogeneous dialogue with the visitors are communication, participation and feedback.

ACKNOLEDGEMENTS

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This CD-ROM contains over 200 objects of the collection, 14 films, 4 trick films, 12 composed soundfiles and a multilingual navigation in German, French, Italian, Romansh and English.

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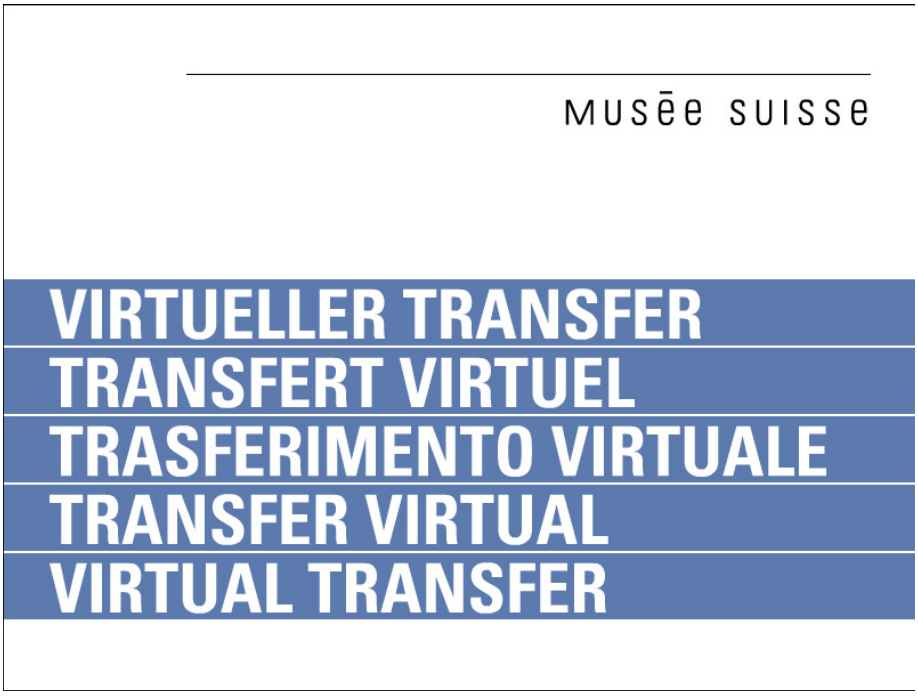

Fig. 1: VIRTUAL TRANSFER, Introfilm of the prototype on CD-ROM

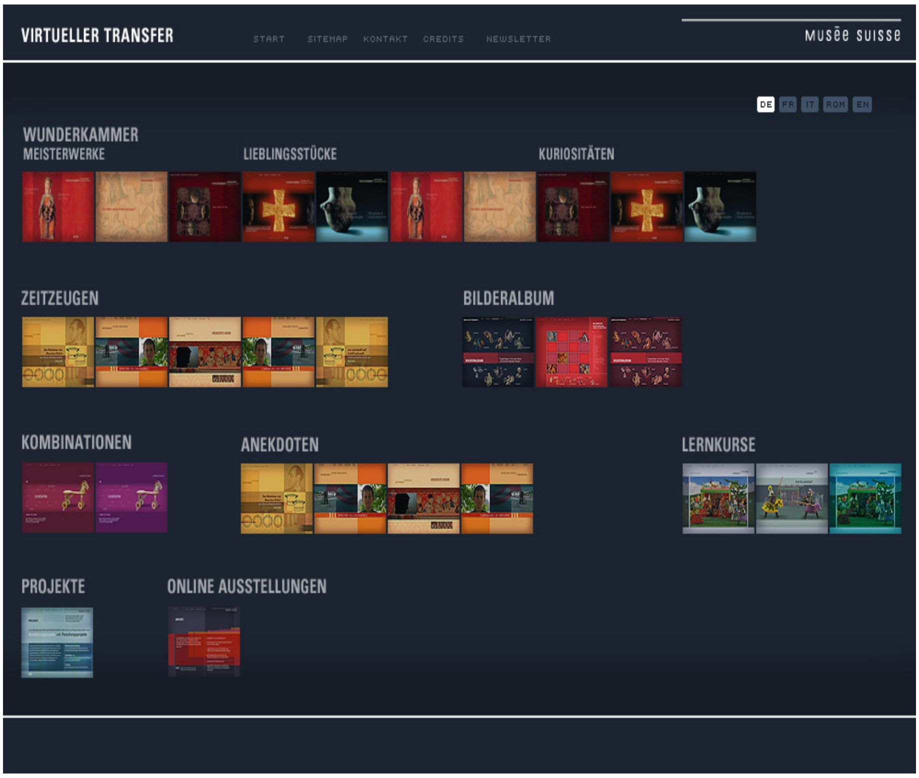

Fig. 2: VIRTUAL TRANSFER, Sitemap

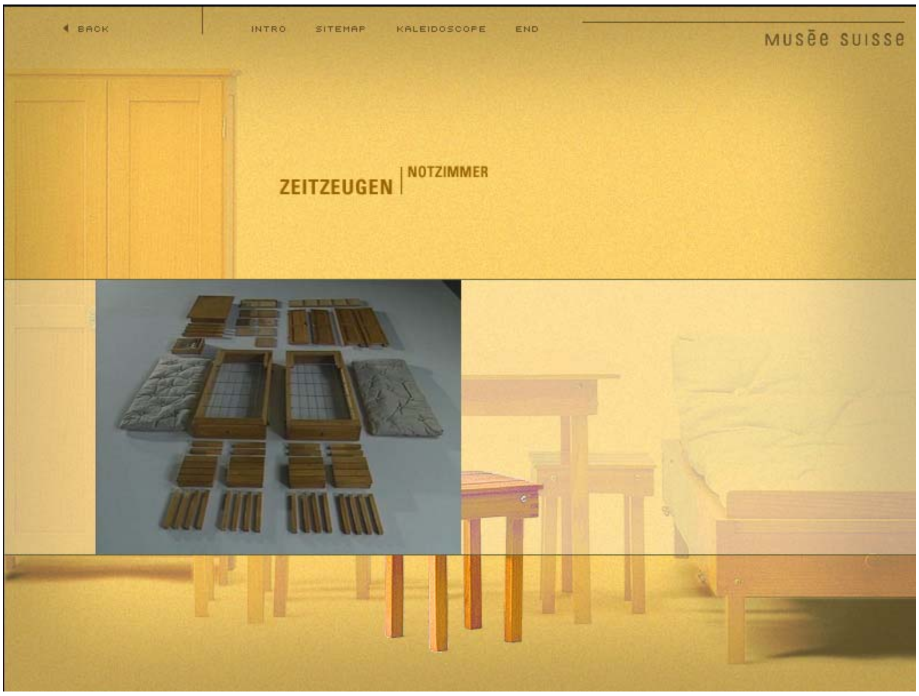

Fig. 3: VIRTUAL TRANSFER, Witnesses: The Notzimmer of Mauritius Ehrlich, trick film No. 1

Fig. 4: VIRTUAL TRANSFER, Witnesses: Rudolf von Ringoltingen is speaking about his time in purgatory.

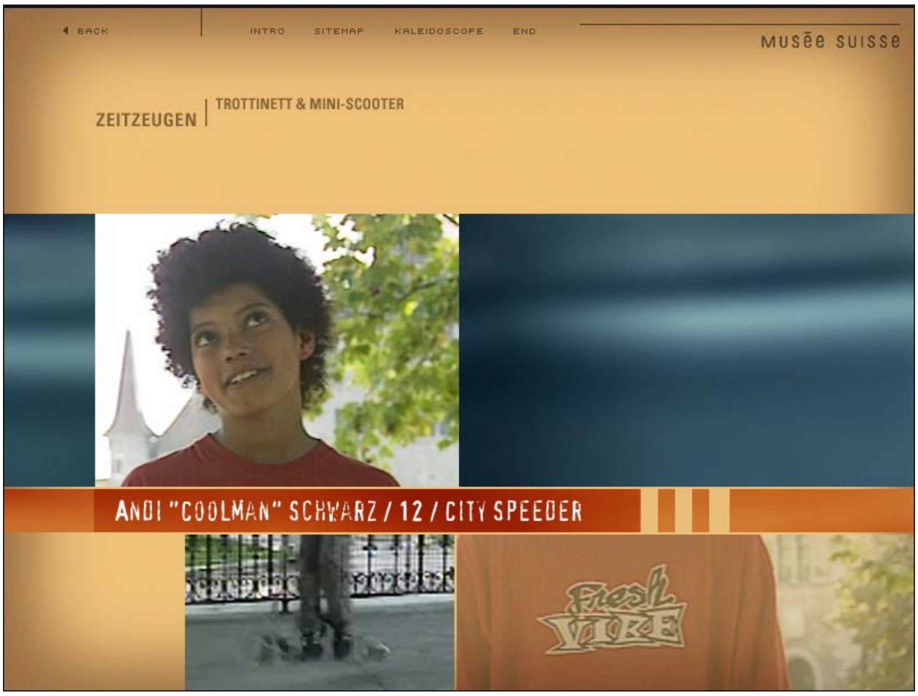

Fig. 5: VIRTUAL TRANSFER, Witnesses: A young kickboard driver is speaking about his passion.

Intellectual system of the complex analysis of economic dynamics on time series

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ABSTRACT

Because the explained issues posses great importance for Azerbaijan experiencing its transition period, creation and implementation of the System of Economic Analysis (SEA) accepted as a non-linear dynamic system, fractal analysis of factors which can influence on the purpose of investment in the region and are stipulated with importance of solving of following problems:

- concrete and systematic analysis of the information;
- capacity of complex and visual usage of the data necessary for decision making;
- operative control over dynamics of progress of processes;
- operative analysis in the cases of emergency;
- quick investigation-information system.

Scientific-technical progress makes a basis for economic development in the XXI century, known as the century of information technologies. So, by analyzing the complicated dynamic processes using modern information technologies, there appear opportunities of foreseeing the probability of emergence of any nonstandard situation and taking certain preliminary measures [2].

Since the statistic indices served only to planning in the period of centralized economy, in the conditions of market economy, operative and effective analysis of these indicators accepted as an effect of facts that are evident and not evident, play very important role in strengthening the state that has already started intensive development, in making optimal decisions for getting new achievements and in directing the economic policy. Because, under the conditions of market economy statistic indicators are used as an aggregate of the primary data for satisfying the demands of users for information through changing into crucial information infrastructure of the society as a fundamental source of information about the past, for analyzing implemented works, obtained results and forthcoming processes and for prediction [1].

Investigations show that, the effective analysis of processes, which might happen under the influence of following factors, can be achieved by implementing Nero network, fuzzy logic, the synergetic analysis methods, which have successfully been experienced in learning and analyzing the formation of market infrastructure of developed countries through systematic approach in the condition of market economy [11, 9].

It is undeniable fact that, the main factors influencing the economic development in the countries with transition economy are as following: objective terms and subjective decisions, reforms, social-political factors, geographical situation of the region, ecological factors, international relations, etc. During the analysis of economic processes, oversight or incorrect assessment of influence of any of these factors will certainly show itself as an ultimate result.

On the other side, it is very necessary to research the existing condition of our economy on the framework of global changes taking place in the world economy. So, barriers between the countries are being removed, global economic area is being formed against the background of scientific-technical progress. The changes in this economic area is so intensive, their quality features are so unexpected that there arises a need for new analytic and calculation methods for the purpose of analyzing and forecasting the processes occurring here.

For that reason, the systematic analysis of transition economy should be made in the following main directions by using mathematical methods of nonlinear dynamics, modern information technologies, and technical means on the base of macroeconomic indicators:

- analyzing the influence of the objective terms and subjective decisions on dynamics of economic development;
- analyzing the influence of the reforms on dynamics of development;
- analyzing the influence of the socio-political factors on dynamics of development;
- analyzing the influence of the geographical location on dynamics of development;
- analyzing the influence of the ecological factors on dynamics of development;
- analyzing the influence of the international relations on dynamics of development.

These processes mainly characterize counter related nonlinear complicated systems and output information is reused as input information here. We cannot automatically include market economy into these systems, but market reflects many effects specific for counter related nonlinear systems. The main elements of these kinds of systems are such concepts as crisis, disaster, bifurcation, cyclic period, running wave, and so on [12]. Because the processes are inconvertible in nonlinear dynamic systems, time factor plays special role there. But the inconvertibleness is the result of complicated and collective actions of internal elements of the object. Because of that, it is very necessary to use experienced synergetic analysis methods widely in systematic analysis of countries with transition economies in which the probability of occurrence of these cases is very high.

Synergetic economy develops on the base of traditional economy. By contradicting some ideas of the traditional economy it explains them as a special case. At the same time, synergetic economy states hopeful directions for explanation and forecast of complicated economic processes [11, 12].

Classical methods are not used anymore and fractal analysis, more productive mathematical method, is widely applied in the western countries at present. Numerous statistic data covering several decades of capitalist markets is investigated by this method. Gained results are very hopeful and it is proved that grounded forecast is not just possible, but also very decisive factor for conducting the economic processes, which is the nucleus of economic upsurge in the countries with transition economies [4].

As transition period is a component of market economy, the following factors considered as characteristic features of dynamic systems, should be taken into account in the systematic analysis of transition economy:

- long-term correlation and counter-relation effect;
- crises in exact time and within exact terms;
- repetition of the process in a short period (fractal structure);
- increase or decrease of the reliance of given forecast (sensitivity to initial conditions);

These stated cases happen only when the system is far from equilibrium. But that belongs to only market economy and doesn't comply with effective market notion.

Along with the natural disasters, the scope of artificial disasters has been widening in the recent years. Now a little mistake can lead to the destruction of the whole world infrastructure. Preventing such kind of disasters is not required from the science yet. But forecasting the further development of the processes remains one of the crucial matters in agenda.

Any change occurring in the environment affects us. Our feelings about the future are formed on the base of experience gained in a long period of time. This is the above stated counter-relation form and shows itself more actively in the market relations. Because, the market economy considered as a real system, posses a very wide memory diapason and the elements of this memory strongly influences the existing situation of market. All these factors make the market to disorder and that's why, the accuracy, optimal decisions are unacceptable here.

Econometrics is mainly related with linear equations. But evidentially, they accept simple number decisions. For that reason, they are mostly implemented in technical fields. Unlike these, non-linear equations are many-valued, disordered, and their results are far from the reality. But as time passes, it becomes clear that major complicated natural processes are successfully modeled by differential equations [2, 6].

Life is disordered. A question may have more than one answer according to the circumstance here. That's why, during the solving of certain problem, there arises a need for having models which can make various decisions according to the circumstance.

Because the explained issues posses great importance for Azerbaijan experiencing its transition period, creation and implementation of the System of Economic Analysis (SEA) accepted as a non-linear dynamic system, aiming at analysis of today's some problems on the base of quantity and quality indicators of the previous years and creating effective visual working environment by statistic-space data assume very great importance for solving of social-economic problems, economic-geographical investigation of area naturality, fractal analysis of factors which can influence on the purpose of investment in the region and are stipulated with importance of solving of following problems:

- concrete and systematic analysis of the information;
- capacity of complex and visual usage of the data necessary for decision making;
- operative control over dynamics of progress of processes;
- operative analysis in the cases of emergency;
- quick investigation-information system.

The creation of such an analysis system creates a possibility to prevent various undesirable outcomes that can occur during dynamics of progress of economical processes, and to predict performance models for a short period of time of forthcoming processes on the basis of quantity and quality indicators of the previous years. As a result of fantastic progress of information technologies and efficient usage of mathematical methods of non-linear dynamics in the solution of complex dynamic system, possibility of directly observing the unique processes of transition period of economy in a computer monitor supports the creation of such a system.

Functional software of SEA consists of program packet, which has been made in C++ Builder algorithmic language. This packet includes functions and tools for information holding, analysis, decision-making and visual appearance. These are divided into three main groups:

- \- operations on the data and input-output tools;
- \- management systems of data and information bases;
- \- analysis and visualization of inquiry and decision making operations.

The primary data of SEA, first of all consist of information, which characterize the space position of economic objects and the data tables related with them. These data can either be prepared by user using recourses of system, or received from outside in an appropriate form.

The bank of information is one of the significant elements of SEA. Because, its comprehensiveness determines in which extent the ultimately made decision is close to the reality. The information, which is the element of this bank – the quality indicators obtained as a result of technological operations composed by user using algorithms that are made on the base of mathematical methods of non-liner dynamics from quantity indicators assembled in the data bank and included to SEA in the forms of functions - is a verbal expression of economic situation.

Generally, the implementation effectiveness of SEA depends on correct creation and choice of algorithms that are main tools in the formation of information base and decision-making. That's why, these algorithms should be able to ensure the closeness of the decision, and made for a short time period to the reality when not all the primary data are known. To achieve this, the following mathematical methods of non-liner dynamics, that give opportunity to obtain results based on above-mentioned conditions, are used [2, 6, 12]:

- - fractal dimension;
- - Hertz R/S analysis;
- - correlation Integral;
- - chaos theory methods;
- - fuzzy sets;
- - Nero network methods.

Algorithms created by using these methods are applied systematically in the processes of analysis and decision-making and each of them has its function.

Fractal dimension reflects how the object (time series) fills up the space in which it is located. For this reason, the value of fractal dimension is always less than the space in which the system is located. In other words, fractal dimension is the item created by those factors, which their influence to the system creates this object (time series) [3,6].

While random time series is accepted as a result of many events of equal probability, non-random time series reflects non-casual nature of influences on the system. The jumps that are faced in the series are result of the influence of objective and subjective factors. But this is an indication of correlation among the elements. In other words, such time series have fractal features [3,6,12].

Time series with fractal features are also characterized by long-term indication of correlation. So, events happened today influence tomorrow. The new time factor assumes an important significance. In the processes of market economy, especially in the transition period, this factor plays a great role.

The exponents of effective market hypotheses declare that, investors react instantly to the new information and deny relationship between past and future. And its purpose is to ground the use of liner models. But, what is in reality? Yes, some people react instantly, but majority wait for the confirmation of the information. But for this, grounded information approved by time is necessary. But this is a long-term memory effect specific for the non-liner dynamic system. The method of Hertz R/S analysis is very reliable for analyzing this memory. This method is directly related with Hertz indicator [6,12].

The following results reflecting the reality were obtained through analyzing the dynamics of growth of exchange rate of American dollar to Azerbaijani manat by Hertz R/S analysis for the time period 01.01.1995-31.03.2001- the years of transition period.

During the given cycle, the time series made by quantity indicators of exchange rate occurred as a result of various influences has been divided into 15 cycles with five months to each. Totally this cycle consist of 77 months (Figure 1). This time series was analyzed by R/S analysis (Figure 2) and Hertz indicator was- H=0.65 and fractal dimension was – D=1.35.

According to the logic of R/S analysis, the last graphic is characterized as below [9]:

- - exchange rate is not random;
- - there is no natural cycle in exchange rate;
- - exchange rate is a non-liner dynamic system. There is a rise in present case and in a future the rise will continue in this way up to a certain point in corresponding circumstance;
- - there are no random jumps during process and the system is far from chaos circumstance.

For grounding the obtained results, elements of time series were arrayed in any style, the structure of system was broken and R/S analysis was reused for obtained time series and the corresponding values of Hertz indicators were calculated. If the series indeed doesn't reflect random events, i.e. there is a long-term memory effect, then the value of Hertz indicator has to change and decrease significantly. Otherwise, the value has to remain unchanged. As a result of calculation it was obtained that H=0.69. But this is the symptom of short-term memory effect. That is, the relation among the elements of observed series is too weak.

Although this memory is long-term in natural systems, it is not infinite. That is, such a moment comes in the dynamics of progress of system that, the sensitiveness to initial conditions decreases and completely disappears and the time series in a certain instant reflects random events.

This period is called average length of natural cycle in the non-linear dynamic systems and the memory about primary conditions is lost during this period. In the economic systems, especially in the transition period the length of the memory varies depending on the structure of the system. The values of Hertz indexes of the exchange rate of U.S. dollar to Azeri manat (AZM) for both mixed and non-mixed cases are close to 0.50 and each other. And this proves that the memory effect is multiperiodic.

This kind of result is not unexpected for an exchange rate. Because, unexpected changes are peculiar to the foreign exchange markets. This is mainly related with the government regulation of the exchange rates through Central Bank, unlike pure market processes. But not existence of natural cycle is explained with being unacceptable of six-years time interval.

Here one of the main factors is the length of time series. How many does the number of elements forming the series have to be? The scientists conducting researches in this field don't show any etalon magnitude for getting an adequate result. It is possible to get numerous practical values during the investigations under the circumstances managed on the base of exact sciences. But economic systems are expressed by the short time series of relatively fractal dimension and subjected to the various influences of market environment. That's why it's necessary to be more attentive during the investigation of economic processes using time factor. Experience shows that, in such systems the aggregate of the data can be considered acceptable for the adequate analyses and results corresponding to the definition of natural cycle without alternatives. That's why, for determination of natural cycle in the growth dynamics of exchange rate of U.S. dollar to Azerbaijani manat it is necessary to wait for the certain period of time.

Thus, Hertz R/S analysis from the side of software gives us 2 main indicators for analyzing the economic processes: Hertz indicator (H) and average length of natural cycle. The cycle periodicity and also fractal property of the series are determined by virtue of the value of the first indicator. But the second indicator allows us to visually estimate the inertia of growth dynamics of the system. As seen, although the fractal analysis describes the real situation well, it doesn't explicate it. Chaos theory solves this problem [5, 6]. The main elements of this theory are attractor, phase space, Lyapunov indexes, information periods and above mentioned fractal dimension concepts. Chaos theory allows us to study dynamics of uncertainty and to find an order in its non-uniformity. It's possible to find the followings through analyzing the state of system by virtue of this theory,

- the length of natural cycle in the growth dynamics;
- the period of prediction or sensibility to primary conditions;
- the shape of the set of solution (attractor);
- the size of phase space;
- the fractal dimension of phase space;
- Lyapunov indexes and etc.

Visual estimation of the process in non-linear dynamics assumes special significance for determination of the given elements. Because, there may be many, sometimes numerous possible solutions, as in real life.

In this case Lyapunov indexes showing the dependence degree of the system on primary conditions are widely used [7, 12]. Though the sign of Lyapunov index is an indicator of quality, its numerical value expresses the level of information about current situation of the system.

Fractal dimension is also used as a main factor in the multidimensional case. Fractal dimension of phase space is determined by correlation integral. Correlation integral defines at which distance two random points are located in the attractor (set of solution) [2,12].

Experience shows that, as the size of phase space increases, fractal dimension (D) approaches to its real value ultimately. Usually convergence occurs when fractal dimension is more than 2-3 times of the size of phase space. Despite of such a dimensional difference, fractal dimension keeps its real value among the elements of system according to the correlation ratio. That's why; correlation dimension is a proper item for determination of the fractal dimension. All variables belonging to the system have to be known for constructing real phase space. But it is almost impossible in a real life. That's why, restoring of phase space using one known dynamic parameter is considered as the best way. Ruelle mathematically proved that, phase space restored by this rule possesses both the fractal dimension of "real" phase space and Lyapunov indexes' spectrum. [5]

Thus, it is possible to explain the real situation properly by virtue of the elements of Chaos theory. Reestablishment of the phase space of the inflation process existing in the state (Azerbaijan Republic) economy, calculation of its fractal dimension and the determination process of the period of prediction are examples of practical explanation.

Generally, the main factors that can influence the inflation process in the transition period are followings:

- budget deficit;
- monetary policy pursued in the country;
- the effects of change in the foreign prices to the domestic market;
- the effects of future expectations about inflation (physiological factor);
- the attempts of market monopolists to increase the prices artificially, etc.

The inflation rate for months, quarters or years forms the time series of this non-linear dynamic system in the time period of the existence of the process in the result of the effects of this and other subjective and objective factors. In this case, there occurs the process with the certain effect showing only the state of system. But this process doesn't make known how these factors influence and which of these factors influence more.

In a case the time series of inflation rate for the months during 1992-2002 years was chosen as primary dynamic series for the reestablishment of phase space of non-linear process (Table 1). The phase space was restored (Figure 6) and its fractal dimension (D) was determined: D=2,463 (Figure 5) in the result of analysis conducted by virtue of above explained non-linear rules. The dimension of phase space was 15. This means that at present it's necessary to use at least three of 15 variables for modeling the growth dynamics of inflation process in Azerbaijan Republic. But the visual analysis of the set of solution shows that chaotic or strange attractor is typical for this system. Lets calculate the greatest Lyapunov index (λ_1) for confirming this fact. Thus, if λ_1 is greater than zero, then there is high sensibility to the primary conditions and this system has chaotic attractor. This means that, a little alteration in parameters can cause to the fundamental changes of performance. Also, there exists a factor that forces active variable to remain in the set of attractor and there is maximum extent of deviation from real value of the current inflation indicator.

Wolf algorithm [7] is widely applied for calculating the greatest Lyapunov index λ_1. The algorithm is schematically shown in the Figure 3. The process begins with the selection of $z_0(t_0)$, the nearest point in the phase space and primary y (t_0) point from the main dynamic series used in restoring of the phase space. After a certain period of time the first point converted into $y(t_1)$ is held , $z_1(t_1)$, its nearest point in the phase space is found and substitutes the second point converted into $z_0(t_1)$. The process is continued up to the end of the time series along the trajectory of y(t).

The greatest Lyapunov index λ_1 is calculated using the formula below:

$$\lambda_1 = \frac{1}{m \bullet \Delta t} \sum_{k=0}^{L\text{-}1} \ln \frac{r'_k}{r_k} \qquad (1)$$

L-the number of steps of substitution, m-the aggregate number of steps over time, -the length of time period, r_k- distance between the points $y(t_k)$ and $z_k(t_k)$. $\mathbf{r'_k}$- distance between the points $y(t_{k+1})$ and $z_k(t_{k+1})$.

In the result of calculations by this scheme, λ_1 was equal to 0.107339 (bit/month) for the time series of inflation rates for the months during 1992-2002 years (Figure 7). If we measure the current situation with the accuracy of one bit, then today's information will be useless after 9 (1/0.107339) months for giving any opinion about future, i.e. the length of natural cycle is 9 months (Figure 8).

Under the conditions of uncertainty, it's impossible to define with simple digit the cases that the behavioral dynamics of process suits in complex systems at the current moment, including in market economy, in other words, to find exact boundary [8, 10]. Some indicators, characterizing different fields of economic state are becoming well known. It includes profitability, durability, capital circulation, income and some other indexes. In addition to these indices, there are also certain norms that characterize the situation from good or bad viewpoint. But in most cases, it's impossible to define these indexes with simple digit during the decision-making process. The specific character of these appropriate economic fields is related with current economic –political conditions and other objective and subjective factors. That's why; the decision-maker is not satisfied with simple quantitative indices. He is looking forward to forming conscious connection among several complex indices that characterize the economic state as a whole. All these show that, decision-maker can not be satisfied with binary "Good"-"Bad", or "Yes"-"No" answers, he is interested in economic interpretation of condition. That is why the main purpose of decision -making is to "unite" all the economic indices, which characterize the current situation in unit complex index, and determine the "state" of the process referring to this index. The main duty here is not forecasting the probability of the crises case but defining the time distance up to the crises and assessing the current situation. There is not any place for statistical probability now. Because, the purpose here is not to find similarity, but make decision discovering the unique features of the process.

The point here is about fuzzy sets explaining complexity and analysis methods of Nero net for decision-making [8, 9, 10]. There is subjectivity in final decision-making and it comes from the complexity of the system. That's why, the adequacy of decision made depends on how the user perceives the problem .In this case; linguistic variables characterizing the process qualitatively are helpful. For example "high ", "low", "more preferable", "expected", "probable","unique".

As well as known, the relationship between the quantitative measure of one factor and quality index is determined by means of belonging function in fuzzy sets theory. The value of this function expresses the extent of comparability of the condition. Its value changes throughout [0;1] and this value does not depend on the density of elements characterizing the process. This value is not also a probability, because the process is not repeated here [8, 10].

In the System of Economic Analysis (SEA) that we analyze, belonging function is constructed on the basis of followings:

Results of analysis of macroeconomic indicators of appropriate field, by means of mathematical methods of non-linear dynamics on the purpose of determination of unique features of dynamical economic process. -Hertz index (H), Fractal dimension (D), and average length of natural period;

Intuitive expert imaginations formed from visual assessment of growth model of dynamical economic process by using modern technical means.

So, on the base of above-mentioned data, new complex indicator is defined as a following outline for assessment of the economic state:

P – set, expressing the current condition at non-linear dynamical process is divided into fuzzy sub-sets:

P_1 – sub-set, expressing "extremum" in a current situation – economic growth experiences deep crisis. The probability of improvement of the situation even due to radical reforms is very low;

P_2 – sub-set, expressing "relative extremum " in a current situation – economic growth tends to crisis, some symptoms of it have already been seen (observed), but the condition is still not dilemmatic, urgent measures have to be taken;

P_3 – sub-set, expressing "stagnation" in a current situation – economic growth is not sustainable, "unfortunate" event may happen any time, urgent reforms have to be carried out, investment calls for a great risk;

P_4 – sub-set, expressing "relative growth" in a current situation – economic development is satisfactory, separate indices make trouble, system is not sustained enough against market conditions;

P_5 – sub-set, expressing "stable growth" in a current situation, - there is high growth in economic development, it is stable enough and has the best opportunities for future development.

In other words, P – term-set, of "Current Economic state" linguistic variable, consists of 4 components. Here, V – is the complex index of current state in growth dynamics.

Fuzzy classification of values of X_i (i = 1, 2, …, N) parameters necessary for the modeling of the growth dynamics is carried out. For that purpose, "level of Xi index" linguistic variable defined by means of the following {B} – is included:

B_1 – "The lowest level of X_i index" fuzzy subset.

B_2 – "Low level of X_i index" fuzzy sub-set.

B_3 – "Average (mean) level of X_i index" fuzzy set.

B_4 – "High level of X_i index" fuzzy set.

B_5 – "The highest level of X_i index" fuzzy set.

Assessment of importance of X_i (i =1, 2, …, N) parameters in complex evaluation. Individual W_i – Weight coefficient of appropriate X_i index is defined in assessment of economic state (information level about the state of index). So, each of the indices able to radically influence to the economic development in the translation period, as investment, export, exchange rate, deposits, import, interest rate, GDP, tax, salary, consumption, employment and inflation, has its own "weight". On the other hand, there are also 3 possible types of contacts among these indices: direct functional, counter functional and indirect contact. These contact relations also make impact on the value of W_1 – weight coefficient of index.

Constructing a complex index. V – complex index is defined with help of X_i – indices and Wi – weight coefficients as following.

$$V=\sum_{i=1}^{N} w_i X_i \qquad (2)$$

Determination of current state of economic growth dynamics. The level of the comparability of the current situation in economic growth is determined by means of M (V) belonging function dependent on V complex index.

The name of index	Value interval	Classification of the level of parameters	Confidence level of assessment (belonging function)
V	0<V<0.15	"Extremum"	1
	0.15<V<0.25	"Extremum"	M (V)
		"Relative extremum"	
	0.25<V<0.35	"Relative extremum"	1
	0.35<V<0.45	"Relative extremum"	M (V)
		"Stagnation"	
	0.45<V<0.55	"Stagnation"	1
	0.55<V<0.65	"Stagnation"	M (V)
		"Relative growth"	
	0.65<V<0.75	"Relative growth"	1
	0.75<V<0.85	"Relative growth"	M (V)
		"Stable growth"	
	0.85<V<1	"Stable growth"	1

Thus, evidentially, complex assessment of current situation in reality is artificial intellectual process referring to subjective judgments and it's not expedient to solve it without the ideology of fuzzy sets. Because, it's necessary to differentiate these subjective quality indices before saying whether it is "Good" or "Bad". And its most effective solution is possible in the framework of fuzzy sets theory and methods of Nero network [9].

Thus, by means of above-explained synergetic methods, Economic Analysis System, which aims systematic analysis of economic processes in Azerbaijan Republic and creates effective visual work environment with statistic space data on the base of quantity and quality indices of past years, makes the construction of technological operations chain possible as following outline (plan):

- discovery of specific symptoms of transition period;
- synergetic analysis of transition economy on the base of symptomatic information carriers;
- visual assessment of the behavioral model of economic development for short time period and decision making.

Because of existing disarray in micro and macro levels, not fitting of bilateral relationships to the real context, lack of the legal base determining the exact limits of government intervention to economic processes, intentions of artificial regulation, incomplete formation of real market and such objective and subjective factors specific to the system, under the conditions of more broadened uncertainty and realization of unit-economic space due to fantastic development at modern information technologies, the great importance of the creation, implementation and the development of intellectual system allowing to the visual assessment of growth dynamics of economic processes by using the time series of quantity indices and fuzzy set of quality indices of effects that formed in the result of different impacts, like SEA to Azerbaijan Republic is beyond a shadow of a doubt.

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ANNEX

Figure 1. Average monthly indicators of the exchange rate of dollar to manat.

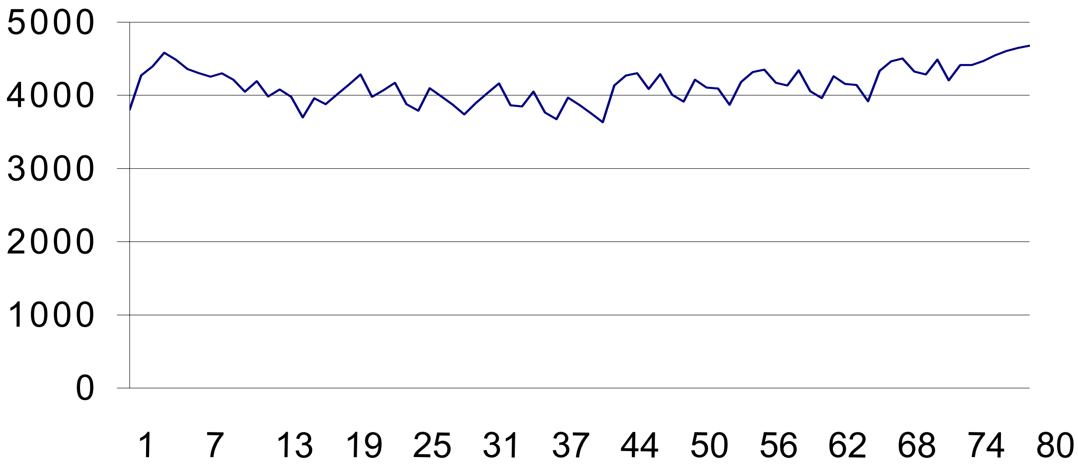


Figure 2. R/S analysis of the exchange rate of dollar to manat.

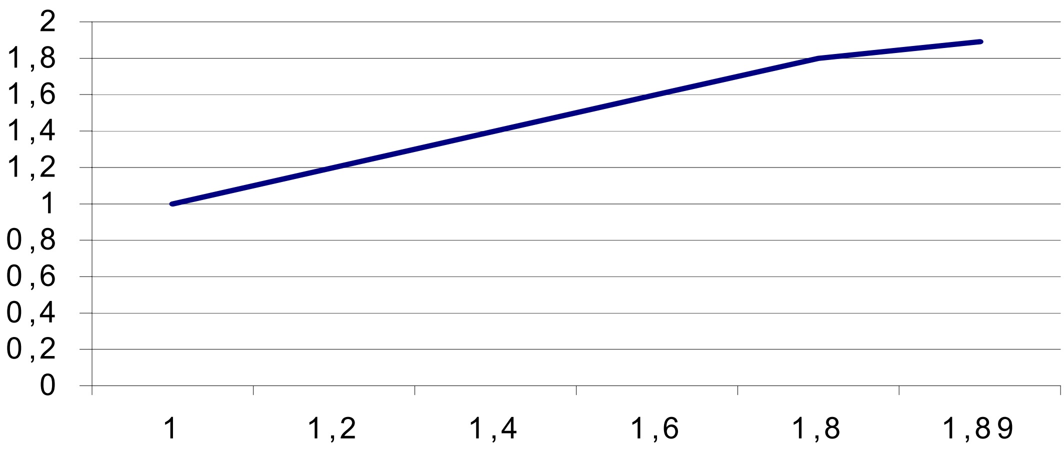
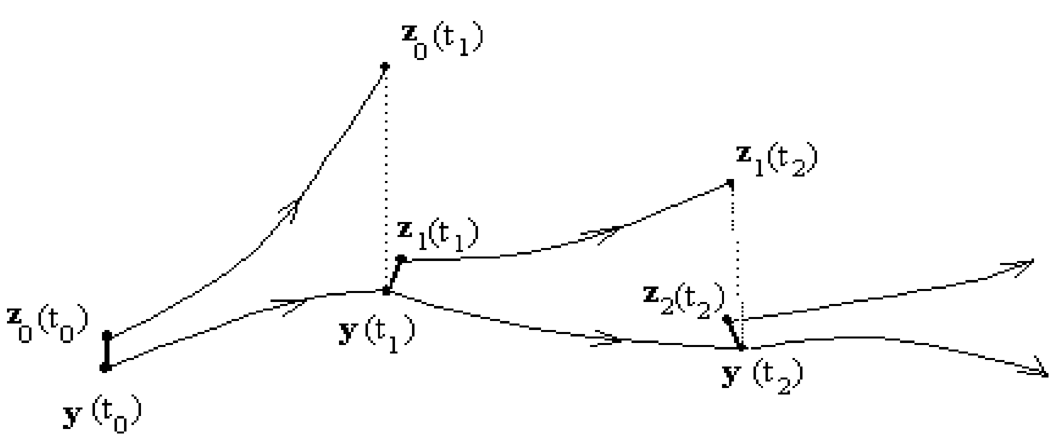


Figure 3. Finding algorithm (Wolf) of the greatest Lyapunov index.



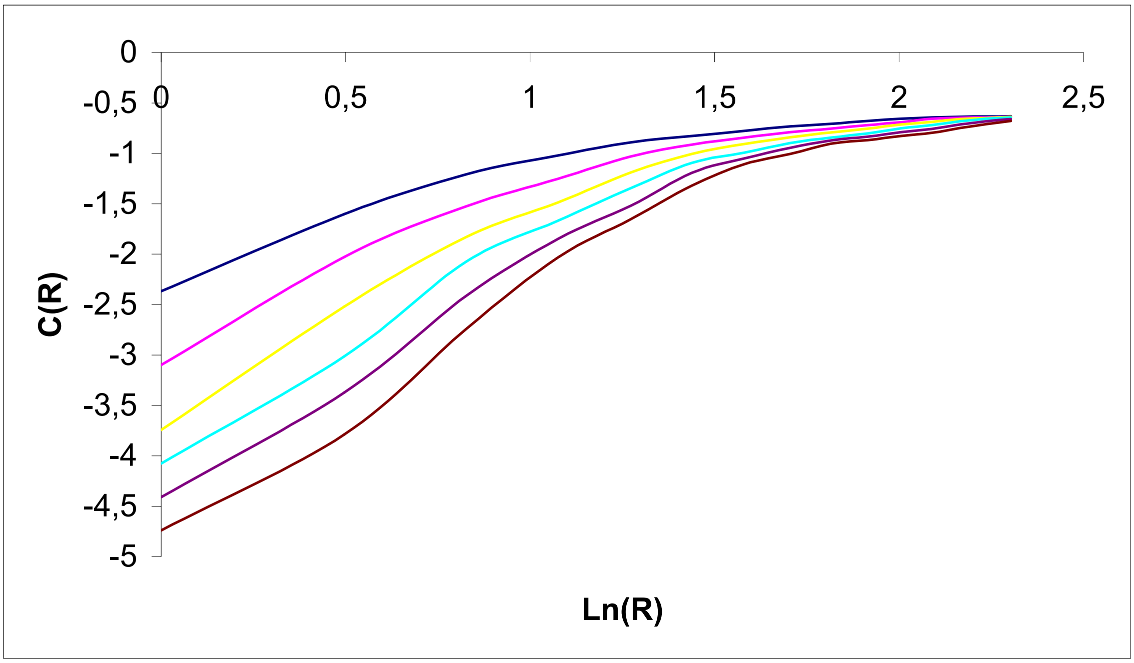


Figure 4. Correlation integrals.

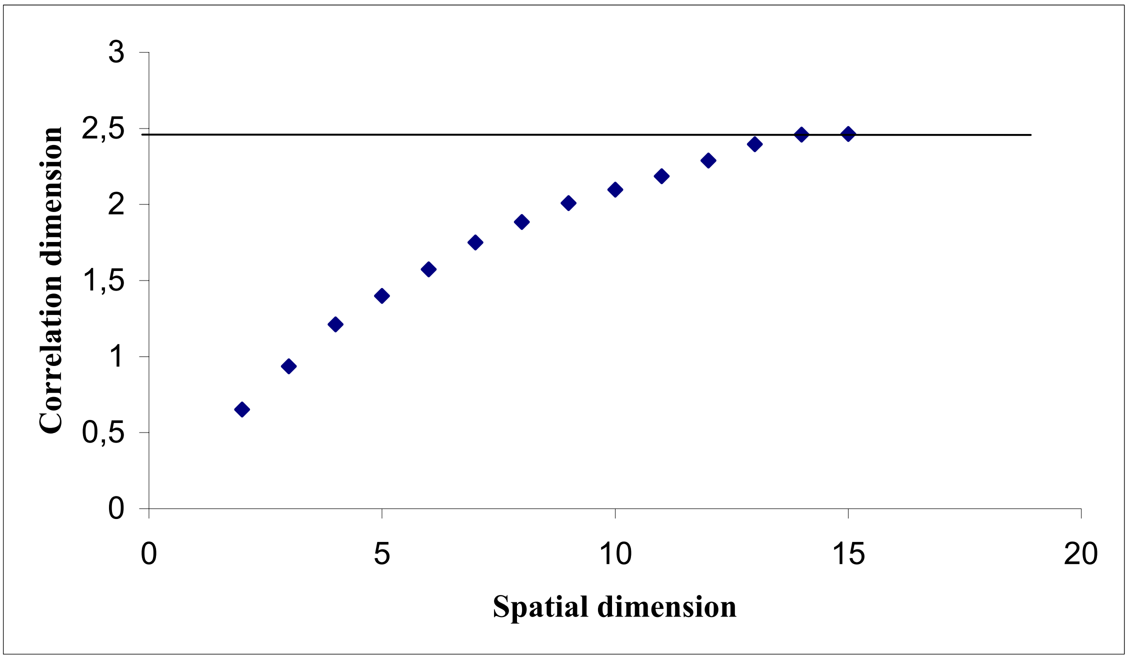


Figure 5. The convergence of fractal dimension.

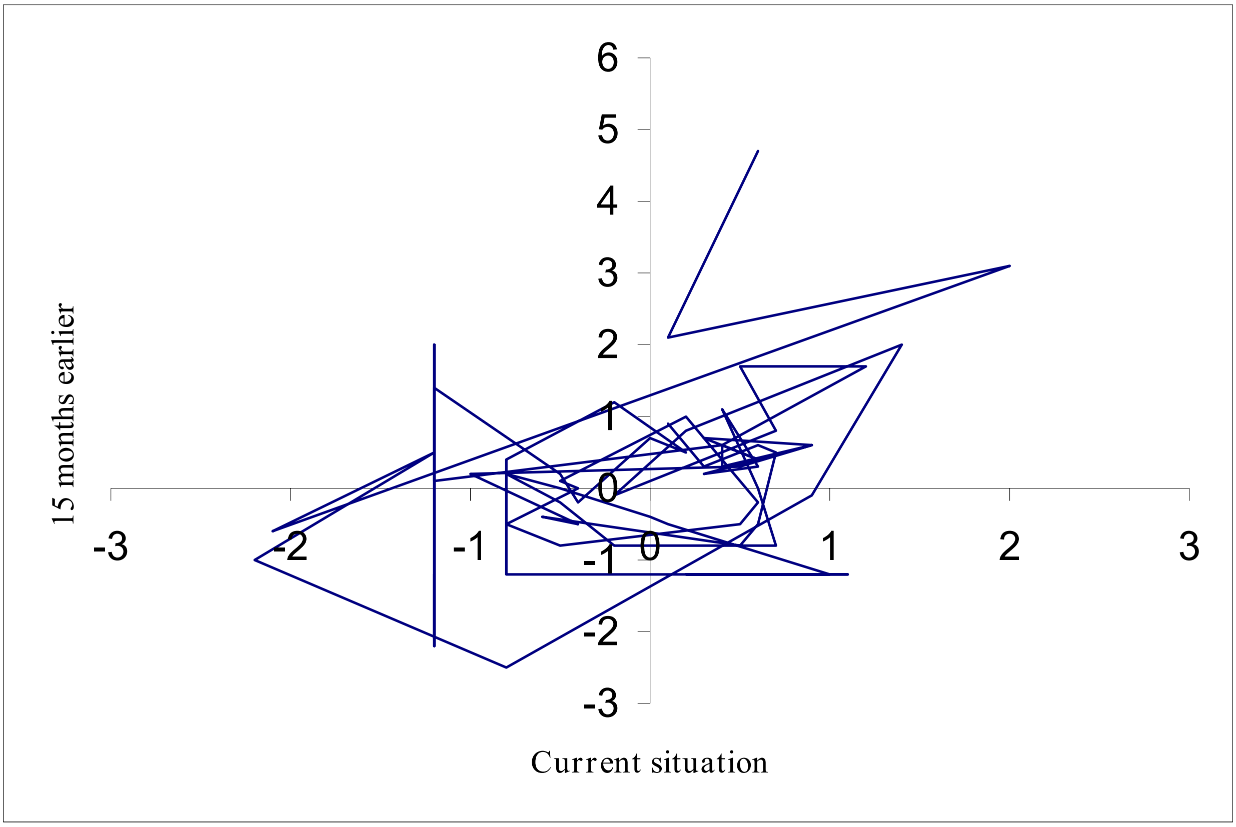


Figure 6. Two-dimensional phase space of restored inflation process.

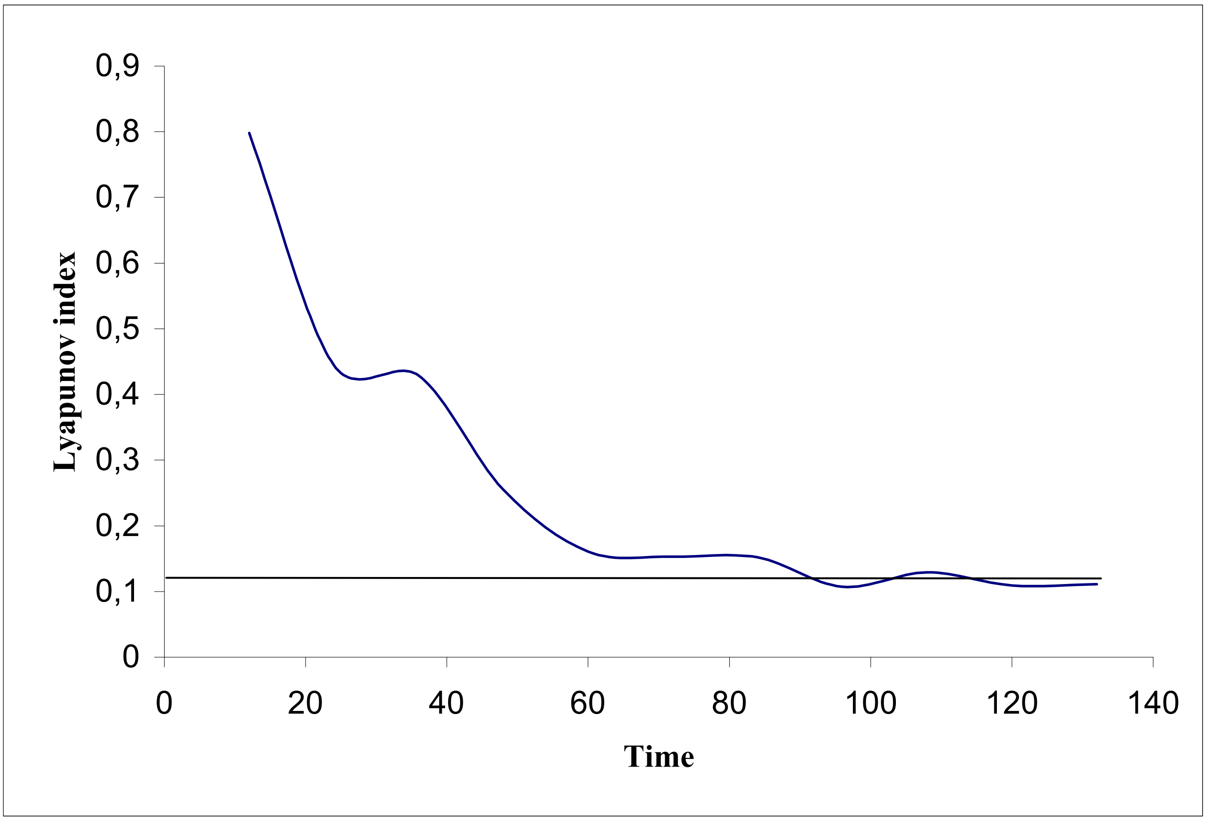


Figure 7. The convergence of the greatest Lyapunov index.

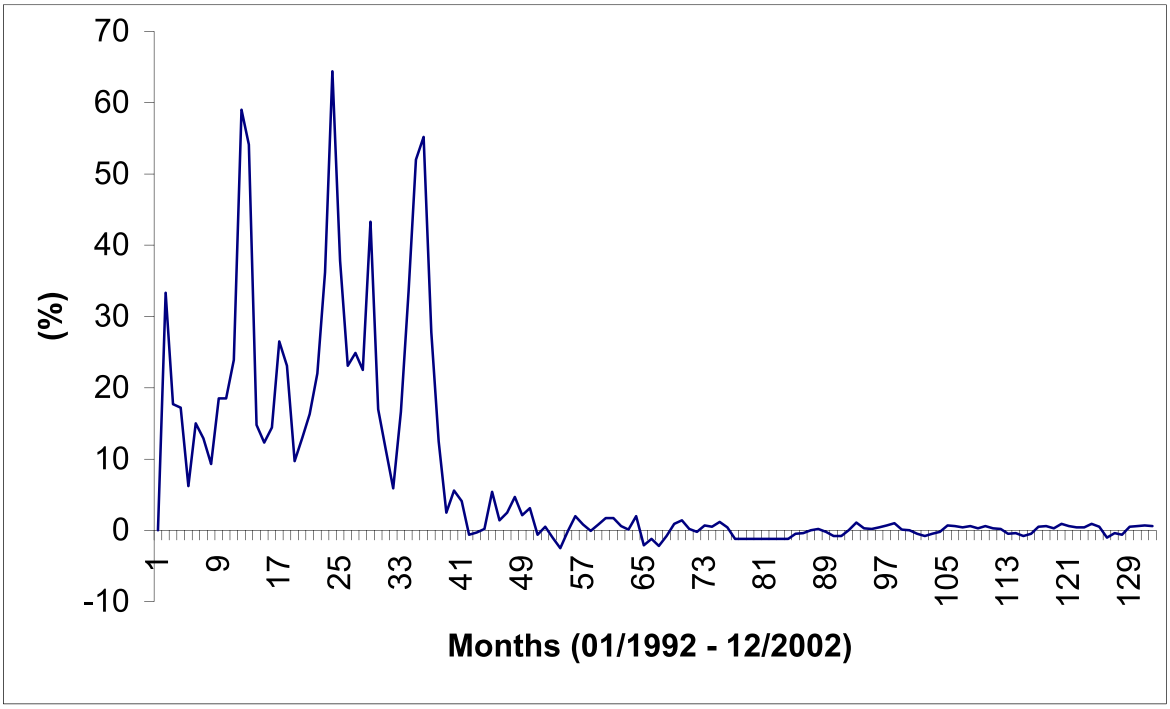


Figure 8. Growth dynamics of inflation.

Table 1. Inflation rates for previous months during 1992-2002.

Months	Years										
	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
January	118.1	54.1	37.8	27.8	2.1	1.7	0.7	-0.5	0.7	0.3	0.6
February	33.3	14.8	23.1	12.5	3.1	0.6	0.5	-0.4	1.0	0.6	0.4
March	17.7	12.3	24.9	2.5	-0.6	0.1	1.2	0	0.1	0.3	0.4
April	17.2	14.4	22.5	5.6	0.5	2.0	0.4	0.2	0	0.2	0.9
May	6.2	26.5	43.3	4.1	-1.0	-2.1	-1.2	-0.2	-0.5	-0.5	0.5
Junky	15.0	23.1	17.0	-0.6	-2.5	-1.2	-1.2	-0.8	-0.8	-0.4	-1.0
July	12.9	9.7	11.5	-0.3	-0.1	-2.2	-1.2	-0.8	-0.5	-0.8	-0.4
August	9.3	13.0	5.9	0.2	2.0	-0.8	-1.2	0	-0.2	-0.5	-0.6
September	18.5	16.3	16.6	5.4	0.8	0.9	-1.2	1.1	0.7	0.5	0.5
October	18.5	22.0	33.5	1.4	-0.1	1.4	-1.2	0.3	0.6	0.6	0.6
November	23.9	36.2	52.0	2.5	0.8	0.2	-1.2	0.2	0.4	0.3	0.7
December	59.0	64.4	55.2	4.7	1.7	-0.2	-1.2	0.4	0.6	0.9	0.6

Table 2. The values of fractal dimension corresponding to phase space.

	2	3	4	5	6	7	8	9	10	11	12
D	0.653	0.937	1.211	1.398	1.751	1.885	2.009	2.098	2.186	2.288	2.397

The role of telecommunications in shaping the urban landscape

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INTRODUCTION .

ICTs (Information and Communication Technologies) shape the urban landscape in two very different ways . They are used to master the urban landscape . Architects, urban planners, archeologists use ICTs to embellish the inner city, the main goal being to preserve the historical heritage . People living or working in the inner city need ICTs . Telecommunications equipments are present, but discreetly . Even the « invisible landscape » (waves) is taken into account . Measures are taken to avoid fears about the effects of waves on health . At the opposite, ICTs are used in urban scenographies, and stimulate them . The urban landscape is changed into a decor, useful to parades, fairs etc … Obviously, the urban landscape is a stake, and a conflict provoking one . Let us remember what Lewis Mumford said about the contrast between the inner city and the suburbs . The inner city is the place of political and social conflicts . Those living in the centre of the city, participate to the social life (often, struggles) . People living in the suburbs forget these conflicts, and seek a world of individual dreams and comfort . ICTs have changed that, but not so much . In the inner city, the urban landscape is rich of sense, and it is the reason why it is a very much disputed stake .

ICTS ARE USED TO MASTER THE URBAN LANDSCAPE .

Architects use software to design buildings, obtain electronic mock-ups, and calculate the costs of the works . Urban planners realize electronic mock-ups of projects . It facilitates discussions on these projects . It allows comparisons between alternatives (for instance, concerning trees along a street) .

An interesting example of the use of ICTs to master the urban landscape is preventive archeology . When archeologists find remains in the centre of a city (in general, when a hole is dug in a building site) , there is a problem . Municipal authorities choose to stop building during some time, to explore the site, or to cancel the project, if the remains are of very great value . In the first case, archeologists have to explore the site in a limited time (it is stipulated by Law) , and they can use ICTs . Take the example of excavations in Alexandria (Egypt) [1] . An archeologist can show a find to a colleague who is far from the site, in 3D, using a webcam . This colleague gives an advice, and it is useful to decide where to excavate, quickly . The two archeologists can speak by phone (through Internet) . Videoconferencing (through Internet) is possible . The team uses a portal . Archeologists can use the GIS (Geographic Information Systems) techniques, to map a site .

As those living or working in the inner city need ICTs, measures are taken to avoid the sight of ugly telecommunications equipments . Wires are hidden (but in industrialized countries, this measure is taken anywhere except in the country) . Parabolic antennas are forbidden . Only rattle antennas are allowed . Cable is the prefered solution . Cable allows to provide TV programs to those living in large buildings (instead of antennas) . Soon TV through ADSL will be at disposal in the centre of cities . It allows providing TV programs through the phone line . People living in the centre of cities will be able to choose between two providers (cable or ADSL)[2] . Emitters for mobile phone are inside premises, or hidden by a fake decor (a chimney, a tree etc …) . In the inner city, the demographic density is high, many emitters are needed, and the consequence is that many people fear the effects of waves on health . It seems that scientific experiments give results which are either optimistic (inocuity) either pessimistic (risk) . In many cities, an agreement between the municipal authorities and the mobile operators, exists . The location of emitters is declared (before the rolling out of the emitters) . Perhaps, a map is at disposal on Internet . Particular measures are taken concerning some sites (hospitals, schools) . Perhaps the treshold (of power) is under the legal value . The goal is to avoid that people living in the city fear the effects of waves on health . Clearly, there is no opposition to the use of mobile phones .

The ICTs are used to master the urban landscape . They are used by the people living in the inner city (and very much, as these people are in general rich) . It is compatible with the quality of the urban landscape . The historical heritage is preserved. This goal is achieved under the control of municipal authorities and professionals (architects, experts who are responsible of historic buildings etc …) . These professionals make choices which are delicate, because it is often in a context of conflicts . They have to choose the colour of façades, the installations around the monuments, to allow or forbid car traffic etc … The frequency of restorations is also a delicate choice (the historic buildings must be kept in a good state, but during the works people cannot see them) . Other examples are visitors paying for money or not, revamping museums etc … That some of these choices are a constraint (for some people) is shown by the example of TV antennas and emitters . The mix of knowledge and power which has been described by Michel Foucault, concerning some professions (an example is the medical power) , exists in this case . These professionals have a doctrine . For instance, currently they extend the field of their interventions (preserving buildings dating from the industrial era, or later) . When they have to explain and justify their choices, they can use ICTs (electronic mock-ups, explanations on Internet) .

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(1) This is described on the website francetelecom.com .

(2) Or more . The historical operator can provide TV through ADSL . Also, alternative operators could provide TV through ADSL thanks to unbundling .

ICTS ARE USED IN URBAN SCENOGRAPHIES .

ICTs have pervaded scenography . It is clear in the case of theatre , but the same techniques are used in medias and in the streets . The « sono » is more sophisiticated thanks to the techniques of digital sound . Illuminating technique benefits from computing . Projectors are oriented, and their light is adjusted, automatically . There is a program . New professions have appeared (3) .

WHAT ARE THE EFFECTS OF URBAN SCENOGRAPHIES ON PEOPLE ?

Having to explain the effects of sounds and images on crowds, we have recourse to the theories on medias .

According to Vauchey, there are three kinds of theories on the effects of medias, the phenomenological ones, those coming from the « social control school » in the meaning of Michel Foucault, the theories at a social and macro-ecnomic level .   We shall insist on the theories of the « social control school » , then examine the economic aspects .

In the words of Vauchey, the effects of medias are described with three notions : solitude, confinment, dissymetric influence . The listener (spectactor) is locked in a room, lonely (or his behaviour is the behaviour of a lonely person) , passive while immersed in a flow of sounds and images . It is a long time, each week, without real human links . There is an analogy with the confinment which has been described by Michel Foucault in « Histoire de la folie à l'âge classique »(4) . To describe the dissymetric influence, the metaphor which is used is « reverse telepanoptics » . In « Surveiller et punir » Michel Foucault has explained why the Bentham's panoptics is an architectural model, when the goal of Society is surveillance of people . Medias are a telepanoptics because the « guards » and the people they watch are not in the same physical place . It is a « reverse telepanoptics » because the signs go from the watchers to the watched people (in the Bentham's panoptics, visual signs and sounds go from the watched people to the watchers) . An other idea is that a radio (TV) station is an organization which is opaque to consumers . It is a complex organization, involving many professional specialties . It is located in many sites . The offices where are the administration and the programmers, the studios, the premises where technicians store and modify the programs, are in cities . For technical reasons, emitters and the premises near from them are (often) in the country. Thanks to telecommunications, all this work together . Technology is useful in an other way . It allows to guarantee that all these professionals speak about the same object (a program) . Techniques allow to control that the alteration of a program (recorded, stored, transmitted) remains bearable . The goal of this organization is to benefit from all the commercial opportunities : a recorded program is broadcast immediately or later, events are recorded in open air or in studios, anywhere, at any instant, programs come from the station itself or from providers etc … The changes in the commercial goals of the station are decided quickly . If the enquiries about audience indicate a change in the consumers'tastes, programmation is quickly modified . The listener (spectator) does not understand how the radio (TV) station works . His reactions are watched through enquiries on audience . He is passive, conditioned to accept fashions, to consume new kinds of goods .

There is a radiophonic power, or influence, on consumers . It implies a radiophonic space, which is centralized . At the centre, the station and its emitters, at the periphery, the consumers . The architecture of the State TV and radio building in Paris reveals this structure of the radiophonic space (at the centre, a tower which symbolizes an antenna, and around a circular building as waves) . Often, in a big city, there is a district for the medias . Medias are part of the « visible city » , but also part of the « invisible city » . We can see this part as a centralized space .

Briefly said, there is a dissymetric influence of medias, and they use some means (fear, seduction) to obtain the adaptation of consumers to the new trends of consumption .

But we have described what is called by Tarde a « public » , and not a crowd, as in the case of fairs and parades . According to this sociologist (who was writing a century ago) , technology (printing, railways, telegraph) has allowed the appearance of newspapers, therefore of publics and opinion . The readers of a newspaper constitute a public, which is influenced by a « publicist » (the person writing the articles which are read by the public) . Tarde has opposed publics and crowds . Public is more intellectual, but also is influenced by the publicist for a long time, each day, which gives a new, strong impetus to fashions . A crowd follows its emotions . Its behaviour is explained by contagion (between the individuals constituting it) . The kinds of behaviour are the same (expecting, attentive, demonstrating, acting) . Tarde was optimistic about the emerging role of public, and the declining role of crowd . His hope was newspapers provoking a spread of conversation, especially in the big cities where people have time for leisure, are diverse, and can easily find topics about which to speak (thanks to newspapers) . But this was before the consumption society (emerging in the twenties) and ICTs (radio, TV, and now Internet). We need an other theory, to describe the crowds, today . We have recourse to the Riesman's theory of the « peer group » .

According to David Riesman, three types of personalities correspond to three historical periods :

- The « tradition directed » personality corresponds to the traditional society, with its stagnant demography .
- The « inner directed » personality corresponds to a society becoming industrialized, with its growing population (because of progress, people live during a longer time) . An individual of this type accepts labour, effort, ambition and considers he is responsible for his own life .
- The « other directed » personality corresponds to the affluent society, with a stagnant demography again (less births) . For this type of personality, the guideline is to adapt oneself to the group . It is the goal, the norm and the best way to solve individual problems .

(3) Some explanations on the techniques of scenography are on the portal voilà.fr .

(4) In the classic age, all those who were a problem for the proponents of Reason were confined (not only mad people) .

The « peer group » is constituted by young people with personalities of the « other directed » type, agreeing on fashions and choices of particular consumption goods . They meet together and speak about this kind of topics . Opinion leaders come from these groups . A leader in one of these groups is a young individual able to demonstrate that a particular product is the most satisfactory, and explain why . For instance, it concerns music, clothes, or new technologies . Nowadays young people are pioneers, when they use mobiles, surf on Internet, or even surf on Internet thanks to their mobile (mobile Internet) . Perhaps, the « peer group » does not need meeting in a room, today . The members of a « peer group » meet one another or use Internet and mobiles . The crowds during fairs and parades are like a large « peer group » . They meet to compare, measure, assess, their choices and tastes . If there is a confirmation (all those coming agree some choices, accepts some tastes) , there is also a test of new choices and tastes . Opinion leaders are there, observing people and their reactions . Often medias are present, because they are interested in the « event » . There are not direct human relations because the program is already chosen by the scenographer . All that people have to do is to listen and to look at the sight . Technology is used (loudspeakers and digital sound, projectors, screens) . There is a disymmetric influence, even if there is no confinment (as in the case of radio and TV) . People are like lonely people, the reason why they are there being not conversation, but the program .

In a consumption society, the « peer group » , the fairs and parades in a big city, the medias have many features in common . People, who are « other directed » individuals, who want to adapt to the other, to behave as the other, demonstrate their choices and tastes, clearly and collectively . Obviously, it is useful to marketers, firms which sell consumption goods etc … Consumers consider it is necessary, to know what are the most satisfactory choices, which are also made by the other .

THE ECONOMIC ASPECTS OF URBAN SCENOGRAPHIES .

In some cases, urban scenographies allow economies . Take the example of fairs in the streets, with many stands selling goods . It is cheap as only some loudspeakers, streamers and posters are needed . But often it is expensive . The scenography must be paid . Decors, devices illuminated and diffusing sound, are used a single time . For example, floats with mobile decors, lighting, sound are costly . Perhaps there are proceeds, if a Carnival in a big city attracts visitors . Or it is a complement of medias, which are also costly (the complex chain, production, programming, transmission, is costly) . The same goal is achieved by an other mean, because people who are together in a place are observed and it is a test of their choices and tastes . Moreover, medias are often present, and when the scenography is decided, it is taken into account . Medias still need « events » (to produce programs in the studios is not sufficient) . Technology allows medias to show « events » more easily . Take the example of a photographer making photos of an event, and transmitting them through WiFi (Wireless Fidelity) antennas, which have been rolled out for this purpose, to a colleague who selects them (and they are sent to the newspaper immediately) . We have all the characterisics of medias : technology is used to benefit from the best commercial opportunities, very quickly .

The crowds at fairs and parades are not ordinary crowds . People coming to fairs and parades are informed on the program, its themes, how it unfolds, and accept it (here we describe the « events » which are really organized, only) . The goal of this crowd is fixed before it gathers and not chosen by itself, when it is gathered . There is a role of medias . Medias professionals are supposed to know the consumers' tastes very well, and when they inform people on an « event » they are sure of the kind of program which is announced . There is also a control, as streets and public places are used . Tarde has remarked that publics generate crowds . In principle, a crowd generated by a public (the readers of a newspaper gathering in the streets) is more oriented by ideas, less subject to the contagion of emotions (but it is not always the case) . It is the same for the crowds in fairs and parades .

When the consumers'choices and their tastes have been observed and tested, how this is interpreted ? Either the accurate techniques of marketing are used . Either it is more empirical, many attempts are made, and when there are some of these attempts which are successes, it is considered sufficient . Fashions, styles (for instance of music, clothes) are concerned . In general a « system of actors » is involved . Here there are, in the « system of actors » , marketers, opinion leaders, medias, the scenographer, firms produciong consumption goods etc … From the point of view of the « system of actors » the urban landscape is a useful decor . The scenographer highlights and magnifies a single aspect of the urban landscape, changing it into a decor which is adequate to the tastes of the people coming to the parade .

At the opposite, the urban landscape can be considered with an experimental stance, or an aesthetic point of view . In this aproach, the quality of the urban landscape is a public good . But even at this stage, there is a question to answer . Either many projects are accepted, and the urban landscape is a patchwork, with a trend of modern art in this place, an other trend in an other place, experiments etc … Either there is a unity of the urban landscape, in a big city .

THE SOCIAL MEANING OF THE URBAN LANDSCAPE .

This point of view, or stake has been described very well by Marcel Poete . He is the most famous historian of the city of Paris, and a theorician of urban planning . According to this author, a city follows a « curve » , like a living being, from birth to decline . Paramount are the commercial opportunities, which depend on communication . Often a city is located at a crossroads . Not only material exchanges, but also intellectual and spiritual ones, matter . In the occidental countries, a structure of the city (visible in its plan) , coming from ancient Greece, has allowed the location and success of cities in various situations . The monuments of the cities are of paramount importance . They display the choices of the city, concerning the existing stakes . According to Marcel Poete, the « curve » is dramatic, and requires a volunteer stance . The memory and the experience of the City are resources, and they are expressed in the monuments . Marcel Poete uses the word « mysticism » . The « mysticism » displayed by the monuments of a city can be the Nation, the King, the Religion, the Progress, the Science etc … Writing in the twenties, Poete believed that the « mysticism » of the city at this time should be the social stake (Society using its resources to solve social problems efficiently) . He was a proponent of innovative solutions for the city of Paris, which were proposed at this time (to organize the growth of this city thanks to urban planning in the peripheral towns) .

This kind of theory puts the stress on the preservation of historical heritage, in the inner city . Even if modern projects are accepted, the quality of the urban landscape is of paramount importance . These projects should reflect the choices of the City, concerning the major stakes and its destiny .

CONCLUSION .

Now we can display the framework of this text, clearly . Our opinion is that when ICTs pervade the society, there are many effects : ancient equilibria and desequilibria remain, new equilibria appear (re-equilibrating) , new desequilibria appear . No wonder that we find ICTs on the two sides (concerning the urban landscape) . There was an ancient conflict (either the quality of the urban landscape, either a decor) , which remains when ICTs pervade the society . In general, in a big city, the quarters which are dedicated to entertainment are not in historical sites, but it is not always the case, and coexistence is difficult when it occurs (because of crowd during the daytime and nighttime, noise, lightings etc …) . On Internet, websites dedicated to entertainment, and history or aesthetics, are separate, but physical spaces have still a role .

Finally, the question of the limits (of the change of the urban landscape into a decor) is posed . In the case of Eurodisneyland, the urban landscape is totally a decor, but it is not a city (it seems that it is a resort) .

Certainly ICTs have changed this conflict . In the past, crowds in the city were making history . As it has been highlighted by Tarde, the press has changed that (the public appears, the crowd has a less important role) . Then this changes again, because of the consumption society (in the twenties) and ICTs (medias) . Nowadays crowds in the city are like « peer groups » according to Riesman . When people meet in the streets, it is an other mean (than medias) to be immersed in a flow of sounds and images . The goal is to achieve an agreement on consumers' choices and tastes . These choices and tastes are confirmed, or they are tested, as people can easily display that the sight is pleasant or that they are frustrated, using signs (or they give their opinion after the « event ») . In exceptional times, the ancient role of crowds in the city, remains, but now medias are involved . During protests, crowds use the streets and public places as a decor, to send messages to the opinion, and they want to confiscate the use of medias (they want to fix the content of the « channel » in the place of the medias professionals).

The existence of these agile tactics confirms that the social meaning of urban ladscape is at stake .

According to some authors, the « post modern city » is a kind of model . The goal is not to allow production, but to promote consumption . In architecture, the post modern style displays details coming from the ancient features of architecture in the city . It is to obtain a visual identity, with a commercial purpose . This kind of city requires many malls, showcases along the sidewalks, streets allowing the car traffic etc … The quality of urban ladscape is not necessarily taken into account . The preservation of historical heritage is not necessarily a goal .

The crucial point is participation . According to the proponents of the social meaning of the urban landscape, it allows and stimulates participation . The places where there is a social meaning of the urban landscape, as historical sites, are visited, have a presence for the inhabitants, have an aesthetic value, are favourable to the local social life . Some people support these choices (intellectuals, artists, creative professions) . At the opposite, those who want to use the urban lancscape as a decor, have commercial purposes .

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Greek bio-climatic design and the Sustainable Development

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1 INTRODUCTION

The continually increasing consumption needs the excessive growth of the population and the improvement of living conditions of a part of the population has led to the rapid increase of energy consumption in the last two decades. The production of petrol has multiplied by a factor of six in the last decade, while the demand for electric energy is multiplied by a factor of ten almost every decade. The thoughtless use of conventional sources of energy has greatly contributed to the increase of the emissions of fumes, which destroy the ozone layer and tragically downgrade the environment gradually wiping out its ecosystems. Greatly responsible for increasing environmental crisis are industry, transport and powerhouses, but also the built environment.

By the term “built environment” we refer to the total space where human construction have developed including first of all buildings which cover the needs of housing, occupation and recreation. According to the size of buildings and relative substructures, the built – environment is characterised as urban, semi-urban and rural. Occupying with the urban environment of big cities becomes extremely interesting for the Greek reality if we consider small building blocks, the increased height of buildings and the big size of the city which perplex the study of the bio-climate. The “climate phenomena” which are connected to the thermal and aerodynamic behavior of the cities deal with the phenomenon of “thermal island” (differences in the temperatures between a city and its neighbouring rural area) and the phenomenon of “urban ravine” (changes in the speed and direction of winds as well as the temperature layer of the air at the city high ways) [1].

The first petrol crisis at the beginning of the 70’s alarmed scientists occupied with the designing and shaping of a building and directed them towards the study and research of new forms of energy so as to create a more practical, economical and ecological building. A new need was born for a dynamic approach in which the building is dealt with as a live organism and not as an object of consumption and vanity. In this direction the factor “ecological balance” is a top priority in every design leading architects to the solution of the immediate application of the principles of bio-climatic architecture and ecological construction.

2 ENVIRONMENT AND BUILDINGS IN THE GREEK SPACE

Buildings affect the environment in various ways during their construction, function and demolishing. The environment has a strong effect on buildings as well. Full awareness of this interaction is demanded so as to properly design bio-climatic buildings. Buildings of Greek mega-cities have an influence on the environment creating however, numerous problems like: [2, 3]

- Aggravation of air-pollution, the greenhouse phenomenon and the creation of acid rain because of fume emissions, a fact, which is due to the thoughtless use of conventional energy resources (mainly heating petrol).
- Alteration of the basic ingredients of the atmosphere, water, ground and underground because of chemical emissions that basically came from urban sewage and waste. The above phenomena appear more intense at the most densely built Greek cities.
- Exhaustion of valuable natural resources like mineral rocks and metals during the intensive use of energy for the construction of buildings.
- Downgrading of the surrounding environment in both local and regional level caused by the continual anarchy building. Serious ecological disturbances for example floods fire the extinction of rare plants and animals.
- Serious consequences on the health and quality of life caused by the use of dangerous radioactive non-ecological building materials and by inhaling harmful toxic fumes even in the interior of modern houses of Greek big cities.
- Unstable climate changes in entire areas caused by the disturbance of the cycle of water, oxygen and carbon dioxide. A striking example is the case of the prefectures of Attica and Thessaloniki.

Based on the above, the contemporary design of buildings is led towards bio-climatic architecture with the use of renewable resources of energy and energy saving techniques. The appropriate programming can lead to the gradual of environmental crisis and the upgrading of the quality of urban environment.

3 ENVIRONMENTAL AIMS AND BIO-CLIMATIC ARCHITECTURE

Bio-climatic design was developed in the 1980’s as a new trend of urban design in relation to the local microclimate. With the term “bio-climatic design” we refer to architecture and urban-planning design of buildings and settlements which aims at their adaptation in the local climate and the natural environment, protecting at the same time sensitive areas with rare ecosystems [4]. The climate in micro, medium and micro-scale determines the lighting, airing, design and the energy behavior of the buildings. More specifically, the macroclimate is shaped by the average weather conditions throughout the year. Medium climate is characterised by the influence of the local topography, plantation and nature of the area. Micro-climate, finally, is created by human intervention by which alters the immediate built environment. [1, 5]

Bio-climatic design aims at the exploitation of positive environmental parameters so as to minimise the energy needs of a building throughout the year and save conventional energy [4]. The application of bio-climate architecture can lead to energy independence from non-renewable energy resources up to a 60%. At the same time, it contributes to greatly reducing the emissions of carbon dioxide and other fumes, which aggravate the orthological use of water as well as the wide use of local building materials, which are environmentally friendly. These materials determine in a great degree the thermal and visual behavior of buildings, while their life span has significant consequences on the environment. Many of the building materials like paint, bricks, tapestries and others, contain dangerous substances, which cause pollution to the interior environment. Additionally, some times plinths are used which come from areas high in radioactivity. It has been observed that the traditional ecological materials of pre-industrial period are reliable, have big life span, are not harmful to health and the environment and thus allow saving renewable energy resources [6]. Bio-climatic design incorporates elements connected to the special physiognomy of each area, local cultural inheritance, prevailing traditional techniques and trade-financial habit [7].

More specifically, bio-climatic architecture is mainly a result of an integrated and complex synthesis, which has to do with multiple parameters like topography, soil, orientation, the right choices of openings, and the study of the shell, the choice of the right materials. This however, does not mean that intervention on the existent buildings is limited. With minimum expenditure and friendly to the user technologies, loss of heat can be reduced, buildings can be protected from over-heating, lighting conditions can be improved and noise can be limited. All the above connect bio-climatic design with the terms sustainability and sustainable development, in other words development which covers the needs of contemporary life without posing a threat to future generations [8].

3.1 DESIGN STRATEGIES OF BIOCLIMATIC GREEK BUILDINGS

Various strategies are applied in Greek bio-climatic architecture, which provide the building with the necessary thermal comfort and the suitable natural lighting by making the most of the characteristics of climate in combination with the topography of the land. During cold periods the building should function as a “solar collector” maintaining heat, while during hot periods it should protect the building from the sun by using technical methods of natural cooling. However, there should be plenty of light throughout the year.

3.2 Heating Strategy

Heating strategy aims at providing users with the suitable thermal interior climate with the exploitation of favourable climate elements though the adoption of suitable methods applied on the construction shell so as to minimise the consumption of additional energy. The heating strategy demands:

- The collection of solar radiation,
- The storage of heat with the help of passive elements and
- The “trapping” of heat.

3.2.1 Collection of solar radiation

Adequate solar radiation is achieved when the building functions as a “natural solar collector”. This depends on the design characteristics of the building and its immediate environment, like:

- Its position
- Its shape
- Its volume
- The orientation and the size of its openings
- The arrangement of its interior
- The color of its exterior
- Its relationship with neghbouring buildings
- Its relationship with the natural environment (rocks, trees, water etc.)

When the building does not function as a natural solar collector” then there is a need for the collection of solar energy through the “greenhouse”, an additional passive glass solar space in the south side of the building.

- *Positioning of the building*

Finding the appropriate position for the construction of the building in a piece of land can be aided by the use of solar and energy maps. It has been proved that the location permitting the maximum degree of sun exposure during the winter and the minimum during the summer is the north of the land.

- *The shape of the building*

Research has proved that the ideal shape for any climate conditions is its lengthening towards the axon of East – West and but with various dimensions according to the conditions present. In this way, the building can have a bigger surface towards the South for the collection of solar radiation in the winter [4]. However, we should seriously consider the micro – climate of the area and especially the winds, which should play an important role in the shape of the building.

- *The orientation of the building*

Finding the best orientation possible is affected by the topography of the area, the landscape, the wind, the solar radiation, demands for privacy, the reduction of noise and the local climate [4].

- *The volume of the building*

In order to achieve the best exposure to the sun it is obvious that the small mass of the building should be facing the South so as to increase horizontal, vertical or sloping surfaces while preventing sunlight entering the rest of the building.

- *The orientation and the size of the building openings*

Glass, as a covering material of openings, provides less thermo insulation than walls. Placed to the south it contributes to the best distribution of solar benefits to the building. As far as Greece is concerned, buildings with opening to the south cover thermal needs during mild seasons thus reducing drastically the use of conventional heating. In contrast, openings of different orientation are constructed exclusively for the improvement of natural light and view [10].

- *The structure of the buildings*

The best organization of the spaces of a house in southern mild climates is the following: Spaces of temporary activities like storehouses, stair-ways etc. are placed on the northern part of the building which is cold and dark and accepts little solar radiation. The main spaces are placed on the south where there is plenty of light since it accepts the most solar radiation during the winter and the least in the summer. The western side is preferable for offices etc.

- *The color of the external surface of the building*

It is widely known that dark surfaces appear to absorb great amounts of heat in all wavelengths, while light – colored surfaces absorb radiation of small wavelength which correspond to low temperatures. The effect of color in the external surfaces relative to the absorbed heat is greatly reduced by increasing heat insulation. The hot Mediterranean climate of Greece demands the use of light colors in contrast to those of the north – European climates where buildings are painted in dark color [11].

- *The relation of the building with the neighbouring ones*

Semi – detached buildings are more preferable than detached in terms of thermal benefits. Bigger buildings appear to have a favorable relation with the external surface according to their mass and thus relatively low thermal loss [10].

3.2.2 The “greenhouse” as a passive collective system

The “Greenhouse” is an appendage of the solar space on the south side of the building. Glass or transparent plastic covers the southern and sometimes the eastern or western side. Its function is based on the greenhouse phenomenon blocking big amounts of solar energy reaching the glass surface and its transforming it into thermal radiation in the inner space, while its efficiency is affected by its geometry, the size, the orientation, the inclination. Its use is very popular in the northern, cold climates where there is limited sunshine, opposite to the warm Mediterranean climates where sunshine sometimes exceeds the 250 days per year (Greece) [12].

3.2.3 Passive storage of thermal energy in buildings

The main aim of the techniques for the storage of the remaining heat from the sun in a building is using the stored heat in colder periods. There are two basic systems of passive energy storage, the direct and the indirect. According to the first technique, when a passive material receives solar radiation, a part is stored in its mass increasing the temperature of the material. The second technique is applied when a passive building element is heated absorbing the heat radiated by other warmer elements or is transmitted through the air when the latter has a higher temperature [4].

A. Direct storage passive systems

Solar radiation entering a building through glass openings immediately heats the walls, floors and roofs. The direct storage of heat is effective when the building has big openings towards the south, big thermal mass for the storage of excessive energy and external thermal insulation. In order for this system to be effective “heavy” passive materials of big thermal capacity and minimal cost are required, while at the same time providing direct visual contact with the external environment is provided. Sun protection techniques are demanded in order to avoid overheating during the summer months especially in Greece when big openings of Southern orientation exist [4].

B. Indirect storage passive systems

Indirect storage passive systems collect the received solar radiation through a glass surface, store the heat within the walls and emit it heat to the internal space of the building. The most popular passive systems of this category are the following:

- Mass-wall or glass-wall
- Mass-wall with ventilation or Trombe wall and
- Solar water-wall

\- *Passive systems of mass-wall*

Mass-wall is a glass wall. It is constructed by passive materials of big thermo – capacity and is placed in the southern part of the building. The thicker the wall and its thermo –capacity, the bigger its thermal inertia which results to less thermal profit. Over –

heating during the summer months can be avoided by placing a mobile barrier. This, used during winter nights, can also reduce the thermal loss of the building.

- *Passive systems of mass – wall with ventilation or "Trombe" wall*

"Trombe" is a wall with big thermo – capacity. It is made of concrete and is 30-40 cm thick. Its external side is painted black (big thermo – absorption) while a surface of transparent insulating material is placed in a distance of 3 cm. The distribution of heat at the inner part of the building is done in a natural way (thermo – circulation) or with mechanical means (ventilators, pumps) in case great amounts of heat are demanded [4].

C. *Passive systems of water-solar wall*

In this case, water is used as a material of big thermo – capacity since it has the greatest ability to store heat than any other material with big thermal efficiency [4].

3.2.4 Preserving – "Trapping" heat through passive elements

During the cold periods of the year, buildings have thermal losses because of conductivity and transmission of heat or due to airing or penetration of air. Minimising the losses succeeds the preservation of heating profits in the interior shell of a building. The methods for achieving the above are based on the following passive techniques:

- Thermo – insulation of the external walls and windows of the building
- Thermo – insulation of the roof of the building
- Thermo – insulation of the floor of the building

3.2.5 Maintaining heat by thermo – insulation of the external walls and windows of the building

The insulation of external walls is succeeded by using materials with pores (thermo – insulating bricks, monoblocks) with a small factor of thermal conductivity or by using conventional building materials combined with an insulation layer (fiberglass). Another solution is the construction of a wall comprising of two layers of thermal mass with insulation and air layers in between. Reducing thermal loss through windows is achieved by using thermo – insulating glass – panels, some of, which change their penetration quality according to the applied electric field or the level of lighting [5].

3.2.6 Heat maintenance by the thermo – insulation of the roof of the building

The thermo – insulation of the roof is similar to that of the external walls. Passive insulation (expulsioning polystyrene, fiberglass, insulation with metal fibbers and for the roofs with tiles: recycled paper, cork, cotton) is placed in the external side or between two layers of concrete [5].

3.2.7 Heat maintenance by thermo-insulaton of the floor of the building

The thermo-insulation of the floor depends on whether there is contact with the ground (i.e. no need for insulation), or with a non-heated space or with the external space (the thermo-insulation layer is placed in the external side of the thermal mass) [5].

Using passive systems in a building, like the ones already described enables it to cover a significant part of its thermal needs. The percentage of saving energy according to the building ranges from 17 to 48%. The use of double-glazing is possible to minimise the need for heating up to 7% while an increase in the efficiency of the thermal system per 10% can save energy up to 17% [5].

3.3 Cooling strategies

During the thermal periods of the year in mild climates like the Greek one, intense solar radiation (immediate and recycled) on the surfaces of the building, the penetration of thermal air, as well as the use of numerous electrical appliances may cause thermal increase in levels that many times greatly exceed thermal comfort [11]. Installing air-conditioning in Greek mega-cities is a common solution. However, this solution involves big consumption of conventional energy with great environmental consequences. Another way to avoid excessive heat is the application of passive cooling techniques in the building always according to the principles of bio-climatic architecture. Passive cooling takes advantage of both the building and the surrounding space and is succeeded in the following ways:

- Appropriate adjustment of thermal profits
- Reduction of the transmission of heat towards the building and
- Securing immediate thermal losses

3.3.1 Adjustment of thermal profits

Some of the most acceptable methods for protecting the building from undesirable thermal "profits" are described below.

A. *Shaping external spaces*

The external space of a building is a combination of natural and technical elements. More specifically, vegetation reduces air temperature and the temperature of the building surface [5]. Water surfaces like fountains and water tanks act like cooling sources except in cases of damp weather.

B. *Sunprotection*

The use of awnings or mobile tents is required especially for the shading of the south parts of the building where openings are wide and use of trees is ineffective [13].

C. *Controlling interior loads*

Minimising heat from interior loads is succeeded by replacing artificial light with natural, by choosing electrical appliances with small electrical loss and by reducing the activity of the residents.

3.3.2 Minimising heat transmission to the building

Reducing the incoming heat in a building is related to the thermo-capacity of the passive elements of the shell and its ability to store this heat. The use of passive elements of big inertia relative to the transmission and emission of heat in interior spaces in combination with the appropriate airing conditions aids the reduction of heat.

3.3.3 Minimizing thermal losses

Remaining heat in a building can be conducted by applying the necessary techniques, like the ones presented below. Airing demands of the interior spaces in Greece are regulated by the use of technical direction issued by the Technical Chamber of Greece [13].

A. *Conducting heat through natural airing*

Natural airing not only contributes to the reduction of temperature but also to maintaining the quality of the air (increase in oxygen levels and removal of odour and pollutants). Providing the necessary natural airing depends on the orientation, position and the size of the openings. Studies have shown that the air can be renewed by 30 times per hour through open window [13] while the maximum internal temperatures can be reduced up to $3^{o}C$ according to the thermal mass of the building and the quality of the air [5].

B. *Cooling through evaporation*

Cooling through evaporation is achieved by surfaces of stable or recycled water like tanks, swimming pools, fountains etc. round the building.

C. *Cooling through the ground (Passiving Cooling)*

The ground appears to have lower temperatures than those of the atmosphere do during summer months. Conducting heat towards the ground is succeeded in two ways [13]:

- Through the flow of heat from the building to the ground
    - By using alternative heat ground-air

D. *Cooling through radiation towards the space*

Lowering the temperature of a building can be managed by emitting big-range wavelengths of radiation (thermal radiation) from the building to the space. In this way the temperature of the shell of the building drops, increasing the loss of heat from the interior parts.

As derived from data issued by the Ministry of Urban Planning and Public Works, improving the sun-protection of a building can secure the average reduction of the “cooling load” of the building up to 30%. Roof fans allow saving energy up to 70%, while the use of night airing reduces the “cooling load” from 40% to 80% depending on the kind of the building. Finally, by the use of additional cooling techniques, direct or indirect, the total coverage of the cooling needs of the building can be managed [5].

3.3.4 Strategies providing natural lighting

Sunlight during the day is direct and plentiful. Plenty of sunlight reaches the final receiver after being reflected on water and floating particles of the atmosphere. The ground also reflects the light that falls onto a surface.

Interior design (size – position of openings, inner wall distances) greatly determines the possibilities for the exploitation of natural light and its distribution to the buildings. Making the most of natural light can be achieved in various ways like the use of sloping – roof, multiple roof openings, vertical dormer – windows, lighting pipes (pipes of great reflecting capacity which directs sun-rays to the desired spot), atrium and “bright shelves” (horizontal reflecting surfaces directing light to inner spaces) [5].

The minimum required quantity of natural light for any space is determined by International standards. The Commission International de l’Eclairage (CIE) standards are prevalent in all European countries, while amounts of light are specified by the Natural Light Factor. This factor is the quotient of the amount of light on a certain spot to the relevant amount of lighting in an outdoors horizontal surface. The average factor in Greece varies from 0,7 to 3,5 according to the use of space [10].

A wide variety of research projects have shown that the greatest percentages of the annual energy consumption in Athens, are consumed firstly by cooling during the summer months, and secondly, by lighting and heating [14]. The global consumption of electrical energy was 12 trillion kWh in 1996 in the domestic section. As estimated, it is bound to exceed the 20 trillion kWh by the year 2020. The electrical energy consumption in Greece has increased by an average degree of 4% in the past few years [15]. It has also been estimated that the proper use of natural light leads to saving electrical energy from 10 to 60% [5].

4 DEVELOPMENTS IN GREEK BIO-CLIMATIC BUILDING DESIGN

The combination of the Greek latitude and plentiful sunlight results to daily sunlight rates of 4,3 kWh of solar energy per square meter of horizontal surfaces. Thus, the design of the buildings, based on the principles of bioclimatic design, in combination with the use of the necessary passive systems can lead to a decrease in the energy consumed for heating which can range from 40 to 60% in cold regions, reaching a 90% in warm regions [16].

The first applications of bio-climatic design in modern architecture in Greece date back to the 80's. Those first bio-climatic buildings of the period were few and mainly belonged to architects who constructed them in an attempt for more quality in design and derived from high ecological sensitivity.

In the years to follow, numerous bio-climatic buildings appeared mainly in Athens, Thessaloniki and Creta. Those buildings were the result of initiatives taken by various research and government centers, with most important the Greek Corporation for Solar Energy, the Institute of Solar Techniques of the University of Thessaloniki, the Department of Architect Engineering of N.T.U.A. and the Center of Renewable Energy Resources.

Various obstacles got in the way of attempts made for the expansion of ecological architecture for many years. The application of bio-climatic design and "clean" building technologies has been in the past few years, the basic axon of the national policy for environmental protection and the reduction of CO_2 emissions. The starting – point of all action schemes was the E.U. and National Programs which aimed at the saving of energy through appropriate techniques supported by the use of Recycled Energy Resources (R.E.R.) in buildings and generally in urban areas in Greece [11].

Photo 1: Central Buildings of the Administration of the Public Petrol Corporation "Hellinika Petrelea", in Aspropirgos, Attica.

The direct result of the above measures is that they have been successfully applied at the Solar Village with great energy benefits. The Solar Village is a complex of 435 homes constructed in 1988 in Likovrissi (construction architect Al. Tobassis) of Attica with the co-operation of the Greek Ministry of Development, the Workers Housing Organisation and the German Ministry of Research and Development. The agreement included the experimental application of energetic and passive systems of high technology. This settlement was carefully designed aiming at the best results possible as far as the thermal comfort was concerned in combination with low energy consumption [17]. All new public buildings (see photo 1) are designed and constructed based on the new legislative frame for the rational exploitation of energy including numerous passive structural systems in their architecture. The re-construction of an old industrial building into a prototype "Ecological Building" for housing the central offices and the organisations of the Ministry of Urban Planning and Public Works in the area of Eleonas.

Moreover, two new public buildings of high-energy efficiency are being completed in Thiva and Menemeni while various old blocks of flats housing refugees are being re-constructed by using environmentally friendly technologies. A great number of individuals have started using autonomous energy constructions for private use. A big part of these bio-climatic buildings (see photo 2) with obvious results in saving energy by using passive systems has been widely advertised in numerous Greek magazines and newspapers in the past few years [18]. In the same time, there are buildings which use geo-thermic and aeolic energy which however are still in experimental stage and have not yet become popular.

The design of a modern bio-climatic building demands through scientific research and technologies that require the co-operation of various specialists. The application of theory today is achieved by the use of the appropriate programs – packages. The most popular PC program of architectural – urban planning design in Greece is the Climate Responsive Computer Aided Design (CRESCAD) which takes micro-climate conditions into account providing in this way the possibilities for bio-climatic and energy settlements and building design. More specifically, it aids the researcher to evaluate design results by using specific sub-programs such as the

Shadowpack – PC (Sun and Shadows in Buildings), the Phoenichs – CFD (Air movement in the space) and the Suncode – PC (Thermal Behaviour of Buildings) [16].

Photo 2: ABB private corporation building in Metamorphossi of Attika

5 LEGISLATIVE MEASURES AND POLICIES TOWARDS A SUSTAINABLE GREEK CITY

Nowadays, there is a tendency to blame the urban phenomenon for the downgrading of the quality of life in big Greek and European cities. However, as stated by Jr. Miller, "the problem is not urbanisation but our inability to create sustainable cities so as to financially support the province" [1]. Various attempts have been made for adopting sustainable behavior of European cities in the last decades.

A significant step to this direction is the publication of the Green Bible for the Urban Environment in 1990 and the White Bible for the European Architecture of tomorrow in 1991. These give the basic directions for urban planning and architectural design focusing at the same time on respecting the environment and the saving of energy [19].

A very important guide for ecological design is the Green Vitrouvious, which was presented in 1999 by the E.U. Board of Architects. As far as bio-climatic design is concerned, it focuses on subjects like: the suitable position of a building so as to exploit the special characteristics of a place, avoiding the application of complex constructions, and predicting the energy behaviour of a building. The Green Vitrouvious also highlights the need for the co-operation of architects with consultants of other specialties (electricians, plumbers, technicians, etc.) in every step of the design and construction of a building so as to achieve the best possible solutions in financial and environmental level [19].

What is considered highly important in the domestic section is consumption and production of energy using renewable resources of energy (R.E.R.) as much as possible. The import of photovoltaic cells in the Mediterranean region is continually increased for the combined production of energy for heating and hot water is continually increasing. The Danish action scheme "Energy 2000" includes limitations of the rate of 15% in the consumption of energy, more than 40% in the consumption of fossil fuels for the production of energy and finally the radical reduction of CO_2 emissions [20].

In Greece, the relative legislative measures are taken by the Law 2244/1994 concerning issues of the production of electrical energy from RER, from conventional fuels and other issues. Based on the above law, a new field for the promotion of R.E.R. was created by the Greek State. The Ministerial Decision 8295/1995 and the Laws 2601/1998 and 2773/1999 followed, leading to the freeing of the production of electricity by R.E.R., either by individual producers or independent producers by putting an end to bureaucracy which interfered in the expansion of R.E.R. in the past.

Additionally, the Greek program for Climate Transformation encourages measures taken for saving energy and the use of R.E.R. in transport, industry, domestic and trades buildings and generally the Tertiary sector of production. This program aims at stabilising and limiting greenhouse emissions. The scheme focuses on measures concerning buildings by giving motives for the application of the article 6 of the Law 1512/85 at the same time combining Greek legislation and the community directive SAVE 93/76/E.C.C.

(stabilising and limiting CO_2 emissions by improving the energy efficiency of the buildings) [3, 21]. This decision regulates issues like the following:

- Manufacturing techniques of new buildings and urban regions for the best energy efficiency of existing buildings
- Taking steps for the improvement of the energy efficiency of existing buildings
- Boosting bio-climate architecture and ecological construction by using "clean" technologies for the saving of natural resources, recycling domestic waste and offering appropriate heating and quality of interior air.

In this frame the action scheme "Energy 2001" was initiated by the Ministry of Urban Planning and Public Works in the beginning of 1996. This was directed by teams of specialists and representatives of branch scientific authorities aiming at the application of systems and techniques, which contribute, to the saving of energy in the domestic sector [22]. In other words, "Energy 2001", specialises the Greek program for climate transformation including measures and motives for "Sustainable Buildings" and "Sustainable Cities", like [19]:

Interference in the shell and settlements concerning heating, cooling and lighting for the improvement of the energy efficiency of the building, by giving legislative, administrative and financial motives.

Special interventions in traditional buildings and generally domestic areas incorporated in their special characteristics.

Obligatory measures for the energy management and efficiency of the total of public buildings and buildings of the wider public sector in general.

Bio-climatic energy design for all new buildings and general domestic areas.

Eventhough passive systems have been applied for decades in European countries, only recently have they been included in the Greek legislation by the General Building Regulation (G.B.R.). This aims at saving energy in the building sector and promotes the sustainable design of buildings. More specifically, the new G.B.R., Regulations of Thermo-insulation are replaced by the Regulations of Rational. Use and Saving Energy. According to the new Regulation, new buildings should consume the minimum energy possible with high environmental efficiency [23] so as to succeed the following:

- The wide exploitation of natural energy and local climate conditions so as to minimise the energy needs of the buildings (bio-climatic architecture).
- The covering of the thermal demands of the shell and the efficiency of the electro-mechanic installations.
- Satisfactory levels of thermal comfort throughout the year.
- Sufficient natural lighting and airing.
- Quality of interior air.
- Consumption of energy according to the building category within limits.
- Energy supervisions and energy – environmental certifications of the buildings and
- Energy Identity Card.

This Energy Identity Card should accompany the building license enabling the users to know the quality characteristics of the building and generally the conditions of the buildings in the country. Based on the Regulations of Rational Use and Saving of Energy, all buildings should have an Energy Identity Card from 2006 and on.

6 ENERGY PROGRAMS FUNDED BY THE E.U. AND NATIONAL PROGRAMS FOR THE USE AND EXPLOITATION OF SOLAR SYSTEMS

Most of the following sub-paragraphs presented occupy with suggestions-actions aiding the wider expansion of R.E.R.

6.1 Operational Energy Program

The operational energy program of the Ministry of Development had a 5-year duration (1994-1999) was included in the European Community Supporting Fund Program and consisted of four semi-programs. This program promoted and funded the use of R.E.R. in the private financial sector by incorporating actions relative to saving energy in buildings of the trade and the general tertiary sector. Among investments made, 92 were of central solar, photovoltaic and passive energy systems of a total budget of 26.7 million euro [24].

6.2 - The SAVE program

The SAVE program has been in action from 1991 to 1995 and was replaced by SAVE II in action from 1996 to the end of 2000. This program was of non-terminal character aiming at the rational use of energy aiding the efforts of the E.U. country members for energy saving. The target was to create a suitable environment for accelerating relevant investments. The expanded program SAVE II provided special actions aiming at the improvement of energy management in local and regional level paying particular attention to promoting modern photo-voltaic systems. Briefing activities included events and conferences in national and European level, as well as the relevant publications organized by the European Energy Net (EnR) [25].

6.3 - The ALTENER program

The ALTENER program is a program of the General Administration XVII of the Community for the energy. It has non-technological character. The sub-program ALTENER II is the continuation of the ALTENER I (1998-1999). ALTENER contributes to the adaptation and materialization of the aims of the White Bible. The aim of this program is to triple the production of electricity from RER by 2010, by providing new motives for the increase of private investments and the reduction of CO_2 emissions by 180 million tones. In Greece, new directives were given based on ALTENER II for investments in energy solar systems by the National Technical University of Athens (N.T.U.A.) and CRRE, especially for the island of Crete [26].

6.4 - The SYNERGY program

SYNERGY (1998-2002) is a program of the General Administration XVII of the Community with the basic aim to promote co-operations in the section of Energy, emphasizing especially on the R.E.R. development while 12 million euro have been given for this reason [25].

6.5 - The COMPETITIVENESS program

The "COMPETITIVENESS" program of the Ministry of Development is included in the European Community Program No. III (2000-2006) and is concerned with financial motivation given for individual investments of Saving / Co-production / Substitution and R.E.R. in the areas of the inter-connected system of the country. It also deals with investments with power more than 5 MW in the areas that are not within the inter-connected system. Suggested investments for the development of passive systems can reach a subsidy of 40% of the total budget of the entire country.

7 BENEFITS AND MOTIVES FOR THE SAVING OF ENERGY BY THE USE OF BIOCLIMATIC TECHNIQUES

The already mentioned policies and programs aim at the maximum exploitation of solar and aeolic energy in the ecological design of buildings based on the use of passive systems. At the same time they contribute to the de-centralization of energy production and towards regional development.

The predicted benefits from the application of especially the program "Energy 2001", which particularly promotes bio-climatic design, are significant especially in social, financial and environmental level. New demands in the design and construction of high environmental and energy efficiency buildings will shape new conditions in the market since there is an increased demand for quality construction products. It is also predicted that novel attitudes and perceptions will be formed leading to a gradual alternation in production and consumption standards not only in energy but in other sectors as well.

The immediate results of the above changes will, in all probability, be obvious in occupation level by the creation of new positions both in the industrial and the construction section. A significant increase of competitiveness has also been foreseen in the field of R.E.R. and generally of "clean" building technologies. As a result the quality of constructions is improved as well as living conditions within the buildings of mega-cities and settlements of the country.

Furthermore the re-enforcement of the national financial economy and the saving of energy and natural resources generally is predicted with the parallel boost in construction activities. The observance and the application of the above suggested measures demand for more than the suggested policies and laws. Co-ordinate efforts towards the basic action frames are extremely essential [22]:

- Raising public awareness on environmental issues and professional training
- Supporting co-operations among social authorities, Local Administration Organisations, Business and Professional Unions, Research Centers, Universities and Technical Colleges, Ecological Organisations and other Non-Profitable Private Organisations.
- Pilot applications in buildings, in regional building constructions, of high environment and energy efficiency.
- Establishing surveillance mechanisms through regular supervisions for the energy certification – rating and application of the required regulations for the installation of energy equipment not only of buildings but of energy consuming businesses as well.
- Tax exemption and funding for the purchase of "efficient" buildings and electrical appliances with the simultaneous increase in the taxation of the use of petrol and generally conventional electrical energy.
- Creation of a legislative frame for the composition of a bio-climate study, and finally
- Encouragement for the research of non-polluting innovative technologies which will give a boost to the social and ecological reality.

8 CONCLUSIONS

Bio-climatic design uses R.E.R., limits the consumption of conventional fuels to a minimum and avoids the use of air-conditioning for the cooling and heating of the buildings. A bio-climatic building offers a healthy environment from a physiological and social aspect with the fewer environmental consequences possible. A new kind of building is created which uses natural sources in a rational way, securing the best possible living conditions, enhancing at the same time the positive "interaction" between the building, the urban space and the natural environment. Consequently, bioclimatic rationale aims at saving energy up to 60% by contributing to atmospheric and generally environmental protection.

The application of bio-climatic design in Greece offers great possibilities that do not oppose to traditional building techniques. The mild Greek weather conditions gives the opportunity for the application of bio-climatic design.

Bio-climatic architecture can be applied in any building with reasonable expenditure. Even when there is an increase in the construction cost, this rarely exceeds a 10% in the total budget. Such an increase is also attributed to extra insulation or to the installation of roof-fans or other relative elements. Increased cost is depreciated by the limited use of conventional heating and air-conditioning units. Buildings designed according to bio-climatic principles offer a pleasant environment and save energy at the same time.

The energy crisis of the past few years had obvious financial consequences, which led to radical changes in the wider policy for the management and use of R.E.R.. Bio-climatic buildings have an advantage over conventional ones as they offer the chance for the reduction of energy needs in the building section. In order to succeed sustainable development R.E.R. and especially solar energy should be fully exploited. The amount of solar radiation is estimated to be 25.000 tones bigger than the total global consumption of energy.

Bio-climatic architecture promotes numerous social and non-financial values like a sense of ecological responsibility, the realization of the exhaustion of natural resources and the pleasures of natural life.

Modern bio-climatic design can and should become the architectural expression of a "wiser" consideration of the society and the environment, focusing on the common "man" with his traditions and values.

At this point, the principles of bio-climatic architecture should be mentioned relative to the reshaping of historic centers, traditional settlements and individual renovations of important buildings. Eventhough, traditional architecture followed natural patterns and can be considered bio-climatic in itself, it is however necessary to systematically research the application of modern bio-climatic architecture design when reshaping a building so as to adapt it to contemporary needs.

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Designing a web-based public participatory decision support system: the problem of wind farms location

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ABSTRACT

Since the Rio de Janeiro Summit in 1992, there has been a strong political will to integrate renewable energy carriers in electricity generation and supply. Demand for wind energy in particular has been mounting. However, difficulties in securing planning permission have been reported by many authors. Through evidence in the literature we contend that more progressive and predictable planning consent can be achieved if the actual decision-making process is reformulated. First, comprehensive and accurate information should be provided to the public, as public attitudes in general are coloured by misunderstandings or biased information. Secondly, the public should be engaged in the decision-making process from the earliest phase of the planning procedure. Internet-based technologies have proved to be an efficient vehicle to disseminate information and have been argued to have the potential to widen participation in planning systems.

This paper presents the design of a web-based spatial decision support system conceived bearing in mind the following aspects: 1) the need to frame the wind energy context to the public; 2) the need to clarify wind turbines' and wind farms' impacts for the public, which can be achieved through the use of multimedia technologies (hotlinks to on-line movies, sounds, pictures, etc.); 3) the need to provide a virtual space where decision-makers (system users) can learn about their preferences concerning wind farm locations by exploring the consequences of stated preferences and have the opportunity to modify them in response until completely satisfied; and 4) the requirement for a framework in which arguments about the siting of wind farms can be explored, both by system users being given the opportunity to argue in favour of their learned positions and gaining knowledge about arguments supporting distinct positions.

This system will represent a contribution to three main domains. In the first instance, the collaborative planning stream concerned with participatory decision-making in spatial problems. In the literature, only a few collaborative spatial decision support systems give non-expert users the opportunity to explore and crystallize their preferences before stating their final judgement. Secondly, a contribution will be made to the field of wind farm planning, where the literature contains no reference to collaborative spatial decision support systems involving public participation. Finally, the web-based public participation arena where, in spite of the interesting examples already available, some aspects still represent major challenges and are worth further development: the use of the Internet as a bi-directional channel of communication between the public and policy authorities; and web-mapping technologies as a way to transmit spatial information at different scales seamlessly.

1 INTRODUCTION

The increasing emphasis on renewable energy and, in particular, the interest in wind energy developments frame the topic of this paper. A perceived sense of discontentment with the current wind farm licensing process motivated research on this topic. Several factors were identified that justify this discontentment: fundamentally, planning authorities have been making decisions without any strategic support and stakeholders have not been involved in the planning procedure until the late stages of public inquiry into project evaluation.

We favour a more positive, "plan-led" approach taking place at the regional level. Thus, decisions can be better tied to strategic needs. Further, we argue that public participation is fundamental to legitimating such decisions. Hence, we propose a collaborative framework that aims to enable stakeholders to participate effectively in defining the balance between local amenities and national policy in relation to wind farms, until now restricted to the licensing authorities. The proposed system explores the Internet as a vehicle to widen public participation and will use an argumentative framework to make reasoning public and trigger critical thoughts. This paper describes the structure of the system and systematises the questions that need to be answered before full implementation of such a system. After completion, we believe the proposed system will represent a valuable instrument for democratic participation.

The present paper is organised in nine sections. The following two sections set down the context of renewable energy and wind energy developments, respectively. Section four tackles the problems arising from current wind farm planning and licensing systems. The fifth and sixth sections depict the framework that supports our research and reveal our proposed way of proceeding. Section seven presents a brief discussion of the literature on public participation, which constitutes the basis of the proposed system, presented in section eight. Finally, the paper ends with some concluding remarks and sets out future work.

2 SETTING RENEWABLE ENERGY INTO CONTEXT

From heating and lighting to transport, industry and communications, energy is fundamental to almost everything we do. Most of the energy comes from fossil fuels, which has a negative impact in the environment due to the carbon dioxide (CO_2) released during its combustion. Annually, millions of metric tons of CO_2 are released to the atmosphere. During the year 2001, the Energy Information Administration estimated a worldwide emission of 24,082 million metric tons of CO_2 from the consumption and flaring of fossil fuels, 1.5% more than the previous year (EIA, 2003). Amongst the 6 main gases responsible for the greenhouse effect, CO_2 is the main contributor to the problem of global warming and climate change, the most serious environmental threats facing the world today.

The alteration of global climate became such a serious question that in 1992, a specific global convention was held in Rio de Janeiro, Brazil, to address this problem. The aim of the Convention was to get countries to agree to stabilise greenhouse gas (GHG) concentrations. Five years later, the subject was again at the centre of international debate during the Third Conference of the Parties to the United Nations Framework Convention on Climate Change held in Kyoto, Japan. A Protocol was signed as an attempt to limit CO_2 emissions levels in the atmosphere. Industrialised nations who signed up to the treaty are legally bound to reduce their collective emissions of the six GHG by at least 5% below their 1990 levels by the period 2008-2012. The European Union (EU) agreed a cut of 8% on its GHG emissions, making internal agreements to meet this target by distributing different rates to its member states.

Several measures can be explored to reduce CO_2 emissions. The two major axes of combat are: promoting renewable forms of energy supply and energy efficiency. We are particularly interested in the former. Promoting renewable energy, other than address the problem of GHG emissions and environment protection, tackles the problem of dependence on energy imports, as renewable energies are indigenous sources of energy, protects exhaustible energetic resources and contributes to the socio-economic development of peripheral, isolated and insular regions. Recognizing the prominent role of renewable energy, in 1997, the European Commission set out the ambitious objective of doubling the renewables' share of the EU's total energy supply from 6% to 12% (and 22.1% of electricity), by 2010 (European Commission, 1997). All Member States are responsible for reaching this target. Thus, in September 2001, the European Parliament and the Council adopted the Directive 2001/77/EC on the promotion of electricity produced from renewables in the internal electricity market (European Commission, 2001). Member States adopted national targets for renewables; the UK, for instance, set the target of 10% of the internal consumption of electricity to come from renewable energy sources by 2010. More recently, the UK Government decided broadly to double renewables' contribution to the energy mix to 20% by 2020, grabbing a recommendation from the Performance Innovation Unit (The Stationery Office, 2003).

3 WIND ENERGY

Renewable energy is obtainable from different sources: hydro, wind, solar, tidal, waves, landfill gas wastes and biomass residues, energy crops, etc. Considerable technological progress has been achieved on some of these renewable energy technologies over recent years, in particular for wind energy. The cost of wind energy plant has fallen substantially during the last fifteen years and this trend is continuing. This conjugated to the fact that wind energy is indigenous, secure and freely available and, in addition, does not create any dangerous waste products has lead some authors to argue that wind energy is one of the most cost-effective energy options for reducing global warming.

Wind energy is generated by wind turbines, most often gathered in wind farms. Traditionally wind farms locate on land. However, as wind speeds are generally higher offshore than on land, major offshore developments started to appear. Prices for energy generated in such a way are more attractive and it opens up further opportunities for wind industry.

By June 2003, 24,904 MW of onshore wind energy capacity were installed in European countries, 24,626 MW of which are in the European Union (EWEA, 2003). As for offshore, BWEA (2003a) state that a total of 10 projects are currently operational worldwide, with a combined capacity of 260.75 MW (all of them in Europe). Recently (November this year), a new offshore project started generating energy: the 60 MW North Hoyle Offshore Wind Farm in the UK. Several other projects both onshore and offshore are planned.

Despite these impressive achievements, difficulties in securing planning permission have been reported and are acknowledged to be a grave hindrance to achieving the necessary growth of renewables. NWP (2000) reported that, in the UK, up to three years are required for wind farms to go through the planning and Public Inquiry process, with less than a one in five chance that planning permission will be granted at the end of it. This problem is further exacerbated by the increasing drive toward larger wind farms justified by gradually falling prices of progressively bigger wind turbines and other factors related to economies of scale.

4 CRITICISMS TO CURRENT WIND FARM LICENSING PROCEDURE

Despite results of surveys of public attitudes, that reveal strong and often overwhelming public support towards wind energy and wind farms (BWEA, 2003b; Braunholtz, 2003), obtaining planning permission has been a problem. Considering current licensing processes throughout Europe, and in particular in the UK, two main reasons may justify this fact. Firstly, although planning instruments provide for local plans to specify suitable sites for renewable energy (cf. PPG22), they rarely contain sufficiently detailed policies to be able to determine in advance of making a planning application whether a project will be successful in planning terms. As a result, strategic wind farm decisions must be taken at a local level without the benefit of a broader strategic approach supported by sound principles. Several consequences derive from this fact: 1) enlargement of the degree of uncertainty for prospective wind farm developers as they are unable accurately to predict public reactions to their proposal; 2) arbitrariness in judging planning applications as it is difficult to maintain consistency over time; and 3) delays in processing planning applications by the already grossly overworked planning departments. Second, current decision-making processes either exclude the public or involve them too late in site selection decisions. Fig. 1 depicts the planning procedure in the UK for both onshore and off-shore wind farm developments. The public is neglected in early phases of the procedure, most often with their voices only heard at the level of an individual planning application (if developers decide not to undertake the recommended scoping exercise prior to the EIA).

The onus of site selection is on the developer, who makes a choice using feasibility studies, develops the project proposal and submits it for planning consent to the licensing authority. In the UK, projects under 50 MW of generated wind power are considered by local authorities. For larger projects, the DTI is the licensing authority.

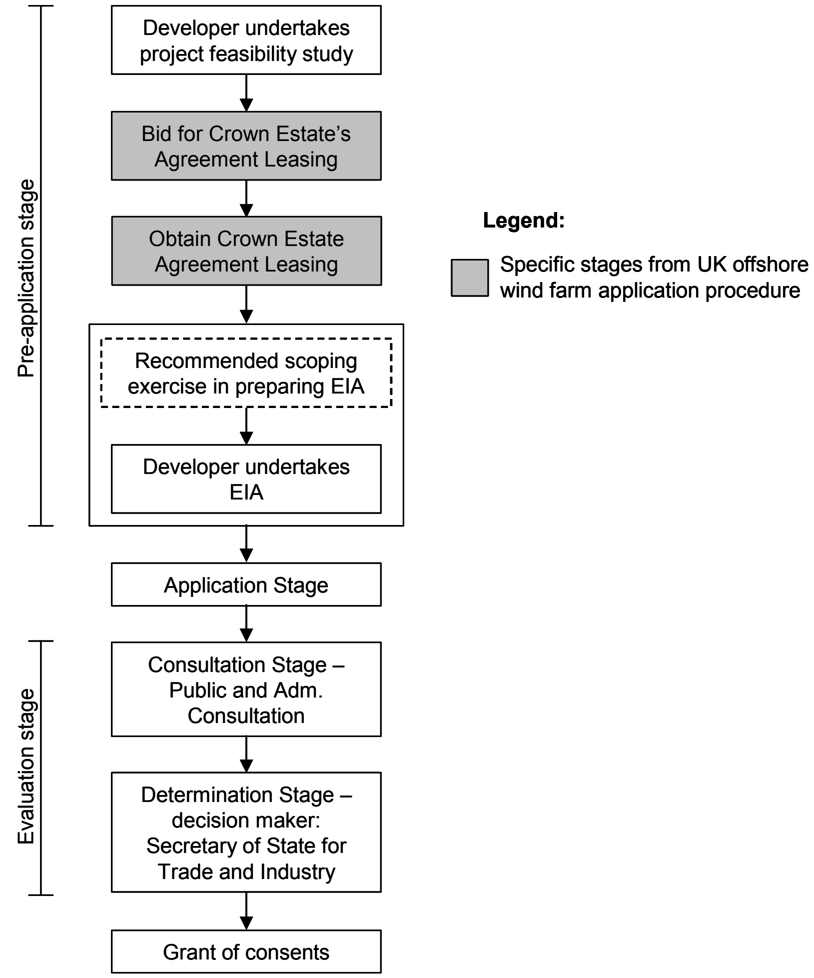

Figure 10 – Planning procedure in UK. Gray boxes enclose supplementary procedures associated to offshore wind farms planning permission.

By the time the public get involved, significant alterations to projects represent a big nuisance and only small changes are willingly accepted by developers. Therefore, whenever there are objections, the debate is predictable. Developers defend their project as they invested a considerable amount of money in its conception. The public, most likely guided by pressure groups, will find more and more arguments to "justify" why the chosen site is "unacceptable" and/or support their standpoint. Impasse is the result until The Secretary of State is called upon to review the application and make a final decision, which often is challenged in court.

5 SOME STEPS FORWARD

The UK Government acknowledges the need to "promote and encourage" wind energy. Moreover, there are huge inconsistencies over approval of onshore wind schemes (BWEA, 2003c) in England (at the local authority level Devon, Lancashire and Northumberland turned down all applications over the past five years, Yorkshire allowed 100% of applications and many counties passed between 50% and 80%) and in the UK (overall, in England the approval rate for the past five years is 50% while in Scotland is 94%). Thus, the UK Government undertook two important initiatives based on the concept of 'thinking globally, acting locally', long associated with sustainable development.

The first initiative aimed to implement a more proactive regional planning system. The Government established a "new" regional agenda which sets up the possibility for Regional Planning Bodies (RPB) to produce Regional Planning Guidance (RPG) (DTLR, 2000). RGP should be based on a sustainability appraisal (The Stationery Office, 1999) and will evolve into a specific integrated spatial strategy for the region, providing the framework for the range of public policies that will manage the future distribution and level of activities in the region. The appraisal process is intended to be continuous, iterative and take place throughout RPG preparation. Regional stakeholders and the community are welcome to participate in the RPG process, as the main idea is to test the performance of a plan, thereby providing the basis for its improvement. In 2001 this framework was enlarged to all EU Member States by Directive 2001/42/EC on the assessment of the effects of certain plans and programmes on the environment (European Commission, 2001).

The second initiative consisted of the Government's request to elaborate a regional approach to renewable energy (DETR, 2000a). This should include regional renewable energy generation targets flowing from the assessments of each region's capacity to generate electricity from renewable sources and a full consultation with local groups of what is realistically achievable in the region. RPG should assist in the delivery of these targets by 1) defining broad locations for renewable energy development; 2) setting criteria to help local planning authorities select suitable sites in their plans and 3) setting sub-regional targets – i.e., feeding into subsequent structure plans and unitary development plans, only "where sensible to do so" according to the Planning Minister Nick Raynsford[1] in 2000. The overall aim is that the strategies and targets should feed through into development plans, which are the starting point for planning decisions at a local level. These plans must be subject to public consultation during the Strategic Environmental Impact (SEI).

These two initiatives compose the scenario where our current work takes place, as described in the next section.

6 CONTEXT FOR PROPOSED WORK

We contend that the way to move forward is by fostering a more positive, "plan-led" licensing system at the regional level that can be cascaded down to lower tiers, i.e., local development plans and individual planning applications. Such a procedure would: 1) offer more predictable planning consents for developers; 2) contribute to greater public familiarity with, and acceptance of, prospective renewable energy developments; and 3) secure the achievement of national and regional targets in a more strategic and advantageous form.

RPG provides a realistic opportunity for wind energy to be integrated into strategic thinking at the regional level. Furthermore, sustainability appraisal as a continuous, iterative and participatory planning process sets the scenario for ongoing research work. Planning instruments, such as guidance, guidelines and plans are the responsibility of planning authorities that have democratic mandates for making planning decisions. Such decisions must take full account of national government policies but also of regional and local requirements. Decisions can not be made in isolation; there is potential benefit to all parties that interested stakeholders get involved in the elaboration of such instruments. In fact, some bodies, particularly nature conservation and landscape protection bodies, often have valuable advice to give and so has the public. On the other hand, democratic participation legitimates outputs and brings considerable weight to the determination of planning application and appeals.

Supported by these considerations, the proposed research aims to design, develop and test a framework for democratic participation by allowing the public to express their opinion and collaborate in the process of determining the "most appropriate" places for siting wind farms. The idea is that if access to relevant information, and the tools with which to use it, are available, then widespread public consultation and participation in the decision-making process surrounding problems of national or local importance could be expected. In return, decision makers (government ministers, local authority planners, etc.) get a greater insight into the views of the participating electorate. In consequence, we should all be better informed and have better informed decision-making.

Before describing the proposed framework, let us outline some general aspects of public participation in decision-making.

7 PUBLIC PARTICIPATION

The biggest impulse towards public participation comes from Local Agenda (LA) 21, the action plan proposed by the United Nations at the Rio de Janeiro Earth Summit in 1992. LA 21 aims to achieve sustainable development and a higher quality of life for all people. As many of the problems and solutions addressed by LA 21 have their roots in local activities, principle 10 of the document expressly states "At the national level, each individual shall have appropriate access to information concerning the environment … and the opportunity to participate in decision-making processes". In June 1998, this basic principle was further elaborated on in the Aarhus Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters, which entered into force on 30 October, 2001 (DETR, 2000b).

7.1 Traditional methods of public participation

Traditional methods of public participation in the planning system range from neighbour notifications, exhibitions, public meetings and public enquiries through to high court hearings (Thomas, 1995). Over recent years, these methods of participation have been criticised by many (Healey, 1998). Council planning meetings, in particular, present several characteristics that discourage participation (Kingston *et al*., 2000): they often take place in an atmosphere of confrontation; sustaining a tone of "them and us", with the authoritative decision makers holding all the knowledge, expertise and information and, more often than not, positioned on a platform with the general public down below in a less favourable physical and psychological position. Such meetings can be dominated by a vocal minority (activists) and often the whole process involves highly technical and legal "jargon" that is barely understandable for laypersons. Finally, meetings are nearly always held in a fixed place or location and at a fixed time, restricting the number and types of people who are able to attend.

7.2 Alternative approaches to public participation

To overcome these difficulties, alternative methods of public participation have been investigated by making use of Information and Communication Technologies (ICT) (Shiffer, 1995; Howard, 1999; Kingston *et al.* 2000; Carver, 2001; Al-Kodmany, 1999; Hudson-Smith *et al.*, 2002). Web-based approaches, in particular, have been argued to have the potential to widen participation in planning system (Kingston, 1998, quoted in Al-Kodmany, 1999).

An immediate advantage of this web-based approach is greatly increased levels of public access. Public meetings available over the web are no longer restricted to geographical location or specific times. The concept of "24/7" (i.e., 24 hours a day, 7 days a week) opens up opportunities for more people to participate in public consultation. Furthermore, the Internet has the potential to break

[1] As quoted in *DETR's strategic planning for renewables* [Online], extract from the July-Aug 2000 edition of Renew On Line (UK) 27. Available from: http://www-tec.open.ac.uk/eeru/natta/renewonline/rol27/6.htm.

down some key barriers to participation by taking away certain physiological elements that the public face when expressing their points of view at a public meeting. In reality, as participants are at the end of a telephone line, they are free to make comments and express their views in a relatively anonymous and non-confrontational manner when compared with making a point verbally in front of a group of relative strangers. Thus web-based systems can provide a more comfortable environment and any person can argue in favour of his/her opinions more confidently. The richness of information readily accessible at a mouse click is another relevant issue. Although some problems may arise from unproductive distractions and even "getting lost" (Shiffer, 1995), the immense sphere of information available on issues being discussed is beneficial as participants can "hunt and gather" a multitude of resources to support individual arguments.

Although they offer noteworthy advantages, web-based participatory systems are not without critics. The principal criticism focuses on the public's ability to understand maps that are essentially "birds-eye" views. In the past, several researchers claimed that many people do not instantly recognize locations when presented as an aerial view (Keetes, 1996; Monmonier, 1996). Currently, other authors rebut this argument stating that "Dynamic maps", which are interactive and provide information about their features, help people to understand the information presented (Kingston *et al.*, 2000). Moreover, multimedia (text, graphics, still images, synthetic animations, video and audio) can be explored to improve people's understanding of maps and contextualize issues in debate (Shiffer, 1995).

Other criticisms concern the technology itself: access to it; the eventual creation of the so called "Digital Divide" (an information underclass); the lack of familiarity with the technology and individual skills in using it (overload of information and how to find his/her way); data and copyright issues and also public trust in the technology (response legitimacy). However, these criticisms are not insurmountable. The future widespread use of the Internet (or whatever succeeds it), its long term availability to all (as with television and telephones now) and increasing experience in using computers and the web are just some of the arguments that balance the debate.

Web-based systems can inform and engage the public in decision-making. They allow individuals to make representations directly to the decision-makers themselves (democratic participation) and thus circumscribe the prevalent system of representative participation, i.e., the public is represented through a series of elected representatives over which individual members of the electorate have little direct control. Techno-optimists believe that the Internet and wireless communications will generate a new public sphere supporting interaction, debate and new forms of democracy that will result in a renaissance of stronger public involvement in the politic/policy arena.

7.3 Examples of web-based systems in planning applications

One of the first experiences using the Internet in collaborative planning is described by Shiffer (1995). Other developments have since come to light. In 1996, a group of researchers from Leeds University made available to the general public across the Internet a Geographic Information System (GIS)-based Decision Support System (DSS) for finding a suitable site for a radioactive waste disposal facility in Britain. The system was developed in collaboration with UK Nirex Ltd, the organization entrusted with the responsibility of managing and disposing of Britain's radioactive wastes. The system allows users to access background information relevant to the problem, GIS datasets and information about these data (source, relevance, etc.), to identify suitable sites according to the user's own ideas about what factors are important in the siting process. The site identification process involves the user choosing site constraints and weighting each of the given factor maps. The original system was later overhauled to bring it up to date with new, web-based technologies and to update the information about the nuclear waste disposal issue (link: http://www.ccg.leeds.ac.uk/teaching/nuclearwaste/).

Based on this same idea and presenting similar displays, two other on-line spatial DSS were subsequently developed. One aimed to stimulate public involvement in locating areas for regeneration of native woodland in the Yorkshire Dales National Park, an area of 1,790 km^2 lying astride the Pennines in the counties of North Yorkshire and Cumbria (Kingston, 2002). The link is available at http://www.ccg.leeds.ac.uk/dales/start.html. The second system (Carver *et al.*, 2002) lets participants decide where the wildest places in Britain are using interactive mapping tools. The link is available at http://www.ccg.leeds.ac.uk/wild/.

In June 1998, a different system was launched by the same group of researchers. The "Virtual Slaithwaite" project mirrors a Planning for Real® (PFR) exercise taking place in the small village of Slaithwaite, located in the Colne Valley in the West Yorkshire District of Kirklees (Kingston *et al.*, 2000). Through a web-based virtual PFR model, the local community could interact with the 2-km^2 area digital map and input their comments, which were stored in web access log files. Thus, a community database was created to represent a range of views and feelings about planning issues in the village, which can be used for future analysis and feedback into the planning process.

Another notable example of Internet use for community participation is described by Al-Kodmany (1999). The web-based GIS application was developed to discover the community's shared evaluative image of Pilsen, a neighbourhood of Chicago with a large Mexican-American and Mexican immigrant community. First, participants' inputs are stored in web access logs, permitting the creation of a database containing a range of views about areas liked and disliked and the associated reasons. Afterwards, web technologies were explored to create visual "tours" of the areas most often selected by residents and to publish the neighbourhood's collective image of the city. The author concludes that the visual clarity provided by web-based technologies results in a highly interactive public participation process. Although asynchronously, this project explores the Internet as a two-way canal of communication: the public communicate with the Planning Team in the first part of the project and the Team publish its findings in an animated and accessible format in the second part.

More recently, framed by the concept of e-Government, which aims to transform government by making it more accessible and accountable to citizens, a number of central government departments and local authorities throughout the UK and worldwide have been actively involved in providing electronic access to their public services, including planning services. An interesting concretization of this concept is The Planning Portal (http://www.planningportal.gov.uk/wps/portal) launched by the UK Government as a gateway to planning information throughout the UK. Although valuable initiatives, most web-sites only give people the "right to know" and the "right to object" but not the ability to "participate in actual decision-making" (Kingston, 2002). Some exceptions are nonetheless in development providing hope that in the short term the full potential of the Internet as a two-way channel of communication might be at democracy's service.

8 THE PROPOSED SYSTEM

As stated earlier, a more predictable and progressive planning permission process can be attained if 1) planning decisions are "plan-led" and 2) democratic input legitimates development plans. Since ideas, values and attitudes over wind farms issues vary among the stakeholders (from national landscape bodies down to local residents), we propose a transparent and open environment where people can learn, crystallize their opinions and contribute to the decision-making process of wind farm siting during early phases of plan development. The Internet is used as a means to engage the public in the democratized decision-making process.

Contextualized by the scenario introduced in section 6, research focuses on strategic planning. Hence, a regional scale will be adopted for work development. Fig 2 depicts the structure for the proposed system.

1st tier

Welcome and introduction to the web site.

Framing of wind energy context; benefits and costs of wind farms; the siting problem.

User identification.

2nd tier

Multi-Criteria Spatial Decision Support System

Technically and economically feasible sites for wind energy developments are presented. Users are asked to sort these feasible sites by choosing site constraints and weighting a set of pre-defined set of criteria depicted by factor maps.

3rd tier

Argumentative Framework

Feedback to users by means of a "composite map" and a "controversial map". Users are given the opportunity to argue in favour of their learnt positions and explore arguments supporting distinct positions.

4th tier

Comments on the system and system usability.

Thanks and goodbye.

Figure 11 – Structure of the proposed system to improve public participation in wind farm siting.

The four-tier web system was designed bearing in mind the following overwhelming requirements:

1. Information is one of the most important aspects in decision-making. Public attitudes have been argued to be coloured by misunderstandings or biased information and a gap exists between the public's generalised appreciation of wind energy and a detailed understanding of the issues behind it. Consequently, there is a need to provide accurate and comprehensive information to the public.
2. Most citizens have not ever tried to articulate their preferences concerning the wind farm siting problem. Therefore, they need space and freedom to explore the decision problem and create personal constructs that represent their own outlook;
3. People feel more rewarded when they receive immediate feedback. Accordingly, updated information about the consultation process's evolution and previous participants' comments should be provided.
4. Consensual decisions result from interaction and constructive dialogue among interest groups. Hence, it seems appropriate to provide an "open-door" space where participants have the opportunity to express their concerns and discuss hot topics and arguments against or in favour of other participants' opinions, using a natural language.

Although the structure of the system is relatively established, each component (tier) is still being completed. Hereafter, we review each component in more detail, highlighting the questions to be answered.

8.1 The first tier

The purpose of the system's first tier is to welcome participants, present the objective of the initiative and introduce the web site by stating the stages users are required to progress through and how the system works. As information and public awareness are important issues in participatory decision-making, yet in the first tier the substantive problem of siting wind farms will be explained, as well as the relationship with geography and how GIS can be used to help solve the complex problem of finding suitable sites for them. Background information relevant to the problem will be presented.

This module concludes with a request for user identification. This information will be used to test out some basic assumptions, such as whether or not a user's qualifications affect acceptability of wind farms or that NIMBY symptoms lay underneath the user's response.

8.2 The second tier

If the decision-making process is to be participative, the preferences of a variety of people, representing many interest groups, must be elicited and validated. This system's second tier intends to "dress users with the decision-maker's skin" and hear from them an opinion about where to site wind farms.

Thus, this second tier consists of an Internet-based public participatory Spatial Decision Support System (SDSS), a framework that enables users to explore the decision problem, experiment alternative choices, crystallize their preferences and, finally, express an opinion about the factors they feel are important in addressing the problem of wind farm siting. Opinions are elicited by asking the users to specify their preferences (weights) for a pre-defined set of decision criteria, giving them the opportunity to re-access their decisions and interactively refine them by inspecting an output map displayed on the same screen. This output is obtainable by means of a cached-running Multi-Criteria Evaluation (MCE) technique. MCE techniques consist of numerical algorithms that derive outputs on the basis of input criteria and their relative importance (weights) together with some mathematical or logical means of determining trade-offs when conflicts arise (Keeney and Raiffa, 1976).

To a certain extent, the purpose of this tier is similar to some of the Leeds group's systems (cf. section 7.3, paragraphs 1 and 2). Thus, some of their strengths can be explored in approaching our problem. These are:

- Easiness to understand and use;
- Spatial materialization of users' preferences, via maps;
- "Real-time" maps that update after a user's re-assessment of preferences (criteria' weights);
- Integration of the control buttons (checkboxes for turning on or off important constraints and slide bars for weighting mapped factors) and the map in the same screen.

However, some other aspects can be refined. They are:

- User's input interface;
- Spatial MCE's output display.

Although interesting from a usability point of view, slider bars that roll freely and without any supplemental procedure warning users about the trade-offs being made can result in "incorrect" inputs or, at least, non generalizable for distinct contexts. Maps depicting users' preferences are interesting in "quasi-real" contexts, but can they be understood as a validation method of a user's input; or, when used in isolation by users lacking the required comprehensiveness of the whole procedure, do they lead to "unfelt preferences"?

The University of Leeds' SDSS are based on raster analysis. Datasets used are either graded maps showing the (un)suitability of a criterion to the analysis process or binary maps representing areas that may be considered suitable or unsuitable. Through a MCE technique these datasets are combined and the final result is also displayed in raster format: a graded map representing different levels of suitability. The user is then given the opportunity to "top slice" a percentage of the derived most suitable areas. Again, as the procedure enabling the identification of the most suitable areas is based on the direct analysis of a particular map, the validity (or generalization) of the user's parameter input can be questioned.

Alternatively, we propose an MCE technique that implicitly classifies feasible sites for wind farm development in three classes: recommended, acceptable and non-acceptable. The use of a sorting MCE technique (Zopounidis and Duompos, 2002) will help users to assess and re-assess proposals as it enables better control over the outcome when compared to graded maps. Furthermore, imposing the same class thresholds on all users brings additional consistency to the classification procedure and simplifies the overall aggregation of proposals. To improve the output map's legibility, only three different colours will be displayed (green, yellow and red).

The above observations raise the following questions:

- Can the spatial representation of a user's preferences in a map used to control experimental policy alternatives be considered a validation method? If not, how should these preferences be validated in a simple, Internet-compatible environment?
- Which sorting MCE technique should be selected from those in the literature? Should the user's capability to grasp the method determine the selection or can might theoretical considerations be more important?

Two other issues may be worth exploring:

1. uncertainty (or confidence) associated with individual preferences, i.e., subjects expressing preferences may not feel comfortable expressing precise trade-offs; there may be a range of values over which they would be indifferent;
2. fuzziness of original and generated datasets.

Whether or not these two topics will be considered in this research and, if so, to what extent, are questions to be answered.

Current work has been directed to the development of a comprehensive set of criteria to be used when considering the problem of wind farm siting. A number of technical guidelines for siting wind farms exist (BWEA, 1994; Sparkes and Kidner, 1996; Baban and Parry, 2000; amongst others) and so does a significant range of specific studies addressing individual issues related to wind farm impacts (Hill, 2001 for public opinion; Kidner *et al.*, 2000 and Miller *et al.*, 1999 for visibility analysis and visualization of the cumulative environmental impact; Percival *et al.*, 1999 for effects on birds, etc.) However, this literature have not yet been synthesised in a truly democratic decision-making environment. In addition to inventorying meaningful decision criteria and collating data from a variety of sources, decisions have to be made concerning dataset manipulations that generate significant spatial representations of these criteria.

Data manipulation often implies that data are reclassified into categories, each one having a different value (or performing differently) with respect to the evaluation criterion. This raises two pertinent questions about class definition and class valuation. Ideally, every individual should be afforded the possibility of defining his/her own classes and evaluating them, as those tasks reflect personal values and ways of thinking. For some users, however, these tasks would represent an overload, both of time required and mental involvement, because they demand experimenting with different alternatives and an input validation procedure. Hence, the way forward seems to be the presentation of pre-defined classes and pre-defined valuations for these classes to users. Such resolution bestows consistency when individual inputs are aggregated. However, this might be seen as a simplistic and highly constraining solution. Some users might be motivated to complete such tasks or, at least, to define classes and evaluate them against criteria from his/her domain of expertise. Considering that such information could contribute to a further refinement of the system, it may be interesting to elicit such information on a voluntary basis. Is it legitimate to assume that submitted inputs from such tasks are reliable and can be used without validation? In other words, because such tasks are performed voluntarily, can it be assumed that users have invested enough time and effort that submitted inputs can be treated as accurate and reliable? If not, how can this information be validated in a simple and effective way? Furthermore, is there a structure for such information that enables us to integrate it into the ongoing appraisal (current system) without undermining the consistency of the individual data aggregation?

A final design for this tier depends on answers to all these questions and will only be possible after comprehensive responses are developed.

8.3 The third tier

The system's third tier has a twofold objective. First provide feedback and, second, allow the public to review and comment on other people's ideas about wind farm impacts and wind farm siting proposals. Al-Kodmany's (1999) Pilsen application (cf. section 7.3, paragraph 4) gives a valuable example of feeding participants with the results of public participation. However, the feedback is not immediate. This system's third tier should offer immediate feedback, consisting of a "composite map" of all participants' inputs (Kingston, 2002; Al-Kodmany, 1999) and a "controversial map" showing the variability of classifications attributed to each feasible site (Kardos *et al.*, 2003). Both maps will continuously evolve by assembling submitted weighting inputs (refer to section 8.1 paragraph 3).

The system will enable users to attach comments to composite map features explaining and supporting their decision as well as review and comment on other people's arguments. In contrast with the previous approach, which aims to identify suitable/optimal locations based on aggregations of multiple criteria (SDSS), this complementary approaches focus on the participatory process for identifying the problem(s) itself(themselves), rather than how to solve it. It creates a valuable environment for people to integrate local knowledge in the decision-making process by means of qualitative reasoning using natural language.

Today, most web-based discussions forums are text-based (i.e., discourses are not spatially referenced). Moreover, "a high tendency to incoherence, drift and dissolution can be observed" (Voss, 2002). Addressing this latter point, several authors assert that the use of suitable frameworks, which are able to capture, structure and present argumentation from interaction between collaborative individuals, greatly contribute to 1) widening participation in the decision-making process (by making reasoning public); 2) trigger critical thought; and, consequently, 3) create a useful public resource for future decision making. Such frameworks are called argumentative frameworks. Several instances of such frameworks exist: gIBIS (Begeman and Conklin, 1988), SIBYL (Lee, 1990), ZENO (Voss, 2002), HERMES (Karacapilidis and Papadias, 2001), etc.

Pilot applications in urban planning and design of such frameworks, generically identified as argumentative systems, have also been reported in the literature: GeoMed (Karacapilidis *et al.*, 1997), CrossDoc (Tweed, 1997), KogiPlan (Voss *et al.*, 2002) amongst others. As Tweed (1998) expressed, due to an increasing demand for transparency, openness and accountability in decision making processes, these systems appear to have something to offer in assisting public participation in this domain. In addition, by allowing access to decision histories, these systems may play a fundamental role in avoiding previous planning deficiencies.

Another interesting pilot application in urban design is described in Horita (2000). The argumentative dimension in the computer-assisted communication tool, CRANES, proposed by Horita is structured through a simple tree mechanism, i.e., arguments (associated to strategic objects) are listed in threads, but arguments made as responses to existing ones are listed below their parent arguments with an indentation. In addition, a "folded" image of arguments is offered, based on an extended version of Analysis of Options developed by the author.

In order fully to develop the proposed third tier, a detailed analysis of these earlier systems is required, evaluating their strengths and drawbacks in approaching the wind farm siting problem. It is extremely important to consider the final system's simplicity as argumentation schemes have proved difficult for non-specialists to understand. Finally we must consider how multimedia technologies can be used and explored to create a more engaging participatory environment and to provide non-local users with a picture of the area in appraisal. Attractive results from associating the World Wide Web to multimedia are depicted in Shiffer (1995) and Ak-Kodmany (1999).

8.4 The fourth tier

The fourth and last tier of the system basically aims to receive users' feedback on both the issues presented and the system itself and to thank the user for their participation.

8.5 System workflow

The basic system workflow is depicted in Fig. 2. However, the system will enable users to skip the second tier if they have already accessed it. This avoids the introduction of "whatever" input in the second tier from already registered users interested in gaining a quick entrance to subsequent modules and facilitates access to the third module for those interested in following the problem's evolution and learning more it.

A technical aspect to explore is the possibility of enabling pre-registered users to change their initial contribution (criteria weights) in the second tier, either because their preferences may have changed as a result of the continuous learning process or because the user had suddenly to abandon this stage. Password-dependent systems certainly make this possible.

9 CONCLUDING NOTES

This paper describes the structure of a web-based, public participatory spatial decision support system to foster public participation in local and supra-local policies. It aims to draw out public preferences on the problem of wind farm siting. Although addressing that specific problem, the participatory tool described is intended to be generic and easily adaptable to any problem. In whatever context the system is applied, there will always be the unavoidable work of data collection, data collation, structuring of the spatial database, and derivation of the evaluation criteria.

Presently, the system is under construction. Current work focuses on the technical aspects of the system's implementation: selection of the Internet technology to apply (client-server architecture); choice of software for project development, concretely whether or not to opt for open source technologies such as GeoTools instead of commercial map servers; choice of database technology; and defining the second tier's layout (i.e., the SDSS) and implicit MCE technique to implement. Forthcoming work will concentrate on finding comprehensive answers to the formalised questions, in particular those datasets to be assembled to create a meaningful framework for site assessment.

In short, a lot of work still needs to be done to accomplish this challenging proposal. However, the motivation is strong as we expect that, after completion, this system will contribute to three main domains. In the first instance, the collaborative planning stream concerned with participatory decision-making in spatial problems. In the literature, only a few collaborative spatial decision support systems give non-expert users the opportunity to explore and crystallize their preferences before stating their final judgement. Secondly, a contribution will be made to the field of wind farm planning, where the literature contains no reference to collaborative spatial decision support systems involving public participation. Finally, the web-based public participation arena where, in spite of the interesting examples already available, some aspects still represent major challenges and are worth further development: the use of the Internet as a bi-directional channel of communication between the public and policy authorities; and web-mapping technologies as a way to transmit spatial information seamlessly at different scales.

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Standards of Visualizing Historic Urban Sites on the Web

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1 INTRODUCTION

Historic Urban Sites (H.U.S.) are important components of the human inheritance. They are the eternal records, which keep the history of the nations, and they are the clear evidence upon the progress of the whole human civilizations over the time. Harmonized, integrated, and beneficial information regarding worldwide H.U.S. should be supplied to the people on a worldwide base, to maximize people's knowledge about these H.U.S… This is essential for these worldwide H.U.S. to be protected against dangers, and to be conserved over as long period of time as possible.

World Wide Web is a vital and effective component of the media and information technologies. Vitality and effectiveness of the web come at first from the highly advanced techniques, which are used in supplying information regarding wide range of different subjects. These techniques play influential role in attracting increasing number of people from all over the world to depend on the web to get the information regarding the subjects, which they are looking for.

Thus, the World Wide Web is supposed to be employed to supply to people the harmonized, integrated, and beneficial information regarding worldwide H.U.S., which is essential to maximize people's knowledge about them. Visualizing these H.U.S. on the web is one of the processes of supplying information to people, by using different types of visual materials of different techniques, i.e. still images, QuickTime panoramas, videos, computer graphics, etc. It is hypothesized that different types of visual materials of different techniques would be used in visualizing H.U.S. on the different web pages.

Typical standards should be applied in the process of visualizing H.U.S. to harmonize and integrate the information, which would be supplied to the people, and to maximize people's benefits from such information. Applying typical standards in the visualizing process would generate common and distinct features of the visual materials used for visualizing these H.U.S.

These common and distinct features could be clearly noticed in, for instance: types of the visual materials, combinations between different types of materials, number of the materials in one web page, file size of the materials, dimensions and resolutions of the materials, correlations between the materials, the visualized elements of the H.U.S.,...etc.

This study aims to distinguish any typical applied standards in the process of visualizing H.U.S. on the different web pages. To fulfill this aim, the visual materials and their features were surveyed. Thus, we searched the web, downloaded all the contents of the web pages, explored the visual materials and their common features, and then derived the results.

The results of the study indicated that the only type of visual materials used for visualizing H.U.S. on the web is still images of these sites. Moreover, we could find some indistinct features of limited commonness between the visual materials on the different web pages. These features could not lead us to distinguish any typical applied standards in the process of visualizing H.U.S. In addition, these features indicate, in some cases, definite deficiencies in the information supplied using those visual materials. Finally, it is concluded that there are no typical standards could be distinguished to be applied in the process of visualizing H.U.S. on the web.

2 PROCEDURES

2.1 Web pages:

We searched the web to find the web pages, which supply any kind of information regarding H.U.S., whatever the categories or the subjects of these web pages. To find these web pages, we searched the web using "GO express search engine" as a Meta search engine within which it contains multi search engines. It was found to be reliable and giving wide range of results for every search.

Different keywords were used in the search to get the best and the widest range of results. We used 40 different pairs of keywords, which were resulted from combining words from two different groups of words. The first group includes some alternative meanings of the word "historic", i.e. ancient, heritage, old, and past. The second group includes some alternative meanings of the word "site", i.e. architecture, area, building, city, district, place, site, and urban. The resultant pairs of keywords are "historic site", "historic architecture", "ancient site"…etc, which would be used for the search.

A list was prepared, including the URLs of the web pages, which resulted from the search and would be included in the study. Before including the URL of any resulted web page to the list, this web page was primarily checked, to be sure that it supplies information regarding H.U.S… At the end of the primary check of all the resulted web pages, the total number of web pages' URLs included in the list is 388 different URLs of different web pages.

2.2 Downloading the contents of the web pages

After searching the web, and saving the resultant URLs in the list, which is mentioned above, all the contents included within each web page should be downloaded as separate files. This is essential to explore the types of all the contents included in every web page, and to explore their features, as well.

Different software were found to be used to download the contents of web pages. We tried five of these software and the “Offline Explorer” was found to be the best of them, concerning reliability of downloading the entire contents of the web pages, speed of downloading, and ease of use.

On Tuesday, September 25th, 2001, all the 388 URLs were put in a “list enquires”, to be downloaded using this software. The depth of downloading was set to zero, which means, “Download all the files within only the given URL”. While downloading files from web pages, “Offline Explorer” creates a folder for each web page in which, files were downloaded. Every folder was identified by a folder name typical to the web page URL. This arrangement makes it easy to explore the files, which were downloaded from each web page separately.

2.3 Filling the data sheet

After downloading all the contents of all the 388 web pages, folders containing all these contents (files) should be explored. Types of all the files included in every web page, and their features are to be recorded in a data sheet, which was prepared as mentioned in Table-1.

Web Pages	Number	1		
	Subject	Academic		
	Link Yes/No	Yes		
Files Used in the Web Pages	Type	Html	Gif	Gif
	Sum	1	2	5
	Total Size	15	20	100
Visual Materials of H.U.S.	Yes/No	-	Yes	No
	Usage	-	Banners	-
	Content	-	Site	-
Correlated Visual Materials	Yes/No	-	No	-
	Correlation Type	-	-	-

Table-1 The typical data sheet

2.3.1 Explanations of the items of the data sheet

Web Pages:

- Number: is the serial number according to the list of the URLs resulted from the search.
- Subject: is the main subject or category of the web page.
- Link Yes/No: is the information about if a web page has, in its main body, links to other pages (Yes) or not (No).

Files Used in the Web Pages:

- Type: is the format of the files.
- Sum: is the total number of the files of the same type.
- Total Size: is the total size of the files of the same type.

Visual Materials of H.U.S.:

- Yes/No: is to inform whether the file is used for visualizing H.U.S. as visual material (Yes) or not (No).
- Usage: is the purpose of using the visual materials within the web pages.
- Content: is the information about the elements of the H.U.S., which were visualized in the visual materials.

Correlated Visual Materials:

- Yes/No: is the information about if the material was correlated with other materials (Yes) or not (No).
- Correlation Type: is the type of correlation connecting the elements of the H.U.S., which were visualized in the correlated visual materials.

2.3.2 Categorizing the items of the data sheet

Some items, which would be filled in the data sheet (Table-1.), were categorized as follows:

- Web Pages, Subject: was categorized into “Academic”, “Commerce”, “Conservation”, “Information”, and “Tourism”.
- Visual Materials of H.U.S., Usage: was categorized to “Backgrounds”, “Banners”, “Headings”, “Links”, “Logos”, and “Page Body”.
- Correlation Type: was categorized to “Angle”, “Detail”, and “Projection”.

2.3.3 Exploring the downloaded contents (files) and recording the Data

All the folders, which were created by the "Offline Explorer" software, containing all the files, which were downloaded from the listed web pages, should be explored. Types and features of all the downloaded files are to be recorded in the data sheet according to the categorizations mentioned above.

For every folder, we checked the downloaded files starting with the "html" ones, to check if the whole contents of the web page had been successfully downloaded or not. If any content was failed to be downloaded, a red "X" sign would appear instead of such content on the downloaded web page.

While checking, if this sign was found on any downloaded web page, the URL of such web page would be included in a list, to be downloaded again using the "Offline Explorer" software, until all the contents of all the downloaded web pages were successfully downloaded. To assure the success of downloading, such web pages were compared with the online web pages, to confirm that they are typical, and all their contents were successfully downloaded.

2.3.4 Repeating procedures for the web pages, which contain links to other pages

After completing exploring the folders, checking the downloaded files, and recording the data, 193 web pages were found containing links to other web pages. These web pages' URLs were listed again to download all the files used in all the linked web pages, using the "Offline Explorer" software. This time, the depth of downloading is set to one, which means, "Download all the files within the given URL and within all the linked web pages".

3 RESULTS

3.1 File types of all the visual contents

After exploring the folders, checking the downloaded files, and recording the data of all the original 388 web pages and the 193 linked web pages, as well as the data of all their contents, the following was noticed:

- Limited varieties of files were found in both the original web pages and the linked web pages.
- Types of files, which were used as visual contents, were found to be "Gif" and "Jpeg" files and some very few "Pdf" and "Bmp" files.

At the beginning of the study, we hypothesized that wide ranges of different types of visual materials of different techniques would be used in visualizing H.U.S. on the different web pages. However, the results indicate that the only types used for visual contents, in general, and specifically for visual materials of H.U.S. as well, are the still images of two file types, "jpeg" and "gif".

This result indicates a shortage in the use of the state of the art in visualizing techniques and materials to visualize the H.U.S. on the web. Moreover, it indicates a shortage in the use of the vitality and the effectiveness of the web in supplying information regarding H.U.S. to the people.

3.2 Web pages, which visualize H.U.S

For the following parts of the study, web pages that contain any visual material, which visualizes H.U.S. will be mentioned as "Visual Web Page", and abbreviated as "V.W.P.".

Web Page Subject	Academic	Commerce	Conservation	Information	Tourism	Total
V.W.P.	25	19	27	72	31	174
All Web Pages	81	31	51	177	48	388

Table-2 Total numbers of V.W.P. and total numbers of all web pages

Table-2 shows a comparison between the total numbers of V.W.P. of the different categories or subjects with the total number of all web pages. It is clearly noticed that the percentages of V.W.P. are low, and the highest percentage is in the case of tourism V.W.P., which is 64.58% of all the tourism web pages. The lowest percentage is in the case of academic V.W.P., which is 30.86% of all the academic web pages.

This result indicates that the tourism web pages tend to supply information of H.U.S. by using visual materials more than the other web pages do. Moreover, the academic web pages tend to supply information of H.U.S. by using visual materials less than the other web pages do.

3.3 Visual materials, which visualize H.U.S

All the Gif files and the Jpeg files, which are used as visual materials for visualizing H.U.S., will be mentioned as "Gif Visual Materials" and "Jpeg Visual Materials", respectively. They were abbreviated as "G.V.M." and "J.V.M" respectively.

3.3.1 Spreading of the visual materials on the V.W.P

Table-3 shows numbers of V.W.P. that only used G.V.M. to visualize H.U.S., numbers of V.W.P. that only used J.V.M. to visualize H.U.S., and numbers of V.W.P. that used both types together to visualize H.U.S., according to the categories or subjects of these web pages.

Web Page Subject / Visual Materials used	Academic	Commerce	Conservation	Information	Tourism	Total
G.V.M only	6	3	3	15	11	38
J.V.M only	17	13	23	52	18	123
G.V.M. + J.V.M.	2	3	1	5	2	13

Table-3 Numbers of V.W.P. according to type of visual materials used in them

It is clear from table-3 that the J.V.M. are more widespread on the V.W.P. than the G.V.M. are, this is true for all the V.W.P. of the different categories or subjects. The highest ratio between the spreading of J.V.M. and that of G.V.M. is 7.67:1, in conservation V.W.P., while the lowest ratio between them is about 1.63:1, in tourism V.W.P.

This result indicates that the conservation V.W.P. tend to use J.V.M. to visualize H.U.S. more than the other V.W.P. do. Moreover, the tourism V.W.P. tend to use G.V.M. to visualize H.U.S. more than the other V.W.P. do.

It is noticed that the percentages of V.W.P. that used both G.V.M. and J.V.M. are low; the highest percentage is in the case of commerce V.W.P., which is 15.79% of the total number of commerce V.W.P... The lowest percentage is in the case of conservation V.W.P., which is 3.7% of the total number of conservation V.W.P.

This means that the majority of the V.W.P. tend to use only one type of the visual materials, to visualize H.U.S.

3.3.2 Densities of visual materials

Web Page Subject / File Type	Academic	Commerce	Conservation	Information	Tourism	Total
G.V.M	71	7	30	30	30	168
All Gif Files	142	55	156	400	175	928
J.V.M	47	36	115	210	55	463
All Jpeg Files	85	89	218	398	140	930

Table-4 Total numbers of visual materials, all Gif files, and all Jpeg files

From Tables-3, and Table-4, academic and conservation V.W.P. have the highest densities of G.V.M.; they are about 8.9 and 7.5 materials/ V.W.P. respectively. For these V.W.P., densities in the case of J.V.M. are about 2.5 and 4.8 materials/ V.W.P., respectively. From the same tables, conservation and information V.W.P. have the highest densities of J.V.M.; they are about 4.8 and 3.7 materials/ V.W.P. respectively. For these V.W.P., densities in the case of G.V.M. are 7.5 and 1.5 materials/ V.W.P. respectively.

From these densities, it is concluded that conservation web pages densely use both the G.V.M. and J.V.M, while academic web pages densely use the G.V.M. only.

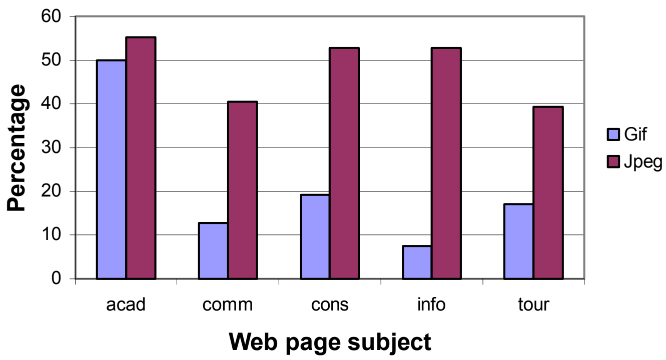

Figure-1 Percentages of numbers of G.V.M. and J.V.M. to all Gif files and all Jpeg files

Figure-1 shows the percentages of the numbers of G.V.M. and J.V.M. used in the downloaded V.W.P., to all the Gif and Jpeg files used in them, respectively. It is clearly noticed that there are big differences in percentage between the two cases in all the V.W.P. of the different categories or subjects, except the academic V.W.P… Figure-1 indicates that the total number of the Gif files contains small portion of G.V.M., while the total number of Jpeg files contains a big portion of J.V.M.

The reason is that the Gif files are densely used in the different V.W.P. as backgrounds, banners, headings, links, and logos, to visualize things other than H.U.S., while the Jpeg files are not densely used for all such usages.

Therefore, it is obvious that academic V.W.P. contain fewer backgrounds, banners, headings, links, or logos, which visualize things other than H.U.S...

3.3.3 Average sizes of visual materials

From Table-4, and Table-5, the total average G.V.M. size is about 33.5 kb/material, is bigger than that of other materials or file types. The biggest average G.V.M. sizes are 46.0 and 43.6 kb/material, in the case of the academic and the conservation V.W.P., respectively. The respective average sizes of the Gif files are 25.3 and 11.26 kb/file.

For the J.V.M., the biggest average sizes are 22.5 and 20.6 kb/material, in the case of the academic and the commerce V.W.P. respectively. The respective average sizes of the Jpeg files are about 20.6 and 15.8 kb/ file.

Web Page Subject / File Type	Academic	Commerce	Conservation	Information	Tourism	Total
G.V.M	3263	99	1308	501	456	5627
All Gif Files	3593	638	1756	2555	1281	9823
J.V.M	1058	742	1734	3549	1116	8199
All Jpeg Files	1753	1407	2729	5739	1825	13453

Table-5 Total file sizes of the visual materials, all Gif file, and all Jpeg files

From the mentioned averages, it could be concluded that some V.W.P. use much more bigger sizes of G.V.M. than other V.W.P. do, because they may use wider dimensions and resolution ranges of the images, or they misuse the G.V.M. by visualizing full color or gray scale images. We checked these V.W.P. again to find out the reason. Few V.W.P. were found to use wider dimensions and resolution ranges of the images, others were found to misuse the G.V.M… That is why the average G.V.M. sizes differ much from all the other averages.

For the case of J.V.M., it is clear to conclude that all the V.W.P. use similar dimensions and resolution ranges of J.V.M. that is why all the average J.V.M. sizes are similar to each other.

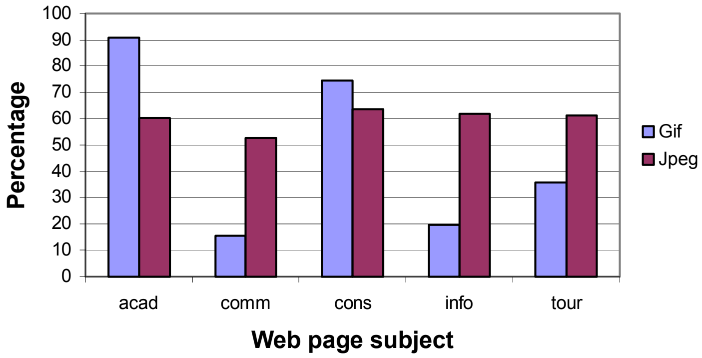

Figure-2 Percentages of total file sizes of G.V.M. and J.V.M. to total file sizes of all Gif files and all Jpeg files

This conclusion could also be declared from Figure-2. The big differences of percentages in the case of G.V.M. prove the big differences in G.V.M. sizes used in the different V.W.P. On the other hand, similarity of the percentages in the case of J.V.M. proves that the different V.W.P. use J.V.M. of similar sizes to each other.

3.3.4 Usages of visual materials

3.3.4.1 Usages, which do not include those of the "Page Body"

This part is about the usages of G.V.M. and J.V.M… Usages will be mentioned in this part do not include the usages of the "Page Body", which express the usage of the visual materials as main contents of the V.W.P. body.

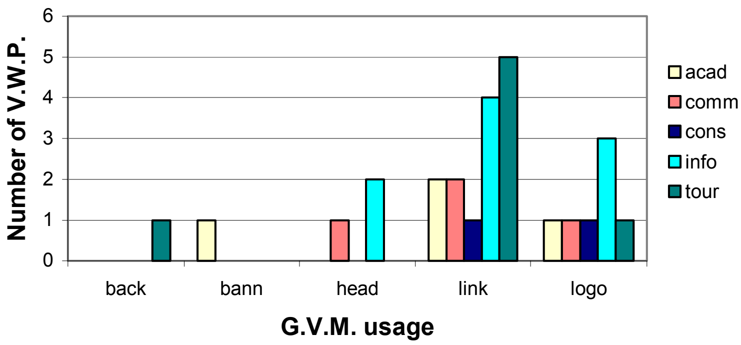

Figure-3 Number of V.W.P. according to G.V.M. usage

From Figure-3, and Table-3, it is clear that G.V.M. were not used regularly on V.W.P. to visualize H.U.S. as backgrounds, banners, headings, links, or logos. The highest percentages of V.W.P. found to use G.V.M. for these usages are 38.46% and 33.33% in the tourism and commerce V.W.P. respectively. These G.V.M. were used as links in both cases.

From Figure-4, and Table-3, the same result can be derived regarding J.V.M... The highest percentages of V.W.P. found to use J.V.M. for these usages are 25% and 24.56% in the commerce and information V.W.P. respectively. These J.V.M. were used as links.

From the two figures, both G.V.M. and J.V.M. are not used regularly for these usages. Moreover, V.W.P. tend to use G.V.M. more than to use J.V.M. to visualize historic urban sites for these usages, especially as links.

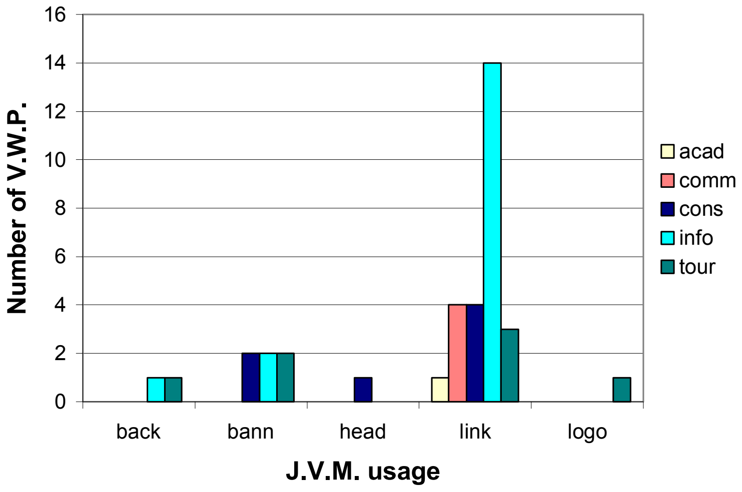

Figure-4 Number of V.W.P. according to J.V.M. usage

3.3.4.2 Usages of the "Page Body"

This part is about the usage of G.V.M. and J.V.M. as visual materials in the main body of the V.W.P... Figure-5 shows numbers of V.W.P. of all categories or subjects, which use G.V.M. and J.V.M. in their page body. From Figure-5, all V.W.P. tend to use J.V.M. more than to use G.V.M. to visualize H.U.S. in their page body. This result harmonizes with a previous result, which indicates that J.V.M. are more widespread than G.V.M. are.

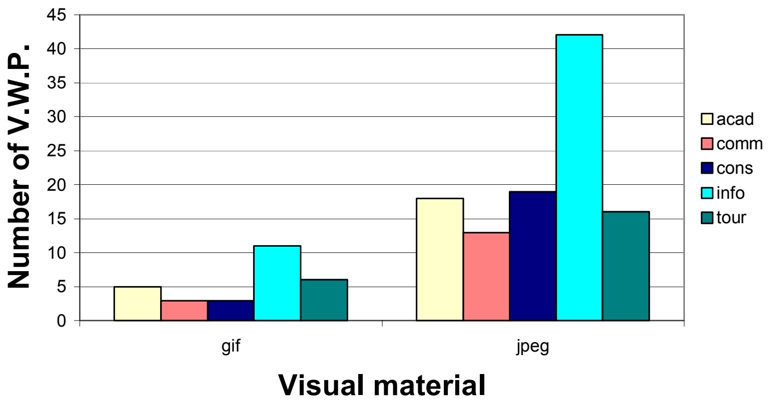

Figure-5 Number of V.W.P. according to the usage of visual materials in the "Page Body"

Table-6 shows the densities of G.V.M. and J.V.M. (material/ V.W.P.), and the ratios between these densities, which are used in the page body of the V.W.P. according to the categories or the subjects of these V.W.P.

Web Page Subject / File Type	Academic	Commerce	Conservation	Information	Tourism
G.V.M.	13	1	9.3	1.7	3.3
J.V.M.	2.5	1.8	5	2.2	2.75
G.V.M./ J.V.M.	5.20	0.56	1.86	0.77	1.20

Table-6 Densities of visual materials per one V.W.P. and the ratios between these densities

From Table-6, there are big differences between the densities of both the G.V.M and the J.V.M in all the different categories or subjects. Moreover, there are big differences in the ratios between these densities. To find out the reason, the main data sheet was checked again; some V.W.P. were found to use much bigger numbers of visual materials in their page body than other V.W.P. do, this fact is true for both G.V.M. and J.V.M.

Web Page Subject / File Type	Academic	Commerce	Conservation	Information	Tourism
G.V.M.	49.1	19.3	46	19.3	17.4
J.V.M.	22.8	25.7	15.3	29.9	20.9
G.V.M./ J.V.M.	2.15	0.75	3.01	0.65	0.83

Table-7 Average sizes of the visual materials (kb/ material) and the ratios between these sizes

Table-7 shows the average size of G.V.M. and J.V.M. used in the page body of the different categories or subject of V.W.P… From Table-7, there are big differences between average sizes of G.V.M. and J.V.M. and between those of G.V.M. themselves and of

J.V.M. themselves. Average sizes of G.V.M. could be classified into two groups; first group includes average sizes for both academic and conservation pages (49.1, 46.0 kb/material). Second group includes the remaining ones (17.4, 19.3, 19.3 kb/material). A gap in values was found between the two groups, and this gap and these differences were noticed to be because of the misuse of G.V.M. in some V.W.P. to visualize color or gray scale images.

The average sizes of J.V.M. could be classified into three groups, first group (15.3 kb/material), second group (29.9 kb/material), and third group (20.9, 22.8, 25.7 kb/material). Although the slight gaps between these groups, they seem to be harmonious. The reason behind these differences is the slight differences of the dimensions and resolutions used in every image.

3.3.5 Contents of visual materials

There are different elements of H.U.S. could be visualized in the visual materials. Figure-6 and Figure-7 show numbers of V.W.P. that use G.V.M. and J.V.M. respectively, which visualize the different elements of the H.U.S.

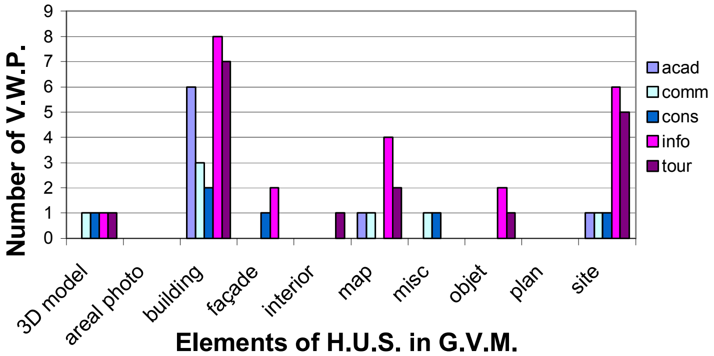

Figure-6 Number of V.W.P according to the contents of H.U.S. in G.V.M.

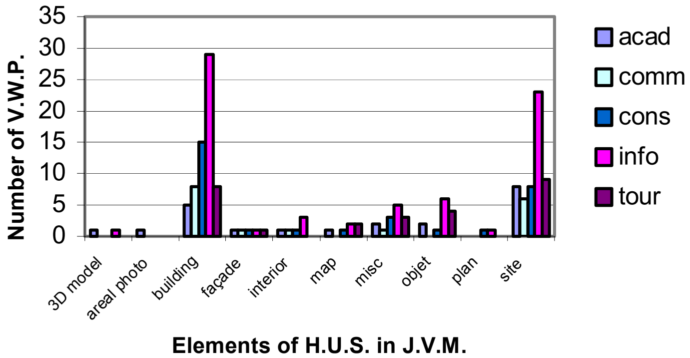

Figure-7 Number of V.W.P according to the contents of H.U.S. in J.V.M.

From Figure-6 and Figure-7, the most visualized elements using both G.V.M. and J.V.M. are “building” (Single building) and “site” (urban site). These elements mostly visualized in the information and tourism V.W.P... Other elements were found to be seldom visualized on V.W.P. using the both types, G.V.M. and J.V.M... Buildings and sites were visualized as G.V.M. on few web pages; instead, J.V.M. is used to visualize them on the majority of V.W.P.

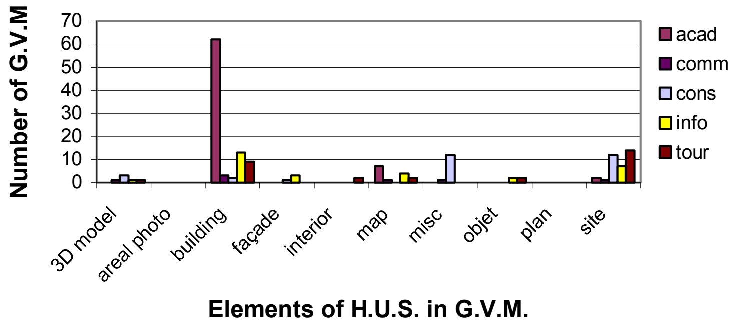

Figure-8 Number of G.V.M. according to the contents of H.U.S. in G.V.M.

Figure-8 and Figure-9 show the numbers of G.V.M. and J.V.M. respectively, which were used to visualize the different elements of H.U.S. on V.W.P. of the different categories or subjects. From Figure-8, it was found that academic V.W.P. tend to use G.V.M. to visualize “building” more than other elements, and more than other V.W.P. do.

From Figure-9, it was found that conservation and information V.W.P. tend to use J.V.M. to visualize “building” and “site” more than other elements, and more than other V.W.P. do.

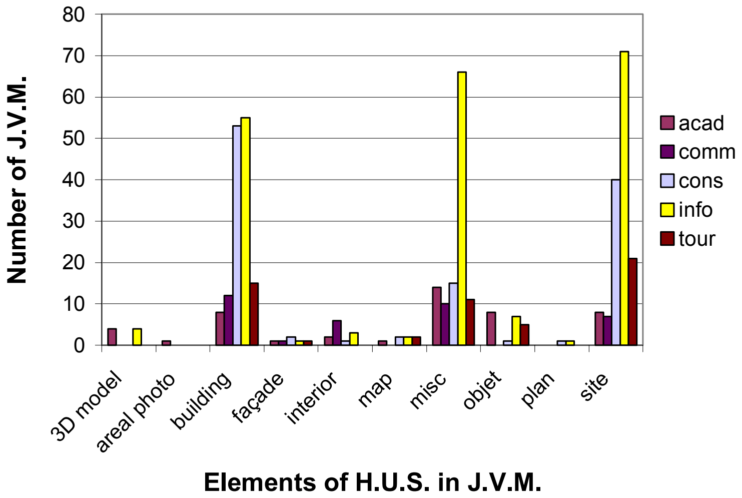

Figure-9 Number of J.V.M. according to the contents of H.U.S. in J.V.M.

3.3.6 Correlation between visual materials

The following part concerns with the correlated visual materials on the same V.W.P., as well as the types of correlations connecting the visualized elements of the H.U.S., which were visualized in these correlated visual materials. Visualizing any element of H.U.S. using more than one visual material increases the ability of the people to understand and to get more information about these elements, through understanding these visual materials and the correlations between them. All the visual materials on every V.W.P. were compared with each other to find out the correlated ones, and the types of correlations between the visualized elements. Table-8 summarizes the results.

Web Page Subject			Academic	Commerce	Conservation	Information	Tourism
Visual	Correlation	Total Numbers of:					
G.V.M.	angle	V.W.P	1	1	0	1	1
		Visual Material	2	2	0	2	2
	detail	V.W.P	1	0	0	0	0
		Visual Material	7	0	0	0	0
	projection	V.W.P	0	0	0	0	0
		Visual Material	0	0	0	0	0
J.V.M.	angle	V.W.P	1	2	2	5	2
		Visual Material	5	9	16	15	4
	detail	V.W.P	0	0	0	0	0
		Visual Material	0	0	0	0	0
	projection	V.W.P	0	0	1	0	0
		Visual Material	0	0	4	0	0

Table-8 Numbers of V.W.P. and visual materials according to type of correlation between elements

From Table-8, V.W.P., which tend to use J.V.M. in correlations, are more than those, which tend to use G.V.M. in correlations. These V.W.P. use larger number of J.V.M. in one correlation than the number of G.V.M. in one correlation, which the other V.W.P. use. Moreover, the most used correlation to connect the visualized elements of H.U.S. was the "angle" correlation. It means that the correlated visual materials visualize the same element of the H.U.S. from different angles. In addition, it is obvious that all the visual materials in correlation, which were used in the conservation V.W.P. are J.V.M., no G.V.M. found in correlation in those V.W.P.

4 CONCLUSIONS

At the beginning, it was hypothesized that different types of visual materials of different techniques would be used in visualizing Historic Urban Sites (H.U.S.) on the different web pages on the World Wide Web. Nevertheless, the results declared that the only technique was found to be used for that is the still images of Jpeg and Gif file formats.

Moreover, we hypothesized that there would be typical applied standards in the visualizing process for using the visual materials to visualize the H.U.S. on the web pages of the different categories. Nevertheless, the results declared that we could found some indistinct features of limited commonness between the visual materials on the different web pages. These features could not lead us to distinguish any typical applied standards in the process of visualizing H.U.S. In addition, these features indicate, in some cases, definite deficiencies in the information supplied using those visual materials.

For instance, we could hardly find some weak threads connecting some of the features of the visual materials in some different web pages like in conservation web pages and in academic web pages. However, these features could not lead us to distinguish any typical applied standards.

Moreover, some conclusions could be stated as examples of the indistinct features of limited commonness, as follows:

- All the V.W.P. use similar dimensions and resolution ranges of J.V.M... That is why all the average J.V.M. sizes are similar to each other.
- Both G.V.M. and J.V.M. were not used regularly as backgrounds, banners, headings, links, or logos. Moreover, V.W.P. tend to use G.V.M. more than to use J.V.M. to visualize historic urban sites for these usages, especially as links.
- All V.W.P. tend to use J.V.M. more than to use G.V.M. to visualize H.U.S. in their page body. This result harmonizes with a previous result, which indicates that J.V.M. are more widespread than G.V.M. are.
- Buildings and sites were visualized as G.V.M. on few web pages; instead, J.V.M. is used to visualize them on the majority of V.W.P.
- The V.W.P. use larger number of J.V.M. in one correlation than the number of G.V.M. in one correlation. Moreover, the most used correlation to connect the visualized elements of H.U.S. was the "angle" correlation.

Depending on these results and conclusions, we can state here that the process of visualizing H.U.S. on the web, using visual materials of such indistinct features and limited commonness, has no typical applied standards. Thus, this process of visualizing H.U.S. on the web would have limited efficiencies in supplying sufficient information regarding these H.U.S. to the people.

Moreover, this insufficient information would be of limited benefits to the people in stepping them to the stage of having the sufficient knowledge regarding the worldwide H.U.S., which assure their participation in protecting and conserving them over as long period of time as possible.

5 DISCUSSIONS

The results of this study lead us to suggest establishing a non-profit organization(s) including web professionals and technicians, architecture conservationists, and artists, to: 1) improve the techniques used to visualize the Historic Urban Sites on the web. 2) Study, examine, and publish typical strategies and standard application methods on which any web page of any category wants to visualize any of the H.U.S. should depend and follow. 3) Observe the web to guide and help these web pages' publishers, who have not the sufficient qualities to apply such strategies and methods. 4) Insure sufficient integrities between the web pages visualizing H.U.S., by connecting them together and discussing all the technical matters in a collaborative manner.

6 NOTES

The downloading process, as well as the searching process were repeated on Wednesday, September 25th, 2002 and would be repeated annually to study the changes of the results over the time.

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Evaluation of visual attributes in urban parks using conjoint analysis

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1 ABSTRACT

This paper focuses on the potential of visualization of urban park scenarios to evaluate observers' behaviour. The research applies digital representations of landscape to analyse individuals' visual preferences for existing and prospective landscapes of urban parks. The "vegetal world" of an urban park in the city of Zürich was inventoried, geo-referenced in a database and then rendered in high detailed three-dimensional models. The park site was *disaggregated* into defined visual attributes and attributes levels. From a full factorial design 64 images/profiles were declined and subsequently tested in a survey experiment. The objective of the research is to analyse the contribution of the visual attributes to the characteristics of personal safety, aesthetic and overall preference expressed by the interviewee.

The combined use of visualization methodology and conjoint analysis methods allows to identify whether and how different spatial arrangements, for selected landscape features, affect publics' preference. In fact by the analysis of the human perception and the acceptance of different digital representations it is possible to understand how individuals "experience" the landscape.

2 INTRODUCTION

The work presented in this paper is part of the EU 5th framework project Greenspace. The objective of the project is to advance the planning and the design of urban green space (Greenspace 2003). In this project methodologies are developed in order to identify the types and variety of green spaces that best satisfy people's requirements. Urban parks provide an essential contribution to the citizen's quality of life, they diffuse life long learning and encourage neighbourhood activities helping to reinforce urban communities. The Greenspace project demonstrates that, in several case study cities, citizens' involvement, with the use of interviews and surveys, can convey to a more strategic planning of green space. The project applies economic valuation methods as well as ecological, social and planning approaches. Within the project consortium (University College Dublin, Robert Gordon University Aberdeen, University of Surrey, Universidad Autonoma de Barcelona, Eindhoven University of Technology, University of Hohenheim and the Swiss Federal Institute of Technology) it was established that strategic planning can maximise the contribution that different areas of urban green space make to quality of life. Three-dimensional visualization plays a key role in the Greenspace project, by allowing people to discover existing and hypothetical scenarios of urban green sites. In particular ETH Zürich developed three-dimensional models used for the visualization of defined parks designs. Interest of the research is to establish the relative importance of selected green space attributes in order to identify the green space form that maximise public welfare.

2.1 Case study: the Platzspitz park

The most important green spaces of the city of Zürich are the greenbelts north and south of the city, the green spaces along the lake and the river Limmat, and some parks in the city. This research focuses on the visualization of two parks in Zürich: Platzspitz and Zürichhorn. In this paper the case study of the Platzspitz park is presented. Platzspitz is a relatively small formal park, situated in the dense part of the city. The park is an example of a "frozen" reality fighting against problem of under use and isolation. In the past the Platzspitz park became a haven for drug dealing and other negative activities. Today Platzspitz park is a "museal park", with a high potential to become a more "gentrified" strategic green area.

The research measures and evaluates the observers' response to hypothetical design interventions, such as the reduction of the density of trees and shrubs, obstructing the visibility, and in the same time the increase of the grass cover area. Such interventions are proposed to increase the activities in the park and therefore to improve the sense of personal safety of parks users. It is also expected that open design profiles simplify the orientation in the park and above all reduce potential "hotspots of fear" (Nasar and Jones 1997), actually present in the site.

Image 1: The Platzspitz park in Zürich

2.2 Purpose of the Visualization

The purpose of the visualization is to provide a basis from which to analyse how people interpret and react to the visual experience of hypotetical parks profiles. In fact, with the use of digital visualization methods it is possible to explore the value that people attach to different attributes related to open green spaces. Thus, visualization provides a basis for the assessment of landscape changes and enables to explore the acceptance of different design profiles. The interest of the research is to investigate, with the use of images representing overall changes or dynamics of urban parks, the level to which it is possible to visualize various potential maintenance practices, or design alternatives and scenarios. The computer visualizations of the Platzspitz park are generated combining two main domains: Geographic Information System representations (GIS), and detailed descriptions of solid geometry, realized with CAD (Computer Aided Design) software packages. The use of a GIS application for the park enables to "visualize" and to manage the spatial aspect of the data. In fact through this application it is possible to get an easier access to spatial information and moreover to visualize different developing processes into the study area. It is important to mention that the visualization of alternative designs is used with the aim to afford a more intensive relation between the parks and their potential uses and activities, and not just to simulate different aesthetical or pleasant images. In particular the application for the Platzspitz park investigates different conditions of visual impermeability. In fact, observing the respondents' behaviour for different images, it is possible to analyse and to describe the influence played by the presence or absence of vegetation barriers in the simulated park designs. The research investigates acknowledged fear problems related to urban parks. It is well documented that the presence of dense vegetation in urban parks generates fear problems (Jorgensen 2002), in particular: fear of entrapment (due to the presence of barriers to escape), and fear of concealment, because of the presence of blocked prospects (Nasar and Jones 1997).

It is believed that with the use of landscape visualization approaches, it is possible to achieve a more conscious attitude towards urban parks. In fact the assessment of people's visual preferences for different conditions of landscape quality (Daniel and Meitner 2001) can establish a useful and constructive ground of discussion for management interventions and planning design projects.

3 METHODOLOGY

3.1 The visualization

This part treats the main object of the visualization approach of the park: the vegetation world. It is assumed that the type of vegetation, with its morphology and its characteristics, is the central key for the assessment of visual parks designs. In fact according to the literature "trees are prominent in theories of environmental perception and landscape aesthetics" (Summit and Sommer 1999). Therefore the vegetal world represented for the Platzspitz park is derived from high detailed three-dimensional models. The vegetation depicted in the images is calculated with AMAP^{TM} (Atelier de Modélisation de l'Architecture del Plantes), a software package, including the modul Glance. Glance is a plant growth simulation modelling software that follows the essential botanical rules and parameters, which are shaping the architecture of a plant, at any stage of its development and in any season. The vegetation, computed from the botanical-true models, respects the natural morphology of the plants. The vegetation represented in the images is calculated with regard to the aesthetic, and to the botanic behaviour of the plants over time. The visualization of the parameters of seasonal changes follows, as much as possible, the colours and the texture of leaves and trunks, characterizing the visible core of the park. Some examples are shown in Images 2 – 5.

As the concept of landscape quality embraces several domains it was necessary to define some limits in the visualization task. The visualization approach reflects the complexity of the characters and elements composing the park, with the aim to discover the potential and the talents of the site represented. Thus the visual approach for the park evaluates and symbolizes the Platzspitz as a specific *topos*, and not as a simple set of design options. The visualization estimates and reproduces changes or dynamics that might be happening over time, with the intention to investigate how an urban park can be safe and attractive.

Image 2: Visualization of urban park - spring

Image 3: Visualization of urban park - winter

Image 4: Visualization of urban park - spring - in detail Carpinus B.

Image 5: Visualization of urban park – winter- in detail Carpinus B.

3.2 Design criteria and statistical analysis experiment

In this part of the paper the experimental design approach that combines the visual attributes, is presented. This approach was used to construct the hypotetical parks options and to develop the digital images. The work started defining the design parameters to setup the visual alternatives for the park. The park was, disaggregated into visible and influential attributes, useful to develop controlled hypotetical scenarios. Three main visual influential attributes were identified: seasons, points of view, and vegetation spatial arrangements. Using these attributes it was created a sort of report of the park, or a dynamic visualization through the park. The Platzspitz park is represented in its developments over the time (seasonal changes) and with an imaginative walk through the site, by a sequence of static images rendered from several points of view, positioned along an imaginative route in the park. Furthermore, vegetation spatial arrangements are represented to illustrate typical formal park changes, due to natural or accidental development, such as death or growth of plants, or small formal alterations due to human interventions of maintenance or planning design. For each attribute of interest are determined four attributes levels. From the combination of the three attributes and the variation of their levels, it was created a full factorial design, representing different condition of visual impermeability in the park. The full factorial design involves 43 different profiles (see in Table 1.); this produces 64 context-setting scenarios.
Table 1.

Attributes:	*Levels:*
Seasons	1. Autumn
	2. Winter
	3. Spring
	4. Summer
Viewpoints	1. Entrance in the park
	2. Representative part of the park
	3. Children play area
	4. Path along the Limmat river
Vegetation spatial arrangements	1. “full enclosure”: vegetation in foreground and background
	2. “foreground enclosure”: vegetation in foreground
	3. “background enclosure”: vegetation in background
	4. “no enclosure”: absence of vegetation in foreground and background

All the 64 profiles were visualized with digital images. Examples of the images/profiles are shown in Images 6-13. The 64 images/profiles visualized were then assigned to evaluation sets.
The 64 images/profiles are presented into four types of evaluation sets, where the images/profiles are differently depicted and ordered. This paper aims to present the results from the assessment of the 64 images/profiles, independently from the type of evaluation set. The evaluation sets are composed by 8 questionnaires, containing 8 images/profiles each. Every questionnaire is repeated four times, this means that in the survey experiment each image/profile is depicted and assessed 16 times. The survey was conducted within a sample of 128 respondents. The respondents’ sample is composed of a selection of:

32 Citizen in Zürich   32 Landscape experts   32 Interviewee near to the park site   32 Interviewee in the park site.

It is important to remark that part of the interview was conducted face-to-face, for example interviewing the park visitors, while another part, for example the group of the citizen of Zürich, was mostly contacted via mail. Hence this group was responding to questionnaires sended by post.
The survey investigates the response variables expressed for the characteristics of personal safety, aesthetic and overall preference.
Respondents were suggested to imagine that they visit the depicted park for the first time and were then asked to assess the images/profiles using a rating scale. In order to familiarize the respondents with the digital images and allow them to setup a personal scale measure, they were shown some digital images depicting an unidentified park site. The respondents were also not informed

about the identity of the park study site, in order to avoid any possible previous induction that might influence the evaluation behaviour. The rating used scale goes from 1 to 7, for example in the case of personal safety the responses ranges from "not safe at all" to "very safe". The means of respondents' ratings of the 64 images/profiles for personal safety, aesthetic and overall preference were analysed. All tests were carried out with SPSS version 11 for Mac OS X.

Image 6: Platzspitz park - Seasonal changes: spring

Image 7: Platzspitz park - Seasonal changes: autumn

Image 8: Platzspitz park - Seasonal changes: winter

Image 9: Platzspitz park - Seasonal changes: summer

4 PRELIMINARY RESULTS

The respondents' ratings of the 64 images/profiles showed significant differences and confirmed the hypotesis that the "visual impermeability" influences publics' assessment behaviour. Mostly in the case of personal safety, it emerges clearly that profiles depicting low vegetation enclosure are evaluated as very safe. Differently in presence of dense vegetation barriers, the personal safety perception decreases, in fact the lowest safety scores correspond to the profile depicting an image with "full enclosure" vegetation, see Table 2.

Table 2.

SAFETY		AESTHETIC	
Highest rating	*Lowest rating*	*Highest rating*	*Lowest rating*
"no enclosure" vegetation summer	"full enclosure" vegetation spring	"foreground enclosure" vegetation summer	"full enclosure" vegetation winter

Image 10: Platzspitz park - Spatial arrangements: full enclosure

Image 11: Platzspitz park - Spatial arrangements: foreground enclosure

Image 12: Platzspitz park - Spatial arrangements: background enclosure

Image 13: Platzspitz park - Spatial arrangements: no enclosure

A further analysis step investigates the interactions between the characteristics of personal safety, aesthetic and overall preference, see for example Figure 1. A large part of the respondents did not distinguish very much between the two concepts of aesthetic and overall preference. It is necessary to remark that the characteristic of aesthetic indicates the simple scenic beauty of the context scenario depicted, while the overall preference implies a more personal involvement of the observer, in the evaluation of the context scenario depicted.

The research at the present is confirming that the combined use of visual attributes and statistical analysis experiments can be an effective evaluation tool to understand peoples' assessment behaviour. The intent was to develop controlled design visualization experiments for the specific context of the urban park and to describe how respondents react. Further research steps are addressed to learn from the respondents' reactions and more, to explicate their assessment behaviour. This means that the future stage of this research will be focused to analyse the visual attributes, presented in this paper, in order to investigate their specific utility and to better explain the observed preferences.

Newertheless there are some limitations to the experiment presented. In fact only a small number of attributes was varied in the full factorial design. This generated a sample of images/profiles, where differences were sometimes very low or in any case difficult to perceive. Some caution is also necessary, considering the landscape as an ensemble of visual and cultural characteristics and not as a simple composition of isolated features.

Figure 1: Evaluation of 64 images/profiles – In red values for SAFETY, in jellow values for AESTHETIC

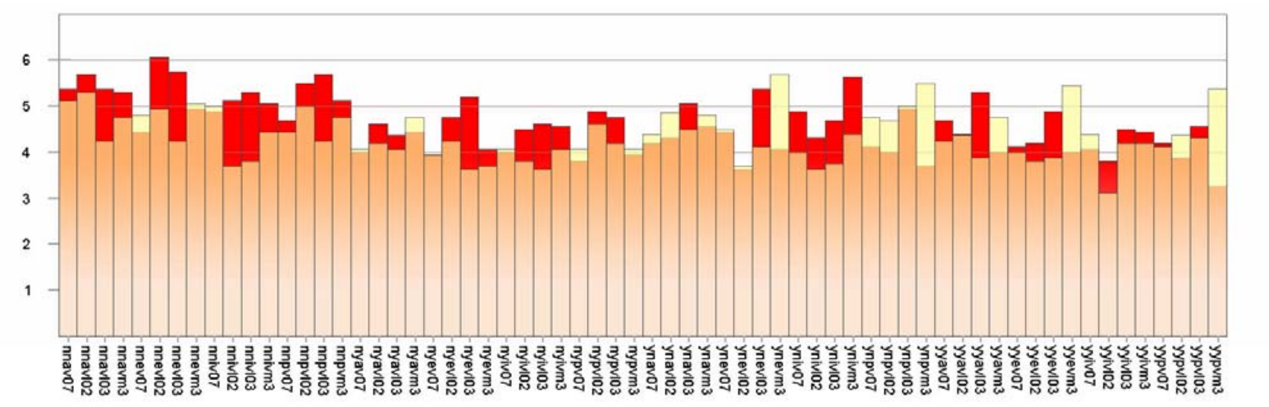
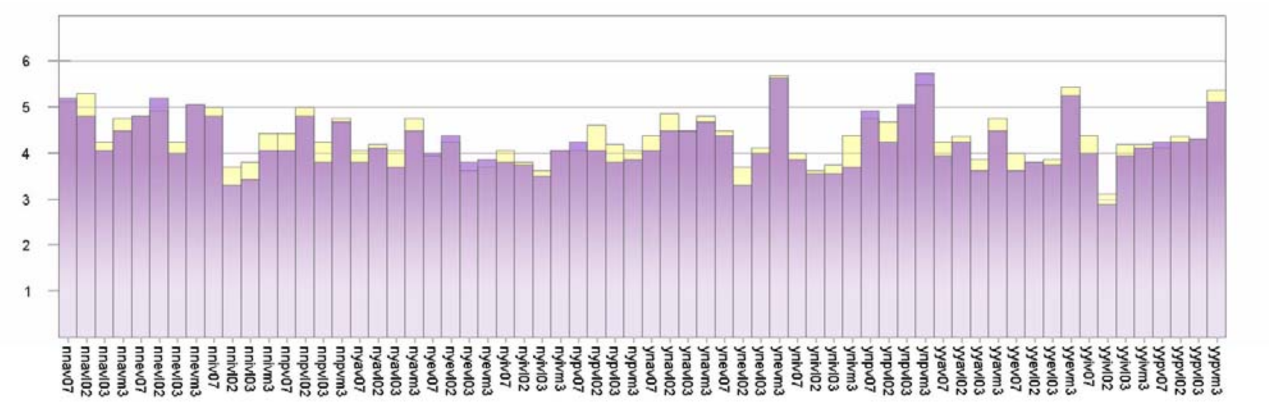


Figure 2: Evaluation of 64 images/profiles – In jellow values for AESTHETIC, in violet values for PREFERENCE



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R.O.S.I. (Real Time Orientation Super Interactive)
The new Dimension of Tourism Information

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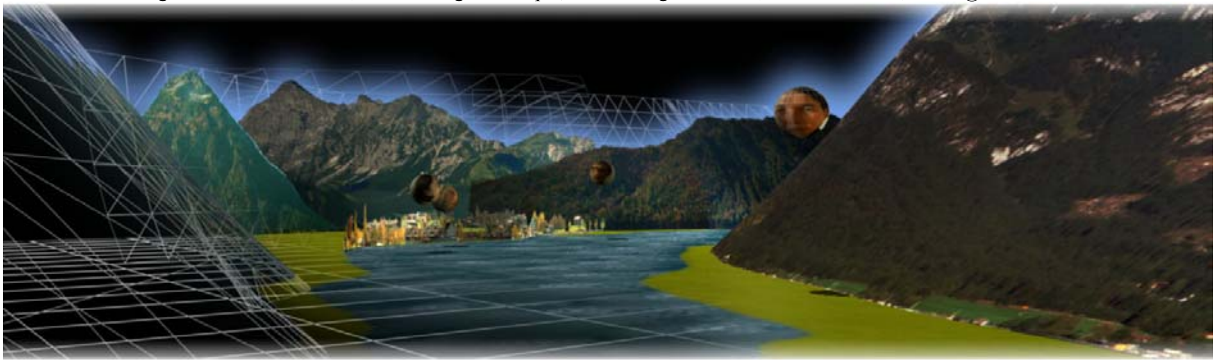


Tab. 1: Virtual Region, 3D Userinterface (Irschitz99)

1 ABSTRACT

R.O.S.I. is a system for orientation, information and communication. It's a broad, interactive and 3dimensional information system for the tourism, where every region which is interested, could be integrated and interconnected. The system is open and flexible and is capable to be adjusted to the topography and the very needs of each region. Also existing databases like room vacancy, ticket sales, etc. could be accessible!

The more area-wide the system gets, the more interesting it will be for the user, because of the increasing volume and density of the information.

A 3dimensional and partly photorealistic Visualisation of the region serves as the user interface of the software. So the topography of the region will be reconstructed as an abstracted wire frame model with photomaps, which contains every prominent and important point of the region.

The underlying information will be available through movie clips, life cams, pictures, graphical-, and spoken information, etc. The navigation of the interface is intuitive and touch less via an infrared light curtain or a infrared camera tracking system. The user points on anything he is interested, and the system provides the available content. The information about activity and attractions is allocated in the virtual space according to its real world position. In this way you achieve a recognition between the virtual and the real and vice versa. This will improve the orientation as well in the real world as in its virtual counterpart. The navigation of the 3d user interface is by hand or finger, so the finger turns into an alternative for the mouse. In this way you can travel to any point in the virtual region, you can either glance from the peak of a mountain, get in the perspective of a boat cruise or fly through a valley; everything is possible. The virtual journeys are a mix of 3d graphics and realistic videos out of a helicopter. By mixing this two techniques, the realism and immersion of the virtual world will be augmented and even closer relations between virtual and real will be established.

R.O.S.I. is not just a death information landscape, but also a communication platform for tourists and locals. ROSI as a patroness and various avatars (virtual characters of the user or the system) will populate the region and will bring life and spirit in the system. Every user, no matter from what info point he is accessing, will get his personal avatar in the cyberspace. Thus he will be enabled to communicate with others and has the ability to exchange experiences or tips of lovely places or just chat.

2 ARCHITECTURE AND DESIGN

2.1 Philosophy

Interactive systems are twofold, the design of the real world and the design of the content and its interface.

Design is the attractor and the catalysator. It should draw the people inside or to the point of interest. If this is accomplished, architecture/design should fulfil needs of comfort ness, functionality and should invite to stay longer. Now the interface and its feedback plays it role! The simplicity, intuitivity, efficiency and speed of response is crucial for the first impression and decides if the user will stay or leave! So a good working interactive system just can be achieved with a good cross design concept what allows a liquid transit between it's Real and the Virtual parts. First I want to address the real world integration. There are two basic ways to install R.O.S.I., static or mobile.

2.2 Static Infotainment Point

The first project has been developed for the Achensee region in Tyrol/Austria.

The goal was to create a marvellous viewpoint over the lake that could be augmented with a virtual information system that is capable to give the user an overview of the region within a couple of minutes. So the guest gets both, the impression over the natural beauty of the region and an quick overview of the leisure facilities and accommodations there, via R.O.S.I. All this happens in a playful and exciting way it's a mixture of film, game and information experience.

The construction of the info point itself is out of steel and glass, freely hovering about 30 meter over the lake. Its freely accessible and self explaining.

To achieve both, as well an open and friendly structure where you have a great view over the landscape, and a closed and obscured space where you have good projection and sound capabilities, the construction has to be adaptable automatically. This is achieved by lamellae, that open and close when the info system is started and a PRIVA-LIGHT projection screen that is either transparent to look through or opaque to project on it. All the hardware and projection equipment is stored in a air conditioned case, so it will be functional at any weather and is secured against vandalism.

Tab. 2, 3: Inside with 3D Infosys., Sideview of the viewpoint (Irschitz99)

2.3 Mobile Road show Container

For PR and advertising purposes like , road shows, fairs, exhibitions, etc. the system can be integrated in a mobile road show container, called the iTube.

It is especially constructed for a quick set up in any location, it just needs electricity. It can be transported either by truck, ship or airplane. There is one iTube for outdoor use, which is a metal construction expandable like a telescope and one iTube for indoor use which is an easy construction kit out of honeycomb sandwich panels. All the necessary hardware and projection equipment is integrated like it is described above in the static info point.

Tab. 4, 5, 6, 7: iTube, transport, setup, inside (Irschitz01)

3 HARDWARE AND TECHNOLOGY

3.1 VR-System for Visualisation

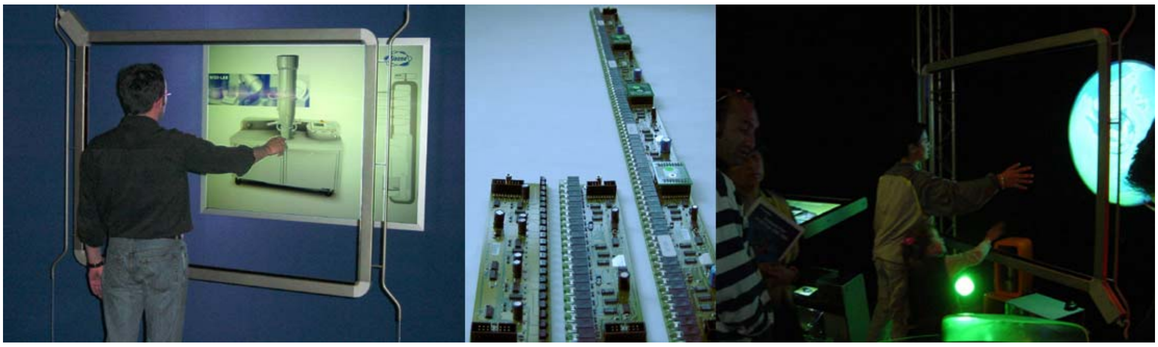
The Configuration of the underlying hardware is very simple. The system is driven by a standard Pentium 4 PC with sufficient RAM (e.g.: 512 MB) and a good Graphic accelerator (e.g.: Geforce 4 or ATI Radeon…). The graphic output will be shown by a projector, either front or back projection, that depends on the situation.

3.2 Natural Input systems

To interact intuitively and touch less with a big screen projection without any appliance in your hand you need special hardware. This kind of interaction is crucial for the ability to give access to the broad public, to be destruction secure and still user friendly. There is nothing more natural than using your hand to point on things of your interest. Like Tom Cruise does in the Spielberg movie "Minority Report" as he conducts the pictures in front of him like a maestro his orchestra.

3.2.1 L.I.P. (LightInPutdevice)

The light curtain LIP is based on a very simple principle. It consist out of a matrix of Light transmitting LED's and receiving photo-diodes in the infrared spectrum that build up a light curtain. By scanning up to 50 times (50Hz) trough this array, the curtain scans the movement of either a finger, hand or whatever you put in the frame. The so generated coordinates of movement serve to drive the mouse cursor, which drives the system.



Tab. 8, 9, 10: iFrame and 3D Userinterface, circuitplates L.I.P., kids playing with the iFrame (Irschitz02)

3.2.2 Camera based user tracking - Computer vision system

This system works with an infrared camera, that sees the hand. By a special algorithm the hand or finger will be detected. Due to pattern recognition the movement of the hand will be followed and so coordinates of movement created. Those coordinates drive again the mouse cursor which drives the system.

[Sparacino, http://www.sensingplaces.com]

Tab. 11, 12, 13: iTube and Feedback from Cam, natural Cam Interface, IR-Cam in iTube (Irschitz, Sparacino 03)

3.3 Peripheral Interfaces

To get information out of, or in the system and to provide something to take away for the user, such interfaces can be implemented. Like printouts of important information, maybe a movie of the flight that will be saved and downloadable on a website.

It could be interesting to connect the system with a room vacancy database or a booking system for tickets.

4 THE INTERFACE AND THE ACCESS TO INFORMATION

4.1 3D User interface

The user interface is the main visual part in the communication between man and machine. It has to be simple, intuitive, efficient and even more important has to give good and necessary feedback. This points are especially important in a public system, because you have non-experienced users with sometimes little to no computer experience. So a 3d user interface makes sense to apply. The metaphor will be a visualisation of the region itself, so the user has a recognition effect between the virtual and the real region. It further helps for better orientation in both worlds as well. To achieve this the virtual region has not to be completely photorealistic. Its enough if the prominent and significant points run into the geometry. Photographic maps of the region, applied on the appropriate geometry will gives the model a sufficient realistic look. Mixed with graphical maps and 3d models that shows and indicate any supplied information, the model gets completed. The Level of Detail will depend on the distance of the viewer, if he flies high or low over the ground.

Tab. 14, 15, 16: Visualisation of a semi photorealistic 3D Userinterface (Irschitz,99)

4.2 Photorealistic Visualisation mixed with real world Video sequences

Flying is the only way to get around in the virtual region. Either you fly high to get an overview, or you fly low to find the details. There are as well predefined viewpoints where you can jump to and predefined flights or cruises where you can embark. This predefined flights and cruises could be real film material, like helicopter flights, train,-boat or car-rides. They connect either the predefined viewpoints or are special events within the model. This predefined viewpoints could be also connected with web cams in the real region. So a patchwork of real and virtual experiences is created that enhance the action and the realism and make sure that the user will get a breathtaking experience. –INFOTAINMENT- would be the appropriate term for that.

4.3 Navigation and Information Access

The movement trough the model does take place via predefined paths, where you can fly back and forth and always have the relative best view. So the user thinks that he navigates freely, but the system helps to a nice journey without getting lost. You also can point on the spots of interest to go there directly. Like mentioned above sometimes you do that by a video of the flight or a realtime movement within the 3d model.

Activities or content of any kind are either represented by video-icons, or 3d-models. Those will be placed in the virtual model according to its real location in the real region. If you choose such an icon, or object the content behind it will be started. This can either be a video, pictures, graphics, animations, sounds, etc.

Tab. 17, 18, 19: Examples for Video-Icons and 3D Models as Buttons (Irschitz,99)

4.3.1 <u>Windows</u>

There are two windows to show either the content or the 3d-model.

- The navigation window, what contains the 3d model of the region
- The Information window, that shows the content behind the chosen icon or object.

Both windows are always open and hover slightly overlapping over each other. You change window by simply pointing at it. The content of the respectively other window gets frozen and will be reactivated if picked again.

Tab. 20, 21: The dynamic info button ,The 2 windows configuration (Irschitz,99)

4.3.2 <u>The dynamic Info button</u>

If a video clip is shown in the content window, there is also shown a little interactive field called the dynamic info button in the lower right corner. Behind this you will find further info to the respectively shown picture or scene.

If touched, the video freezes and the button enlarges to a little screen that reveals the additional information to the actual scene. That means if the video goes on, the information behind the button changes according to the scene shown in the video. If you click in the video again the screen changes back to a button and the video goes on.

5 COMMUNICATION WITHIN THE SYSTEM

5.1 ROSI the systems help and patroness

ROSI is not just the name of the system, its also the name of a virtual character. She is the patroness of the system and guards, protects and helps its users. She will welcome the user with a friendly smile and will familiarize him with the system. She gives the technology the personal touch and makes it more human. She talks to the people with a smooth and comforting voice, she gives you explanations or can be your tourist guide. Her appearance will be always when she is most needed and provide assistance. ROSI has the face of a real person, that is filmed and mapped onto a sphere. So its simple but still efficient, humanoid but not human. So the character will win the sympathies of the user.

5.2 Virtual Characters life in the Virtual environment

Avatars are the digital image of the user, and will populate the virtual environment. The face of the user will be filmed by a camera and mapped in real-time on a sphere, like ROSI. So the virtual personality of any user that operates whatever info stand comes into being. You see your avatar from bird-perspective according to the momentary viewpoint. He follows the movement of the cursor, that means you can navigate him by finger and thus the movement through the virtual environment. If two or more avatars meet now in the system, they get enabled to contact each other and communicate. The system will allow a normal conversation like in the real world. You can ask questions, exchange experiences, get tips about the region or just chat with each other. Thus a new communication platform could arise, not just for tourists, no, for everybody who wants to dive into this parallel universe. You can compare the communication platform with a video conferencing system. The face of the conversational partners will be captured by video, the voice by microphone and on the other side played back by a projector and speakers.

Tab. 22, 23, 24: Virtual Characters and direct communication within the system (Irschitz,99)

5.3 Other inhabitants of the virtual region

In this region there could be a wide variety of different inhabitants (avatars). Each one could fulfil an other service to the user. So, there are different characters who could help the users to find things, to explain or guide, to make contacts, what ever. There are actually no limitations of the fantasy and creativity.

Feasibility

A feasibility study has been made for this 3D infosystem. Actually all necesarry hardware-parts are developed in prototype or even available on the market now. Computing and graphics-power of hardware is at a sufficient level to create such a rich media info system. So the major effort would be the development of the 3D userinterface and its intuitive control. To guaranty a high quality realtime graphic combined with extensive media integration as movies, sounds, graphics, animation, avatars…., a high performance realtime engine is required (i.e. Java 3D, viZrt, virtools)

So the conclusion is: “ The time is ready to build such a system”!

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The Issues of System and Data Interoperability for a European Tourist Information System

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ABSTRACT

The objective of the GEORAMA project is to develop a geo-navigational web portal that serves sportsmen, tourists, and the local population by offering relevant spatial and thematic information in several European tourism regions. The web service aims at promoting the access to public and private information related to countryside and mountain tourism by offering digital maps and additional data on the web and enabling the potential visitors to plan their visits.

To provide the necessary information, various data from selected tourist regions all over Europe had to be acquired, coming in different formats and from different sources. In order to meet specific requirements and conventions regarding legal, economic and technical aspects, the datasets have to be pre-processed before their integration into a map viewing application. The map viewing application presented here is able to deal with geographic data of all kinds and is open and easily extensible.

1 INTRODUCTION

Interoperability is an important issue in European projects dealing with the integration of data into information systems. The term interoperability refers to the ability of software modules to communicate. In a European funded *eContent* project ("GEORAMA") Austria, Belgium, Finland, Greece, Italy, and Portugal are represented by selected tourism regions either in mountainous, countryside, or eco-tourism related areas. In the project a web portal with a map viewing application is developed that integrates digital maps and data in order to enhance local development of mountain and countryside communities by concurrently preserving competitiveness of the tourism industry.

The overall aim of the project is to encourage users to access public and private data and to promote the access and dissemination of data via new technologies according to the latest initiatives towards a European "information society". The service makes a contribution to increase the value added potential of public and private data. The technical aspect of this project demonstrates the interoperability between systems and data from various sources. The methodology of data collection and acquisition in participating project countries, problems encountered as well as requirements on basis data are shown up in section two of the paper.

The legal framework for involved datasets regarding rights of use, copyright regulations and license agreements is dominated by individual solutions varying from nation to nation. These issues are discussed in the third section of the paper. The project aims at finding a solution for a harmonization among project partners leading to a legal standard for provided and re-used data. The same is considered for different pricing models of mainly public data where GEORAMA wants to increase the awareness for the need of standardized pricing policies.

Section four describes how data from heterogeneous sources are published in the Internet with the GEORAMA map viewing application. For this application standardization efforts of the Open GIS Consortium are exploited. The Open GIS Consortium (OGC) is a voluntary association of organizations from government, university, and private industry. The consortium took the initiative for promoting interoperability in the geospatial community by developing specifications of services. The service employed in this project is the web mapping service (WMS), which supports the publication of maps on the Internet and is not bound to specific data formats or software systems.

The result of the efforts taken to establish a map viewer for geographic data from various European countries are presented in section five. The main outcome is a prototype of a web mapping application that is based on the specification of the OGC and therefore permits data interoperability. The closing sixth section of this paper gives a conclusion and an outlook.

2 DATA ACQUISITION

Data acquisition and data collection from the selected tourism regions were focused not only on geographic datasets but also on content or thematic data. In this paper, when talking about web mapping and system interoperability only geographic datasets are targeted, although some aspects (e.g., legal framework) are related to both types of data. In order to avoid confusion about the terms in this specific context, a short explanation is given.

- Geographic data

  Geographic, topographic, or geodata is data which describes phenomena directly or indirectly associated with location. Examples are topographic base maps, aerial images, digital elevation models (DEM) or topological elements like points (e.g., location of infrastructure, buildings, museum, etc.), lines (e.g., hiking routes, streets, rivers, etc.) or polygons (e.g. area of skiing resort, lakes, etc.). Topology of objects or elements means that the relationships of one spatial element are stored with respect to another. The processing, preparation, and visualization of data is performed within a Geoinformation System (GIS). Geographic data are usually stored in a certain data format and coordinate system.

- Content data

  Content data, also known as thematic data, is generally defined as "raw information" like texts, graphics, sound, video, or any other multimedia elements. In case of GEORAMA, content or thematic data is considered as ancillary information about tourist regions or activities originally without any direct spatial relation (opening hours of museum, number of lifts in skiing resorts, descriptive texts about hiking routes, etc.). Although a direct spatial relation is not necessarily required, nearly every content dataset can be geo-referenced by linking the attributes to spatial objects.

In order to store the great amount of various content data in a structured way, a content database management system will be situated centrally on side of the portal.

Since in some cases the assignment of provided datasets to either content or geographic data is not clear, there will always be some sort of "fuzzy tolerance" between both data types. The question arises, if textual descriptions, images, etc. relating to a geometric feature like e.g., a route are directly or non-directly spatially related. Two possibilities are feasible. These elements can be stored as independent objects or as attributes of geo-objects.

2.1 Specified data requirements

The geographic data for the GEORAMA map viewing application has to fulfil certain requirements and conventions, which were specified for the project. These requirements are referred to the value of data that is characterized by information density, the issue of data update and maintenance as well as data formats, cartographic guidelines and multilingualism.

2.1.1 Information density

A valueable geographic dataset for the project's purposes requires more than just topological information: It must offer relevant ancillary attributes in regard of tourist services. The example in Fig. 1 demonstrates route data for the activity "trekking" in the Austrian project region *Hinterstoder* where additional information like difference in altitude, time required, difficulty, season and many other attributes are collected and stored.

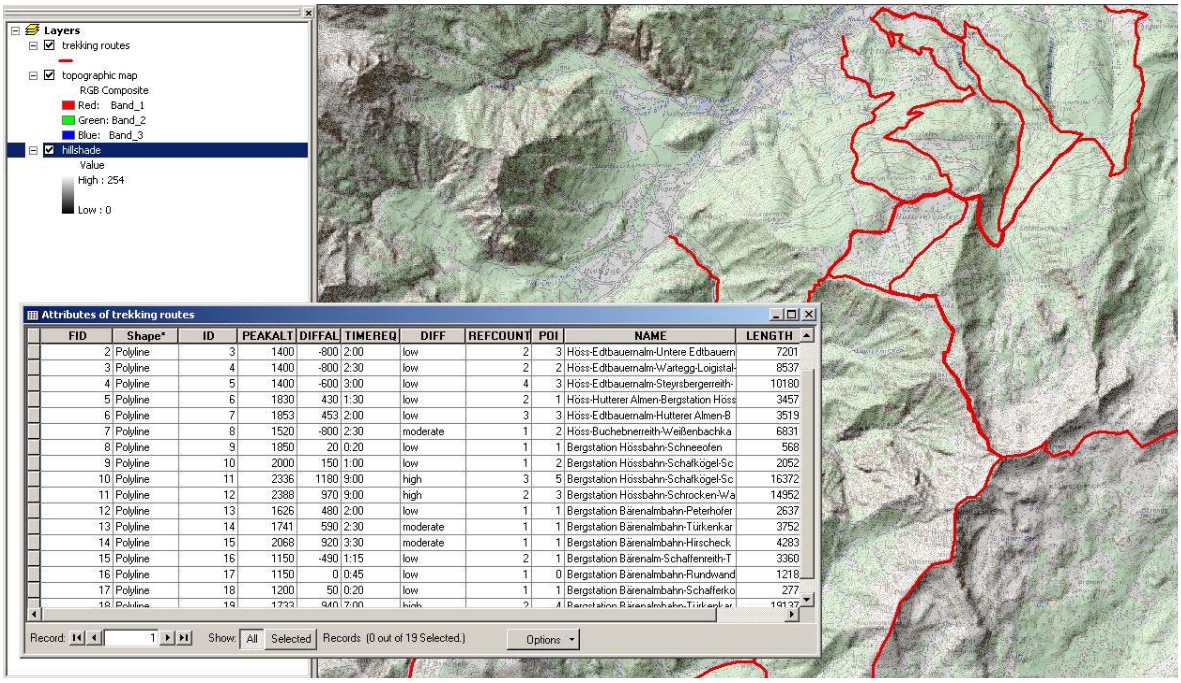

Figure 1: Valuable geo-data requires adequate attribute information

2.1.2 Data update and maintenance

The collected data from participating project countries represent a heterogeneous cross-section of principal data availability in European countries with varying information content, accuracy, and also refreshing periods.

Data maintenance and updating of both types, content and geographic data, should be managed preferably locally within the corresponding project countries. Since especially content data underlie permanent changes, the direct involvement of local e.g., countryside communities or outdoor sport companies etc. facilitates the task of updating. A general solution for the question of updating is to encourage data providers to take the responsibility for updating and maintaining of their own data, regulated by special contracts. From the economic point of view regularly updated datasets create win-win situations for all involved parties.

2.1.3 Data formats

Possible input data for the web mapping service can be all from GI Systems supported vector data formats (*shapefile, coverage, dxf,* data base formats *like mdb, Oracle*, etc.) and raster data formats (e.g., TIFF, JPEG). A Web Map Service produces maps of geo-referenced data while "map" is defined as visual representation of geo-data - a map is not the data itself. These maps are generally rendered in a pictorial format such as PNG, GIF, or JPEG or occasionally as vector-based graphical elements in Scalable Vector Graphics (SVG) or Web Computer Graphics Metafile (WebCGM) formats (OGC 2001b).

2.1.4 Cartographic requirements

In web mapping services there is a strict separation between data and data visualization (SOGI 2003). This separation leads to difficulties in the preparation of a valuable respectively legible map. As data is the most important source for the creation of a map, it has to contain useful information. This means for example that it has to provide additional information about objects, if the map objects are clickable (see 2.1.1.). Even when data is well prepared the created map might not meet the users' expectations, because cartographic design rules for their visualization are not considered. Design rules have to be considered during the registration of the data sources on web mapping servers. When the data sources are well prepared and these design rules are considered, a valuable map can be created. The cartographic design rules imply that:

- the amount of data displayed has to correspond to the current zoom level,
- the size of symbols changes when the zoom level is altered,
- the colors of the data layers are well chosen,
- a legend, which allows the map reader to decode the map objects is provided,
- an adequate generalization of elements according to the map scale is applied.

2.1.5 Multi-lingual aspect

The names of data layers in a web mapping application, a legend and all attributes of the geographic data have to be available as multilingual datasets. This includes the languages of all participating nations. English has been chosen as system language. Challenging issues are the translation of specific terms that might not exist in any language and the handling of special characters.

2.1.6 Data characteristics

Experiences from the project show that geographic data have to offer certain properties. Without claiming completeness, Table 1 provides a compilation of basic requirements concerning specific datasets for a tourism related project like GEORAMA. The recommendations can serve as guidelines for similar web mapping projects.

	Layer	Illustration / scale	Additional attributes	Data type
Basic data	Topographic map	1: 25000 – 1: 50000	-	Raster
	Digital terrain model *	Hill shade	-	Raster
	Aerial image *	-	-	Raster
	Streets, railway, rivers, etc.	Line symbols according to categories	Infrastructure number and code, river names, etc.	Vector (lines)
	Administrative boundaries	Local or regional level	Name, ID-code, etc.	Vector (polygons)
	Contour lines	100 – 500 m intervals	Height information, e.g., 100 – 500 m contour intervals	Vector (lines)
	Cities, villages, etc.	Symbols	Names, coordinates, etc.	Vector (points)
Specific data / activities	Protected areas (e.g., national park), bird or flora watching area, geologically interesting areas, etc.	-	Kinds of species, season from – to, restrictions, etc.	Vector (polygons)
	Skiing resort, diving zones, airport, etc.	-	Area, perimeter, season from – to, other specific parameters	Vector (polygons)
	Routes, trails, pistes, etc.	Line symbols according to categories	Name or code of route, description, length, duration, difficulty, other specific parameters	Vector (lines)
	Points of view/interest, historic sites, accommodation facilities, gastronomy, refuges etc.	Appropriate symbols according to types	Name, description, opening hours or months, prices, other specific parameters	Vector (points)

* Reasonable only for certain zooming levels

Table 1: Basic requirements on geographic data for a web mapping application

2.2 Methodology of data acquisition

Within the preparatory work of data acquisition the question of metadata documentation ("data about data") was discussed as well. A number of main standard metadata elements adopted from the publication ISO 19115 (ISO 2003), by the International Organization for Standardization were stored for each collected dataset.

The general methodological approach of the data acquisition phase was organized in several steps that were partially overlapping and related to each other.

- Data investigation: Conducting researches in order to figure out data availability in the participating project regions at public national mapping authorities or local authorities as well as private GIS companies, tourism agencies, natural reserve administrations, etc.
- Cooperation with local authorities, institutions, tourism associations providing content data for the project regions;

- Design of data acquisition including general considerations (metadata documentation, data types, conceptual database design for content data storage etc.);
- Pre-processing, preparation and visualization of collected geo-datasets within a Geographic Information System;
- Pilot phase: Collection and processing of selected data for two pilot regions *Hinterstoder* (Austria) and *Kerkini Lake* (Greece) and presentation within an early web mapping prototype;
- Final data collection and arranging legal issues for data (including license agreements, royalties, usage contracts);
- Valorization of data: Aggregation of data from other project areas in order to increase information density (see 2.1.1.) combined with a valorization of existing dataset regarding quality enhancement;
- Post-pilot and commercial phase: Implementation of further project regions in a future step into web mapping application and finally transition of project into commercial exploitation stage.

2.3 Problems encountered

The data acquisition phase was characterized by several difficulties regarding data-related, seasonal, and areal restrictions. The corporation of the different cost models and updating issues have also been a challenge. Some of the following listed problems were individually depending on the participating countries and some were faced as general problems in every country.

- General data usage restrictions: copyright regulations, constraints and rights of use (similar in all project regions for public and private data). These restrictions are discussed in section 3.
- Military restrictions: publishing of maps or data showing military bases in border areas is prohibited (e.g., in Greece at the borderline to Bulgaria).
- Seasonal or areal restrictions: there are several restrictions regarding the acquisition of primary data affecting for this reason also leisure activities inside the area. Especially in nature protection areas and national parks seasonal or areal restrictions are often imposed on visitors due to specific breeding times of birds for example (project area of Portugal). Other areal restrictions can be declared hunting grounds that are limited to open season or restricted forest zones due to woodworks (e.g., Austria).
- Costs: examples are web page links to thematic information liable with costs (e.g., web cameras or commercial tourist information services), costs for commercial and permanent use of data contrary to special usage agreements for project's purposes and finally royalties for basic data.
- Data maintenance: Though geographic data are considered to be more expensive than content data, the update rate of content data is supposed to be higher. A high update rate is considered for data provided by private companies with commercial interests. Content data have the characteristics to be subjected to a high fluctuation regarding up-to-dateness and maintenance. Mainly private companies are considered to be responsible for the project's content data (e.g., gastronomy, accommodation facilities, outdoor companies, etc.).

3 DATA POLICY AND LEGAL FRAMEWORK

In European countries exist various concepts for geo-data policy combined with different strategies for access to public spatial and non-spatial information. An explicit and coherent data policy for the European Commission (EC) is urgently needed, particularly at a time when the EC is promoting several European Union (EU) policies aiming at an efficient and wide-spread use of digital technologies and information (*eEurope*, *eContent*, *eGovernment* Information Strategies) (COGI 2000). Andrew Frank states that the selling of topographic data at low costs fosters the use of geographic data and therefore would be the preferable policy (Frank 2003). The position paper from the Joint Research Centre "Towards a Geographic Information Policy for the European Commission" states in that context:

"The object of an EC geographic information policy should include the terms and conditions for the acquisition, use, maintenance, and dissemination within the Commission and to third parties of all the geographically referenced data that is necessary to formulate, implement, and monitor EU policies" (COGI 2000).

3.1 Copyright regulations and licence agreements

Negotiations resulted that in each project country the property rights of acquired data remain at the data owner and only the right of use can be acquired. Generally, data can be purchased either by single licence contract (unlimited duration, one-time data delivery by paying 100% of licence fee), subscription contract (including regular updates of provided data) or limited contract (thematic and temporal limitation of data usage) (ARK 2001). In case of GEORAMA special licences agreements have to be arranged individually with local private and public data providers to be authorized in re-using and publishing data on the Internet.

Functionalities like printing of maps or downloading of data is on principle possible in the presented application (see section 4). In practice though, only printing of maps will be enabled. Downloading of acquired data cannot be offered due to copyright restrictions and restricted license agreements from the participating project countries.

3.2 Pricing policy strategies

From the perspective of economics, geo-data are merit goods and the use of such goods is of national interest. Geo-data are characterized typically by high fixed costs (due to acquisition and maintenance) and very low marginal costs (dissemination) but their optimal price is not determined by a market price (Krek and Frank 1999). The spectrum of possible strategies for pricing policy ranges from no-cost dissemination (public domain) to full cost recovery. In between are situated the Low Cost Strategy (LC) and the Partial Return on Investment Strategy (PRI). Since there are a number of pros and cons there is no optimal strategy among the mentioned variants for pricing of geo-data (Keller 2001).

Within a future commercial phase of GEORAMA revenues will be raised partially either from advertising or from offering specified services. It is intended to provide digital maps from the web mapping service completely for free while information for mobile phones (future scenario) will be offered for marginal costs as paid service.

4 PUBLISHING GEOGRAPHIC DATA WITH A WEB MAPPING SERVICE

A web mapping service is a service that publishes geographic data in the Internet. In the service the data sources and their representation are defined. The viewing of the geographic data is done with a map viewer. The first map viewer was developed by the Xerox Palo Alto Research Centre (PARC) ten years ago (Xerox 2003). The PARC map viewer's zoom and pan operations could be performed, which means that the size of the objects in the map could be changed and the map could be moved. In addition to that it was possible to search for predefined geographic locations (Putz 1994). Today many web applications like for example route planners; company finders, and tourist information sites, etc. make use of map viewers.

The web mapping service of the GEORAMA project has to meet specific demands, because of the

- spatial distribution of the data,
- the different Geographic Information Systems employed,
- the required extensibility of the service.

Different system architectures for web services were evaluated in respect to their technical, legal and economic constraints. The implementation of a centralized architecture, which implies the set-up of one European database for geographic data, seems impossible, because of the legal aspects for data and the difficulties in standardising and maintaining the available data. To solve the problems of copyrights for and maintenance of data, a distributed architecture was aimed at. The data reside in their country of origin and the responsibility for data revision remains at the side of the data providers. The GEORAMA service has to reach independency from employed geo-information products, because the data providers already use GIS and the unification of products is a challenging and expensive task. The demand for software independency and extensibility of the service can be met by the use of *interoperable web mapping services*.

The Open GIS Consortium (OGC), which is a non-profit organization having members from government, private industry and academia, took the initiative for the development of computing standards supporting interoperability in the geo-information community. Interoperability refers to the collaboration of software components provided by different companies where barriers of communication (e.g. import/export problems) are overcome. The OGC provides implementation specifications, which define the interfaces – sets of methods – conforming web services have to implement. The interfaces of the web services are therefore standardized and known. This is the basis of interoperability, because the functionality of any conforming service can be accessed from a client machine. The vision of this approach is to "geo-enable" the web and move away from monolithic systems. The flexibility, functionality, and productivity of geographic information systems are augmented when web services for the geo-information community are available in the Internet (SOGI 2003).

There are different kinds of OGC web services: services for coordinate transformations (OGC 2001), the search of metadata of data collections and services (OGC 2002), the display of maps (OGC 2001b) and others. The service mentioned at last, which is developed for publishing of geo-data on the web, is called *web mapping service* (WMS). The GEORAMA project employs this kind of service, which is based on the WMS implementation specification (OGC 2001b)of the Open GIS Consortium. As usual in web applications, a client and a server communicate. This approach is also valid for web mapping services. The client of the GEORAMA project is represented by the prototype of the map viewer and the servers are the WMS servers. The map viewer is responsible for sending requests to a server and processing respectively displaying the server's replies. At the side of the web map server the data sources, which are available for web publishing, are registered and administered.

Different web map service versions exist and the specification is steadily extended. The GEORAMA map viewer is developed for WMS in the version 1.1.0, which was the current version at the beginning of the project. At the time this paper was written, WMS in the version 1.1.1 has been available. The steady improvements are a problem for applications using OGC WMS, because the downwards compatibility can not be guaranteed. A web map server basically implements three interfaces: GetCapabilities (required), GetMap (required), and GetFeatureInfo (optional). The GetCapabilities interface provides the client with a description of the data available at the server. The returned capabilities document contains metadata specifying the owner of the data/service, the costs of the service, the version of the WMS server, the geographic extent of the data, the spatial reference system etc. The GetMap request returns a map as a raster image that is created on the server based on the requested data. The request for a map requires, among other things, information about the data layers to be included, the spatial reference system and the geographic extent of the data, and the styles defined for the layers. These pieces of information are retrieved from the capabilities document. The optional interface GetFeatureInfo makes map images queryable, if it is activated. Features that are provided attribute information can be clicked and the additional information is presented. Figure 2 is a schematic representation of the concept of open interfaces described above: There are different data sources respectively web mapping services available providing data layers for maps when addressed through the interfaces. The service registry contains a listing of the available services.

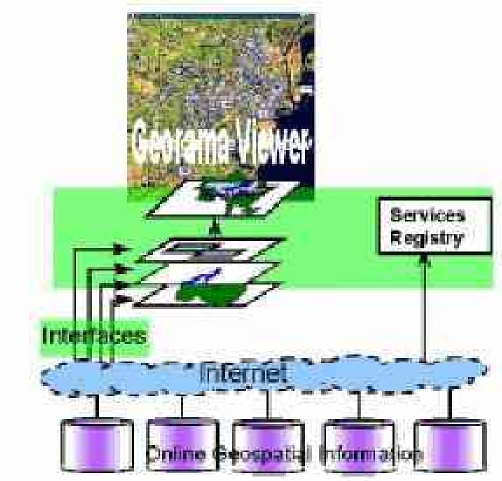

Figure 2: Concept of open interfaces

Within the GEORAMA project data providers join the GIS framework by publishing their data via the OGC WMS interface. Any compatible GIS can be used for data collection, processing, and maintenance, because OGC WMS can deal with all common geographic data formats. There are OGC WMS servers offered in different price classes and from different software companies. In general the expenses for setting up a web mapping server are acceptable, because usually documentation is available (Gietler, Hofer et al. 2003), (Kolodziej 2003). Open source and low cost solutions are available on the market like for example WMS of the German company lat/lon (www.deegree.org) and the University of Minnesota (http://mapserver.gis.umn.edu/). The GEORAMA map viewer, the client of this application, requests and displays the maps of the different web mapping servers and provides functions that allow the users to interact with the map.

5 RESULTS

In the course of the GEORAMA project a prototypic implementation of the presented framework has been carried out. We have been relying on available publishing software from prominent vendors as well as open source products (OGC WMS compatible). A map viewing software has been designed and developed using server sided programming technology. The prototype aims at reducing the expenses for the realization of the system architecture and makes the participation for many regions possible. These important requirements were achieved, because of the reliance on OGC web mapping services. Employed WMS allow the map viewer to present different data types and therefore data interoperability is reached.

The map viewer offers functionality, which is based on the interfaces of web mapping services. The functionality of the map viewer cannot compete with the one provided by proprietary services. Basic interaction operations like zooming, panning, and the re-centring of the map are implemented. Information about an object is provided when clicking on it and it is possible to influence the content of the map by adding or removing data layers. Any interaction with the map requires a new server request; because of that the performance of an OGC client suffers. The offered functionality allows people to get an overview over a region, which is the main intent of the maps presented in this project. In addition to that, little experienced map users are not swamped with features. The usability of the map viewer was an important aspect; this led for example to the implementation of multilingualism in the map viewer. Figure 3 shows the prototypic map viewer of GEORAMA.

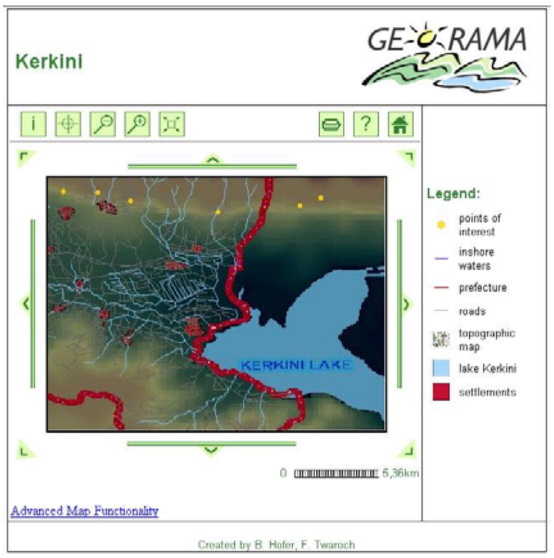

Figure 3: Screenshot of the map viewer prototype showing the WMS of *Kerkini* (Greece)

6 CONCLUSIONS AND OUTLOOK

The project showed that by using the specifications of the Open GIS Consortium an open and easily extensible web mapping application can be implemented. The application supports the interoperability of data, which means that various data formats can be integrated. There are still requirements geographic data have to meet: legal and economic issues have to be solved, the update rates negotiated, the information density assured, and cartographic guidelines applied.

Tourist information systems like GEORAMA would be a lot easier to accomplish when standards for the description of sport and recreation activities existed. The standards should be developed with regard to geo-information services. Tourism regions do not have the resources to provide several web sites with their content information regularly. The envisioned standard could support them in such a way that they produce one file only, which is used for different products like web pages, press released, and flyers. The file could be provided in a dialect of the eXtensible Markup Language (XML), which is a standard for describing information.

Several extensions of the OGC web services can be expected in future. The interfaces of OGC web mapping services will be extended and allow for example the use of 3D information and attributes in WMS. Further these services will support indoor and outdoor activities. Standards for “publishing, finding, and binding” of services are enhanced, which is another step towards the geo-enabled Internet the OGC has.

The future procedure of the GEORAMA project will focus on the integration of new project regions within the existing partner countries and beyond, by embracing further EU countries. In a future commercial phase the project aims at the continuous extension of the web mapping service in order to encourage the dissemination of public and private data for tourism purposes by providing relevant information through new media. These efforts will imply the integration of mobile services. The web portal will benefit from further developments in the area of mobile services. Investigations on the use of data and open web services with Personal Digital Assistants (PDAs) and cellular phones can enrich the functionality of the portal.

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Texture Management for high-quality City Walk-throughs

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1 INTRODUCTION

For a city viewer application to be a useful tool in supporting municipal planning and various other urban applications, high quality texture maps, for both terrain and building facades are essential. We present a texture management system which makes it possible to view high resolution textures on a state-of-the-art consumer PC, with a resolution of up to approximately 1 cm per pixel for all the buildings in a city walkthrough. The system is based on estimating the average viewing distance for all facades and the terrain in the field of view, and continuously loading the necessary high-resolution textures for optimal display. The effect is to simulate a high-resolution texturing of the complete city corresponding to a total of multiple gigabytes of texture data. By providing such high texture quality, important detail information is available for both the city planner and the tourist: street labels on houses can be read, traffic signs are easily discernible, and ground markings can be read (provided the data is available). The system has been successfully demonstrated using the data provided by the City of Graz.

Figure 1: Screenshot of a Walk-through of the city of Graz

2 PROBLEM STATEMENT

State of the art City Models that include image data for facades and terrains, contain huge amounts of textures that cannot be loaded into main memory or onto the graphics card at once. Thus in standard viewing applications it is not possible to view the model with all the modelled data. For a number of applications in the areas of municipal planning and urban management, it would be highly valuable to be able to view all the data at once. In order to facilitate such a viewer application, the available geometry and textures have to be organized in such a way, that the part that is visible at any time can be loaded on demand. Previous work on this topic is either specialized to terrains [ULRICH] or very general without taking into account the special properties of city geometry [BOOL, CIGNONI et al.].

3 SPLITTING OF THE MODEL

The available data of a city model for viewing contains two major classes of data: geometry and textures. In the general case, the available data in both these classes is larger than the available main-memory. In order to be able to load parts of the geometry and textures, the data has to be split into manageable chunks. The strategies for splitting the data are different for the two classes of data: geometry has to be handled differently than the texture data.

3.1 Splitting of the Geometry

In order to be able to load the visible geometry on demand, the geometry has to be split into chunks in such a way, that the viewer application can easily calculate which chunks are close to the viewing point, or will be close to the viewing point in the near future, so that they can be loaded into main memory. Here an arbitrary hierarchy of splits such as a k-d Tree or a BSP-Tree would be possible, however in order to keep the management algorithms as simple as possible, a quad-tree based structure was chosen: the geometry is split in half in both dimensions at each level, giving 4 rectangular sub-chunks at each level. At the finest split level this gives rise to a rectangular grid of geometry chunks.

The typical geometry in a city contains terrain data and building data. Splitting the terrain data geometrically is necessary, since the complete terrain object is as large as the complete city. However it is in general not necessary to split the data of each and every building, it is only necessary to place the geometry of each building inside the chunk that contains the center point of the building. This avoids costly and unnecessary splits of geometry.

The terrain data of a city is often associated with a texture map containing an orthophoto of the terrain. This is often generated from aerial photographs and available as a single large texture image. In order to be able to load this texture in manageable chunks, the texture data has to be split into small textures that correspond to the chunks of geometry that have been created by splitting the geometry data.

3.2 Splitting of the Textures

In order to be optimally suited for rendering on current rendering hardware, it is necessary to split the terrain texture maps into tiles that have dimensions that are powers of two. A large terrain will then be textured using a grid of texture tiles. Optimally these texture tiles are completely aligned with the grid of geometry chunks. Although it is normally useful to resample the data in order to meet the power-of-two requirement, resampling on a rotated grid is complicated and error-prone. Therefore we decided to align the geometry splits with the texture splits, simplifying the underlying management routines.

Texture seams

A naive splitting algorithm for the textures, would just cut the textures into power-of-two tiles and calculate the necessary texture-coordinates for each associated geometry chunk. However due to the linear interpolation of texture maps that is used in current hardware in order to increase the rendering quality, this can lead to visible texture seams at the border lines of the texture tiles [TURNER, B] (see figure 2a).

Figure 2: a) Texture split with seams on the left. b) Corrected textures on the right

In order to avoid these artefacts it is necessary to generate the texture tiles with one pixel overlap, and adjust the texture coordinates accordingly (see figure 2b). Only by integrating this improved splitting method, high quality textured terrains are feasible.

3.2.1 Sequence of Texture Resolutions

The resampled textures are made available at a sequence of resolutions, so that they can be rendered at different output quality, depending on the distance to the view-point:

- Textures which appear close to the view-point are rendered at the maximal available resolution in order to achieve the highest possible rendering quality.
- Textures which appear very far from the view-point are rendered at a low resolution, so that they need not be kept in memory at their highest quality level.

4 DATA MANAGEMENT

Based on the split geometry and textures, the second important step for interactive city visualization is the management of loading this geometry and the associated textures into memory on demand. In order to accomplish that, it is necessary to maintain a cache for the geometry and the textures in main memory.

4.1 Caching of Geometry

Currently the city models that we have available are of limited geometric complexity: the model of the city of Graz has about 150 000 Triangles, including both buildings and terrains. Thus the geometry of such a model can be completely loaded onto the on-board memory of current graphics hardware. Thus it is currently not necessary to implement and use a full-featured geometry caching system. Of course this will be changing in the near future, and therefore we are developing a geometry caching system that interacts with the texture caching system described in the following sections.

4.2 Caching of Textures

The texture cache in main memory is responsible for holding each texture tile at an appropriate resolution in memory. Thus the following functionality is implemented:

- Loading of texture tile at a specified resolution.
- Recording of timestamps whenever a texture is used (i.e. viewed) at a specific resolution.
- Releasing of texture at a specified resolution based on usage: e.g. a least-recently-used (LRU) scheme, that eliminates textures that haven’t been used for a while.

4.3 Two-level cache hierarchy

The texture cache in main-memory is however only one step to a complete texture management: all textures that need to be rendered also need to be loaded into the on-board memory of the graphics card. Thus a second cache has to be maintained, that works on the same principles as the main-memory cache, but manages the textures that reside on the graphics card at any point in time.

4.4 Implementation Issues

For both caches, it is important to schedule the loading operations in such a way, that they do not block rendering, as this would result in stalls that impede interactive viewing. For this reason,

4.5 Texture cache policies

The basic functionality of the two-level texture cache only provides the mechanism for getting high resolution textures into memory when they are needed. Based on these mechanisms, an adequate policy has to be set, that determines when to load a specific texture, and at what resolution to load this texture. Such a policy has to take into account a number of parameters, so that it can be fine-tuned to a specific application:

- Distance of the textured object to the view-point: far away objects can be shown with very low resolution textures, whereas close-by objects need to be shown with high resolution textures.
- Speed of the view-point: when the viewer moves through the city, it is prohibitively expensive to load the textures for all close-by objects at high resolution, only to release them moments later when the viewer has passed the objects.
- Size of the texture caches: the policy has to be designed in such a way, that it optimally uses the available memory.

Experimenting with a few policies that take the above points into account, we arrived at the following cache policies:

- Low resolution textures for the complete geometry is loaded on startup. The resolution is chosen in such a way, that all low-resolution textures will fit in memory.
- High resolution textures are loaded for objects that are visible and whose distance is closer than a predefined threshold. Determining of the actual objects can be performed in various different ways, such as stochastic raycasting.
- For a city walk-through application that allows to switch into a flying mode, the height above ground can be used as a simplified estimate for the closest distance of objects: above a certain height it is not necessary to load any high resolution textures (see figure 3).
- The movement speed of the observer: above a certain threshold speed, no textures are loaded into memory.

The described policy only uses two resolutions, a low texture resolution that is chosen so that all textures fit in memory (with enough free space for high resolution textures) , and a high texture resolution, that is chosen in such a way that enough space for all high resolution textures for visible close-by objects is available.

Of course more sophisticated cache policies are possible, and we are continuously improving our existing policies, nevertheless the described policies lead to a fairly good user experience already and can be thought of as a basis for city walk-throughs.

Figure 3: Screenshot of a Fly-over of the city of Graz

5 CONCLUSION AND FUTURE WORK

We demonstrated how intelligent texture management can cope with the huge amounts of texture data that is available in city models with facade and terrain images. This texture management makes it feasible to interactively view state-of-the art city models on consumer PCs.

However it is foreseeable, that in the near future large geometric models will be available for certain buildings in a city. We are currently developing improved algorithms to manage this increased amount of geometry while maintaining interactive frame rates in our viewer application.

6 ACKNOWLEDGEMENTS

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INTREST + EUROMAP: Intermodal Digital Network Models for Europe

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SUMMARY

Until now European Digital Network Databases usually cover just one mode of transport, refer only to a specific area or are merely suitable for information issues. A new concept of an integrated data model will be presented which offers an open and consistent platform of network data for multi-modal and inter-modal transport applications. The network data can be used for applications in the field of transport planning, travel information and operational planning. Different data sources, e.g. digitised road networks from commercial navigation systems and public transport passenger information systems are integrated to provide a basis for uni-modal and inter-modal routing purposes.

1 REQUIREMENTS AND EXAMPLES FOR EUROPEAN DIGITAL NETWORK MODELS

High quality and up-to-date digital content is the key to high quality transport, traffic and mobility applications and services for public and commercial as well as private purposes. Typically, data pools such as hotel registers, yellow pages or digital road maps by the major commercial providers can only reach limited completeness and relevance on local level. Centralised content acquisition by commercial providers is costly and can often not yield sufficient quality and detail due to the lack of local knowledge. At the same time, different actors are working on a local as well as application-specific level. They acquire and process transport-related digital data, e.g. for transport planning, traffic management and tourist information.

These data pools cannot be easily accessed and combined, due to different map bases and referencing techniques as well as different data formats and quality standards. Furthermore these data pools usually only have local to regional coverage. The separation of digital map content is also visible in the area of public transport information, which is not integrated with road transport. Intermodal applications and information services therefore require particular effort with regard to digital map maintenance and integrated services.

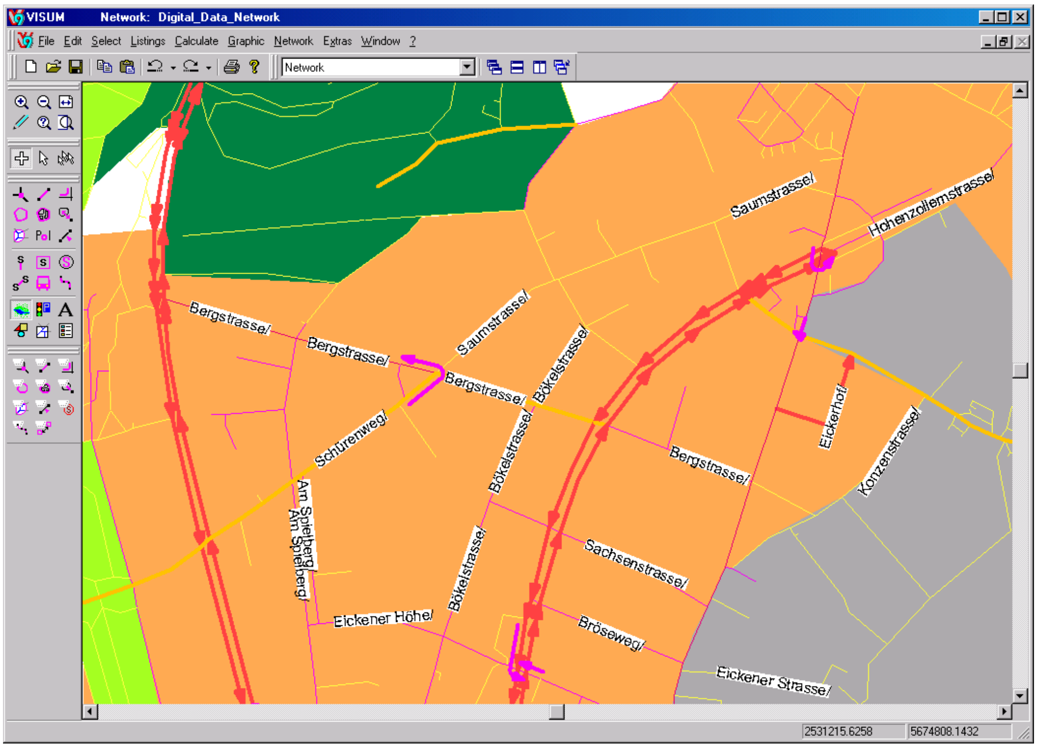

Figure 12: Transport network derived from commercial European digital data source including one-ways (red links) and turning prohibitions (violet links)

PTV and DDS provide these data in easy to handle formats like ATF or Shape File, which are easier to handle than GDF data description. If street and public transport networks should be covered by one common system, a significant extension of base data model and its format is needed. GDF e.g. doesn't cover the field of public transport or more general spoken timetable or headway based line services.

For different applications relevant data sources are offered for European networks on a highly detailed level as well as based on the major network only. In general link networks are updated and extended regularly. Additional spatial information layers such as settled areas, industrial areas are provided without as much precision.

Link network data is offered as pure network data including link information only. Applying advanced conversion methods simple networks without any routing restrictions and attributes can be derived to generate the minimum requirement for routing networks –

links and nodes. More comprehensive data sources include additional routing information and network attributes such as turning prohibitions, link types and one ways (see Figure 12).

One essential task is data integration of different spatial data sources. Two main aspects have to be considered: spatial (coordinates) and data (attributes) integration. A first step can be done within GIS programmes. They handle objects such as points, polylines and polygons within a spatial framework. Coordinates are defined based on projections or depictions. Objects are described by attributes within databases and coordinates. External objects with yet no spatial context (e.g. petrol or railway stations) have to be geo-referenced (e.g. based on street name and house number or GPS-data) to be included in the complete data framework.

Coordinates of different digital data sources can be transformed into one common system to get a spatial data integration. No depiction system can be called the best system for a European network display. As a conciliating system e.g. a “Lambert conformal conical” system, using two standard parallels, can be applied.

European networks can be generated for individual transport (e.g. water, road and road network) as well as for public transport (e.g. rail, bus, air transport). Many aspects of a transport or traffic model cannot be described within a GIS data model (e.g. turnings at a node, directed links attributes, time profiles). Therefore further specialised programme systems are needed. A newly developed data model for *ptv vision* describes the different requirements for individual and public transport networks.

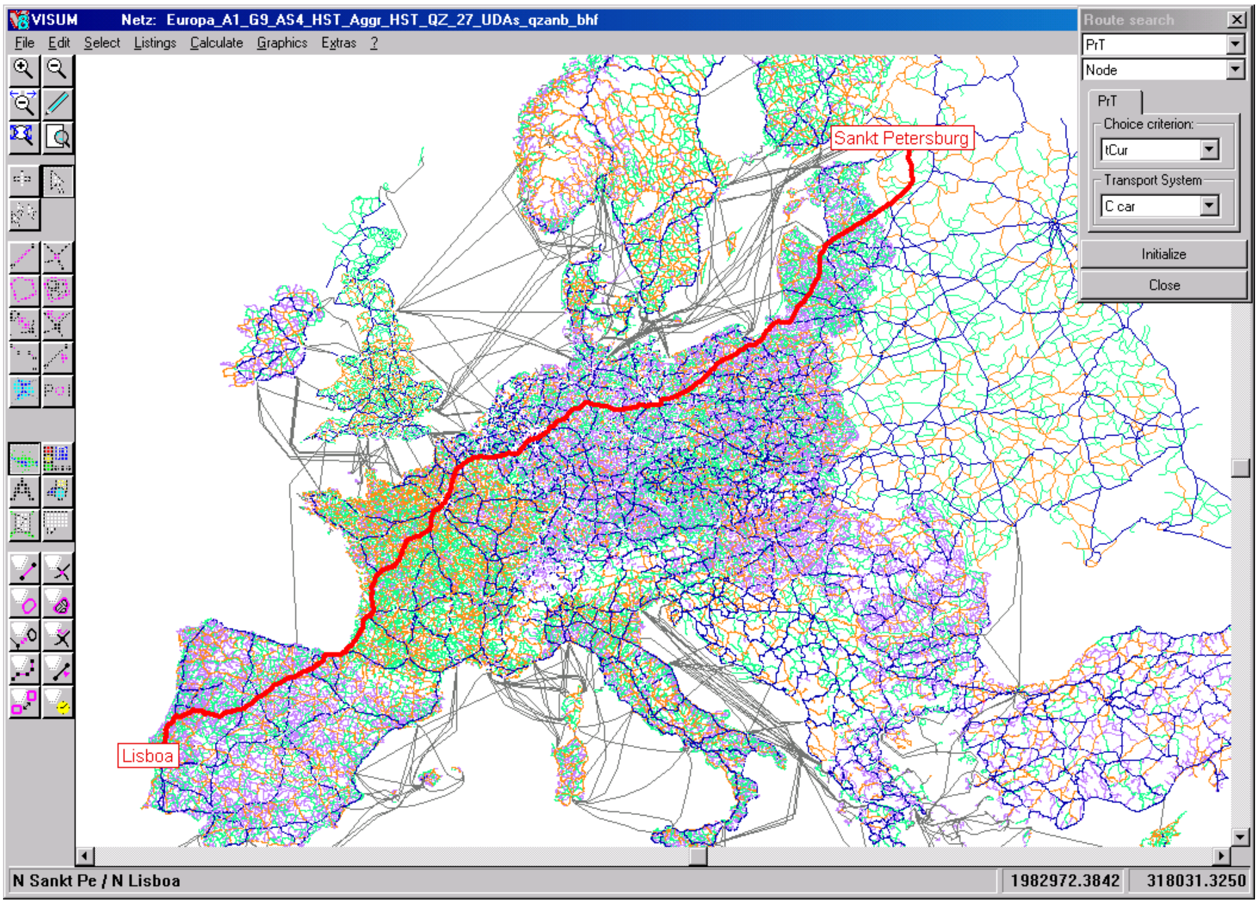

Figure 13: Route search in European road network: St. Petersburg -> Lisbon

Navigation network data is widely used in road routing systems. The fitting and consistency of different sources has an important role. “Holes” in the link network are highly disabling to these systems for European-wide route guidance calculations. The European road network as displayed in Figure 13 contains 173.000 nodes, 506.000 links and more then 1.6 Mio turnings. A route search between e.g. St. Petersburg/Russia and Lisbon/ Portugal takes a few seconds within ptv transportation/VISUM using a standard PC. This transport network is based on DDS/PTV European network data. The first major 4 link categories are considered (4 of 7 categories).

The generation of a public transport network needs more input data then a road network. The road network can be used an initial network e.g. for bus networks. Rail, water or air bound networks have to be generated separately. Some more specific public transport elements have to be added as well: stops, line routes with its time profiles, timetable information. Figure 14 shows a European railway network with more than 64.000 stations plus several 1.000 turning junctions, nearly 150.000 rail links and approximately 330.000 turnings.

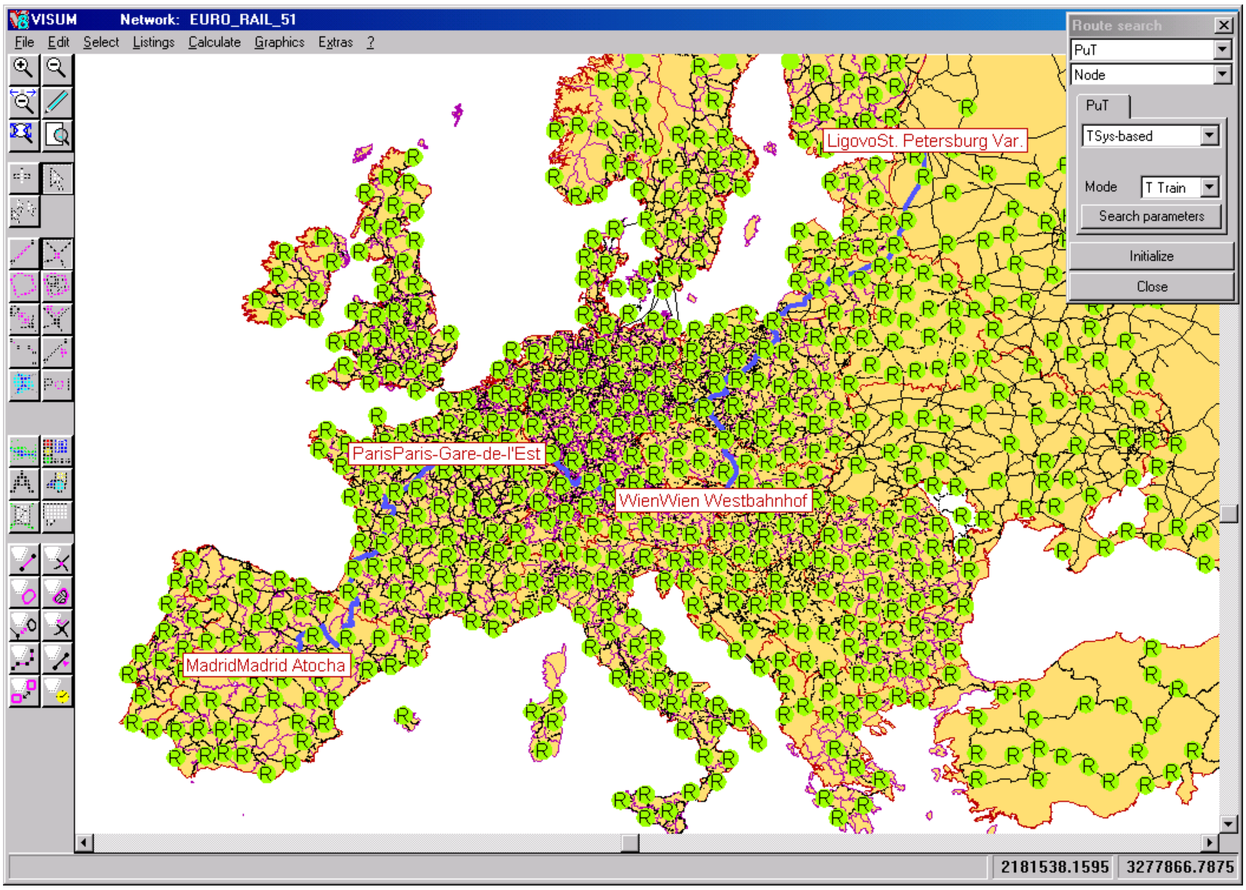

Figure 14: Route search in European rail network derived from digital data sources (R: station)

As soon as line-routes and timetable information are included, the modelled transport system offers all functions for a public transport passenger information system.

Integrated information systems based on digital maps are needed for easier data access and minimisation of parallel non-connected databases. These can have huge advantages for the system operators as well as for the users. Only one database has to be managed (e.g. reduced cost for system extensions) and only one database has to be consulted by the users, offering many different spatial data. A good example for such a highly integrated spatial database is developed within INTREST for the whole state of Bavaria.

2 INTREST – DATA INTEGRATION

The INTREST project develops and demonstrates the technical infrastructure as well as the commercial and organisational framework for a central, inter-modal referencing platform for transport-related digital data in Bavaria. Local and application data and data specific to different applications, which are collected and maintained by public and private entities, are combined in a central data pool where they are referenced to a digital map and marketed to third parties. Two transport software providers, PTV Planung Transport Verkehr AG, Karlsruhe and Mentz Datenverarbeitung GmbH (mdv), Munich have been charged with the conception and development of the system, which is scheduled to operate in 2004.

2.1 Objectives of Interest

As part of the Bavarian mobility 21 initiative, the INTREST-project develops the technical infrastructure as well as the commercial and organisational framework to overcome this situation in Bavaria. Central objectives for the Bavarian state (Board of building and public works, Bavarian Ministry of Interior Affairs) for the project are

- *Improved access and exchange of transport-related digital map data* and corresponding content areas for public and private entities in Bavaria by establishing an integrated geo-referencing system and digital map data pool which is shared and maintained by the INTREST partner network,
- *Improved quality and completeness* of transport-related digital map content for Bavaria: diverse, decentralised INTREST partners with local and application-specific knowledge ensure the content supply. Central to INTREST is a comprehensive digital vector map, which integrates public and private transport modes in a network model,
- *Open and extendable system architecture and content catalogue* in order to integrate diverse applications and services; the INTREST object model and the INTREST interface are public,
- *Maximum synergies with commercial digital maps:* With a commercially available digital (vector) map as base supply in INTREST, initial content layers and their regular updates are ensured. No redundant collection of digital map data occurs. If necessary, digital map data with coverage outside Bavaria can be easily joined,

- *Establishment of a dynamic, inter-modal trip information system* on the Internet as showcase for data pool,
- *Development of organisational and commercial terms* for the continuous operation of INTREST by a private operator after the end of the project.

In the longer term, the INTREST referencing system and data pool shall

Facilitate and improve digital map applications and services of the different Bavarian state authorities with regard to transport planning, infrastructure operation and information services. Examples are applications such as road accident evaluation, road construction management systems, or road management systems and their related information services;

Create an improved inter-modal transport content base and subsequent services, which help to achieve a more balanced modal split in passenger transportation; stimulate new IT applications and services by third parties through high quality and low cost local digital map content.

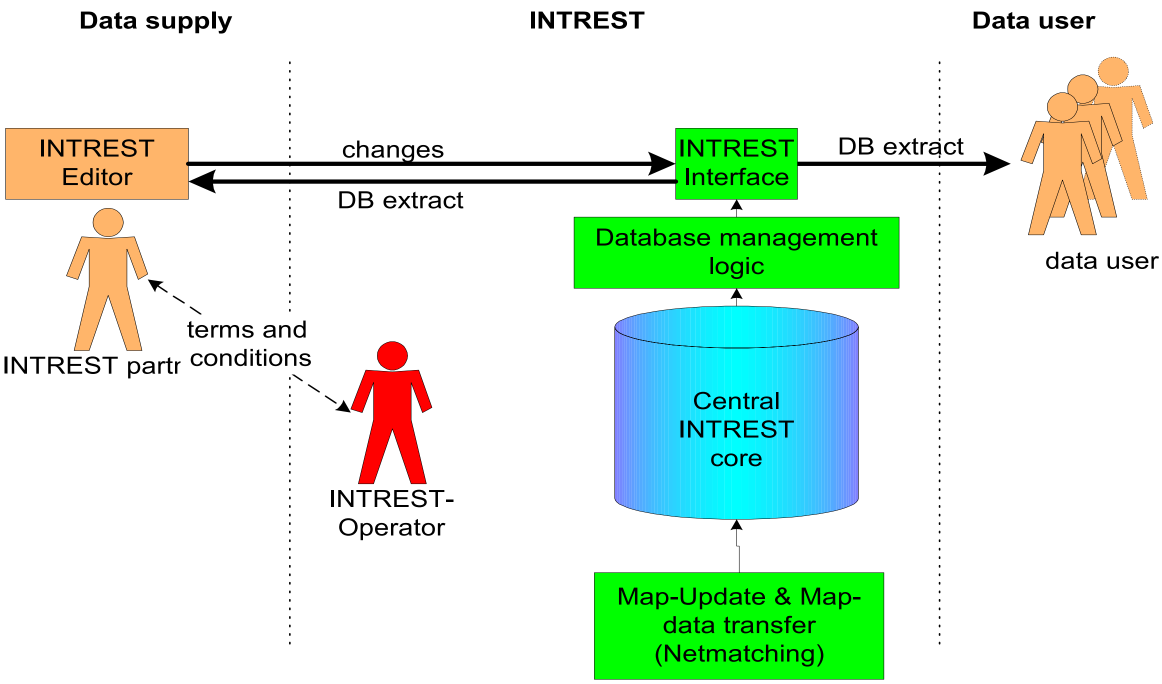

Figure 15: Principle workflow of INTREST

2.2 Use cases and scenarios

The main use cases for the INTREST system are described, together with the concrete scenarios, where they are applied. The scenarios reflect activities of pilot INTREST partners, which will use and test the INTREST system during the test operation phase.

<u>Obtaining data from INTREST</u>

The INTREST customer has to register with the INTREST operator and agree on the general commercial terms of INTREST (incl. licences, see below). With a web browser application, the customer can customise the content for extraction from INTREST, with regard to the object layer and geo-graphical coverage. The data are then extracted and stored. The customer then receives a link to download the data in the standard INTREST format.

> *Example 1:* The Bavarian traffic management centre is an INTREST partner and regularly references its detection units and other data in INTREST. A telematic service provider wants to use additional dynamic information layers from the Bavarian traffic management centre in order to upgrade his own information base. For this purpose, the service provider needs the stationary detection units on the motorways including their geo-references. Instead of re-entering and referencing the data, he purchases the detector data including the reference to the commercial map database from INTREST.

<u>Entering and maintaining data in INTREST</u>

Entities supplying INTREST become INTREST partners and have access to the data pool at preferential terms. Initially, the operator agrees the extent of the data supply with the partner, in terms of coverage, content layer and update frequency. Usually, the partner will communicate with the INTREST server via a web-browser interface in order to obtain a data base extract for editing. If no other editing restrictions (e.g. from another editing partner) exist, he locks this content layer for other editors and receives the data in the standard INTREST format via download. The data entry is then handled off-line via an INTREST editor or a compatible editing application. Having completed the editing, he will login on the server via the browser interface, upload the changes and free the lock. The server checks the data and integrates them into the data pool or rejects them. The user is informed about the result and the user account is credited with the value of the data delivered to the server.

> *Example 2:* A large public transport provider supplies INTREST with data on public transport lines (sub-way, tramway), cycle paths and pedestrian paths. He enters this information to make it available in information services using INTREST

data. The public transport provider becomes INTREST partner and has the rights to change those content layers in his area of operation.

Example 3: The authorities of a large Bavarian city together with the public transport provider wish to enrich the digital map content available for their information service on the Internet. They therefore will make use of the editing possibilities and enter points of interest (POI) with regards to public places as well as tourist information.

Updating the digital map in INTREST

The underlying commercial digital map is regularly updated in INTREST, in order to maintain the compatibility with the current commercial map coverage and in order to benefit from the updated map content. Since the editing operations might have altered the original topological content of the INTREST map (e.g. inserted a new link), the two maps need to be matched, i.e. links in the INTREST map have to be mapped to links of the new commercial map update to identify the differences. The INTREST map is then enriched by those changes, new in the commercial database. All geo-references by other data objects to the INTREST network are then updated to the new enriched network base. This complex process is done at least once a year.

Integrating data from foreign map databases

Certain content layers in foreign digital map databases can be useful to the INTREST data pool though their transfer cannot be handled via an editing tool. This way of data transfer into the INTREST database is important, since it allows existing databases to be tapped with their own referencing and digital map. It also allows the transfer of INTREST data to external network references in foreign databases. In such a case, a net-matching process between the foreign map base and INTREST is performed. In an offline process, corresponding links in both networks are identified. After an automatic identification of corresponding links, a remainder of links, which could not be matched automatically, needs to be treated manually via an editor. With the resulting set of corresponding network links, attributes and objects in the foreign database can then be transferred to the corresponding object or reference in the INTREST database. Such a process cannot be handled by the INTREST partner supplying data via the INTREST interface, but requires the special intervention of the system operator.

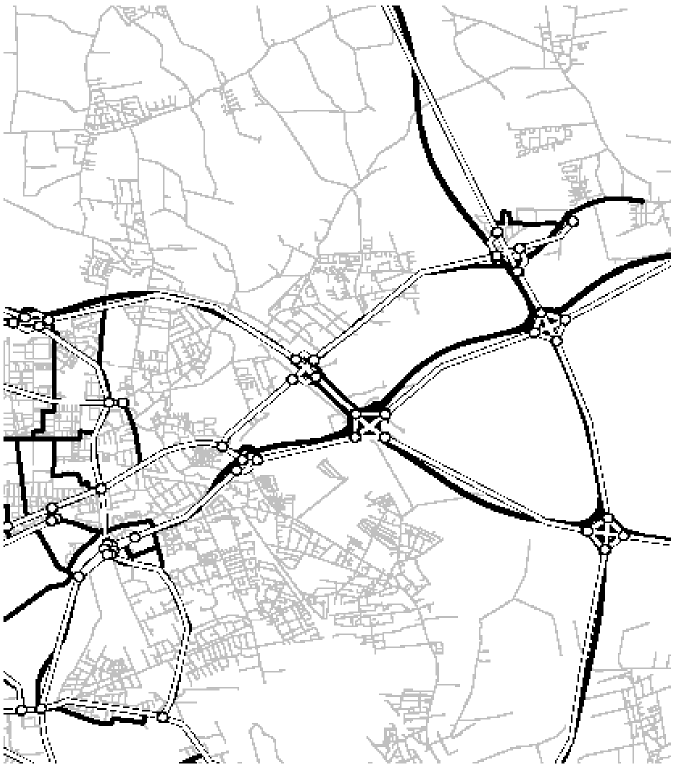

Figure 5: Example of two digital networks which are matched against each other

Example 3: The Bavarian traffic management centre integrates certain (static) base objects in INTREST to which dynamic information layers refer to: this includes stationary traffic detection units, 'LOS'- links (links to which a calculated Level of Service refers to) etc. The traffic management centre plans to update its digital map regularly through INTREST including the references for its own specific objects. With regards to the linear objects, a net matching with the INTREST map has to be made. (see figure 5)

Example 4: The Bavarian road authorities have built up the Bavarian Road Information System (BaySIS) for planning and running their operations. BaySIS uses their own digital network and maintains information such as road width, number of lanes, road kilometre counter in this system. With the help of a net matching such information can be transferred towards the corresponding INTREST objects.

2.3 Integrated digital map data model for inter-modal traffic information services

The digital map model that was developed for INTREST is geared to support the broad content requirements of inter-modal, dynamic traffic information systems. It also reflects the first INTREST partners and customers that wish to enter and to use the data pool. Of course, the current object content is useful for many other applications as well. With new requirements from further applications, new data objects and extensions can be added to the INTREST data model.

The data model contains the typical network and map objects from commercial digital map data providers (node-link topology, geometry, background layers, streets, addresses, points of interest), which have been adapted and enriched to the purposes of INTREST. Particular attention has been given to the modelling of public transport lines as well as non-motorised modes (by foot and or bicycle). Data objects for better coverage of administrative regions, specific public transport objects (a hierarchical model for transfer points between modes), traffic objects (like detectors, road construction, or traffic signs) and the representation of weather information have been added.

These objects are modelled and maintained in INTREST to the extent at which the content is interesting to more than one specific application and user. This avoids handling and maintaining too differentiated objects and content in a central database for general use. Additionally, specific information remains with the original data holder, who can save the INTREST Object-ID and network reference in case other INTREST partners wish to link this specific content to the core INTREST content (see figure 6**Fehler! Verweisquelle konnte nicht gefunden werden.**).

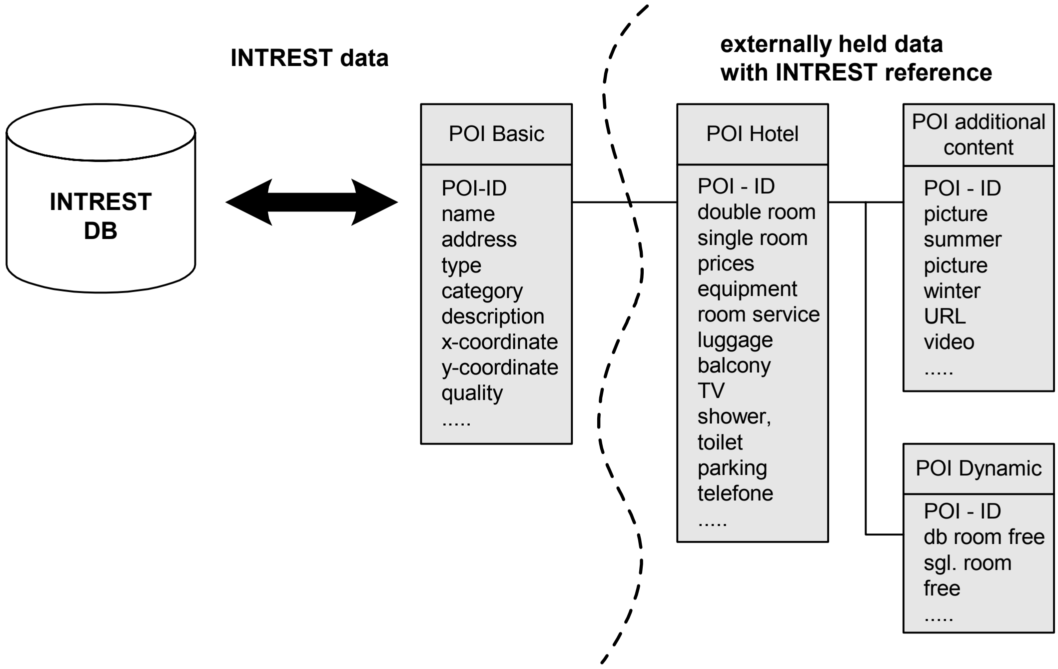

Figure 6: INTREST internal data object and corresponding object details with the data supplier (example: point of interest)

Dynamic content itself (e.g. current detection values) and the public transport schedule is not included in the data model but held in adjacent databases which use INTREST references to the respective static objects (e.g. the detection unit). To some of these objects, INTREST offers an object model as a recommendation.

2.4 Commercial view on INTREST

INTREST & EUROMAP have a particular position in the value-added-chain for digital map content since it aims at a content enrichment of commercially available map material through local sources and knowledge. This content is difficult to market on its own since it typically has a limited regional coverage, is not comprehensive enough on its own and since costs for processing the data for sales and marketing outweigh the benefits of the limited content by far. In this context, INTREST offers three basic functions to INTREST partners feeding content into INTREST:

- The referencing to a common (commercial) map;
- The compilation of separate data pools and suppliers into one database thereby creating a larger, more comprehensive content base;
- The brokering of the acquired data (together with the underlying commercial map);

In this way, INTREST can create a market for focused and small-scale content providers for which INTREST offers a central marketing and outlet of data. Such a sales perspective to third parties, while attractive in principle, will only work if INTREST has gained sufficient popularity, i.e. supplying partners and hence the INTREST specific content have reached a certain, critical level.

INTREST also offers partners the possibility to edit and enrich a (commercially available) digital map in their specific area and customise it to *their own specific purposes* on a continuous basis. Users of proprietary and self-maintained maps might eventually adopt the INTREST solution and replace their own isolated map maintenance through INTREST.

It is this latter motivation, which brings content owners without own marketing activities to collaborate with INTREST during the starting phase. Typical pioneer users of INTREST, which have already indicated their interest are municipalities, public transport providers as well as public authorities involved in road management activities.

For the operation of the data pool, data entry and data use need to be valued, otherwise data suppliers cannot be credited on the level of their contribution to the INTREST data pool. This is done through an internal user account, which records data entry and data extraction. The data entry is valued in an internal INTREST currency according to number, type and entry type (update/delete or insert). Similarly, data extracted are valued and debited to the users account. As long as the INTREST operator makes no commercial turnover of data, no money can be fed back to the data suppliers. As soon as data sales occur, the data suppliers can be rewarded according to their overall contribution to the whole INTREST data pool. No specific tracking of supply and sales of specific data (e.g. one specific hotel information) are envisaged so far.

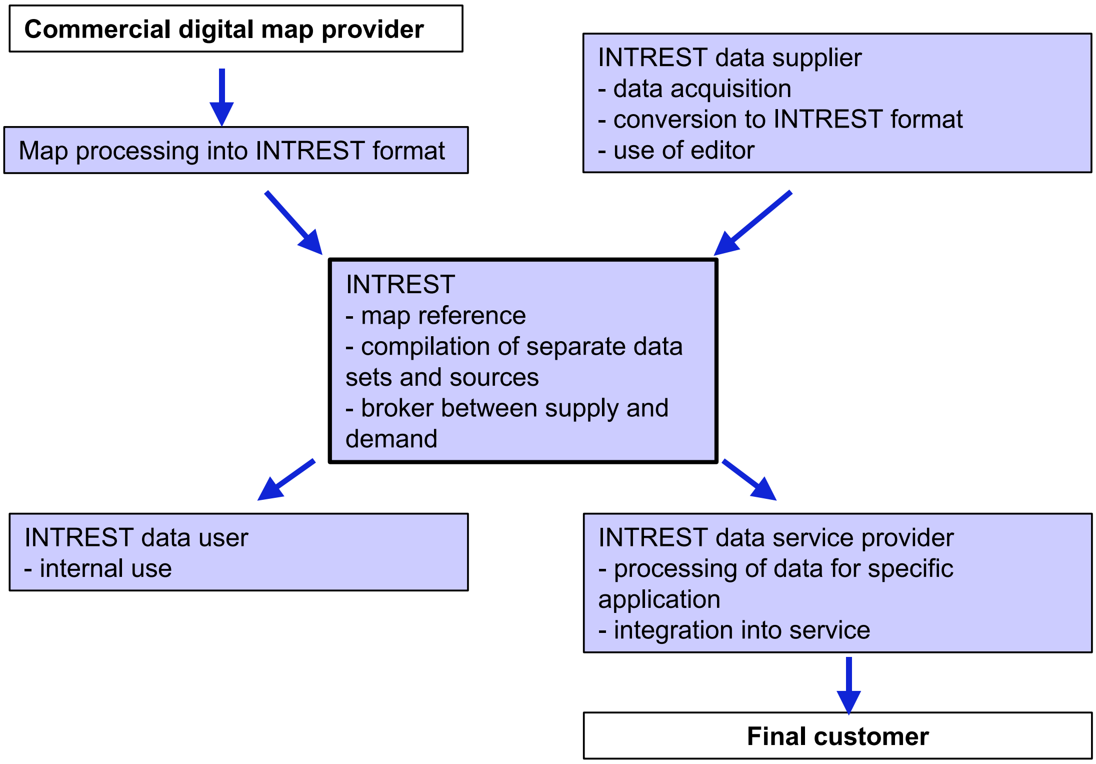

Figure 7: INTREST in the value-chain for digital map content

Obligatory to the use of INTREST data is the possession of the digital map licence of the supplying digital map provider. In the INTREST-project a licensing arrangement regarding transport-related usage has been negotiated and concluded between the Bavarian state and a major digital map provider. It offers preferential terms to INTREST partner supplying data to the pool. In order to motivate and push participation, the Bavarian state covers licence cost for its transport-related authorities and the major public transport providers with regards to desk top applications. Data use for Internet services or print media are ruled by separate arrangements.

3 TECHNICAL ASPECTS OF THE EUROMAP DATAMODEL

Based on the ideas of INTREST a similar project is being developed on a European level. The required data is available. It has to be collected and integrated within a core system e.g. like *ptv vision* and VISUM. The first results are shown in figures 2 and 3. While the main purpose of INREST is the improvement of the inter-modal passenger information the objective of PTV is to provide a comprehensive data model covering the requirements of road and public transport planning on strategical and operational levels simultaneously in one application.

A core system integrating data from various sources needs to be an open system with several interfaces for exchanging the data. This includes the ability to read and write several common data formats.

Starting to build up a new network the interfaces play a central role. Compared to a decade ago major projects no longer involve manual digitising of the core network, but will rather rely on already processed data. Especially data that is used for navigation systems for cars has proven to be very convenient. These navigation networks are not only very precise and have a high resolution, but are even updated regularly.

The data model is the base of any software application as:

- it defines all objects and there interrelationships,
- it determines the level of detail of the model,
- it limits or extends the possibilities of the applications.

For the integration of the product *ptv vision* into a consistent software package several adjustments were essential. Additionally the alignment with external data supplier and software producers made modifications necessary:

One example for an extension of the data model is an improved stop model for public transport. It introduces new levels of modelling with stop points being the smallest entity. Stop point describe locations where public transport vehicles stop for passenger transfers. Stop points are located within stop areas representing platforms, bus bays or station buildings. One ore more stop areas are aggregated to a stop (see figure 8).

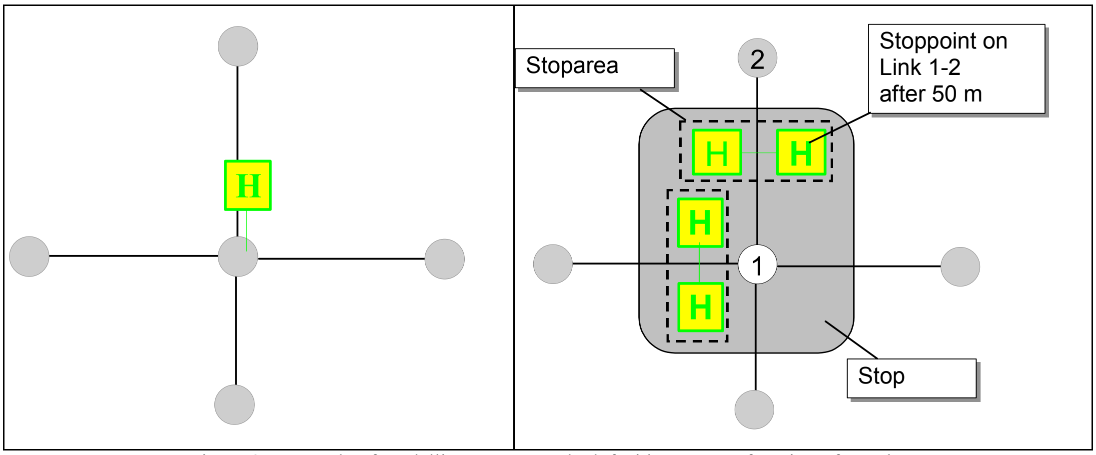

Figure 8: Example of modelling a stop: on the left side a stop as function of a node,
on the right stop points along a links united to stop areas and the stop itself.

This data model enables a much more detailed modelling of a stop (e.g. a railway station with different platforms) and thus supports additional types of information and evaluations. Such an extended model opens up new possibilities:

- a improved interaction between macro- and microscopic simulation,
- an intensive use of navigation networks,
- a linking-up with passenger information systems,
- navigation systems can be provided with dynamic traffic flow data and current travel times,
- passenger information systems can consider specific customer input (e.g. transfer with wheelchairs),
- vehicle data is analysed to calculate possible delays.

The core system is consequently not only a network editor and calculating tool, but also the core data framework, which is structuring, processing and improving information.

4 ACKNOWLEDGMENT

The reported developments in INTEREST and EUROMAP wouldn't be possible without the help of numerous colleagues namely Klaus Nökel, Steffen Wekeck, Thomas Friderich, Markus Friedrich, Michael Landwehr and Axel Gußmann.

5 CONCLUSION

The objectives of EUROMAP and Interest are to provide a wide and comprehensive access to high resolution navigation data for transportation planning and information purposes for reasonable costs. EUROMAP can build the backbone of a transportation data warehouse which allows to store and process multiple data in a consistent manner. The data platform is open, well documented and system interfaces to relational databases and standard GIS systems are supported. INTEREST is still under development. It is planned to publish in 2004 a white book which describes in detail the technical approach and the data model.

Does the Growth of Urban Settlements Follow a Certain Pattern? – Answers Given by Long-term Monitoring of European City Regions

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1 INTRODUCTION

The land use and its structure are basis indicators for the socio-economic and ecological capacity of cities (Arlt et al., 2001). Yet, the growth of settlement and traffic areas is alarmingly high, not only in Germany but also in other Western industrial countries (Federal Environmental Agency, German Environmental Index DUX, 2003). Since in particular the multi-temporal recording is very time-consuming, there are only a few national and international GIS data bases available which allow quantitative, comparative investigations of the land use development. Within the research project "Long-term surveys of land use changes and their environmental effects on soil and landscape structure", which was started at the IOER in 2001, urban and rural regions have been investigated over long-term periods. As an example for this purpose the land use data of the EU project MOLAND (Monitoring Land Use/Cover Dynamics, EEA 2002), recorded at four time slots during the past 50 years, for the cities of Bilbao, Bratislava, Copenhagen, Dresden, Lyon, Munich, Oporto and Palermo were chosen for decided GIS analyses in order to answer questions on the sustainability of the urban development. Furthermore, the provision of the cities with recreational areas including their reachability as well as the degrees of soil sealing and urbanisation were calculated. For the city of Dresden the investigation was expanded to a period of 200 years (eight time slots), and sophisticated analyses in connection with the population trend, the traffic route development and the consumption of valuable land for agriculture were accomplished.

2 DEVELOPMENT OF LAND USE

The development of the land use according to the main classes of the eight European study cities revealed some commonness (Fig. 5). The areas of urban fabric as well as areas used for industry, commerce and traffic saw a steady increase on the expenses of agriculturally used land, forests and semi-natural areas within the past 50 years. Admittedly, a decelerated development of this process was visible within the last survey period starting from the middle of the 80s. The development of land use – distinguished by core and surrounding area – also revealed that the growth of settlements took place mainly in the surrounding zones although there were still potentials – albeit to a different extent – for a densification in the core zones of the cities (Fig. 6).

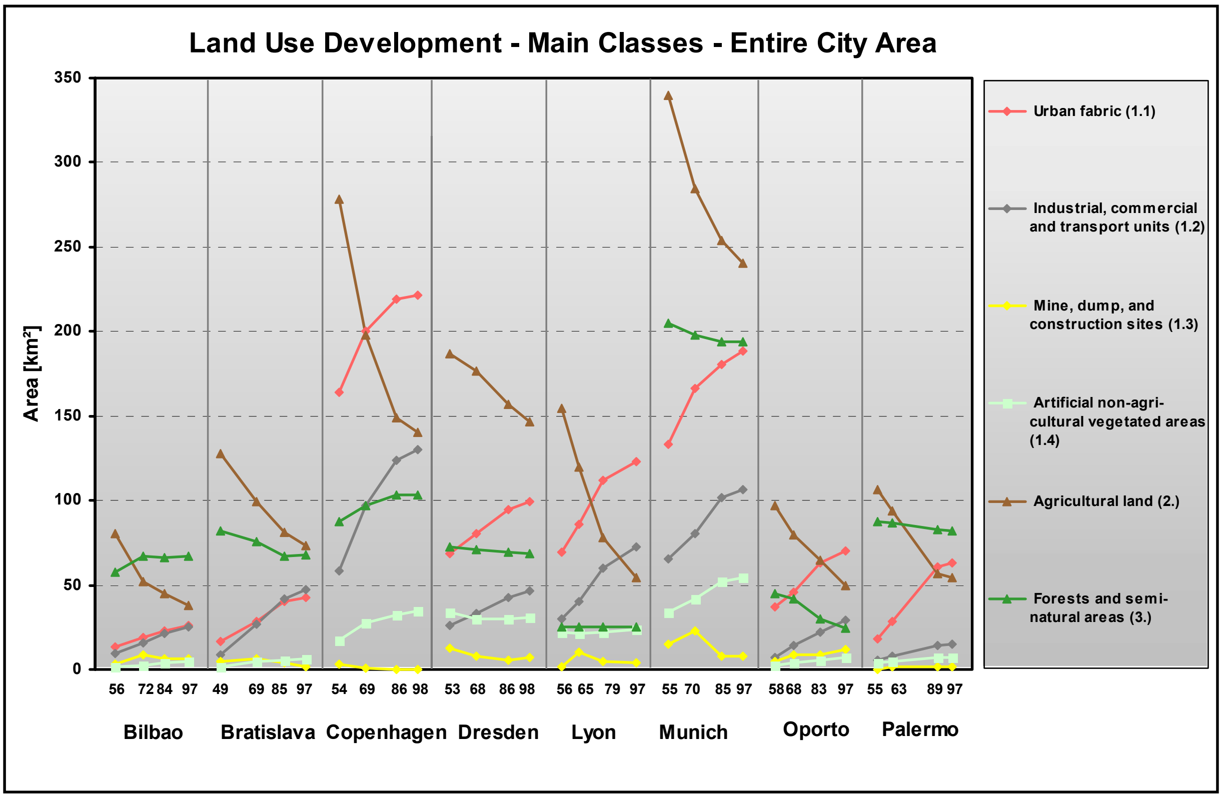


Fig. 5: Comparative presentation of the development of land use according to main classes for the entire city area.

The degrees of soil sealing for the core, surrounding and entire city area were calculated by assignment of a specific average degree of soil sealing for each land use type (Fig. 6).

The degree of urbanisation is defined by the ratio of the settlement area to the total area. It was calculated separately for the core, surrounding, and extended surrounding area as well as the entire city zone and entire study area of Dresden (Fig. 7). Most remarkable is the almost linear increase of the degree of urbanisation in all analysis periods since nearly 200 years, despite the completely different societal and economic conditions during that time. Only the period of promoterism between 1880 and 1900 ("Gründerzeit") saw an even bigger rise of the degree of urbanisation caused by a strong population growth and a powerful economic development.

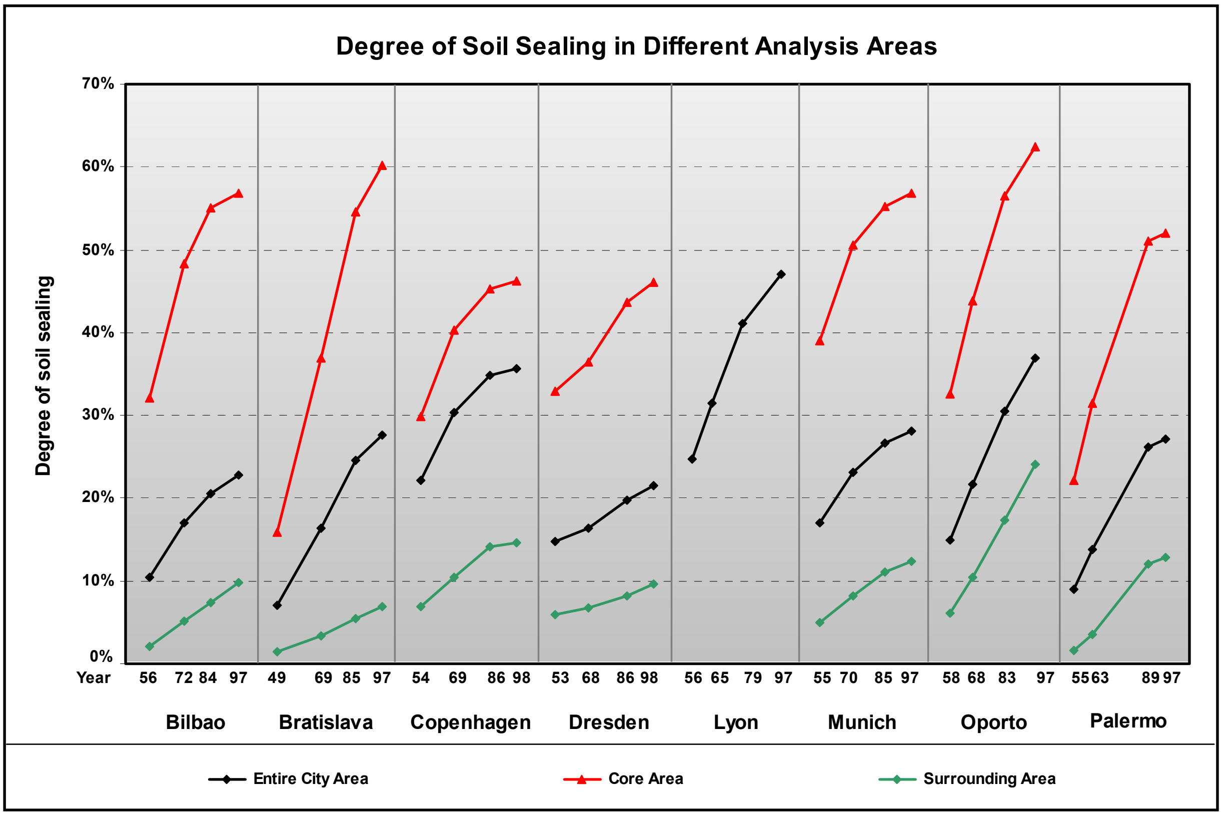


Fig. 6: Comparative presentation of the development of the degree of soil sealing for core, surrounding and entire city area.[1]

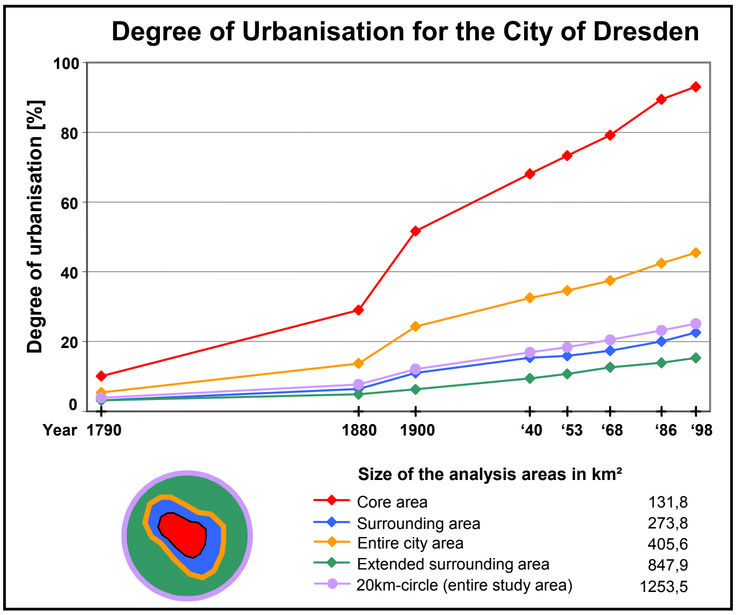


Fig. 7: Development of the degree of urbanisation of the city of Dresden for different extents of the analysis area.

3 ASSESSMENT OF NEW SETTLEMENT AREAS

In order to achieve a sustainable city development preferably short distances of the new settlement areas to the settlement core (e.g. traffic-reducing effects) and their strong integration into the existing settlements (minimizing development costs, etc.) should be aspired. For that purpose every new settlement area was evaluated according to its location in relation to the settlement core and its degree of integration into the existing settlements. For the classification according to the location three classes were created: 1st inner

1 Since for the city of Lyon no core demarcation line had been delivered investigations could be carried out solely for the entire city area.

development (I), if the new settlement area was situated within the respective old settlement core, 2nd fringe development (F), if the settlement growth took place between the old and the new settlement core within two time slots, and 3rd outer development (O), if the new settlement area was situated outside of the new settlement core (Neumann, 2002). By means of a GIS-supported analysis of all new settlement areas for all study periods and subsequent cumulation the periods of development can be assessed regarding their sustainability (Fig. 8). It appeared that the last period (1986-98) was characterised by high settlement processes in the outer region (Type O), which did not characterise a sustainable development.

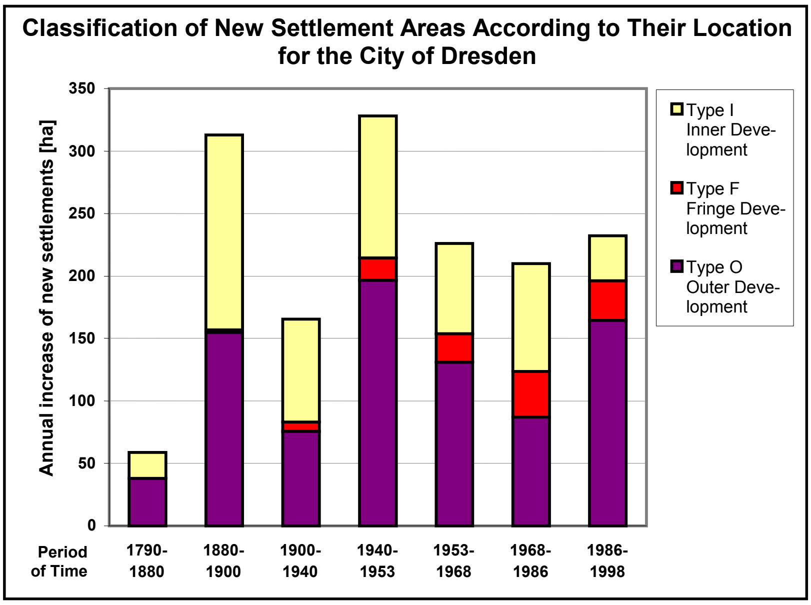


Fig. 8: Statistics of new settlement areas differentiated by their location for the city of Dresden.

The degree of integration of new settlement areas into the existing settlements can be assessed by the ratio (I) of the length of the shared borderline of the new artificial area with the existing settlement area and the perimeter of the new artificial area itself (Winkler, 2001). Thus, four classes of the new settlements were created according to the way of their integration into the existing settlements (Fig. 9): totally ($I>2/3$), well ($1/3<I\leq 2/3$), less ($0<I\leq 1/3$) or not integrated ($I=0$).

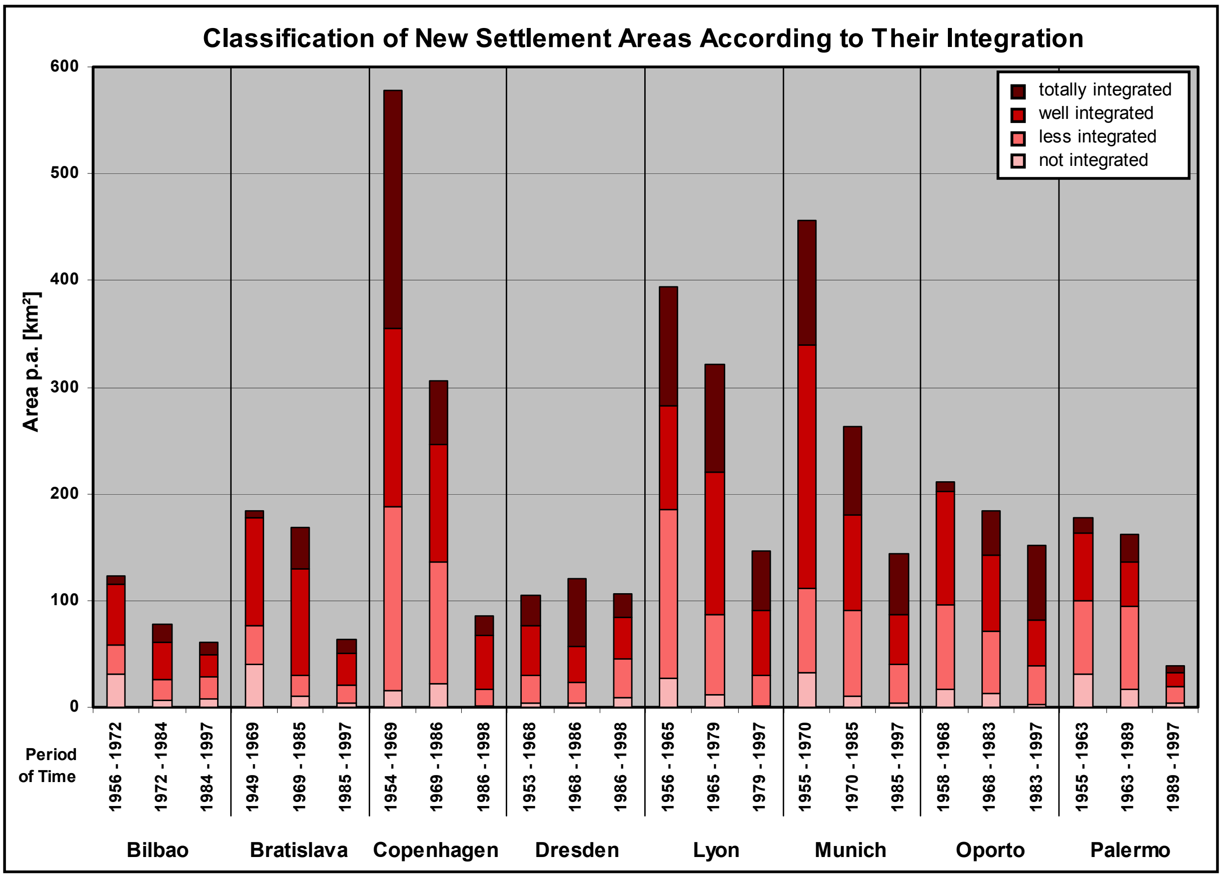


Fig. 9: Statistics of new settlement areas by their degree of integration into the existing settlement area – comparative overview.

4 PROVISION OF RECREATIONAL AREAS

Furthermore, the provision of public recreational areas within the eight study cities, including their reachability for the urban population, was investigated (Meinel/Winkler, 2003). The analyses yielded that there was not only a drastic decrease of the amount of recreational areas in all study areas (Fig. 10) but also a worse reachability became visible particularly in the core zones of the cities (Fig. 11). The research was based on the calculation criteria of the “European Common Indicators” (Technical Report - European Common Indicators, 2000) which refers to the share of residential areas being situated within a buffer zone of 300 m around public recreational areas (mainly parks and forests, to a lower degree agriculturally used areas).

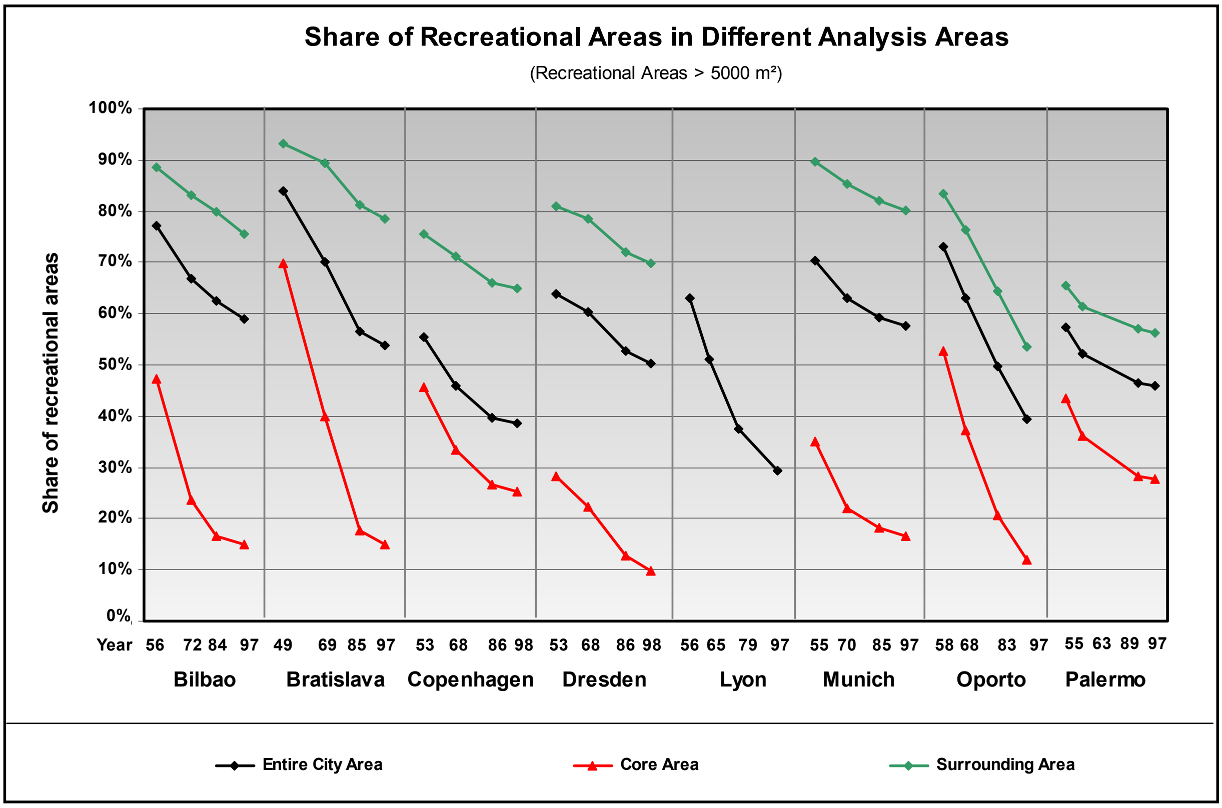


Fig. 10: Share of recreational areas in different analysis areas.

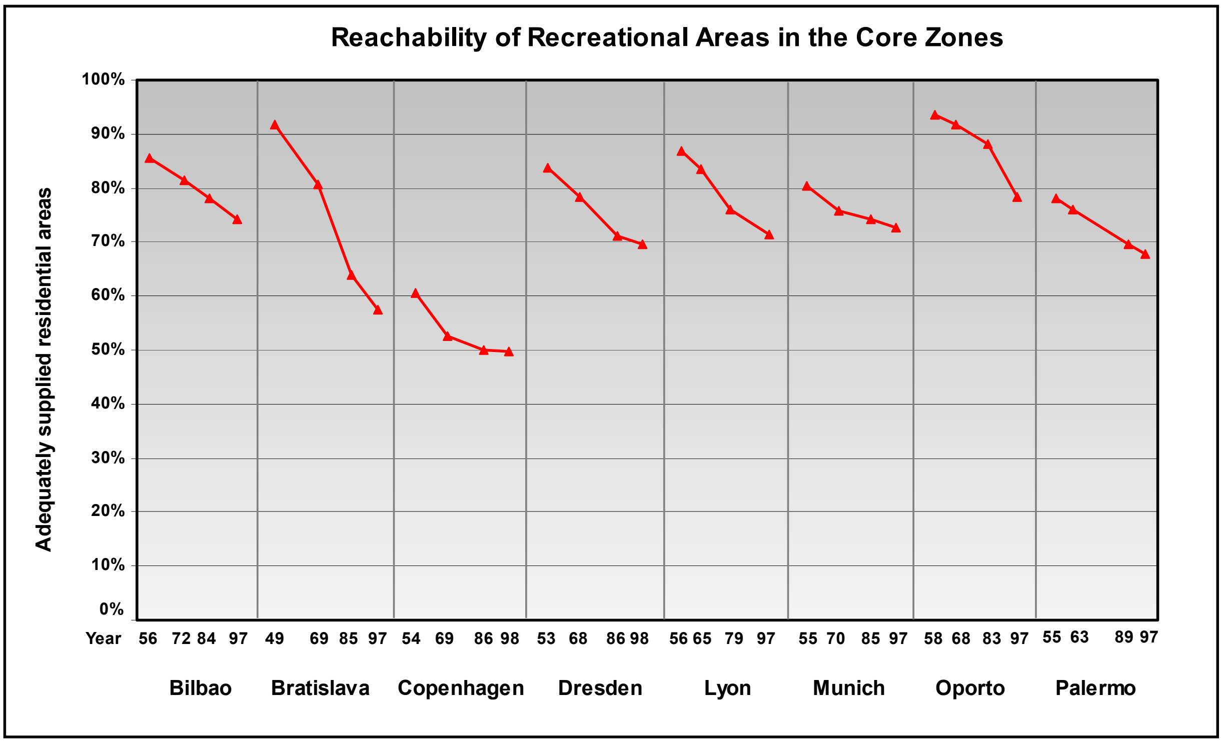


Fig. 11: Reachability of recreational areas accessible to the public and free of charge in the core zones.

5 LIVING DENSITY AND POPULATION FIGURES

The increase of settlement areas is determined by population growth, increasing demands for living space (size of flats and urban open space) as well as an expansion of industrial and commercial areas. In order to differentiate between these driving forces the population figure was put into ratio with the residential area (Fig. 12). The figure shows that the highest living density (27,000 inhabitants/sqkm) was reached in 1900. Until 1998 this figure dropped down by around 75 % to 7,000 inhabitants/sqkm due to a decreased building density in the residential areas (also caused by the massive destructions in World War II) as well as increased demands for living space and urban open space (Meinel/Neumann, 2003). As an additional reason the incorporation of suburban communities with a lower population density compared to their settlement density can be stated.

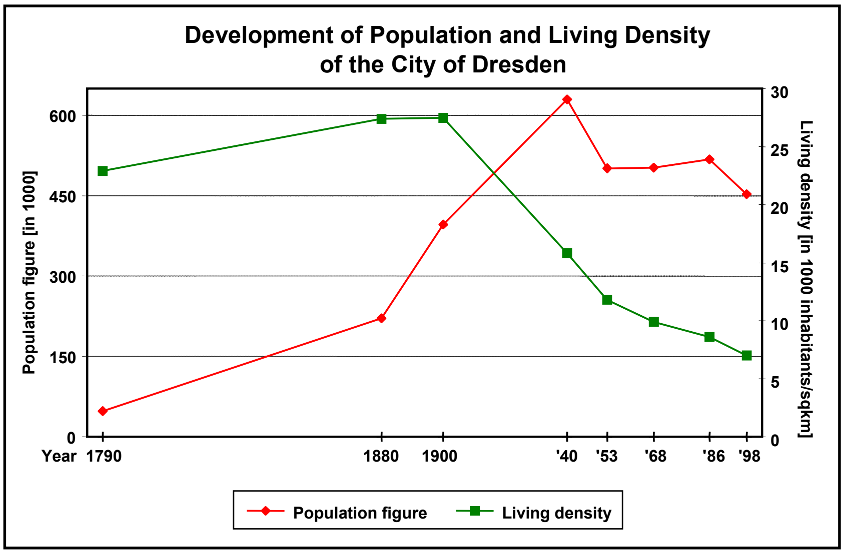
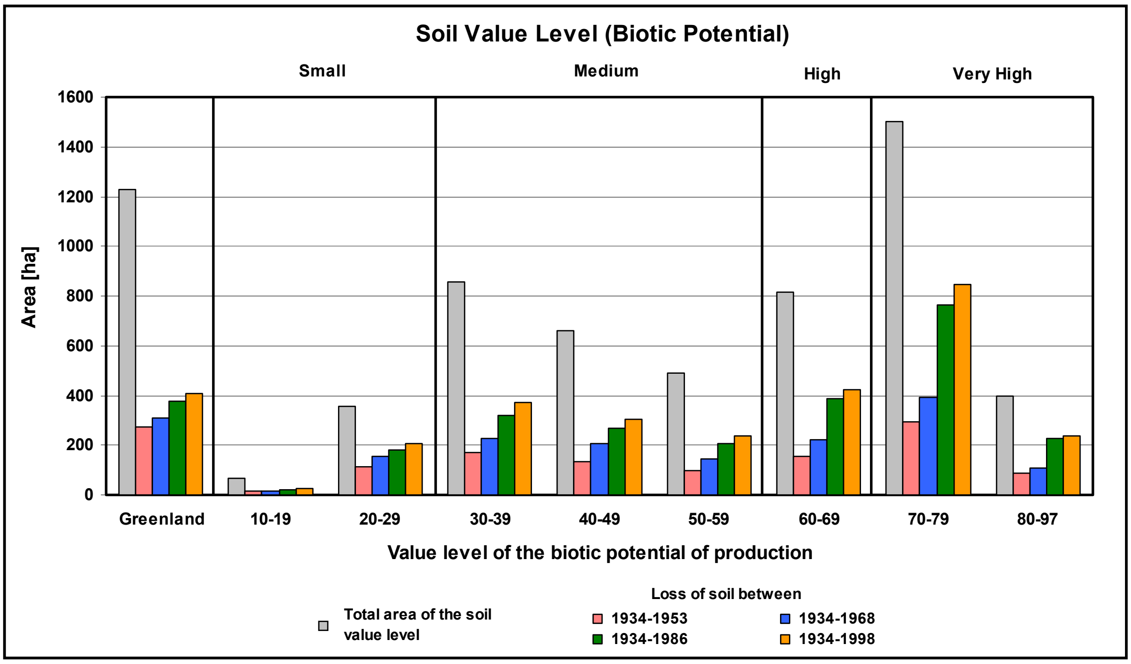


Fig. 12: Development of the population figures and the living density in the past 200 years for the city of Dresden.

6 CONSUMPTION OF FRUITFUL SOIL

Many cities have been grown along rivers and therefore in most of the cases on very fertile floodplain soil. Due to suburbanisation processes very fruitful arable land has been used for settlement activities and got sealed until today. In doing so it lost its capability for agricultural usage in a mostly irreversible way. By processing of the data of the "Reichsbodenschätzung"[2] and subsequent intersecting with the land use data bases of the city of Dresden the consumption of soil differentiated by their biotic potential of production could be calculated (Fig. 13). It was revealed that the land had been used for settlement activities without considering its quality. At no point of time fruitful soil has been conserved.



2 The soil assessment was started in the German Reich in 1934 and finished in the German Democratic Republic in 1955 (data taken from the "Environmental Atlas Dresden").

Fig. 13: Loss of soil caused by building and sealing, differentiated by their biotic potential of production for the city of Dresden.

7 PRESENTATION OF THE STUDY RESULTS

The continued consumption of land and the therewith related problems are still insufficiently reflected in the society. Easy-to-understand dynamic and interactive presentations of the creepingly ongoing land use development could improve the perception of the problem. Therefore different methodological module and results of the studies of the research project "Long-term surveys of land use changes and their environmental effects on soil and landscape structure" have been prepared for the Internet (www.ioer.de/Langzeitmonitoring). The start up web page can be seen in Fig. 14.

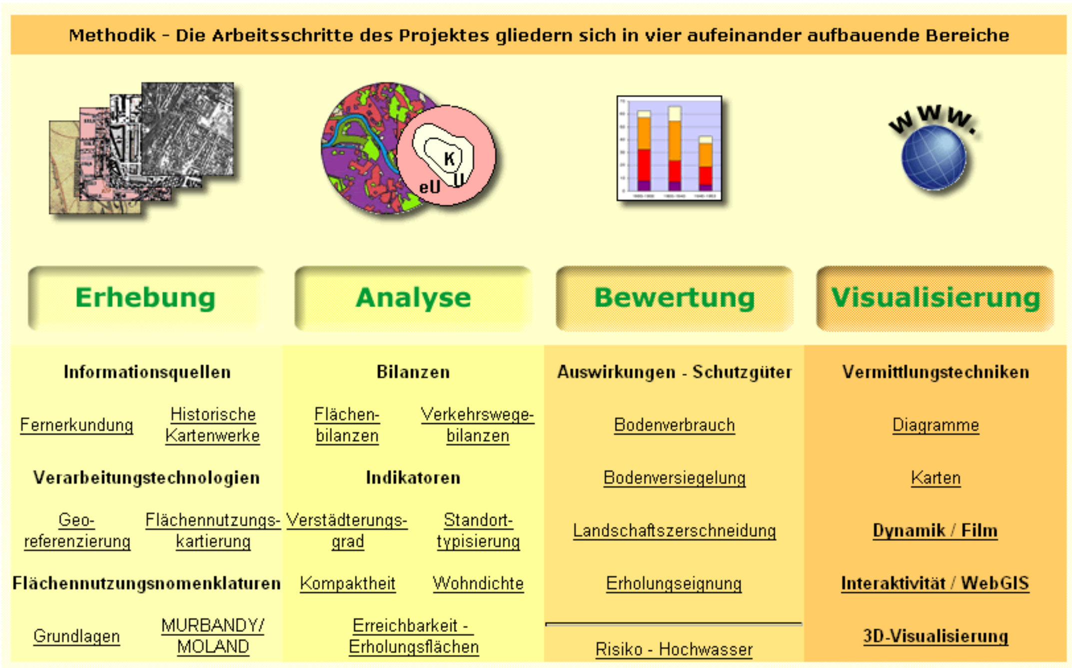


Fig. 14: Start up web page of the research project „Long-term surveys of land use changes" (www.ioer.de/Langzeitmonitoring).

With the aid of the Macromedia Flash the development of the core settlement area of Dresden – among several other applications – was displayed using a morphing algorithm of the eight different time slots Fig. 15, (Seckel, 2003). Furthermore, the land use data bases as well as the historic maps were made accessible in an interactive presentation in the Internet on the basis of ArcIMS including the options "Select Layers", "Zoom", "Roaming" and "Queries" (http://map.ioer.de/website/FNDD/viewer.htm).

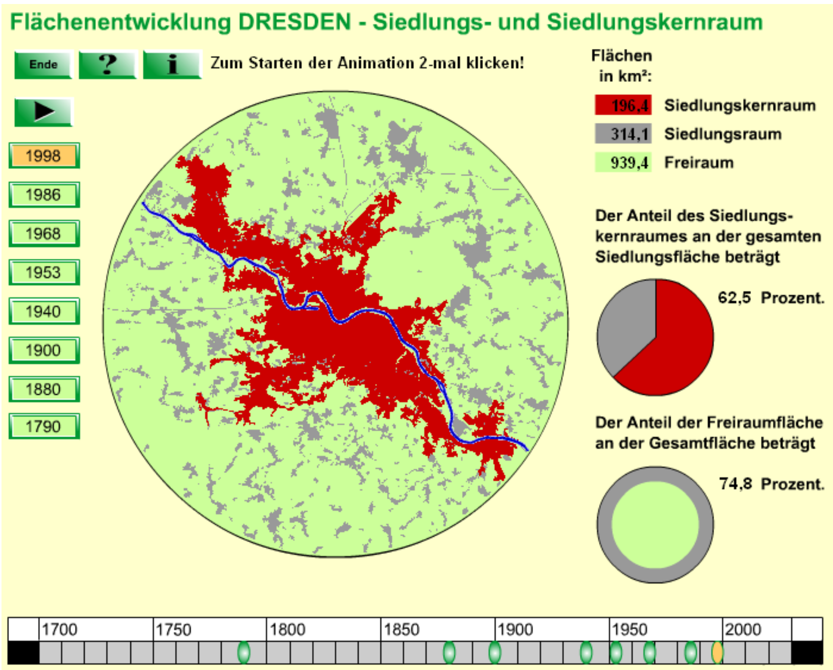


Fig. 15: Dynamic presentation of the settlement development of Dresden on the Internet using Macromedia Flash.

8 BACK TO THE INITIAL QUESTION

When looking at the results of the researches one may come to the conclusion that the growth of urban settlement areas seems to follow a certain pattern. Widely uncoupled from the societal conditions including the economic and demographic development the urban settlement area has increased (Fig. 7). For that many reasons can be identified. In Germany, for instance, the settlement growth has been determined by domestic constructions by almost the half of the building activity since 1993 (Federal Statistical Office, 2003). The subsidisation for the erection of single-family houses provided by the state[3], the strong lobby of the building industry (including building and loan associations) and the wish of large parts of the population to live in the green caused this settlement growth which could be decelerated only by the economic stagnation in Germany since 2001. On the other hand there are a growing number of unused areas in the form of derelict land (increase 12.7 % from 1993 until 2001) due to shrinking processes (e.g. surplus of flats). In Germany there are more than 128,000 ha of derelict land which were formerly used for industry, commerce, military, and traffic (BBR 2003). A sustainable development can only be achieved by a consequent usage of these derelict lands by revitalisation or recycling. Thus, the manifold obstacles of the revitalisation of these areas (e.g. unsettled ownership structures, land contamination, endeavours of speculation of the owners) must be reduced (Tomerius/Preuß, 2001). This long-term learning and working process requires an open-minded discussion among the groups and persons involved (e.g. municipalities, owners, possible users, planning offices, and residents). Tackling that challenge is not only a German but a European-wide issue.

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3 In 2002 the Federal Government of Germany spent 9.5 billion € (Federal Office of Finances of Germany, 1999-2002) on the so-called “Eigenheimzulage”. The “Eigenheimzulage” is a special tax relief for families investing in housing property for their own usage. It is mostly granted for erecting single family homes at the urban fringe.

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Socio-cultural contradictions in the arab/Islamic buildt environment an empirical study of Arriyadh, Saudia Arabia

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ABSTRACT

Since the beginning of this century, in-acculturation which is the full acceptance of foreign ideas and concepts, have produced a negative impact on the Arab/Islamic socio-cultural milieu. Instead of the synthesized approach to the transfer of ideas and concepts or in another word acculturation, the in-acculturation approach resulted in many socio-cultural contradictions in the Arab/Islamic built environment. Every built environment consists of distinctive features that relate to social, cultural, economics] and environmental parameters inherent in that particular built-environment.

Before the 1950s, the built-environments of the country of Saudi Arabia were a natural continuation of city —building techniques throughout history. The most significant period that affected that urban continuity was the advent of the religion of Islam. However, since the 1950s, fast and dramatic changes- with mainly Western connotations- had occurred in the built environment that had affected it in social and cultural terms. These urban changes were not synthesized with the socio-cultural norms and ways of life of the residents of these built-environments. In another word, a process of urban in-acculturation had been taking place in the urban structures of the country’s cities and towns.

This paper attempts to understand and explain the process of in-acculturation by investigating the deep roots of two distinctive civilizations; the Islamic and the Western. The city of Arriyadh was chosen for an in-depth empirical investigation for this paper.

Parts of the resultant field study analysis were used for this article in order to share some of the benefit of the main research. Using both, quantitative and qualitative approaches, it examines the socio-cultural contradictions, the urban identity, and the causes of failure in the built-environment.

The study reveals that the traditional built-environment had less socio-cultural contradictions, clear urban identity, and perceived in positive terms. While the contemporary built-environment resulted in socio-cultural contradictions and ambiguous and distorted urban identity and perceived as containing negative socio cultural handicaps. The paper will end with thoughts and recommendations arising from the research findings on the preservation of the traditional urban environment

1 SOCIO-CULTURAL CONTRADICTIONS IN THE ARAB/ISLAMIC BUILT ENVIRONMENT WESTERN & ISLAMIC THOUGHTS AND PHILOSOPHIES: A COMPARATIVE APPROACH

Let us begin with a very essential question, why look at the traditional past of a civilization as we consider its future?

The significance of analyzing and studying the traditional past of a civilization – our concern here is with the architectural and urban aspects – such as the Arab/ Islamic civilization lies in the importance of intensifying the historical and urban consciousness of its members and community as a whole.

In addition, such a study would help us to understand and comprehend the circumstances imposed by present –day needs and problems, as well as the requirement of the future. Abdulhaleem, I. argues that:

“…The historical consciousness of the civilizational presence of any city, and of the historical depth and extension of that presence, is vitally important in order to enable the city to define its reality and to give expression- architecturally and Urbanistically- to its identity and requirements, both present and future…" (Abdulhaleem, I., 1984:43)

Abdulhaleem raises the issues of a duality between the acquired and inherited. The evidence of this two-fold aspect could be found not only in the architectural expressions but also in all government institutions and public life itself. The contemporary architecture and urbanism in Arab/Islamic cities are an embodiment of the conflict between the acquired which is foreign, mostly Western, in its origin, secular in its thinking, materialistic in its economy and cumulative in its laws, and the inherited which is Islamic in origin, religious in ideology, social in economy and regenerative in its laws.

1.1 The Acquired and the Inherited: Reasons of Failures

Finding a common element or theme between the acquired and the inherited or the contemporary and the traditional (pure aspects of a civilization), has always been a sensitive issue that has puzzled thinkers and philosophers for a long time.

Trying to reach an objective solution for that equation, and creating a balance between its two sides is not an easy task that could be solved by nostalgic feelings since this will hamper the objective mind from seeing things on their true meanings and explanations.

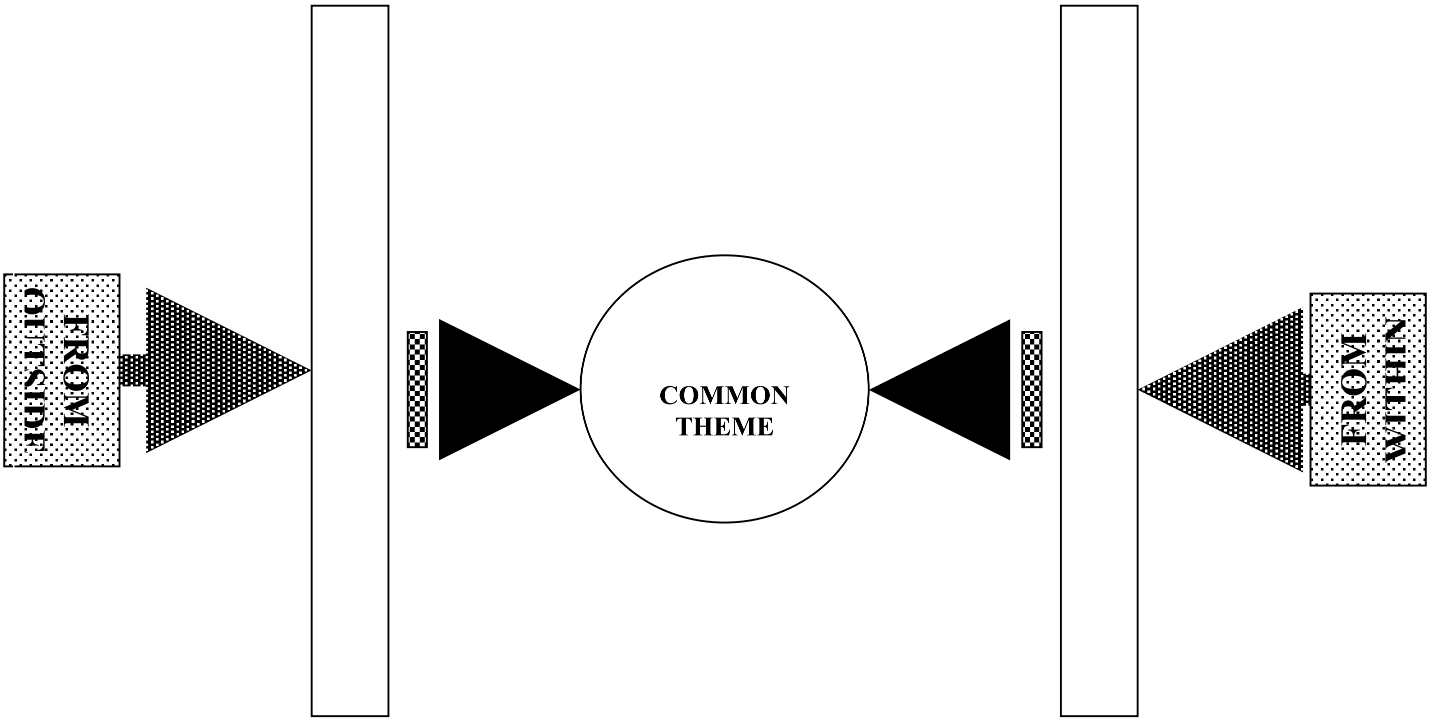

Figure 1: The Common theme between the **acquired** and the **inherited**

It is known that the theory of "cultural borrowing "came into light by the end of the last century and is strong today. And it is also known that research into that concept of " cultural borrowing " was not developed into the Arab / Islamic ways of thinking and comprehension as a natural development, but it was developed through different psychological factors that we could call as the " inferiority complex " of imitating a more advanced technological civilization.

Ibn Khaldoon (1332-1406), the sociologist and historian of the 14th century AD, argued that: "…the loser always looks out to imitate – copy - the winner in his thoughts, clothing, religious beliefs, and all his ways…"(Fattah, 1985:327 translated by Author).

As a result of that, all the suggested solutions for that very difficult "equation "were not genuine enough and did not describe a natural necessity. Those recommended solutions came from ideas and viewpoints that were foreign and alien to the reality of the Arab/Islamic world. They were borrowed heavily from principles and thoughts of Western philosophy which, in many ways, differ from the process that led to the development of the Arab/Islamic thoughts and philosophies in its creation and development.

In order to understand the process that led to the alienation – feelings of inferiority – of the Arab/Moslem ways of thinking which was translated into the architectural and urban environment of his urban spatial structure, let us go back in time and try to construct a comparative historical analysis on the process that led to the development of both Western and Arab/Islamic philosophy and schools of thought.

Since its inception by the Greeks in the sixth Century BC, "Laws of contradiction and conflicts between opposites" dominated Western schools of thought. In order to explain what is meant by the "Laws of contradiction and conflicts between opposites ", we have to go back in history and try to trace the development of Western thought.

The contradiction between opposites was obvious between the two schools of thought of the absolute unity theory of Parminidius in 544 BC, and the immortal effusion theory by Hiracladius in 504 BC.

The absolute unity theory saw existence as a whole, one, constant and infinitely eternal. It could not deteriorate or disappear and that it will always be there in existence.

Therefore, Parminidius did not believe in the principles of motion, movement, impossibility, and transient time.

On the other hand, the immortal effusion theory saw existence as always in motion, (not constant) and therefore changing every time from one state to another disallowing relative, temporary and absolute stability.

The followers of the "absolute unity" school of thought ended in proving the existence of a rational being. This being or God is absolutely perfect and the "perfectness" does not allow him to be linked with any thing in this materialistic world which is imperfect. In the other hand, the opposite school of thought "immortal effusion" ended up in proving the absolute materialistic existence with an extreme atheist viewpoint. It sees this materialistic existence as explaining itself. And that everything is material, even thoughts, principles, and morality. This school of thought looks at the social system we live in, and the individual, as revolving in a completely changing and immortal cycle although it consists of distinctive units.

The contradiction between opposites continued with the model or utopian philosophy of Plato and the natural or empirical philosophy of Aristotle as known to the Moslem scholars.

The inner development of western thought and philosophy was realized during the middle ages between the two schools of thought. That development was realized in nominalism and realism. Nominalism (St. Augustine) rejected the existence of names and things outside the human mind. It implied absolute abstractness of the essence and nature of names and that they were just “a blow of air that does not have any meaning”.

The other school of thought of the middle ages of the Western Civilization, realism, implied the existence of the absolute abstractness of names and things independently outside the human mind. And that they exist, regardless if whether the mind senses them or not. According to the realists (St. Thomas Aquinas), the world of materialistic particles recognized in reality were the world of extinction and non-being. So in accordance, they could not really exist in the absolute sense of the word.

With the beginning of the modern age, the contradiction and conflict between different schools of thought were more apparent. This was obvious between rationalism and empiricism. The rationalists (Rene Decartes) relied heavily on the mind in order to understand and explain the world. The mind, itself, as the source of all knowledge and it is independent from the senses. On the other hand, the empiricism school of thought (John Locke) stressed that all knowledge originated from trials, sense, and reality. This school of thought was heavily influenced by Aristotle’s natural philosophy.

In the 19thcentury, the Marxist school of thought (Karl Marx) emphasized that the principle of conflict between opposites was the ultimate, eternal and immortal law in which history has no choice but to submit to it. Marxism stressed that the individual human being was the result of the conditions of his circumstances, and therefore has no choice but to submit forcefully to his materialistic conditions.

In comparison with the Western development of schools of thought, the Arab/Moslem thinking developed on the basis of a divine book called the ‘ Kora`an’. It was based on completely different inner development to what was discussed earlier in the development of Western thought. The law which governed that development could be called the law of “coalition, customary and averages”. This attitude toward coalition relied heavily on the consensus of the Umma or Moslem community as a whole, and was based on the Kora`an and Sharia law. Throughout the historical development of Arab/Moslem thinking, extremist or radical thoughts were either eradicated from the process of development or contained in a way that ensured that those thoughts were controlled with the process of time and evolution.

On the other hand, the West – in his traditional way of thinking and civic cultural infrastructure – is pluralist in creation and evolution. What is meant by that is the pure Greco – Roman cultural roots and fundamentals on one hand and the religious philosophy – Christianity – on the other hand. The Western religious philosophy has Eastern roots and fundamentals that were different from the Greco-Roman ways of thinking in creation and evolution. It took over three centuries before Christianity could have a foothold or a presence in the Western ways of thinking. At that stage of evolution, there existed some kind of a line between the reality of the Western secular thought and the spiritual values and teachings of the religion.

As a result, the Western history – in opposite to the Arab/Moslem history – was a continuous and lasting effort to ensure and protect the separation between the secular and the spiritual so that matters of life are not mixed with religion. That pluralistic approach of essence and infrastructure of the Western philosophy continued emphasizing the separation between history and religion and that they were not compatible in outlook and knowledge except in a few limited periods of history.

For our comparative purpose at hand, as was explained before, the Arab/Moslem ways of thinking were based mainly on the Kora`an and Sunna (tradition of the prophet), followed by the two important concepts of ijma`a (meaning consensus) and qiyas (meaning analogy). Arab and Moslem thoughts emphasized assimilation and synthesization. And that mind and matter were as equal as theology in the sense that both worked as sources of knowledge.

In comparison, the Western scholastic theology and philosophy acted as two different and distinctive areas of knowledge. Philosophy dealt with the actual realities of truth to the human mind; on the other hand, theology studied the spiritual facts of immortal things. That differentiation was emphasized by St. Thomas Aquinas (1274 AD) and Dennis Scot (1308 AD), and that both theology and philosophy acted independently from each other. Arab and Moslem schools of thought rejected that differentiation between philosophy and theology. And as was discussed previously, they equaled them to each other as sources of knowledge implying that there is no religious fact that exist without some support from the mind. Al-Gazali (1058-1111AD), a philosopher and intellectual of the 12thcentury AD, wrote:

“…if theology – scriptures – was as a mind from the ‘outside’, then the mind itself is no more than a theology from the ‘inside’. And that both, theology and mind have to agree on deciding rules and laws…” (Fattah, 1985:326, translated by Author)

Al-Razi, another intellectual of the 14th century AD, went even further than that and he stated that:

“…if the evidence of the mind contradicted the evidence of ‘isnad’- which is the chain of authentic authorities on which a scripture or a tradition is based – then the ‘isnad’ have to be evaluated within the criteria acceptable to mind and logic, since that religion was not in fact proved without the evidence from the mind…” (Fattah, 1985:326, translated by the author)

On the other hand, there existed a school of thought that differed with Al-Gazali and Al-Razi and other intellectuals of that period. The pioneer of that school of thought was the philosopher Ibn-Rushd (1126-1198 AD), known in the Western culture asAverros.

Ibn-Rushd differentiated between philosophy and theology and there was a medieval Islamic controversy between Al-Gazali and Ibn-Rushd on the interpretation of theology and the concept of consensus (Bello, 1989). Many historians argued that the writings of the philosopher Ibn-Rushd had a major effect on the development of the Western philosophy from the 13th century AD onwards and its struggle for the differentiation between philosophy and theology. However, the Ibn-Rushd school of thought (Averros) acts as an example of the containment process that was evident throughout the development of Arab/Islamic philosophy and ways of thinking.

The influence of philosophy could be considered very minimal on the whole of the Arab/Islamic schools of thought and did not have a major effect on its development as some researchers had suggested, like Danner in his book, The Islamic Tradition. Many

Arab/Islamic intellectuals of that period cautioned against what they termed "the disease of un-controlled reasoning" by philosophers and intellectuals (Danner, 1988). A recent writer observed that:

"…The Islamic mind differs from that of the West …It differs from it simply in that it still clings to certain concepts of the absolute, the West has, for the time being, abandoned. Whether, in so doing, the West has achieved a triumph, must surely remain a matter of opinion. What does seem clear is that, for better or worse, the two intellectual modes are, for practical purpose, largely incompatible." (Hiskett, 1993:69)

The Arab/Islamic schools of thought did not approve of any pluralistic division between philosophy and scholastic theology. Moreover, throughout history, these schools emphasized that they acted on equal basis.

1.2 Acculturation or In-acculturation: Is it a dilemma?

The pure aspects of the Arab/Islamic socio-cultural milieu remained constant since its inception. That culture evolved through acculturation with many different great civilizations like the Greek, Romans, Persian, Indian, and others.

In the early stages of that period in human history, the thinkers of that Islamic civilization were under no pressure. There existed no psychological or political "inferiority complex" which hindered the concept of acculturation with other cultures and societies. The acculturation concept emphasizes the integration and synthesis of alien concepts and thoughts into the mainstream indigenous socio-cultural framework. There was a balanced cultural absorption throughout the period of that particular civilization, the philosopher Al-Kindi (801-866 AD) emphasized the tolerance of accepting foreign knowledge. Al-Kindi wrote:

"…We should not be ashamed to acknowledge truth from whatever source it comes to us, even if it is brought to us by former generations and foreign peoples. For him who seeks the truth there is nothing of higher value than truth itself…" (Hourani, 1991:76)

The independent will to create and evaluate was the key factor to the greatness of that period. The people of that period excelled in many spheres of life. The result was evident in the literature, sciences, medicine and our main theme in this paper "the built environment".

In the contemporary Arab/Islamic period, the thinkers work in a very limited "breathing space". They are under tremendous political, economical, social and psychological pressures. Their independent free will of choice has been diminishing to a great extent. The benefit from the Western thought is very limited because the majority of the contemporary thinkers (being architects, city planners, civil servants, poets or others) rely heavily on Western thinking instead of the inner-self development of their own creative thoughts. As one contemporary writer emphasized:" What each one of us wants to know today is how to get out of ourselves, how to escape from our mountains and sand dunes, how to define ourselves in terms of ourselves and not of someone else, how to stop being exiles in spirit." (Laroui, 1977:384-5)

However, to give an example of the socio-cultural contradictions in the area of the Art, the Islamic art emphasized the concept of abstractness. The Islamic art is usually non-representational and non-individualistic. This is so, because the teachings of the Islamic culture does not approve of imitating human figures, since it implies a paganistic outlook and that God is the only Creator. On the other hand, Western art is usually representational and individualistic in its sculptures and paintings. Contemporary artists in the Arab/Islamic world work with differentiated ideas. If one travels through the built environment of many cities like Cairo, Damascus, and others, he will notice huge sculptures of human-figures. Many people are offended by their presence on their squares and streets because they are not accepted as an Islamic art. The same applies to other so-called "creative minds". The result was a heterogenetic collection of thoughts that separated them from the "realities on the ground" and distanced those thinkers from the problems and aspirations of the culture itself. In another word, the example mentioned previously in the area of art shows a classical example of in-acculturation or the inability to integrate a foreign concept into the mainstream socio-cultural framework.

There was and still exists a weak connection between thinkers and intellectuals, and their own culture, norms and ways of life. Unfortunately, few people realized what was happening since the beginning of this century. There existed a heavily unbalanced evaluation and criticism of the Arab/Islamic thoughts and traditions. Albert Hourani, one of the thinkers of the period, called it the "Arab renaissance" (Hourani, 1991). To him and others, the hidden contradictions of completely imitating a scientifically superior culture were not foreseen. A result that will be demonstrated empirically on the urban spatial structure.

The modernization theory advocated by many resulted in a pattern of in-acculturation. The hope and desire to advance and modernize since the beginning of this century was carried on, unfortunately by losing socio-cultural individual characters and the denial of rich historical experiences. The historical experiences produce the autonomous culture of any human group. These historical experiences are called traditions and they constitute the heritage of any cultural grouping. In the Arab/Islamic culture, the word is derived from the concept of inheritance. Al-turath meaning tradition and heritage is derived from the word Al-mirath meaning the inheritance of an individual. While the inheritance (mirath) is distributed among the deceased family, the turath is the spiritual, intellectual and experiences handed down from generation to another. In another word, it is the presence of the father in his son or daughter or the past in the present. This presence includes; theology, language, literature, ways of thinking, aspirations, and nostalgic feelings.

According to Al-Jabiri, the tradition, heritage, or turath is: "…the turath is whatever present with us or in us from the past. This past could be ours or somebody else's past whether it was the distant or close past…" (Al-Jabiri, 1992:45)

Since the concept of tradition contains many elements of imitation, many questions could be put forward. Among these: How can tradition evolve and change through time? And how can we continue to see tradition as one and the same tradition? In another word, does continuity exist in a changing tradition? And the most crucial dilemma to any socio-cultural setting is whether to preserve its own socio-cultural tradition, or to establish a sense of continuity with that tradition. In our own culture of the Arab/Islamic world the answers to these questions and dilemmas were not looked at seriously.

In consequence, the regenerative impulses in the architecture, town planning and other disciplines of life were seriously hampered. Hassan Fathy, a renowned Egyptian architect and town planner, cautioned against full acceptance of imported town planning principles and concepts. (Fat'hy, 1972)

The idea is not to deny the acceptance of modern knowledge or the blind imitation of tradition.The argument is to have a sense of continuity with the past by open evaluation and criticism of tradition. The past should not be always sanctified and authoritative but should be given its own weight of value. "…You may create a theory, but the new theory is created in order to solve those problems which the old theory did not solve." (Popper, 1968:132)

Anderson argued in his writings on history, theory, and criticism of architecture. He wrote that: "…The tradition we prize is not a mere accumulation of knowledge, and undifferentiated catalogue of past events, but rather a vital body of ideas, values, mores, and so forth that we have as yet found resistant to criticism." (Anderson, 1970:81-82)

The theory of cultural borrowing did not emerge as a natural development. Instead, it came about through different imposed factors. One of those is the desire of some elements in the society to dis-regard the socio-cultural tradition entirely. This position denies a given society's freedom of choice and implies a lack of authenticity and non-participation on the part of a traditional culture and population. Their position, as Laroui maintained is based on the assumption that progress is necessarily an intervention from outside and they were happy importing as many ideas and materials as possible from the presumably superior cultures. The cultural borrowing phenomena would have worked and flourished if there was an objective theme which followed the earlier successful attempts of cultural absorbtiveness. The pure aspects of the socio-cultural milieu were kept constant. The "dynamism" representing cultural borrowing worked effectively through assimilation into the Arab/Islamic culture.

The suggested themes of modernization at the end of the nineteenth century failed because instead of enhancing acculturation, they produced in-acculturation. The results were that:

- Solutions were not genuine enough.
- Solutions did not describe a natural necessity.
- Solutions represented an extremity of thought and the full acceptance of Western models.
- Solutions borrowed heavily from Western philosophy, which differed from the process that, led to the development of the Islamic thought, in creation and development.

After this brief discussion of the historical development of Western and Islamic ways of thinking, philosophies, and the original cultural aspects of two distinctive civilizations the next part of this paper will deal with the question of socio-cultural identity. In order to test what have been already discussed, the empirical results of part of a comprehensive and focused field study conducted in thirty six neighborhoods of the city of Arriyadh in Saudi Arabia, will be presented in the following section of this paper. The study covered an area estimated to be 1782 sq.km. Moreover, this resulted in the accumulation of 504 completed questionnaires.

According to Norberg-Schulz (1965), the built environment has three related aspects; the physical, social and cultural issues. With this understanding, the following section will discuss, with empirical results, the concept of socio-cultural identity and its significance to the physical built environment.

2 SOCIO-CULTURAL IDENTITY AND THE BUILT ENVIRONMENT

The main hypothesis of this paper is that socio-cultural identity in the built-environment of Arriyadh city has changed dramatically since the 1950s. The urban transformation from a traditional built environment to the contemporary urban setting was not matched with changes in Arab/Islamic way of life and rules of conduct. Therefore, this resulted in socio-physical contradictions between the contemporary built-environment, and the residents of the city'' districts and neighborhoods (in-acculturation).

In order to clarify the hypothesis even further, there are two main elements connected with this empirical investigation;

- A physical environment
- Socio-cutural identity and related values

Both of these two elements have changed, but at different degrees. Whereas before, in the traditional urban spatial structure, there was a harmony between people and their built-environment. Nowadays, the harmony is distorted and not clear. Therefore, there is a gap (mis-match) between socio-cultural identity and the physical environment of the city of Arriyadh.

Since the 1950s, the identity of the built-environment has changed dramatically in contrast to the socio-cultural identity of the Arriyadh city's residents. The identity of the house, street, neighborhood and the urban form as a whole have changed. This has not been through natural evolution or acculturation, but as a result of new internal and external factors. This very rapid change was either imported or imposed by the contemporary urban rules and regulations. Consequently, an identity distortion has occurred in the society leading to high levels of dis-satisfaction with the contemporary urban environment. Largely, the problem of identity was expressed in terms of the relationship between the urban and architectural heritage of the past and the contemporary needs of the present.

The Analysis

In order to investigate the distortion that had occurred in the identity of the urban scene, our field study sample was asked about their socio-cultural identity and its compatibility to the urban environment. (34%) of the total number of respondents said that the contemporary urban environment suited the Arab/Islamic socio- cultural identity. However, (60.30%) of the respondents did not agree, and stated that the traditional urban environment was more compatible with the Arab/Islamic socio-cultural identity.

Furthermore, when the respondents were asked the same question but in a different phrase (that the traditional city suited its residents socially and culturally and that the contemporary one, contradicted its residents socially and culturally), more respondents (73.80%) agreed with that particular statement.

In continuing to investigate the state of socio-cultural identity in the Arab/Islamic world as a whole, our respondents were asked whether they thought that the changes that have been occurring during the last hundred years (e.g. the changing urban environment, the changing house decorations and styles, the changing educational methods, changing clothing styles…etc.), represented a specific state of socio-cultural identity. (54.80%) of the respondents said that these variables in socio-cultural identity represented some kind of a crisis in the culture's identity. While (31.90%) of the respondents did not agree with the others. They argued that these variables do not affect the Arab/Islamic socio-cultural identity. These responses did not significantly correlate with the level of education of our respondents. Many respondents, regardless of educational background, felt there was a problem with the socio-cultural identity issue.

ITEM	Primary	Intermediate	High School	Junior College	University	Post Graduate
A	10	32	43	17	227	43
B	3	4	13	6	43	15

Notation: **A:** The traditional city suited its residents socially and culturally. And the contemporary one contradicted its residents in socio-cultural terms. B: Do not agree with the above statement

Table 1 Socio-cultural contradictions in the built environment and the level of Education.

To investigate the cause/causes that resulted in the **contemporary** state of the urban environment, our sample was asked whether they thought it was simply **imported** from outside the Arab/Islamic culture in respect to urban and regional planning in the contemporary built-environment. **(54.20%)** of the respondents did not think that changes in the urban environment was simply the result of an intervention from the outside world. However, **(29%)** of the respondents thought it was. Clearly, it is **deducted** that more educated and professional respondents can not simply blame the outside world for the drastic changes that happened in their own urban spatial structures. Rather, they see it as a combination of causes within the Arab/Islamic entity.

The Arab/Muslim architects and planners and the official decision-makers in the government were blamed for most of the **urban contradictions** present in the contemporary urban environment. **Logically, it is argued that if we want to have an urban environment compatible with our socio-cultural norms and values, then we have to change our own urban and regional planning regulations in a manner that will suit our own society**. Many of the respondents see the **solution** for the socio-physical contradictions in the contemporary urban scene **from within**, and not from outside.

This educated attitude to the causes of failure in the urban environment takes us back to the **acculturation and in-acculturation** concepts discussed in the theoretical part of this study. Unfortunately, the process of **in-acculturation** continues to be the norm practiced by the high decision-making level of the country. Ironically, nothing has been done to alleviate the problems facing the contemporary urban spatial structures. Even professionals and decision-makers that use to advocate such changes have not done what they have been preaching, all through their professional careers.

CATEGORY CHOSEN	SCALE OF ESPONSE (Aggregate)
The Arab/Islamic community	231
The Arab/Muslim architects and planners trained in a foreign system of education.	257
Expatriate architect and planners who are contracted in the area	229
Arab/Muslim intellectual who followed mainly Western philosophy and schools of thought	173
Official decision-makers in governmental agencies.	237
The colonists and their impact on the culture as a whole.	191

Table 2 Causes of failure in the Arab/Islamic built-environment according to the survey sample

The Western observer to the contemporary Arab/Islamic scene, who has witnessed the disastrous effects of the European "modern movement "originated in the 1920s and the 1930s as a reaction against what was called the "academic style "of the 19th century and expanded greatly during the 1950s and 1960s (Blake, 1974), that Western observer seem to be puzzled that decision-makers in Arab/Islamic countries are not questioning the validity of imported urban planning and zoning concepts.

That same observer become more surprised because many architects and planners in Europe and the United States have been showing a growing interest in the timeless values of traditional architecture in general. They are looking at these timeless values as a reference for modifying and rehabilitating the current Western planning methods since its major failure was probably its ignorance of organically grown traditional urban settings (Alexander, 1975). Unfortunately, these lessons in urban planning and architecture have been ignored by the decision-makers in the Arab/Islamic scene. The superiority of the foreign model and the feeling of inferiority within, have resulted in the importation of complete urban ‘packages’.

This Type of importation disregarded the cultural context; the rules of conduct and behavior in addition to other environmental factors. Most of the time, these “urban packages” were chosen for prestige and not function. The whole sale importation of alien urban planning policies has left the traditional urban setting to decay or have been rigorously destroyed. In the meantime, modern villa/grid pattern of settlements has been erected in a very short time scale especially since the 1973 period of economic boom. These new settlements have contradicted the specific cultural and environmental needs of the urban environment.

In addition, the identity with the urban scene have been culturally eroded and continuously undermined. The self determined urban regeneration is weakened because the organic innovations are no longer from within the society itself (Bianca, 1982). In contrast, the Western architects and planners live on their failures and mistakes. While their Arab/Islamic counterparts do not attempt to genuinely rectify the mistakes and failures practiced for a long period in the contemporary urban spatial structure.

In concluding this paper, it might be appropriate to write the thoughts and observations of a contemporary writer on the urban spatial structure. This Writer is not a specialist on the field; however, his thoughts represent a large segment of the society of the country as has been deducted in the empirical results of this study. He wrote:

“…Why did we lose satisfaction with ourselves? Moreover, why couldn’t we adapt to the contemporary reality? Simply stated where is our identity?

The answer is very painful and sad. We have built large and spacious houses and competed with each other to build the most extravagant of dwellings. We competed to import the best available house furnishings. Then, we tried to convince ourselves to accept what we have done!!. At the same time, we were looking for something that was already lost. We are trying to cure some of the nostalgic feelings within us. Inside the large house, we had built a small nostalgic setting. We put the tent and

build the fire in search of our identity! We put large and numerous paintings of traditional urban settings in our living rooms!!. We try to look for help from Japanese technology, but there is no taste or smell. We try to put mud colors in the facades. Something inside us is screaming to get our identity back which was lost in the traffic of contemporary life. Let us go back and discuss these matters with ourselves so we can arrive at a good and lasting cure. “ (Al-Rabiya, 1992: Translated by Author)

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Monitoring the development of informal settlements in Ulaanbaatar, Mongolia

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ABSTRACT

Ulaanbaatar, the capital of Mongolia, as many cities in the developing countries, encounters increasing problems with urban expansion and in particular with the growth of unplanned (informal) settlements. Planning of urban and sub-urban development requires timely and accurate information on existing land use and land cover to analyse the existing situation and support policy making. Besides, it also requires a basic understanding of trends in land use changes.

This study tries to supply information about the urban development of Ulaanbaatar with the focus on the development of the 'Ger' areas, the traditional Mongolian dwelling that has evolved with nomadic life. These areas are nowadays rapidly growing in the outskirts of Ulaanbaatar, as predominantly unplanned settlements. These relatively low-density settlements are consuming an increasing share of land and raise the question of sufficient and efficient infrastructure supply. For this purpose different remote sensing data were analysed about the potential to supply information on the development of the informal settlements from 1986 to 2000. To perform the change detection for the urban area a SPOT XS image of 1986, a SPOT Pan image of 1989, a LANDSAT image of 1990, and an ASTER image of 2000 were used. As ground truth information a topographic map scale 1:5,000 and aerial photos scale 1:10,000 were used.

Generally urban growth between 1986 and 2000 occurred north and northwest of the city centre, mainly in mountainous and consequently quite steep areas, which are frequently non-suitable locations for urban expansion. The majority of this expansion happens in the form of growth of the traditional Ger areas.

1 INTRODUCTION

Mongolia, as many other developing countries, has an increasing problem with urban expansion and the growth of informal settlements in the capital city Ulaanbaatar, located in north-central Mongolia. The highest point of Ulaanbaatar is the Tsetsegun peak, having an altitude of 2257 metres above sea level. Figure 1 shows the localisation of the whole city area, which includes 3 rural sub districts (B, C and D). A is the capital city, which is the most urbanised city of Mongolia (see figure 1).

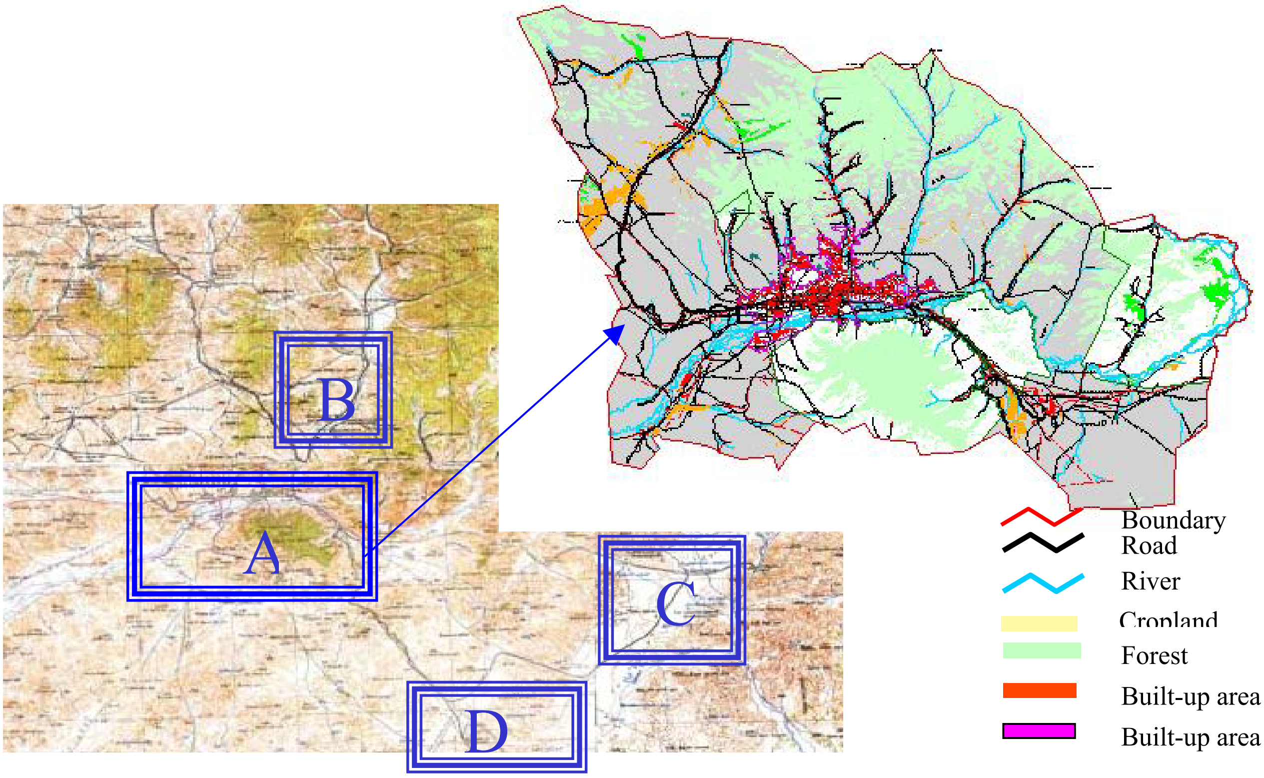

Figure 1: The land use map of Ulaanbaatar city, 1998 (scale approximately 1:300 000): city area, which includes 3 rural sub districts (B, C and D) and the capital city (A).

One reason for this rapid urbanization and growth of informal settlements is the political transformation from a centralized economy to a market oriented economy starting in 1990. Since this year the city has significantly expanded due to different development activities accompanied by the migration of people from rural areas into Ulaanbaatar. The obviously attractive city life, as opposed to the rather traditional rural life with its rigid social structure, has provoked the massive influx of people to the capital city, causing the growth of new informal residential areas in the city. These unplanned settlements are dominated by traditional Mongolian dwellings, the Gers. The Gers have evolved with the nomadic life generating the need for a portable dwelling. The history of the Mongolian Ger goes back to about 2500-3000 B.C. and still is used as a dwelling type everywhere in Mongolia. The walls of a Ger are made of narrow birch willows held together by leather strips. The entire outside surface of the Ger is covered with felt. One layer is sufficient in the summer season, two or three layers are required in winter. The assembling and taking down of any Ger is done within half an hour (Amarsaikhan, 2000). Examples of Gers are shown in figure 2.

a) Continuous Ger area   b Gers surrounded by formal residential. area   c) Ger area in an aerial photo

Figure 2: Examples of Gers

These rapid urban expansion and consolidation processes are hardly reflected by regular maps. Thus, this rapid process of urbanisation apparently would require a state-of-the-art technology that allows the city to be monitored, in order to generate reliable information in a more timely fashion. Important questions in this context are: Where are these changes taking place and which remote sensing data can assist to monitor those changes?

Ulaanbaatar's official (registered) population are in 2002 approximately 812,000. An additional 150,000 unregistered persons are estimated to live in the city. This is a 48% increase since 1989 (Bat, 2002). Based on these numbers, Ulaanbaatar had an average annual growth of slightly more than 3.6% since 1989. An estimated (and growing) 45-50% of Ulaanbaatar's inhabitants now dwell in Ger areas, which are predominantly poor. This is obviously an increasing social, economic, environmental and political concern to the government and residents alike.

2 METHODOLOGY

Forster (1985) stressed the usefulness of remote sensing approaches to urban studies because it can assist in regular and rapid updating of land use data, and is spatially more relevant for reporting urban development than census-type statistical data. In this context this study will focus on the following general tasks:

- Identification of urban objects and areas in different types of remote sensing images.
- Analysis of different images to provide up-to-date information for monitoring the urban development of Ulaanbaatar.

In a first stage the remote sensing data listed below were used for this study to analyse the potential of remote sensing data with different spatial resolutions to identify and extract urban objects of Ulaanbaatar city, with a focus on the identification of unplanned areas. For this purpose standard image processing methods and procedures including geo-coding and image enhancement techniques have been applied to the aerial photo, the SPOT XS, the SPOT Pan, ASTER and Landsat TM. For the visual interpretation the classic parameters of image interpretation have been used: shape, size, pattern, tone, texture, shadow, site and association (Lillesand and Kiefer, 1994).

Sensor	Resolution / Scale	Date	Remarks
Spot XS	20 m	01/05/1986	
Spot Pan	10 m	10/21/1989	
Landsat TM	30 m	09/10/1990	
Terra - ASTER	15 m	06/09/2000	
Aerial photo	1 : 10 000	26/07/1998	Covers the central part of the urban area
Topographic map	1 : 5 000	1999	

Table 1: Data Sources

Based on the high resolution aerial photos and the topographic map a set of relevant urban objects was selected and these objects have been identified in a next step in the different satellite images. The capabilities of different spatial and spectral resolution remote sensing data for detecting different classes of urban objects were then compared. This knowledge was later used for performing a change detection for urban growth patterns between 1986 and 2000 for the urbanised part of Ulaanbaatar. The method used for the change detection is a visual interpretation of the individual satellite images of the different years and finally comparing them in order to detect changes.

3 RESULT AND DISCUSSION

3.1 Identification and classification of urban objects in the study area

To evaluate the capability of the different remote sensing data to identify urban objects and types of urban structure, five classes were defined based on the topographic map scale 1:5 000 of 1999. These classes were considered as the most relevant surfaces for analysing the changes in the selected target area of Ulaanbaatar city.

Class 1 is **residential** discontinuous urban structure, where buildings have more than **5 floors**.

Class 2 is **residential** discontinuous urban structure, where buildings have **2 - 5 floors**.

Class 3 is **residential individual** urban structure composed of **1 floor** buildings.

Class 4 is residential continuous urban structure dominated by traditional residential **Gers** and some wooden buildings.

Class 5 is continuous **open sp**ace of grass fields, vegetation and bare soil.

First, for a comparison submaps for representative areas of the five classes were created from the different geo-coded remote sensing data (aerial photo, SPOT panchromatic, SPOT XS, ASTER and Landsat images) and topographic map (see figure 3).

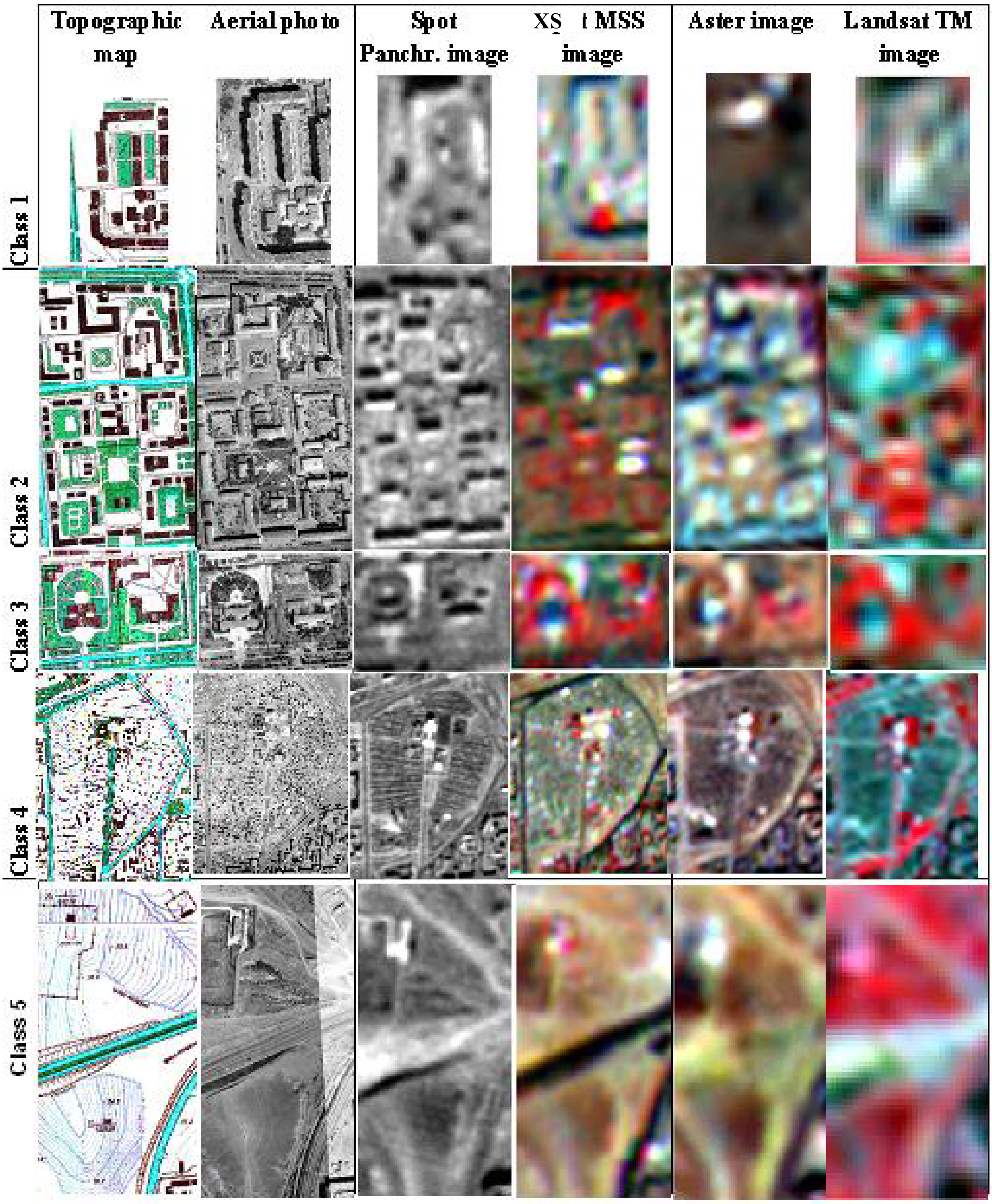

Figure 3: Comparisons of images in the different resolutions

After comparing the result of the interpretations a summary of the observations for the different image data has been made (see table 2).

Class	Topographic map	Aerial photo	SPOT Panchromatic	SPOT XS	ASTER	Landsat TM
Class 1	All relevant objects are visible.	Compared to the topographic map detailed objects can be identified and it is easy to analyse the situation	Only location and shape of buildings can be identified, their exact boundary cannot be defined	No clear information	Only location and shape of buildings can be approximated, their exact boundary cannot be defined. Small trees are highly reflecting and can be identified.	Some parts of buildings are reflected as well as small green vegetation areas.
Class 2	All urban objects are mapped.	Compared to the topographic map detailed objects can be identified and it is easy to analyse the situation.	Only location and shape of large buildings can be identified, their exact boundary cannot be defined. The information given by the shadow improves identifying buildings.	Some green area and large buildings can be approximately identified but the exact boundary cannot defined.	Only the location of the green areas can be approximately identified and the exact boundary cannot be defined. Some buildings having a strong reflection and can be identified.	Some green areas and buildings can be approximately identified but the exact boundary cannot be defined.
Class 3	All urban objects are mapped.	Compared to the topographic map detailed objects can be identified and it is easy to understand the situation	Only location and shape of buildings can be identified, their exact boundary cannot be defined. The information given by the shadow improves identification of buildings.	Some green area and buildings can be approximately identified but the exact boundary cannot defined.	Only the location of the green areas can be approximately identified and the exact boundary cannot defined. Some buildings have a strong reflection and can be identified.	Some green areas and buildings can be approximately identified but the exact boundary cannot defined.
Class 4	Basic data for interpretation, but there are no individual Gers and houses displayed in the streets.	Very clear to identify urban objects, including individual Gers and wooden buildings. It could be used to update the topographic map scale 1:5 000, especially urban objects that are located inside fences.	Possible to identify the boundary of Ger areas and the street line between 2 Ger areas can be identified.	Less ability than the ASTER image to identify the boundary of the Ger area (boundary of the Ger area is the road network).	Boundaries of Ger areas are less identifiable than in the SPOT Pan image.	Less ability than SPOT XS and ASTER to identify the boundary of the Ger area (boundary of the Ger area is the road network).
Class 5	All urban objects are mapped.	Compared to the topographic map detailed objects can be identified and it is easy to understand the situation	Possible to identify roads and shadows of the steep hills. Possible to identify buildings, located within the area.	Less potential than the ASTER image to identify roads and the shadows of the steep hills.	Possible to identify shadows of the steep hills. Possible to identify the buildings, which is located within the area.	Less potential than the other data to identify objects.

Table 2: Detailed interpretation of images with different spatial resolutions

Following conclusions can been drawn based on figure 3 and table 2 regarding the identification of urban objects in the study area:

- The potential of the different remote sensing data identifying urban objects in the study area varies.
- Aerial photos are a very useful data source, not only for identifying urban objects, at the same time they can help to update the existing topographic maps.
- Based on the SPOT XS, SPOT Pan, ASTER and Landsat TM images it was not possible to identify exactly the shape, size and calculate the area of individual buildings or urban objects. But it was possible to identify approximately their locations in the images.
- The boundaries of areas in the city (blocks of buildings) can be identified using SPOT XS, SPOT Panchromatic, ASTER images.

Comparisons of the potential of the different remote sensing data in the case of Ulaanbaatar:

Aerial photo In the aerial photo urban objects can be clearly identified, including small parcel units (individual Gers and wooding buildings). It could be used to update the topographic map.

SPOT Pan It has a better ability to identify urban objects than the other satellite images, but not on the same level of high accuracy as the aerial photo. Further, it has a good ability to define boundaries of sections or blocks of built-up areas of different types/classes.

ASTER For this study it showed a better effectiveness than SPOT XS and Landsat TM images in identifying urban objects, but it does not offer the same capability as the SPOT Pan image to define boundaries of sections or blocks of built-up areas of different types/classes.

SPOT XS It has the capability to identify approximately urban objects and defining boundaries.

Landsat TM It has less capability for the identification of urban objects than the other satellite images. Only main landcover classes could be identified.

3.2 Change detection analysis

For the change detection of the urbanised part of Ulaanbaatar only changes in terms of sections or building blocks were analysed (not changes of individual buildings). The change detection was based on the SPOT XS image (pixel size 20 m) of 1986, the SPOT Pan image (pixel size 10 m) of 1989 and the ASTER image (pixel size 15 m) of 2000.

The Ulaanbaatar city area is 470,444 ha. The urbanised or built-up area is only 5 percent (approximately 23,700 ha) of the total city area (Land Administration Authority, 2002). First, a target area was selected containing the built-up area in the central part of Ulaanbaatar city, which covers approximately 23 km x 14 km or an area of 32,200 ha, sub maps were made for the SPOT XS image of 1986, SPOT Pan of 1989 and ASTER of 2000.

For the visual interpretation of the urban core area 7 classes of urban structures were defined, based on the results of the urban object classification. These were determined as the most important built-up surfaces in the selected target area of Ulaanbaatar city.

Class 1:**Central business district** (CBD) hosting most of the governmental organisations, including the parliament and the central government and other important offices.

Class 2: **Commercial areas** (commercial buildings, which are located isolated apart from the CBD).

Class 3: **Industrial areas**.

Class 4: **Medical centre** (buildings being part of a medical complex, which could be distinguished as a separated block from other classes).

Class 5: **Military complexes**.

Class 6: **Recreational areas** (green areas, parks and a lake).

Class 7: **Formal Residential** areas.

Class 8: Residential **Ger** area.

Subsequent to the visual interpretation the summary of changes (table 3) measures the spatial variation of the classes between 1986 and 1989 and from 1989 to 2000. The table provides a class-by-class report of changes by area and percentages. Table 3 and table 4 provide details of the urban area changes during the study time (14 year) classified and digitised by the visual interpretation. For each case the change in area and change in percentages of the individual classes is presented in the tables for the respective period.

	Year / Area					
	1986		**1989**		**2000**	
	ha	**%**	**ha**	**%**	**ha**	**%**
Central business district	66	1.0	66	0.9	66	0.8
Commerical	195	3.1	218	3.1	218	2.7
Industrial	1785	28.0	1833	26.0	1833	22.9
Medical center	44	0.7	49	0.7	49	0.6
Miliary complec	274	4.3	278	3.9	19	0.2
Recreational	68	1.1	68	1.0	68	0.9
Formal residential	1666	26.2	1767	25.0	2077	26.0
Residential ger area	2269	35.6	2784	39.4	3668	45.9
Total	6367	100.0	7063	100.0	7998	100.0

Table 3: The urban area in 1986, 1989 and 2000 by classes in the target area

Generally urban growth occurred between 1986 and 2000 north and northwest of the city centre. The majority of the growth took place in mountainous areas with relatively steep slopes. The development of the city is restricted by the Tuul river, as well as by four highly elevated mountain valleys. The river valley, between the Tuul river and the railway line is a protected area by law and thus land use activities are not permitted. This protected area is a clean water zone, which includes a water transportation point transporting underground water to the whole city. Therefore the majority of the relatively flat land is either already developed or protected. Consequently, the urban growth has expanded in less suitable areas for urban development, even though it is more expensive to build in the mountainous areas and they are not well served by public infrastructure.

Focusing on the urban area an absolute and relative increase can be observed (see table 3). In 1986, approximately 6,372 ha of total urban area were identified in the target area by visual interpretation. From 1986 to 1989, the amount of land classified as urban area grew by 696 ha (being an increase of 11 percent) and from 1989 to 2000, the amount of land classified as urban grew by 935 ha. In total from 1986 to 2000, the amount of land classified as urban grew by 1631 ha (table 4 and figure 4).

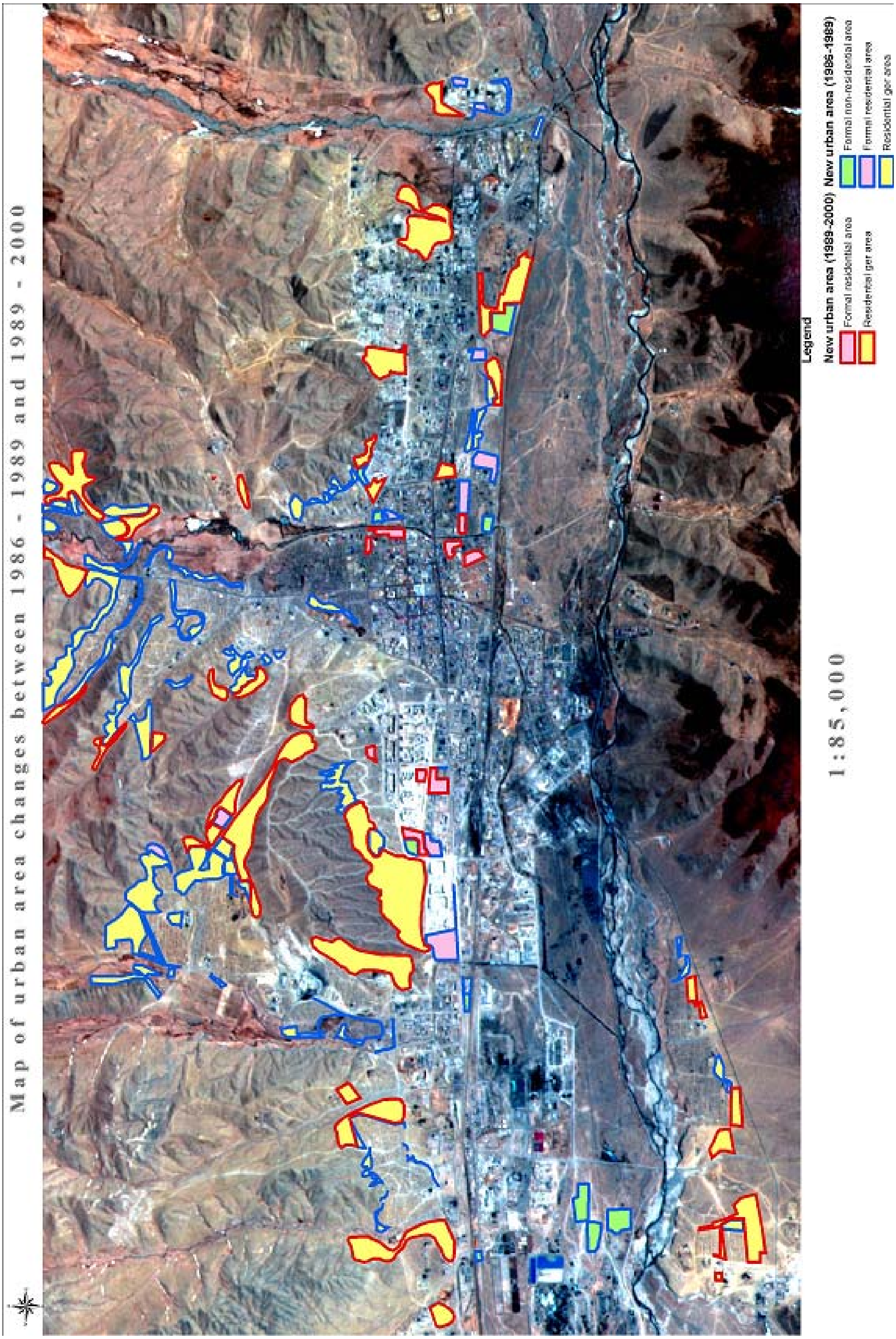

Figure 4: Urban area changes between 1986-1989 and1989- 2000 in the target area

	Differences		
	From 1986 to 1989	from 1989 to 2000	from 1986 to 2000
	ha	ha	ha
Central business district	0	0	0
Commerical	23	0	23
Industrial	48	0	48
Medical center	5	0	5
Miliary complec	4	-259	-255
Recreational	0	0	0
Formal residential	101	310	411
Residential ger area	515	884	1399
Total	696	935	1631

Table 4 Urban area changes from 1986 to 2000 in the target area, Ulaanbaatar city

When analysing the rate of urban area growth and changes in the target area by classes the following conclusions can be drawn:

- All urban areas classified in table 4 have increased or have remained constant (with the only exception of the military complex).
- During the study period, most classes had an increase in area, but the informal residential Ger area had the most significant increase of 1399 ha since 1986 compared to other classes.
- For the classes CBD, commercial centre and recreational area no recognisable spatial change has could be observed during the study period.
- The military complex decreased from 1986 to 2000, by an area of 255 ha. This area was converted into a residential district.
- The relative change in urban land indicates that substantial urban growth is occurring in the rural areas.

4 CONCLUSIONS

This study indicates that remote sensing techniques have a potential to analyse urban expansion for the case of Ulaanbaatar. However, urban objects of more complex patterns are not easily identified by the satellite images used in this study. This would require higher spatial resolution remote sensing data, such as Ikonos or QuickBird. The following conclusions can be drawn:

- It was not possible to identify exactly shape, size and calculate the area of individual buildings or urban objects from the SPOT XS, SPOT Panchromatic, ASTER and Landsat TM images. But it was possible to identify approximately their locations in the images.
- The boundaries of areas of the city (building blocks) can be identified using SPOT XS, SPOT Pan and ASTER.
- Urban land in the study area increased continuously from 1986 to 1989 and from 1989 to 2000. The growth rate during the study period (14 years) was 26 percent (about 1631 ha).
- The majority of the growth has happened in the residential Ger area, which increased by 1399 ha since 1986. Today the residential Ger areas occupy about half of the built-up area in the city.
- No notable change occurred in the CBD, the commercial centre and recreational areas during the study time.
- Other residential buildings, including high-rise buildings are slowly increasing.
- Generally urban growth occurred between 1986 and 2000 north and northwest of the city centre,which are predominantly mountainous areas of relatively steep slopes, being less suitable for urban development, even though it is more expensive to build in this mountainous areas. As most of the relatively flat land is already built-up or developed, the expansion of the city there is very limited.

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Low Cost High Quality 3D Virtual City Models

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1 ABSTRACT

There are several projects aimed at creating the 3D virtual city models for bigger cities all over the world. In order to bring these models closer to smaller cities to be used e.g. in urban planning or regional development the trade-off between cost and quality of the model should be solved. From this point of view we discuss the input data available at low cost, the relatively simple work flow in creating the model and the quality parameters of the final model.

We discuss the low cost input data such as DTM and terrestrial images taken with ordinary digital cameras with special focus on the cadastral data providing the building footprints that can be used for reconstruction. The simple work flow includes the data-processing providing the block flat-roof model and also the silhouette based building reconstruction method. Special focus in the work flow is given to relatively simple texturing and rendering to obtain the photorealistic large scale model. The quality parameters of the model are discussed, mainly the navigation, speed, accuracy, manageability of the model data and subjective feeling of the user. The proposed procedures can achieve many of them in the final model as can be seen from the examples of low cost high quality 3D virtual model of Bratislava.

2 INTRODUCTION

In more than 100 cities all over the world the 3D virtual city models are being created, solving the problems of modeling, texturing, storing and rendering of such models for various purposes. Mainly the bigger cities are using virtual models in order to better address the problems of urban planning, regional development, virtual tourism, flood prevention, saving of the cultural heritage and many others. Sooner or later the models will be available also for smaller cities that need to address similar problems. For them the cost of the model is the issue on one hand and the quality of the model on the other. This paper offers one possible solution to the problem how to create low cost model with satisfactory quality e.g. in urban planning.

3 INPUT DATA FOR LOW COST MODELS

The classification of the input data is here provided mainly in accordance to the cost of their acquirement. At low cost one can have digital terrain model (DTM), terrestrial images with low end camera and also the cadastral data. Usually the aerial photos cost more, in this paper we take in this category also the height photos taken by the low end camera from the high buildings in the city.

3.1 DTM

High-quality samples and lower-quality DTMs with larger coverage can be found freely on the internet [USGS02]. Therefore we treat them as a base for low cost virtual city reconstruction giving the model realistic terrain which it stands on. One can get DTM also as a by-product of the photogrammetric processing of the aerial photos if they are available. The details of the DTM´s role in the model are discussed in the section 5.

3.2 Terrestrial images

This data can be taken with low end camera from the ground usually providing at least two views on the building. They can be used for the refinement of the building´s model or for more precise texturing of the building. Some software need special high end camera, see e.g. [Graz03], some are able to use the ordinary camera with the calibration before modeling. In section 7 we present the modeling method using the silhouettes extracted from the terrestrial images providing the more detailed model mainly for the symmetrical buildings. In general the terrestrial images bring more details to the model, like windows, doors, protrusions etc.

3.3 Cadastral data

This is the information source containing 2D vector data like street index or the building footprints, which are very helpful for the city modeling. Cadastral data are usually operated by the particular cadastral authorities. In some cases they are collected and maintained directly by the cities themselves [Petzold03]. The analogue cadastral data exist for every region and can be relatively simply transformed to the digital form if they are yet not available like that. Apart from their content, they are valuable for the accuracy and relatively large area coverage. The usage of this data type in low cost 3D city modeling is discussed in the section 6.

3.4 Aerial photos

This is the prevailing source of data for the creation of the 3D city models. They can be obtained either from the specialized companies photographing the city with the professional camera providing all parameters of the photos and usually offering also the photogrammetric processing (at the prize of 110 EUR for the square area 100x100 m^2) or by the “height“ photos taken from the higher buildings in the city like churches or chimneys or other dominants. For the purposes of the low cost modeling we use them mainly for texturing but also their modeling role (not using photogrammetry) as discussed in this paper. The merging of aerial and terrestrial data in automatic generation of 3D model is discussed in [Takase03] and [Fruh03] using also the laser scan data which is relatively new source of higher cost data which do not need photogrammetric processing.

4 WORK FLOW IN THE CREATION OF THE MODEL

The proposed work flow (Figure 1) consists of the line leading to flat roof block model located on the textured DTM. The block model is created from the building footprints (from the cadastral data) by elevating them to the average height and then texturing them by mapping the aerial (or height) photos onto it as well as on the DTM. This results to the photorealistic large-scale model of the city, which can be then refined either in large scale or in the small scale. In large scale it means to add the information about the real building heights to the block model or to find the height by manual elevation of the footprint until it fits with the texture taken from the aerial photos. For the refinement in small scale the silhouette based modeling method is being proposed. It uses terrestrial images and special information called azimuth connected with the orientation of the image. If the city decides to use other types of input data for modeling (either aerial of laser scanned) they can provide alternative (more precise) models in the area chosen which can be georeferenced in the created large scale model by the proposed work flow.

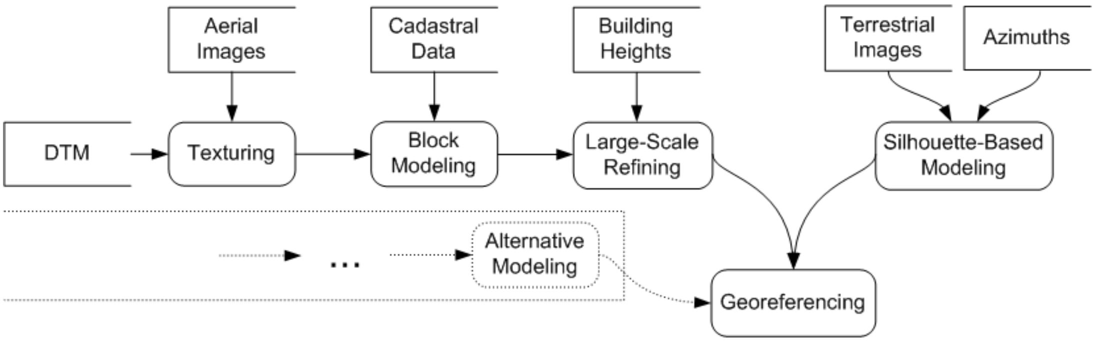

Figure 1: Dataflow diagram for the processing stages with mandatory input described in the text.

5 DIGITAL TERRAIN MODEL

Despite the wide offer of a contemporary DTM-processing applications ([TEC03] shows an exhausting list), we have developed our own software solution, exploiting a virtual city creation-specific approach. Description of its capabilities can be found in [Boro03]. Figure 2 shows a brief overview of the modeling features added to the standard DTM viewer functionality, especially the pin-planning tool (helping to sketch new plans) and a color fill technique we call flood painting. Next sections analyze DTM "cheap" texturing methods designed to enrich a low-cost terrain model with visual details applicable to the city buildings, too. This is far beyond the scope of the pure terrain viewers and it leads to the photorealistic city model(er)s, gaining results like the one shown in the Figure 6.

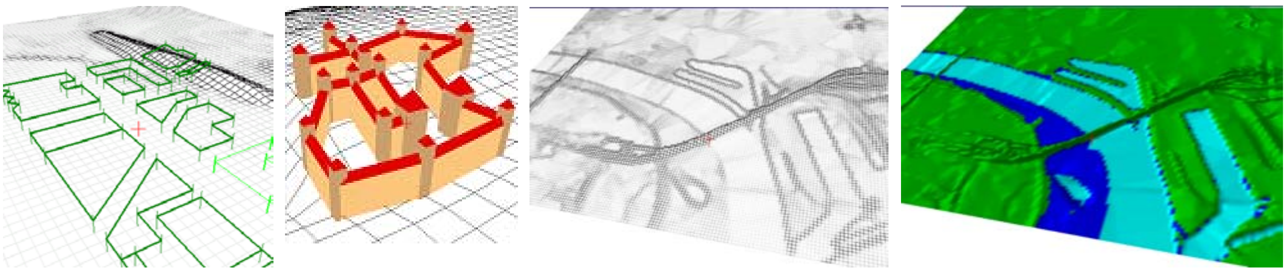

Figure 2: Planning a virtual city on the DTM, medieval city walls as a plan representation, Bratislava river harbor DTM and its flood levels.

5.1 DTM Texturing

Texturing is a common photorealism technique. Otrophotomaps are usually applied as textures in the terrain visualization systems. Texture mapping (2D texture space ↔ 3D object space association) is very simple in the orthophotomap case: ground point of *(x,y,z)* coordinates, where *z* denote the height, would have *(f(x),g(y))* texture coordinates, where *f*, *g* are simple functions modifying the texture space so the texture domain copies terrain region it covers (planar texture projection approach, illustrated in the left part of the Figure 3).

We have proposed more accurate method for aerial photograph texturing. It is an inverse simulation of the photography process: light rays carrying the texture color information are cast from the camera to the terrain surface. Therefore we refer to it as a raycasting, an algorithm suitable both for terrain texturing discussed in this section and building texturing, discussed in section 5.3.

Our method precisely maps the texture onto the terrain surface, as it is illustrated in the right part of the Figure 3. If the photograph was taken by the system similar to the ideal pinhole camera (which is true for standard survey systems), raycasting resembles the central perspective texture projection (texture domain is set to the reversed image from the positive photoplane), which can substitute our method. Nevertheless, raycasting is more general than the usual perspective texture projection, because it can simulate more complex or less precise camera systems and remove any known optics distortion. Theoretically, it can simulate any higher-distorting "low-cost" camera, originally not intended for the aerial photography. Moreover, input parameters for our method (focal distance, photoplane dimensions, etc.) can be easily transcripted from the camera calibration protocol.

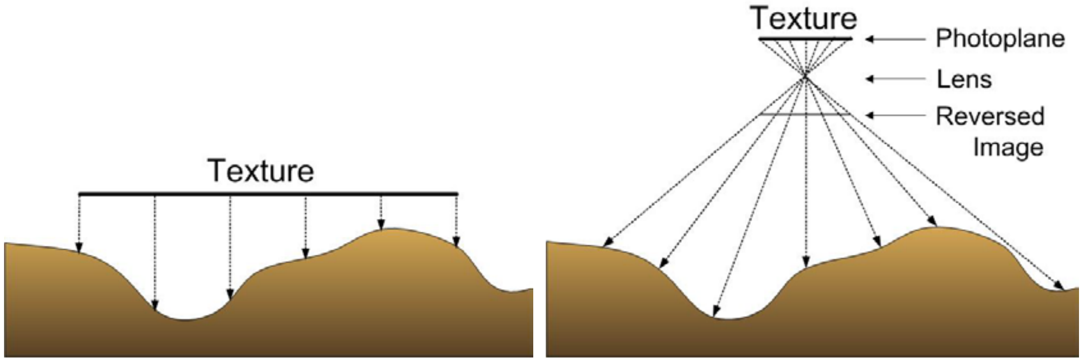

Figure 3: Difference between planar projected ortophotomap and the aerial image cast from the pinhole camera.

How to accurately relate the given texture to the DTM? In case of knowing the camera exterior parameters (position & orientation) our software solution fixes the virtual camera in the proper position above the terrain. In case of missing or incomplete exterior parameters, we developed two camera-positioning methods: manual and semiautomatic. Manual method allows user of the modeling software to interactively move and rotate the virtual camera, unless the raycasted texture fits to the terrain. He should choose some control objects (texture points/segments for which the terrain location is known) for evaluating the exact texture placement.

Manual camera-positioning method is very quick (it takes only about a minute in our software to fit an aerial texture to the ground) and as precise as the user wants. We appreciated it for adjusting vaguely set values like camera altitude (very suitable for GPS systems with approximate localization). However, it has two significant drawbacks: it is user-limited and it does not handle the camera interior parameters (e.g. focal distance). Even we can design a user interface capable of changing interior parameters interactively (normally, they are manually typed from the available camera calibration documents), tedious control of at least 14 parameters (pinhole camera exterior parameters plus focal distance, texture dimensions, position and rotation in the photoplane), simultaneously by one user would be far from an intuitive approach, with no guarantee of quick result.

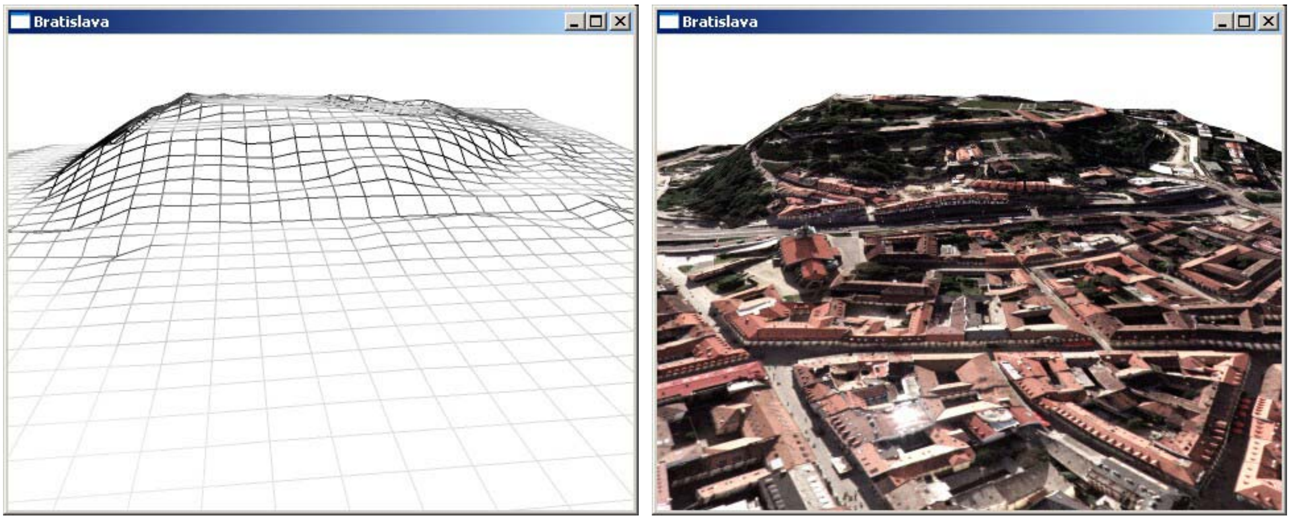

Figure 4: DTM wireframe visualization and the aerial photograph raycasted from the manually positioned virtual camera.

5.2 Texture Mapping Optimization

Raycasting in the software allowing the user to interactively set the camera parameters achieves satisfactory results in case of unknown/incomplete camera parameters. While trying to extend the interactivity from the basic parameters like camera position to the all other parameters, we found it hard to control and even evaluate the result, e.g. changing one parameter could lead to better texturing in one control point, but worse in some other.

Due to complexity of parameter setting, we proposed more simple and user-friendly method and built an application that computes the camera parameters. Basic idea is that each texture mapping can be set up with couple of pairs consisting of 3D scene points and their corresponding (u,v) coordinates. At least four such pairs (with scene points not lying in the same plane) determine the most simple central perspective texture mapping. The more parameters influence the mapping, the more pairs are needed for definite specification. The user interferes the computation only once; for setting the (u,v) and corresponding scene coordinate pairs. This is the only one possible source of an inaccuracy; result can be as precise as the user input. Therefore, we let the user to specify as much coordinate pairs as possible. Since we are combining more input pairs, we can achieve results with even less than one texel accuracy.

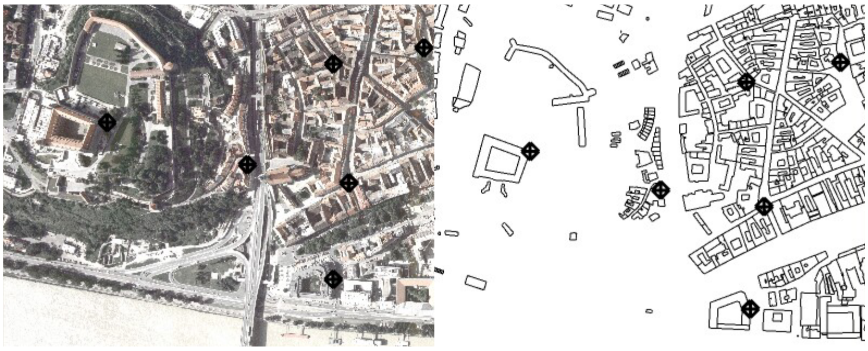

Figure 5: Corresponding texture↔scene points specified by the user (false colors and widths applied due to the print issues). For the scene coordinate specification our application uses ground data (the right half). Hence, we got rid off the third dimension and allow user to work conveniently in 2D.

How to compute texture parameters from the user input? Instead of explicit computation of 14 parameters, which would not always lead into definite solution in case of extra input coordinate pairs, we have chosen the stochastic approach. Our algorithm tries to find the best solution while it generates parameters on the random base. Particular solutions are compared by an error function: each input coordinate pair produce an error, which is a difference between input and computed (u,v) coordinates. The error function is an average of all errors.

We exploit the well-known hill-climbing algorithm to find the optimal solution with minimal error. In each step, algorithm moves parameters randomly and checks if the error function gives better results. It searches the ε-surrounding of the actual parameters until it finds better result (smaller error mean), which then becomes an actual parameter set. If it did not succeed after preset number of guesses, greater ε is chosen. Number of steps as well as the initial threshold error mean is given by the user. We refer reader to the more in-depth details in [Boro03].

5.3 From DTM To Building Texture Mapping

Our raycasting method maps the texture on any object in the virtual scene, in general. We have demonstrated it on the terrain example, however it is obvious how to extend it to building models usually made from triangle meshes: each vertex in the mesh asks for its (u,v) coordinates, regardless it is visible from the camera position. Unpleasant artifacts in invisible faces can be suppressed by involving more photographs from different angles, so the object is fully texture-covered. Fortunately, city buildings represent objects coverable by only a few photographs. Moreover, in most cases, each building façade (at least its upper part) should be visible somewhere from the air and the overall city model can be viewed as a height field defined all over the modeled area. City model semiautomatically textured by couple of aerial photographs therefore yields satisfactory photorealistic results in the flythrough applications. For such virtual flythrough just a simple building block models as described in the next section is sufficient.

Figure 6: Semiautomatic texture mapping was used on the DTM and the castle model input shown in the Figure 8. Source texture is an aerophoto taken from about 2100 meters above the terrain.

Recently, in [Fruh03] a semiautomatic texturing technique adapting the Lowe's algorithm, essentially same to ours, appeared. They use it for laser scans, where each 3D mesh face, simultaneously photographed and scanned, associates the best texture among the all possibilities after setting couple of corresponding texture↔scene points. Our approach differs in three main issues. At first, we can use any reasonable texture, even a distorted photograph found on the Internet. Next, only one aerial photograph alone can be applied to the large city area. If it is an orthophotomap, only a ground and the building roofs would be textured, since the ortophoto contains no facades. If it is a photograph which captured building from a different angle, it can texture also all visible facades as it is shown in the Figure 7. Compromise between coverage and the angle most suitable for facades is a photograph captured from an appropriate high building, which makes data acquisition relatively cheap. Since the façades invisible or stretched in the photograph are textured with high perspective distortion (Figure 7), more photographs taken from different angles are needed to apply.

Finally, we have designed an user interface that abstracts from the third dimension, since we use a precise 2D map (e.g. cadastral data like street map or building ground plans) for fixing the (*u*,*v*) coordinates to the ground (Figure 5). Our application computes the third dimension from the DTM. This makes texture mapping as easy as clicking the corresponding points in two pictures.

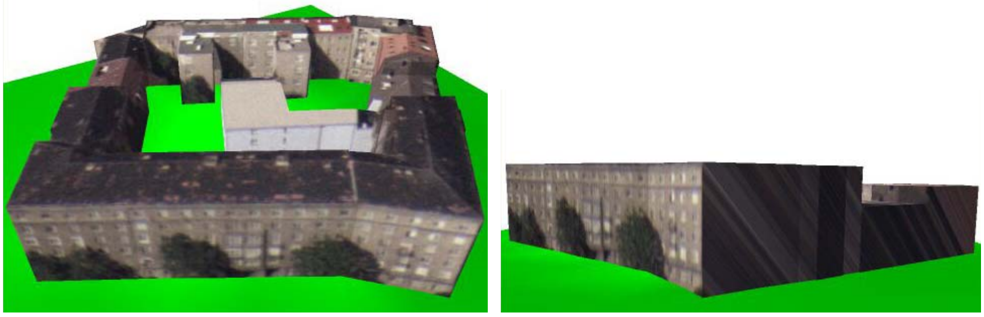

Figure 7: One texture mapped to the structure from its front side (left) leads to a perspective distortion from the other sides (right).

6 LARGE SCALE BLOCK MODELING

Ideal city modeling input would be a dataset containing all city structures in a 3D vector format (Figure 8). However, such an input is very costly. We found out that large city structures satisfactory for virtual flythroughs and photorealistic pictures taken from farther distances may be modeled from cadastral data, which includes vector data like street index or ground plans, suitable for determining the texture mapping accuracy (Figure 5) or the building shapes in two dimensions. Despite their usual 2D nature, they can help to build a large city model with minimal effort. Only requirement is to have the software exploiting their biggest advantage: large area coverage. In this section we focus on the building ground plans as the most essential part of the cadastral data. We introduce a simple block-modeling technique (one of the results is shown in the Figure 7) and also the idea of constructing 3D models from the aerophotographs, where the footprints can specify the first level of detail.

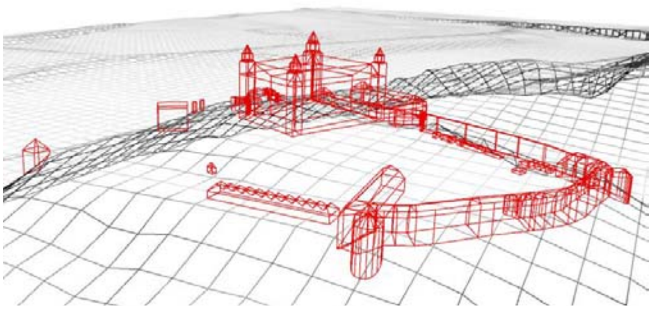

Figure 8: Bratislava Castle roof plans wireframe achieved by effortful manual photogrammetric processing.

We are mapping footprints on the terrain and exploiting their features for 3D modeling in two ways. At first, we use them as the control objects for our texture raycasting method described above. The relation between DTM and footprint coordinates is usually known, since the DTM data inputs are expected to have the latitude/longitude dataset specification and their georeferencing is straightforward. Hence, mapping of the building plans onto the terrain model is as accurate as the DTM and cadastral data precision.

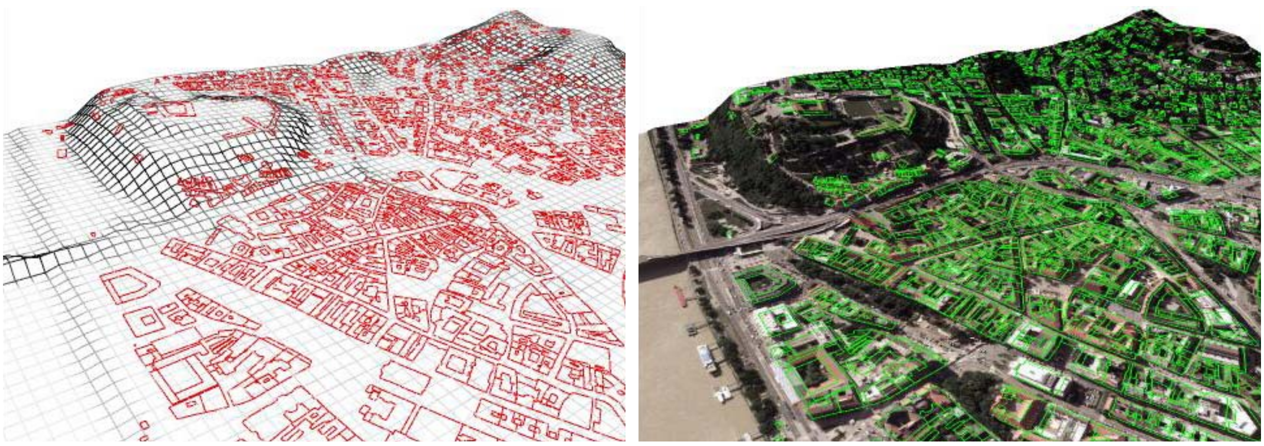

Figure 9: Building footprints and the aerial photograph mapped onto the terrain model, controlled by overlapping ground plans.

Most important footprints exploitation is a rough city block model specification: having the 3D building ground plan and its (average) height we assemble the model with exact ground lines and flat roof. Although the roofs in this model are less precise (than e.g. the roofline models in [Graz03]), the model is very competitive for the walls accuracy, since the real walls are usually perpendicular to the terrain. The building plan – the building contour – is sufficient for the wall geometry and topology specification. On the other hand, roof contour datasets are less accurate for the wall specifications, because an ordinary building roof is often hanging over the wall, setting an offset to the building contour. The best way is to combine both ground and roof plans as it is show in the Figure 10. However, the flat-roof models are still good enough for the overall city snapshots or virtual flythroughs.

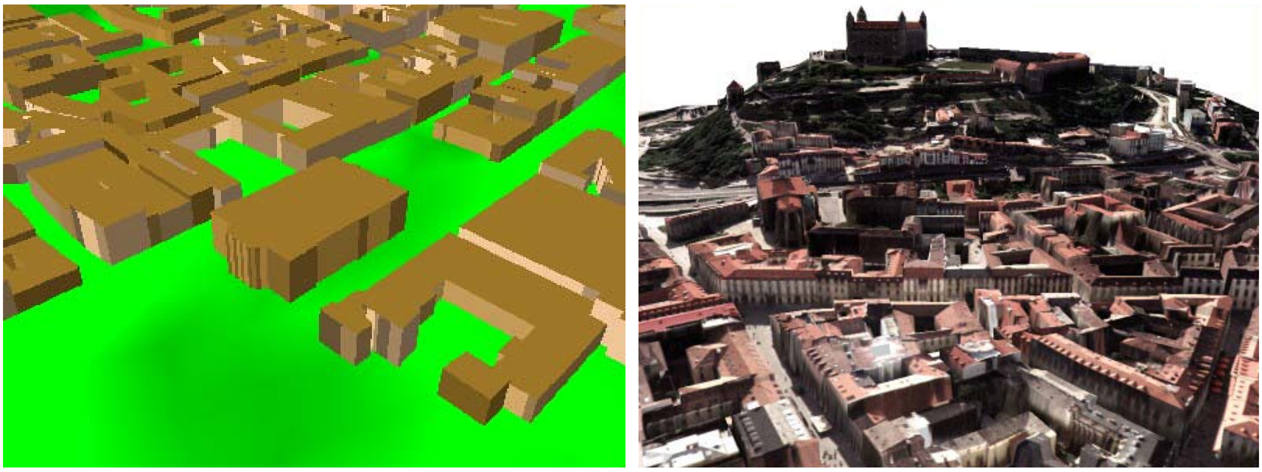

Figure 10: Flat-roofed building block models made from the footprints and the city visualization. The only one exception in the right picture is a castle surrounding, made from the roof plans from the Figure 8, all the other buildings are flat-roofed.

Ground plans dataset does not contain any altitude information. Anyway, we are still able to estimate the heights in large city areas, because they are often based on a typical regular pattern. We use a pseudorandom algorithm, which generates the building height with regard to a dominant (average) height in the location, following the expected architectural style. It generates the number of floors and adjusts the elevation according to the neighborhood. Surprisingly pleasant results are gained in the homogeneous areas as it is shown in the Figure 10, where no real heights were applied and the model construction took only as long as the data fetching.

6.1 Refining 3D Models from Aerial Photographs

Up to now, we described the texturing and the rough block-modeling stages from our dataflow diagram (Figure 1). We are able to achieve very accurate texturing, however the pseudorandom building height estimation devalues its precision in high details. One solution is to acquire the necessary altitude data, which requires a survey if they are not available. We offer a more comfortable solution, based on the texturing accuracy. Having the terrain and the camera set in the virtual scene, user of our software can easily adjust particular model height by stretching it into its eligible shape as it is illustrated in the Figure 11.

Figure 11: Modeling the geometry from the only one aerophoto texture: none, underestimated, real and overestimated building heights.

Adjusting the height from one suitable photograph is very simple due to the vertical facades. Extracting any other geometry information needs slightly sophisticated modeling interface, e.g. the sloping roof on the building from the Figure 11 would require to set a roofline somewhere in the middle of the box top and elevate it into the space unless the texture fits on the edges of the temporary roof shape. Same principle can be applied to all geometry controllable by the texture: texture mapping is conserved, the model changes, and the texture rays incident new shape.

For exact geometry determination, the user would need to raycast two photographs in general (2 intersecting rays define one 3D point) and the modeling would resemble the photogrammetry techniques. However, we enriched the standard stereoscopic photogrammetry by the use of an ordinary photograph (instead of a highly specialized hardware and its outputs, see the reasoning in the section 5.1) as well as the footprints and other auxiliary data. Moreover, merely one photograph is sufficient in many cases (photogrammetry needs 2 or even more). The fastest large-scale block model refinement requires to estimate at least the building heights, which is the most essential geometry information missing in 2D cadastral data. The fast interactive method illustrated in the Figure 11 substitutes the mandatory height data from our dataflow diagram. Terrestrial photography can be involved to achieve finer texturing and hence detailed geometry. An alternative method (not requiring the DTM and other space dependencies) of model refining is introduced in the next section.

7 SILHOUETTE-BASED MODELING

We now present a method for reconstructing building from terrestrial images. This approach can be used with a good precision for symmetrical buildings and also in the case we do not need a model with a high count of polygons. It is suitable for replacing particular buildings from the large-scale model (places of higher interest) with more detailed geometry, constructed from scratch.

As an input we need at least two terrestrial images (ordinary photos) of the building. For each terrestrial image we also need an angle of the directional vector. We call this angle azimuth (e.g. if we are looking in the image on the building from the north, the azimuth is equal to 0). If the footprint of the building is given, we can use it as another optional input parameter for a more accurate reconstruction. Because as input we need only few images and few azimuths to create reconstruction and we don't need images with high resolution, this method uses only low cost inputs. Some buildings can be reconstructed from only one image.

Output of this method is a 3D model of the building. We can also use given images to texture the model, making it to look more realistic. We store the output in VRML file so it can be viewed via Internet. Because resulting model doesn't have high count of polygons and also images don't need to have high resolution, downloading and viewing of the model is fast. It also has its inner format for storing geometry and topology of the model.

7.1 Related Work

There are many papers related to image-based building reconstruction. Most of them are based on finding projection matrices for each image, detection of corresponding objects (points, lines, windows, etc.). As a result one can have point clouds [Metro97] or polygonal model [Debevec96]. The visual hull method (intersecting of silhouette cones) is usually used for reconstruction of small objects from a set of images using a volumetric intersection [Dyer01], [Rama00]. Another algorithm with a similar approach is used for generating models of trees from terrestrial images using B-rep [Shly01]. The exact position of the camera must be given. Then the silhouette is extruded into the cone with its top at the camera location and the intersection is calculated.

7.2 Method Description

First we have to find a silhouette in each given image. User does this manually because in some images it isn't possible to find it automatically. Then the algorithm extrudes a silhouette in the direction of azimuth given for each image. It extrudes silhouette into a prism so the opposite lines will be parallel. If the footprint of the building is given, we get more accurate result by extruding that footprint in the direction of z axis. By intersecting of these prisms we get a visual hull of the building that can be treated as its approximate 3D reconstruction. This still leaves some scaling errors, but if images are taken from a longer distance from the building and the viewing direction is perpendicular to the facade, the result is more accurate. Also the algorithm is more successful in the reconstruction of symmetrical buildings like towers. For more accurate results some steps can be added to the process. Images taken by low-cost cameras are often warped by the perspective projection, so it is suitable to unwarp the image first. At the end of the algorithm this image can be back projected onto model in the direction of azimuth.

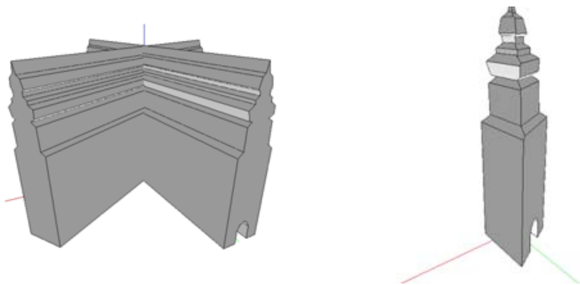

Figure 12: Example of silhouettes extruded into prisms and their intersection (St. Michael's Tower in Bratislava).

As we can see in the Figure 13, models of symmetrical buildings with satisfactory quality are gained. Based on the low cost input, resulting models with mapped textures yield high quality. Additionally, the creation time is short; it takes only a few minutes to achieve presented results.

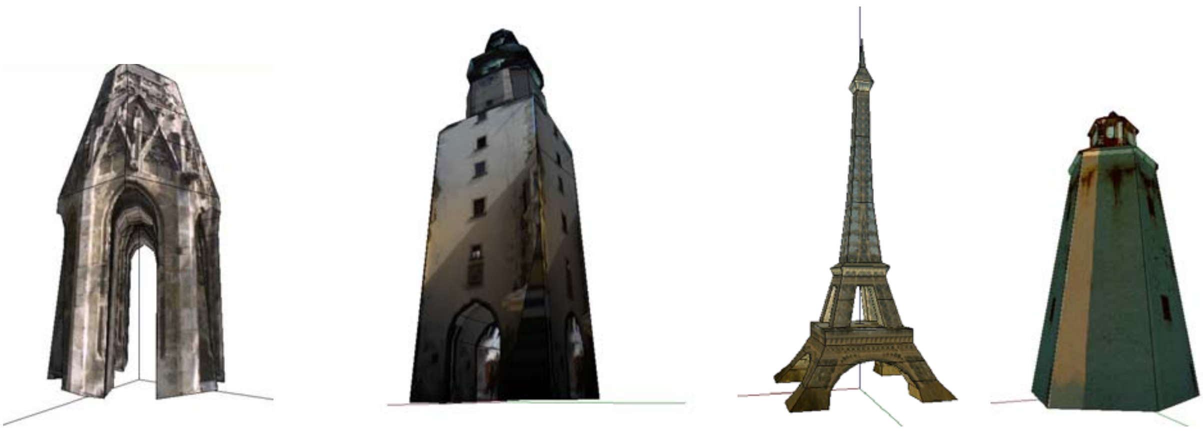

Figure 13: Silhouette-based models: towers from Janko Kral orchard and St. Michael's Gate (Bratislava), Eiffel Tower in Paris and a lighthouse.

8 THE PARAMETERS OF QUALITY

The quality of the created model is usually discussed only with respect to the accuracy of the model, which strongly depends on the scale of the input data. The DTMs found on the Internet are usually provided as the grids with around the 20 x 20 m^2 resolution, the cadastral data are provided in the scale of 1:1000 up to 1:2000, the aerial photos have usually the resolution 20-40 cm per pixel, all of them satisfactory for the necessary accuracy. The other parameters of quality that we treat as important are mainly the navigation in the model, speed (with special focus on Internet application), manageability of the model data and subjective feeling of the user.

The large scale model, which can be created at low cost by the proposed methods provides mainly the bird's-eye navigation in the model, where the subjective feeling of the user is very realistic and it strongly depends on the quality of the textures provided by the aerial photographs. We have developed a special viewer for rendering the overall model in the real time, including also the limited walk through mode that enables the views close to above the ground.

To achieve the reasonable rendering speed of we have to solve the problems of rendering, culling of the objects, levels of detail (LOD) of the model. This is much more urgent, when the model should be accessible via the Internet. If the models should be used in real time, the fillrate must be around 25-30 fps. Even in the large-scale model proposed in this paper this is achievable.

Manageability of the model data means to provide the user with the desired part of the model in reasonable time. Usually two databases are being used: one for storage of the modeling data including the GIS data and the second for the data used for the viewer.

The feeling of the user is a subjective parameter of quality reflecting the photorealistic view of the model. Even the rough low-cost models achieve very positive acceptance in large scale. Moreover, the proposed refinement methods support the photorealistic effect.

9 CONCLUSION AND FUTURE WORK

The methods for the creation of the low cost 3D city model have been presented. They include the photorealistic texturing of the DTM and also texturing of the rough flat roof block model, created from the building footprints, taken from the cadastral data. Methods for further refinement of the model have been proposed, including the large-scale geometry refinement by interactive fitting of the building height with the underlying texture and also the silhouette based modeling using the low cost terrestrial images, which provides geometry refinement on smaller scales.

In the future we shall continue working with the geometry and texture refinements, we want to implement our image-based modeling ideas from the section 6.1, on the other hand we would like to examine the automatic extrusion methods in our silhouette-based modeling and in general, we are seeking for more automated techniques, that would assist (but not artificially substitute, as it is often seen in some automated projects, resulting in much more limitations than the authors wanted) the user to quickly (re)construct desired virtual city. Accurate georeferencing and the combination of all the methods in the final low cost model are also the part of our future work as well as the elaboration of parameters of quality in the existing city models.

AKNOWLEDGEMENTS

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Design of a 3D virtual geographic interface for access to geoinformatin in real time

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1 ABSTRACT

In 1999, the County of Northern Jutland in Denmark became a national project for implementation of Information & Communication Technology (ICT) in local government. It was supposed to become the Lighthouse for others in the implementation of ICT, e-learning and e-democracy. The idea about a digital region struck this part of Denmark at it has struck many other places in Europe and around the world. At about the same time the first ideas about a virtual geographic interface was initiated and launched as one of the projects at the newly build Virtual Reality Centre of Aalborg University. Later named as VR Media Lab. The Centre for 3D GeoInformation was opened in 2001 and the main purpose of this facility is to extrude the region from 2D to 3D. Through the means of traditional geoinformation such as building footprints, geocoding, building and dwelling register and a DTM the region will be build as a 3D model. The purpose of this 3D model is not only to provide a visual presentation, but also to use it as a real 3D GIS - for both queries through the use of a 3D model and for visualisation of geoinformation in 3D. This paper will present the design framework for the 3DGI system and also give some examples of future use of these kinds of multi-dimensional geographic interfaces.

1.1 North Denmark Digital Lighthouse

The decision to appoint the County of Northern Jutland as the digital lighthouse for the rest of Denmark was taken in 1999. The same year the local university (Aalborg University) could celebrate its 25th anniversary. The innovative research environment that was a spin-off from the activities at the university had proven to be a strong factor in the local community and even at a regional scale. It had e.g. resulted in a research and development cluster for mobile telecommunication. Also many other branches at the university had proven to be successful at both national and international scale. Together with the fact that many of the local municipalities also had shown a great deal of interest in digital administration, these aspects were the primary reasons for the government to give the region status as a Digital Region.

Figure 1: The County of Northern Jutland is app. 6.000 km2 and have 500.000 inhabitants

The objective of the Digital Region was to create the future networked society and try out experiments aimed at tomorrow's ICT society. The activities in the Digital Region were divided into four main categories:

b) ICT Infrastructure

c) ICT Industrial Development, E-Business and ICT Framework conditions for the industrial sector

d) Qualification and Education

e) Digital Administration

The main project ran from 2000 to 2003 with a budget of DKK 510 mill. (€ 69 mill.) and a funding from the government of DKK 170 mill. (€ 23 mill.) granted by the Ministry of Science, Technology and Innovation.

First priority of the initiative was to explore the potentials of the network society for all citizens of North Denmark. This was done via 89 various ICT projects. Among these projects a great deal of them were focusing on e-government. Two main areas were present under e-government: "Service, political authority and efficiency" and "Citizens, democracy and information". The aim of the projects from the first category were focussing on integration of ICT in the administration with examples reaching from citizen self service (electronic forms etc.) to advanced online GIS solutions. The projects within the second category were focussing more on involvement of users in local democracy initiatives. That could be the digital village or participation in spatial planning. This paper will especially focus on the first type of applications and stress the need for an underlying spatial infrastructure to support the use of 3d geovisualisation in the digital administration.[1, 2]

1.2 ICT in Local Government

Before the mid-1990's, citizens only had very few alternatives to choose from when they wanted to confront the local administration. Either they used the phone and called in to the local administration, or they showed up to meet the person they wanted to communicate with. In both these alternatives it required a synchronous action between the citizen and the official. The final option was to write a letter to the administration, which could be a demanding task for citizens who were not very used to write letters in a formal way. The Internet has brought new alternatives for both synchronous and asynchronous communication, where information also can be reach outside officehours and where electronic media have presented new ways of communication between citizens and the local government. This has meant a broad range of different solutions for communication through this reasonable new media [3]. It has also meant a gigantic growth rate for the amount of information being available on electronic form. The problem is not the amount of information available, but how to find the exact information you are looking for. There is definitely a need for new types of interfaces for finding your way through the vast amount of information available.

2 THE MAIN IDEAS BEHIND 3DGI

Different research activities at the end of the 1990s under the management of GISplan [1, 2] also displayed the need of new user interfaces and possibilities of interaction in relation to the work with GI. First of all this need was about breaking with the traditional settings of the GI work, where the representation of the data model usually took place in 2D (in the map), and about introducing different suggestions of the representation of the third dimension.

Already in 1989 [4] showed many examples of the use of 3D in the visualization of GI. At this time the representation of the third dimension was a question of visualizing an attribute to a perspective reproduction of a 2D continuum. This gave new ways of showing geographical information, but in relation to the data organizing there was no new approaches. Several others have also been engaged in describing the bases of a 3D GIS [5, 6], but not until the latest years has 3D GIS been adopted as part of the research agenda for geovisualization [7]. The latest contributions to this part of the research within GI indicate that the subject is a topic in many places[8, 9].

The Internet has opened a large number of interesting initiatives in the multimedia field, which may for example be seen from [10-13]. Also the Digital Earth Initiative has acted as a very large source of inspiration to the foundation of 3DGI.

Another important step towards 3DGI has been the intentions of being able to link geoinformation and the very 3D-geometry model. This has primarily required a standardised 3D model description. Already in 1995 VRML (Virtual Reality Modelling Language) was introduced on the basis of the proprietary object-oriented model format Open Inventor from SGI. VRML was introduced as a standard for exchange of 3D information, and different browsers quickly appeared on the market. VRML 2 at SIGGRAPH in 1996 followed the first introduction, and in 1997 it was even authorised as an international standard for 3D contents at the Internet under the name VRML 97. The interest in VRML implied that the format was the basis for the preparation of a proper suggestion of a 3D format for GI. This format has had the working title GeoVRML and has actually been the basis for the work that has now led to GML (Geo-XML) and parts of the newest format X3D, which is also XML-based. It is evident that new initiatives in this field can only be started with reference to the new standards for a formalised description of 3D

2.1 Purpose of 3DGI

The purpose of the centre is to gather knowledge and competence during the process of creating 3D models of cities and landscapes for organizing and presenting geoinformation applications.

This will be done by:

- collecting competence and knowledge within the field by arranging seminars/conferences, establishing international research networks and by employing researchers within this particular field
- collaborating with companies, who already possess the most recent competence within VR and three-dimensional urban and rural models or are interested in acquiring this
- establishing a VR user interface for looking for position-fixed information in the northern part of Jutland
- creating a geographical model of North Jutland, which can form the basis of digital visu-alization and the marketing of the resources of the region
- developing a basis of knowledge and documentation for the use of a geographical communication concept covering the northern part of Jutland, adapted to the expected in-creased band width in digital transmission media (Fixed and Mobile Nets) and as a framework for developing virtual environments
- forming the basis for future research and for building up regional knowledge within lo-cation-based services (field registration with mobile units). Augmented reality (a mixture of 3D models and reality), three-dimensional user interface and the use of broadband for mobile knowledge services.

2.2 VR and GIS

Virtual Reality and GIS is a fairly new cocktail due to the general differences in concepts. Where VR has been concentrated around the creation of virtual environments and realtime visualisations, GIS was defined from a 2d concept with the third dimension described as an attribute to a specific location. On a world scale [14] have investigated the different available solutions. A number of very early adoptions of the Virtual Reality technology can also be found [2, 6, 11, 15-21].

One of the new aspects in the project is the user interface, based on intensive use of Virtual Reality (VR) and 3D. By creating a virtual threedimensional (3D) model of reality and then use it as an index for many other types of information, it becomes possible to use the general human ability to familiarize with the surroundings and navigate through space.

The Virtual Reality metaphor describes a conceptual model where reality meets virtuality. This becomes a navigable 3d space where existing objects are mixed with simulations of urban planning projects or regulations. The different solutions for Augmented Reality and for tangible interfaces also belong to this category [22].

A spatial user interface will create new possibilities for presenting reasonably large amounts of data. This means that business communities, politicians and the citizens will gain access to a new media, which is able to present frequently very complicated contexts in an easily accessible way. This media can be used within local and regional planning, marketing of the region (tourism, commercial resources, competence and knowledge) – and also to visualize more abstract forms of information (such as environmental and traffic information). The goal will thus be establishing a pioneering project, which will be the central force for the very latest knowledge about the combination of VR and GI technologies.

Together with other partners within this field of research, 3DGI expects to clear the path for new 3d datamodels that are required to get the best integration between VR and GeoInformation. This could really move the main focus from the 2d map and give more attention to the development of new methods for investigation and visualisation of our geographical resources in many new ways.

3 DESIGN ISSUES

Given the main idea, the purpose and some general considerations about GIS, VR and 3d, the next step in the development of a 3d virtual geographic interface, was the system definition. A system for multidimensional geo visualization is, in contrast to an ordinary GIS system, which at most handles surfaces, a system that can store, retrieve, analyze, simplify, generate, and visualize spatial data. Furthermore it must allow user interaction with these data. The system must be able to handle "soft" real-time demands as well as being application and device adaptable - that is the system has to be module based and object oriented so it can be adapted to PDA's, PC's, mobile units and so on, without requiring alterations to the code of the applications. The system has to be collaborative so that more than one user per session can experience and interact in the same virtual world. The system is expected to be build around one or more database technologies, used in a scalable and distributable system, in which large amounts of data will be present (magnitudes of about one TB), powerful server hardware and fast 3D graphic hardware. The system is part of a research project and for that reason the users are not specified ahead of time. The user group is potentially vast from system- and application programmers and administrators to users of applications in the system.

3.1 3D Mapping

The 3D map will create new possibilities for presenting reasonably large amounts of data. This means that business communities, politicians and the citizens will gain access to a new media, which is able to present frequently very complicated contexts in an easily accessible way. This media can be used within local and regional planning, marketing of the region (tourism, commercial resources, competence and knowledge) – and also to visualize more abstract forms of information (such as environmental and traffic information). The goal will thus be establishing a pioneering project, which will be the central force for the very latest within 3D and GI technologies.

The ultimate challenge for 3D mapping has been to develop an integrated system where the 3D objects including attributes and behaviors are kept in a database, which at the same time would be accessible for different kinds of queries and visualizations. The application that are outlined in this paper, will have the goal to both fulfill these demands and at the same time be the source for a real-time VR simulation of urban and rural areas.

The development of the datamodel for 3D mapping is an important part of the research program that has the objective to utilize the third dimension within the geoinformation society in a way so that it becomes more common to use 3D simulations and visualizations in both the public administration (as a tool) and in the many different medias that we use to plan, navigate, seek information, organize and learn from in our lives. Within some years it should be just as natural to use 3D maps as we feel it is today when we make use of traditional 2D maps.

Most geographical datamodels are being constructed with the purpose to support the traditional representation of geoinformation as a 2D map. One of the best examples is the registration of property. The traditional cadastral map is a topological 2D map with attributes, and the purpose of this map is to document the juridical rights to the property. But in urban areas this concept is not sufficient. The utilization of the third dimension through high-rise buildings and complex infrastructural constructions has made the traditional data models inadequate in respect to modern planning support systems. Beside that, there is now a greater demand for more quality in the visualization of new planning initiatives.

3.1.1 Separate 3D and GIS solutions (type 1)

There are many possible ways out of this. In this paper three different data-models will be presented and a reason for why it has been decided to use the most demanding data-model in the 3D mapping project will be described later. They can be classified in three different groups of solutions. The first type of data-model is a divided solution with two separate systems with a dedicated link between the systems. One for the traditional geo-information (generic GIS) where all the 2D maps and respective attributes are kept in a proprietary system and the 3D modeling of the city is done in a CAD-related environment. The systems might use same coordinate system and are therefore capable of doing spatial queries both ways. This means you will be able to navigate in one map and still follow the spatial movement in the other. The solution is not sufficient when it comes to real GI queries since the data structures in the two geometric representations are very different.

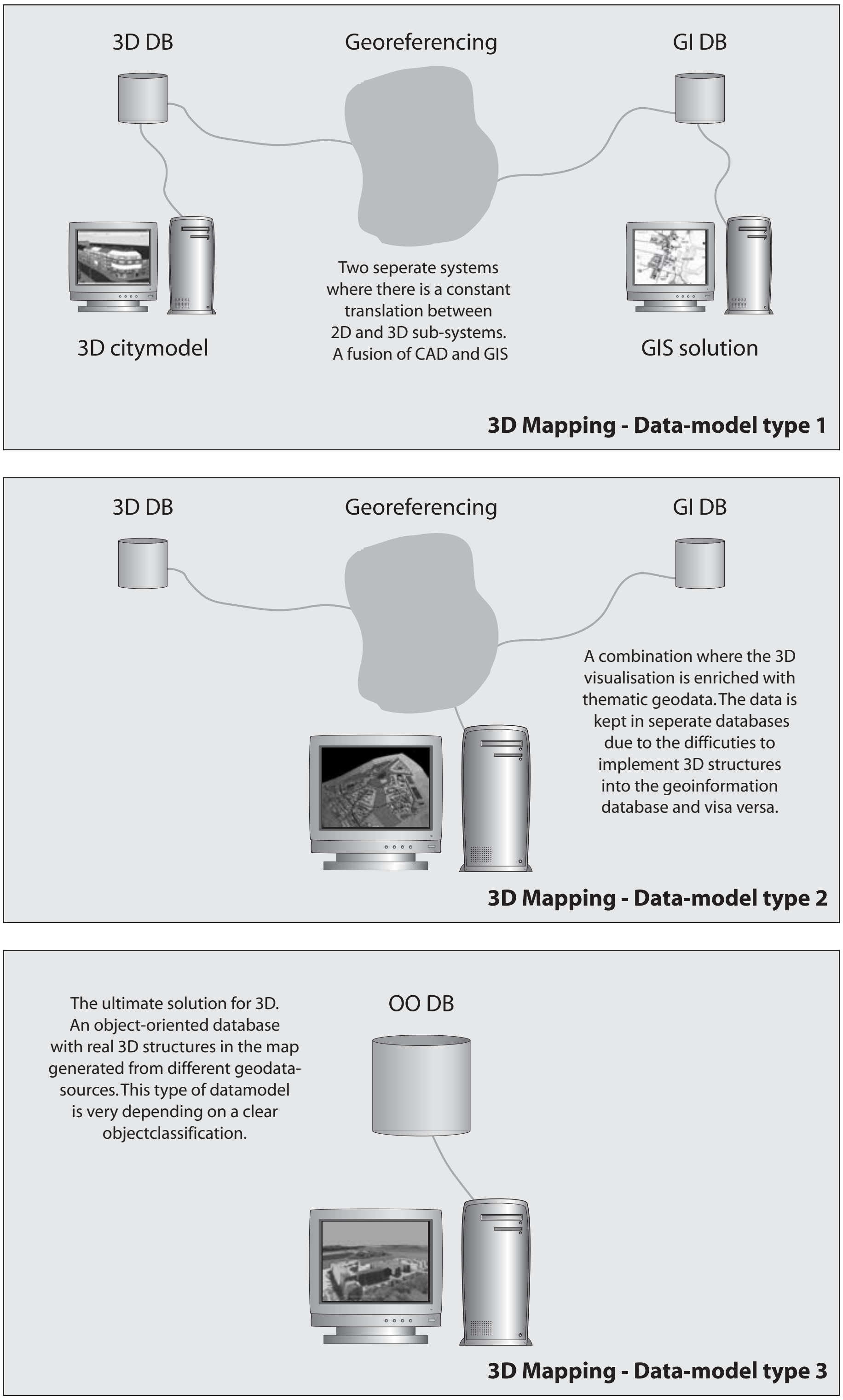

Figure 2: The different 3D mapping solutions can be generalized into three different data-models. Most common solutions are the type 1 and 2 solutions. Type 3 is still an issue for basic research and development. There are no commercial type 3 solutions available yet.

3.1.2 Combined systems (type 2)

This type of system is the most widespread solution at this time. Here it is possible to query and visualize the two different data-types within each other's environments. The link between the two systems is build as a georeferencing application. The systems are normally capable of exchanging data between 2D and 3D. By mapping the features over a dedicated surface representing the terrain, the 2D data is visualized in the 3D models. These features can even be elevated through the use of height attributes in the 2D database. There are several commercial systems that have been build over this data-model.

3.1.3 Object-oriented solution (type 3)

The ultimate solution for a 3D data model is build over an object-oriented database. The difference from traditional systems is very big. Traditional geoinformation databases are developed over the relational data-model. The relational database has its strength with simple geometric forms because of the tabular structure for the organization of data. As long as we only have polygons, lines and points, it is no problem to keep the data in the relational data-model, but as soon as we go from 2D to 3D we multiply the complexity with a very high number. At the same time the amount of data is exploding because we need to see more detailed visualizations and we need textures at the same time. This requires a lot from the database. It is both necessary to find an efficient way to create a spatial index for the database, so that objects can be found and retrieved for visualization purposes and at the same time we need the database to be very fast for real-time visualization purposes. Furthermore there are issues such as Level-Of-Detail (LOD) and orientation of the individual objects to consider. The considerations are numerous and the only way to get through this will be by working closely together with others that have the same goals to reach.

The object-oriented database requires a very detailed object-classification to work correctly. It is not decided how this classification should be generated, but since there are other projects working on 3D mapping, it would be obvious to participate in this work and develop this as a collaborative effort. The goal is not to invent our own object-classification, but to join and encourage the use of open standards for both the database but also for the visualization and later for the distribution of these maps to everyone.

3.2 System Architecture

The next step in the development of an object-oriented solution for the system would be to outline the conceptual datamodel or the system architecture for a 3DGI. As shown in figure 3, this model consists of 4 parts: 1) The Object Building/Construction, 2) The Object Database, 3) The Data Representation and 4) The Viewer.

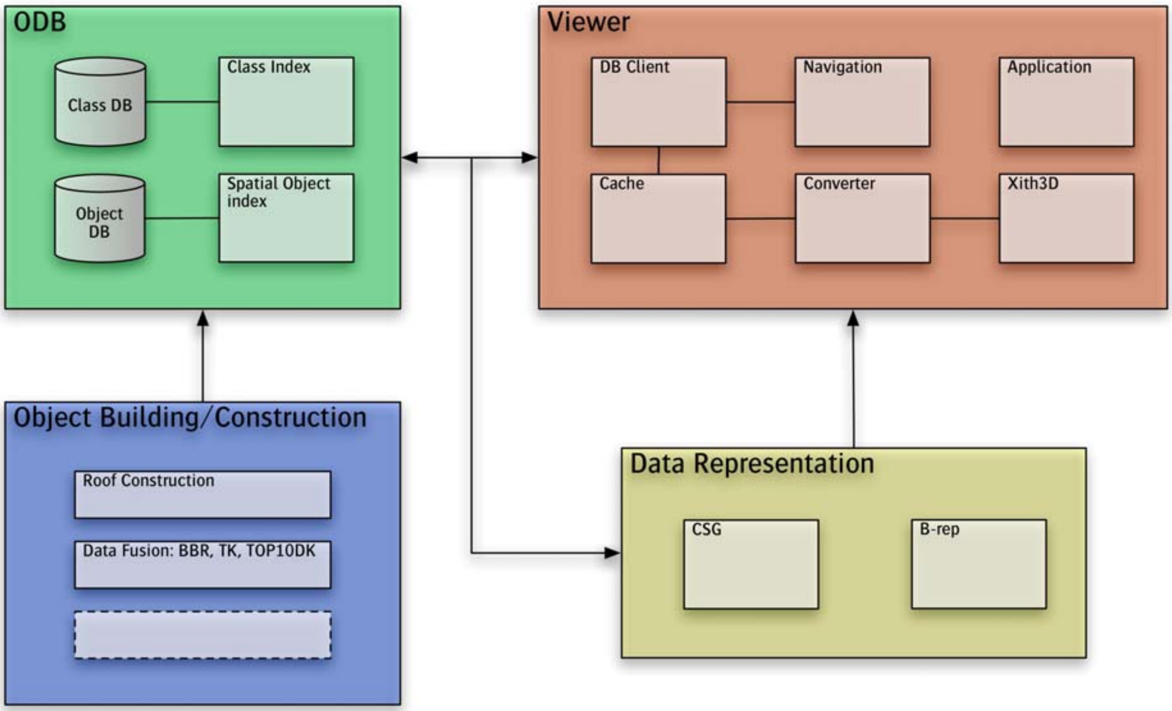

Figure 3: The system architecture for the 3DGI object-oriented system for 3D Geovisualization

3.2.1 Object Building/Construction

The first part of the process is a conversion of traditional 2D geoinformation to 3D objects. This will be done in separate steps for each of the object types. It will be too comprehensive to go through all the different types of entities. The final 3D model will consist of several very different object groups. Those will among others be: terrain, buildings, roads and vegetation. To give an idea about how e.g. buildings will be generated, a short description will be revealed here.

The information for the reconstruction of each building comes from several different sources. First of all it is nessesary to have a footprint of the building with very high precision. This can be provided from the highly detailed technical maps (1:1.000) from the municipalities. Secondly information about heights of buildings is extracted from LIDAR data that are available in urban areas. Then information about each specific building is found in the national building and dwelling register. Here is registered information about the specific number of storeys, type of building (residential, factory, shed etc.) type of use (housing or commercial), building material (for the best simulation of building texture) and type of roof. Several of these information's can be valuable for the correct reconstruction. The roofs are found through feature-extraction from the LIDAR data and even each individual unit (e.g. flats) in the building can be generated through a separate workflow also with information from the building and dwelling register. More specific details about this process will be documented in future publications.

It is obviously not an easy task to generate the database as 3D objects, since it involves a lot of very time-demanding modelling which is not general but very specific for each object type. It is a hope that this procedure in the future will be a part of the commercial map production.

3.2.2 Object Database

Some of the commercial database solutions were tested in the initial phase of the 3DGI project, which resulted in the conclusion that there were very serious shortcommings regarding the indexing of objects in 3D and regarding the nessecity to query the database in something very close to real time. The commercial databases were simply not fast enough for the purpose of 3DGI. This meant that a new object-oriented database was developed and beside the storage of the objects there is a database for the different classes. This means that new classes can be introduced very easily and that existing objects can be reclassified. Another important thing about a customised object-oriented database is also the ability to test and reengineer the database up against the viewer developed for 3DGI.

3.2.3 Data representation

Between the database and the viewer, there is a module for data representation. Each object is saved in the database in a parametric way. This way it is possible to generate either a boundary representation (B-rep) or a Constructive Solid Geometry (CSG) for the viewer. The plan is to keep an open architecture, where CSG and B-rep representation can live beside each other in the same model. Buildings can be a combination of CSG in the body of the building and B-rep for the roof, which is extracted from the LIDAR data. There are still many decisions to be taken especially regarding representation of the objects in the 3DGI system.

3.2.4 Viewer

The viewer should be both independable of certain hardware and very flexibel in use. To fulfil these demands it was decided to use Java for the development of the viewer. At the moment only a very early implementation of the viewer has been developed. This viewer is build around Xith3D [23]. The viewer will eventually also consist of navigational tools for interaction with the 3d virtual environment. Research is at the moment ongoing especially on these subjects.

3.3 Conclusion

It is our belief that the future geographic interface for geospatial information used in the coming digital administration will not be build around a 2D flat concept of the world, such as the well-known paper map, but around a conceptual virtual 3D environment, where the semantics are very much like the real world. When you want to known more about a specific location near you, it will only take you a short virtual trip through the model to go there and just ask the question in the system. Also the administration will gain from this change, since the interface can be used as a common virtual space for meetings, for introduction of new planning initiatives etc. But the road towards this ideal situation is not straight or without holes. It will take time and much more research before it will be possible to implement these systems in a broad scale.

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CyberCity Modeler,
Generation, Updating and Continuation of 3D-City models with on-line-Editing – Visualization with TerrainView 2.0

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1 INTRODUCTION

Because of the new technology and the herewith lack of data, updating and continuation of 3D-city models was not a big issue in the past. Municipalities and other organizations have been satisfied with collecting 3D-data for selected areas. While more 3D-data becomes available, the updating and continuation of data has to be considered more seriously. Because of this reason CyberCity Modeler was extended by a new tool to an efficient updating by comparing existing 3D-city models with new aerial photographic information. Updating a city model means deleting of no longer existing buildings, adding of new constructed buildings and modifying of changes in existing objects. A new software module VisualStar was developed as a photogrammetric workstation with special functionality for data continuation and 3D measuring. The 3D-data is managed in a GIS database like ESRI's ArcGIS and ArcSDE or C-Plan's Topobase.

For interactive visualization ViewTec improved TerrainView (version 2.0), which includes additional sophisticated functions for on-line visualization. One of the most important requirements was the possibility of moving, deleting and importing objects. New objects can be taken over from various formats and combined to complex sceneries. Another important issue is the web streaming of landscape and city models, where TerrainView offers the possibility of viewing large data sets with very high speed.

2 VISUALSTAR: UPDATE AND CONTINUATION OF 3D-CITY MODELS

CC-Modeler is a software tool for generation of 3D-city models. It was described in several papers (see www.cybercity.tv) and presented e.g. at Corp 2003. The amount of existing data is rising and therefore the necessity of updating and continuation of the data is required. Additionally the data must be handled within GIS databases. Following points are important for actualization:

- Comparison between existing 3D-city models and actual status.
- Deletion of objects which do not exist anymore
- Edit of objects which have changed between the different status
- Add new objects by direct modeling
- Management of the actual city model in a GIS database (incl. attributes)

To perform these tasks, CC-Modeler was extended by a new tool called VisualStar. VisualStar is a digital photogrammetric station, which was especially developed for 3D-city modeling. It requires a PC with a stereo-capable graphic card and monitor. With a shutter glass the stereo viewing is performed. VisualStar also has standard photogrammetric features like stereo-model orientation, automatic and semi-automatic measurement of aerial triangulation, DTM and DSM, orthophoto computation including mosaicking.

For working with 3D-models existing data is imported from a GIS database or file system and is displayed together with the aerial stereo model. This means that the old city model is overlaid with the new image information and differences and changes are visible immediately. Buildings, which do not exist anymore, can be deleted from the database. New buildings can be recognized because they are visible in the stereo model and not yet represented by the necessary vectors. These buildings can be measured and modeled directly. The modeling is performed automatically after measurement of the polygons of the boundary points and the inner points of the roof. The operator just measures points, the lines and vectors are created automatically. The modeling is performed without knowing about the roof structure. E.g. it is not necessary to tell the program if it is a saddle-, tent- or other roof.

The 3D-data can be managed in commercial databases with ESRI's ArcGIS, ArcSDE or C-Plan's Topobase.

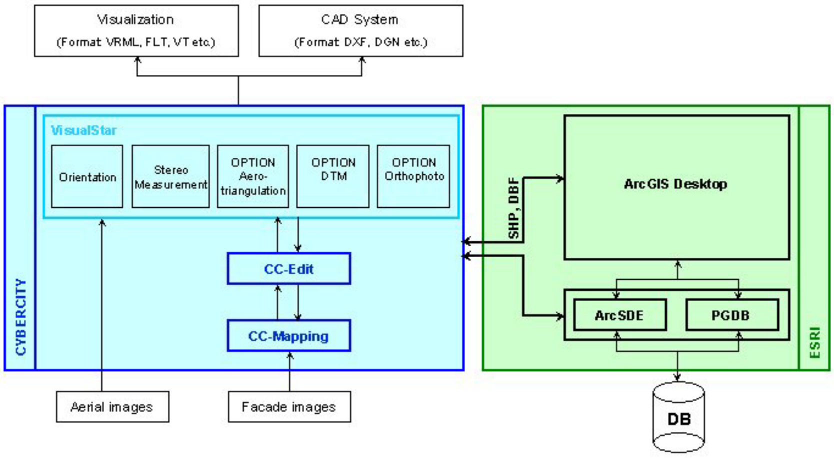


Figure 1: Workflow for Updating of 3D-city models in CyberCity processes and the management with ESRI's Arc products

CC-Modeler is an automatic topology generator for 3D-objects. The main components of the system are shown in Figure 1. The first obligatory step is preprocessing, which includes the checking of the measurement order of the boundary points (BP), detection of redundant points, and determination of the possible groups of faces, based on sets of adjacent (BP) point pairs.

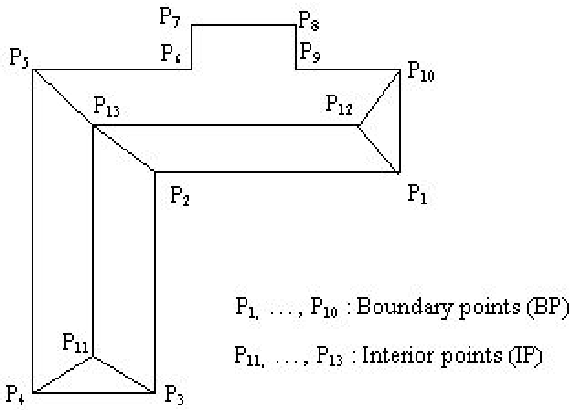


Figure 2: Data capturing procedure with CC-Modeler

The next step is to build the face model of the 3D-object, i.e. to determine how many faces the 3D-object has, which points define an exact face and the spatial relations between the faces. This is implemented through a *Consistent Labeling* algorithm by probabilistic relaxation operations, in which two procedures are involved, the initial probability determination and the relaxation processing. The result of *Consistent Labeling* is the face definition for every face. Then, least squares adjustment is performed for all faces simultaneously, fitting the individual faces in an optimal way to the measured points and considering the fact that individual points are usually members of more than one face. This adjustment is amended by observation equations that model orthogonality constraints of pairs of straight lines between boundary points. Finally, a vector description of 3D-objects is obtained.

This procedure allows the operator just to measure points, the vectors of faces and lines are generated automatically which means a distinctly more efficient data capturing procedure.

3 AUTOMATIC GENERATION OF FACADE TEXTURE

A software tool was especially defined to optimize texturing of facades. The goal was to reach a high degree of efficiency for big city areas. With CC-TLSAutotex or CC-Autotex, facade textures, which are taken from aerial images, can be put automatically on wall facades. This software module is an addition to CC-Mapping, where manually taken terrestrial pictures are handled or pictures within a library are used as generic texture.

CC-TLS Autotex allows to map images, which are taken by helicopters. TLS stands for Three-Line-Scanner, a digital camera system developed by Starlabo, Tokyo and equipped with software developed by ETH Zurich and CyberCity AG. The principle is shown in figure 3.

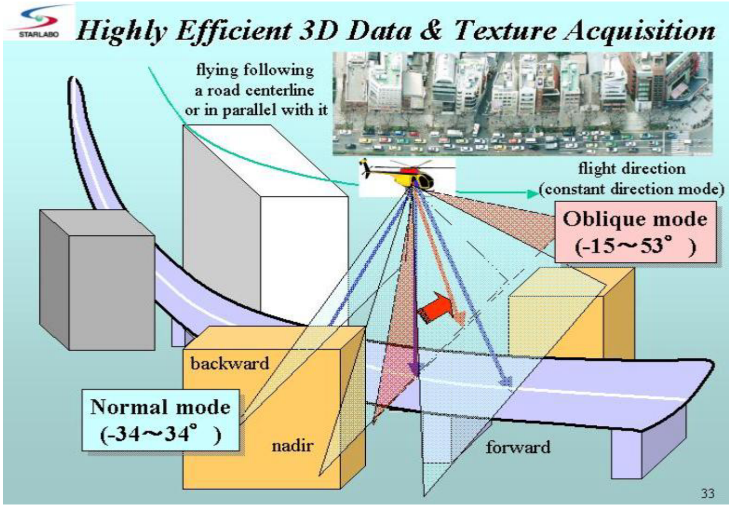


Figure 3: TLS data taken by helicopter for facade mapping

With CC-TLSAutotex the texturing of facade images is performed automatically for all non-hidden planes of the walls. The program detects occluded facades and textures all visible facades automatically. In case of occlusions the operator has to decide, if he will manually map this part or copy parts of the wall. An editing functionality for manual improvement of the image is included in the package. The 3D-model must exist either as v3d (Format of CyberCity) or dxf object. At the automatic procedure the quality of the different picture is analyzed and the best in respect to resolution, brightness and contrast is selected.

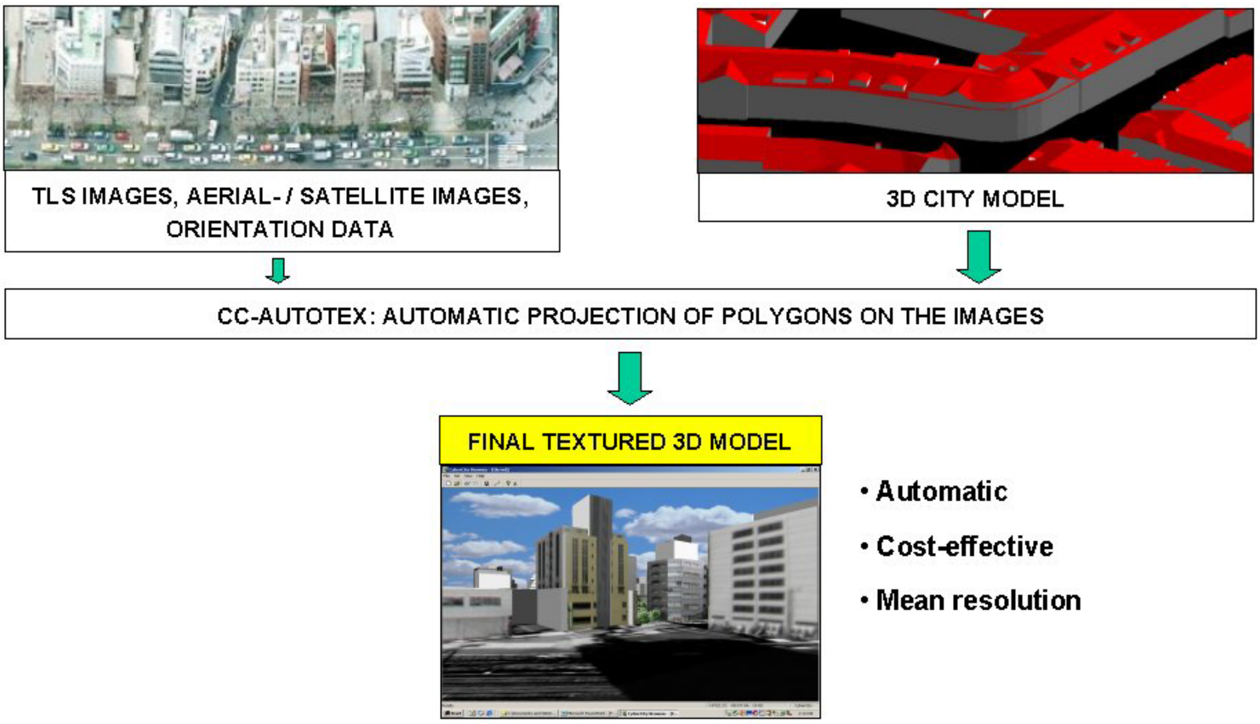


Figure 4: TLS results by CC-TLSAutotex

CC-Autotex is used for photos taken by planes. Starting with a 3D-city model in v3d or dxf format, the polygons within the images are computed and then textured to the object face. A projective transformation is applied for rectification. A special procedure for deriving the facade texture was developed and will be published later. Using this procedure we can generate about 90% of the facades automatically. If required, retouching must be done manually. This is only necessary for a smaller number of images, because there is less occlusion in images taken from planes than in terrestrial photographs.

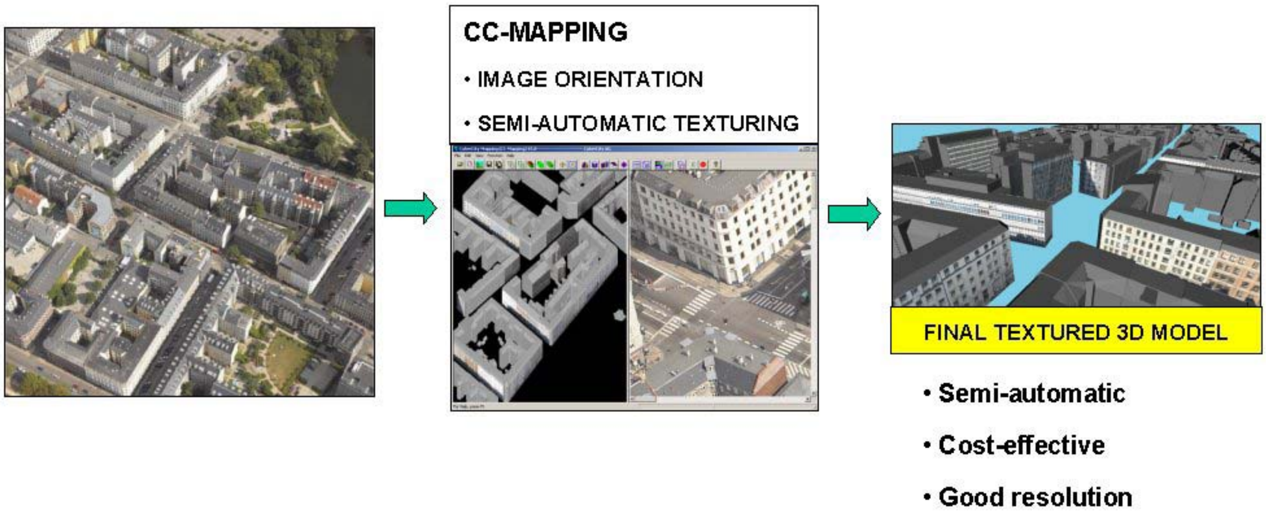


Figure 5: Aerial image data taken by plane for facade mapping

4 VISUALIZATION WITH TERRAINVIEW 2.0

The **TerrainView** application is a state of the art Virtual Reality based software solution that facilitates the interactive visualization of high-resolution 3D-terrain data over the **Internet and Intranet**. Due to ViewTec's advanced software technology and innovative data management concepts, large amounts of data may be processed in real-time. Digital elevation models, high resolution orthophotos, satellite images, 3D-buildings and vector data provide the real time application with the information to display excellent high quality representations of complex terrains and landscapes. It was described in several papers (see www.viewtec.ch).
Spatial planning, works premises and city visualization, TerrainView gives benefit by visualizing present or future building projects in a most attractive way. TerrainView can include the corresponding information into the terrain model of your site, to visualize any preferred number of textured buildings. Optimization of production sites, marketing and public relation strategy can now be improved.

Main features of TerrainView are:

- Web streaming support
- Import of 3D-models of different formats
- Manipulate objects
- Various modes of navigation
- Points of interest editor
- Advanced flight path editing
- Terrain paging
- Weather visualization
- Arbitrary resolution screenshots
- Stereo support
- Generation of digital video
- Information tree

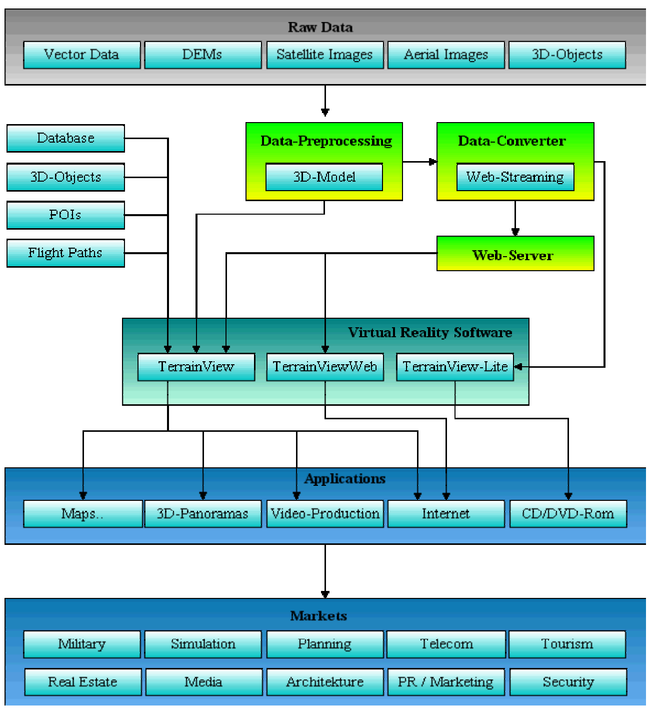


Figure 6: Workflow of Visualization

Web Streaming Support

With TerrainView you are able to connect 3D-terrain databases through Internet. Cities like Munich and Berlin with more than 500'000 buildings can be streamed. The 3D-terrain data size is only limited by the available disk space. TerrainView runs in conjunction with proxy servers and firewalls. All data streams are compressed and heavily encrypted. A standard Web Server delivers and manages the 3D-terrain data and orthophotos for the TerrainView application over the Internet or private computer networks. While using standard server technology, the user has access to large sized databases that can be viewed over low-bandwidth networks in real-time.
The TerrainView-Web ActiveX component/plug-in for Microsoft Internet Explorer is also available free of charge (see www.viewtec.ch/techdiv/terrainviewwebplugin_e.html). City planners and architects have now the possibility to visualize big cities, import planned 3D-building models and show the results within one hour. TerrainView can visualize building blocks from vector data, texture the roofs with geospecific orthophotos and the walls with generic and geotypical textures. Landmark buildings can be imported as textured CyberCity or 3D-studio models. Urban planners can also access the whole Switzerland in 2m-resolution and cultivate this Internet model with their own buildings.

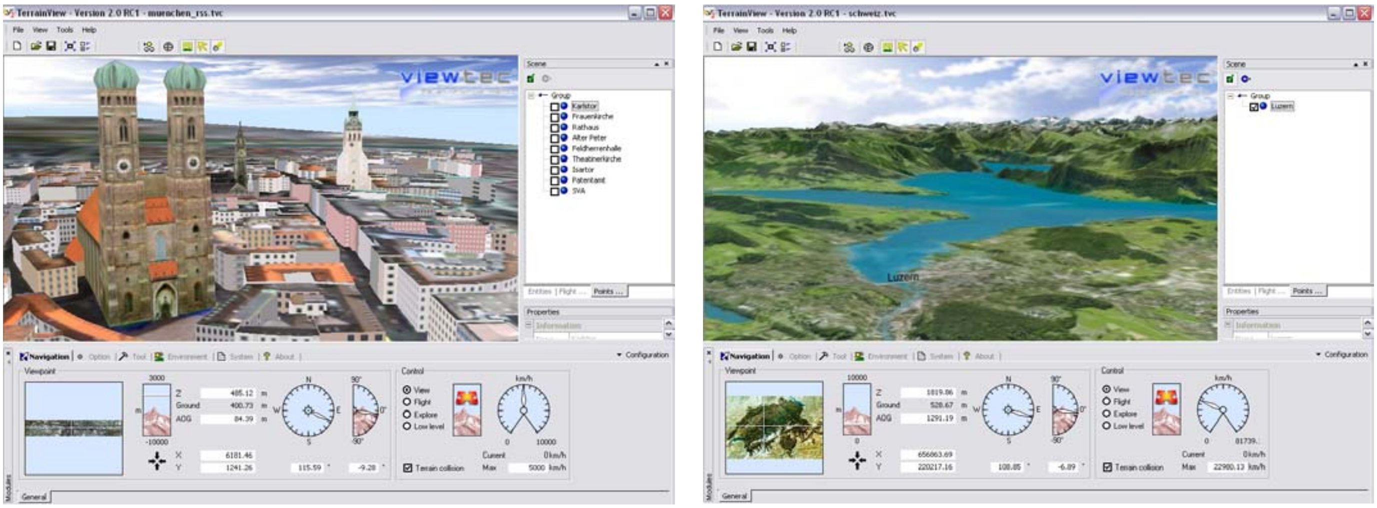


Figure 9: City of Munich with integrated landmark buildings and Switzerland with 2m-resolution

Supports Industry Standard Formats

Models such as buildings, billboards, and points of interest can be imported to enhance the realism of the terrain. Currently the supported data formats are Multigen OpenFlight, Terrex TerraPage, Quantum3D VT, Carbon Graphics geo, CyberCity v3d, Autodesk 3ds, Discreet 3D Studio Max (MAX), VRML 1 and 97, Design Workshop dw, Wavefront obj and NewTek LightWave 3D lwo. TerrainView rendering is accelerated through OpenGL, the industry standard for high-speed 3d graphics programming and takes full advantage of leading-edge OpenGL features.

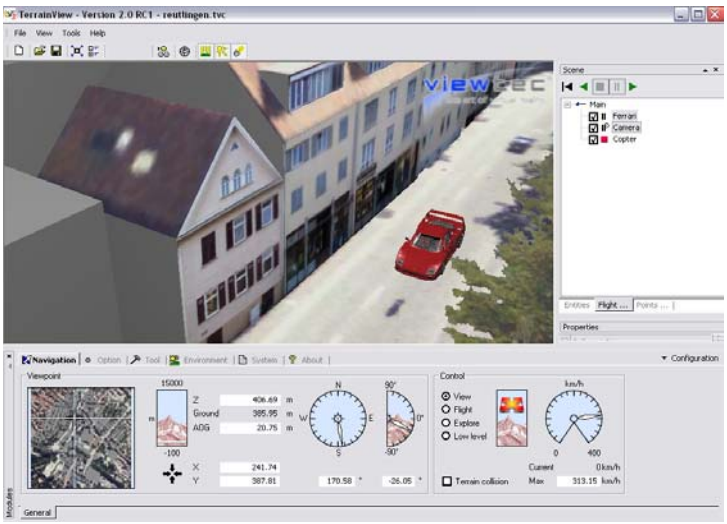


Figure 7: TerrainView scene with different 3D-models

3D-Object Manipulation

The imported 3D-data can be manipulated and adjusted to the customer's needs in an easy and comprehensive manner. The user may merge and group multiple 3D-objects of different formats together. TerrainView can change between presentation and modify mode. If in modify mode, selected 3D-models can be moved, rotated, and scaled by the user. It is also possible to select, group and manipulate several objects at once.

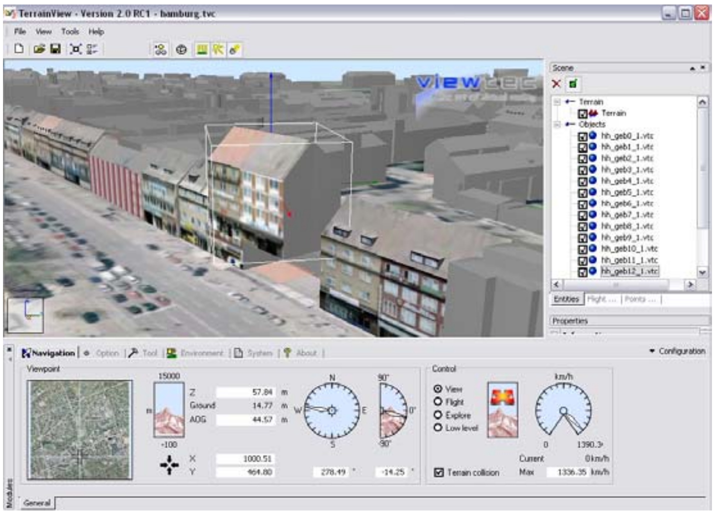


Figure 8: City of Hamburg with selected and manipulated building

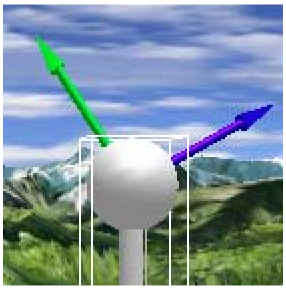
Flight Paths Editor

Flight paths are smoothly interpolated curves between a series of user-defined control points. TerrainView flight paths can interpolate positions and orientations.
The flight paths in TerrainView use cubic interpolation what guarantees that every control point will be actually positioned on the calculated curve. TerrainView offers two vector interpolation methods:

Catmull-Rom	This is a specialized cubic interpolation method, creating nicely curved paths. Apart from the control points' position no further input is needed.
Viewing Direction	This interpolation method uses the control points' orientation vectors as tangents for the cubic interpolation. I.e. the user must set not only the control points' position, but their orientation, too.

By using natural parameterization for the calculated curves, TerrainView achieves constant speed during motion along the flight paths.

Control point for Catmull-Rom interpolation



Control point with orientation information. The green arrow represents the forward direction, the blue one the upward direction.

Figure 9: Different interpolation methods

The green and blue arrows which are visible for spline interpolation represent the orientation at the control point and are called the frame vectors of the control point.

In TerrainView it is also possible to attach any object to a flight path. Furthermore, the camera can be attached to a flight path as well, and can be pointed at any other object that has been loaded, including any object currently flying along a different flight path.

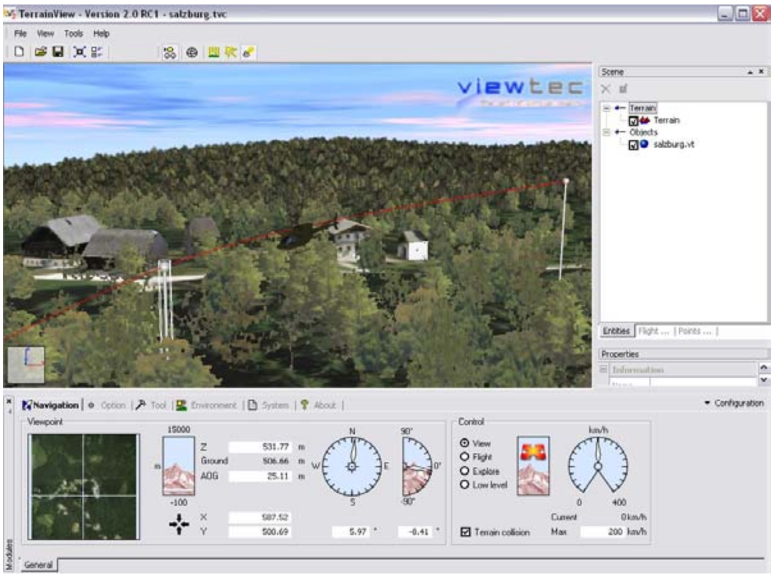


Figure 10: A helicopter is attached to a flight path

Generation of Digital Video

TerrainView offers the functionality to create video files in the AVI format using various encoders/decoders e.g. MPEG4. TerrainView offers two possible modes to create a video, “Interactive”, or “Flight path”. In the interactive mode, the currently rendered view is written to the video stream while the user navigates across the terrain, whereas in flight path mode one or more previously defined flight paths are started and the one with the active camera provides the images for the video.

5 CONCLUSION

CyberCity and ViewTec offer together new modules needed for updating and high-end visualization through Internet. CyberCity’s VISUALSTAR allows online updating and editing, AutoTEX the efficient mapping of façade textures with high quality and low cost. TerrainView now allows modification of 3D-objects online and permits the visualization of complex landscape and 3D-city models. Flight paths can be generated in a very sophisticated manner. CyberCity Modeler and TerrainView together are highly developed tools for most ambitious 3D-model applications.

6 REFERENCES

Publications, references and detailed information may be found at

www.cybercity.tv

www.viewtec.ch

3D-visualisation of Vienna's subsurface

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1 SUMMARY

For the planning of major construction projects such as subway tunnels or building foundations, knowledge of the structure and material properties of the subsurface is essential. We have developed a three-dimensional, geo-referenced model of Vienna's subsurface using the information from over 40.000 boreholes as described in a database at the Vienna City Administration (Municipal Department MA29 - Foundation Engineering) and analysed geologically over the last 3 years. This model shows the geometry of geological layers including the depth and morphology of layer boundaries and the thickness of geological sediments. Combined with knowledge of the genetic origin of sediments, material properties of the subsoil can be estimated.

A Java-3D-viewer, developed at the Netherlands Institute of Applied Geoscience, is used to visualise the model and to construct cross-sections (clip planes) at any location and orientation (horizontal, vertical or inclined). The interactive viewer provides immediate access to available data on Vienna's subsurface and represents an innovative IT-tool for urban geologists, engineers and city planners concerned with mayor construction projects. The fast and accurate presentation of underground structure constitutes an economical means for the communication of information among spatial planners and urban developers.

2 INTRODUCTION

City planners as well as engineers, legislators and public workers all depend to some degree on geological and geotechnical information on the subsurface of urban areas. The characterization of construction sites, the evaluation and protection of urban ground waters, the environmental review of contaminated ground water, surface water or substrates, the management of urban waste all require detailed knowledge of the geological characteristics of city areas. These characteristics include the structure (geometry) of geological layers as well as their respective material properties. While the structure of layer boundaries and the thickness of geological sediments is described by a three-dimensional model, the nature of sediments is expressed by hydraulic, chemical and engineering parameters such as permeability, adsorption capacity, grain size or water content to name but a few. Filling a geometric model with values for these parameters results in a complete account of the subsurface. Put into an information system and combined with the geological expertise of urban geologists, this provides all information necessary for decision making.

The Geological Survey of Austria together with the Vienna City Administration (MA29) are developing such an information system for the city of Vienna built on geological maps, borehole logs collected in over 40.000 boreholes, and on data derived from standard material testing. At present, the geological analysis and evaluation of borehole logs and the construction of the geometric model are completed (Hofmann & Pfleiderer, 2003) whereas the connection to material data is still ongoing. However, with knowledge of the genetic origin and sedimentary history of geological layers some parameter values can be estimated.

2.1 Geological background

The geological situation of the city area of Vienna is described by Brix (1972). The western part of Vienna is dominated by flysch (sandstones, claystones and marls; brittle material with poor conductivity for groundwater), while the central and eastern parts constitute the Vienna basin which is filled with loose sediments. At the western edge of this basin, along a narrow N-S-trending band, clay and silt occur at the surface (impermeable, fine-grained layers with occasional sandy units). In the central and eastern part of the basin, these clay and silt layers are overlain by gravel (coarse-grained layers with high conductivity for groundwater). Occasionally, gravels are covered by a thin layer of fine-grained material (loess and loam). The structure and tectonic evolution of the Vienna basin are explained by Decker (1996).

2.2 Borehole data

In the course of the last 100 years, the subsurface of Vienna has been probed by over 40.000 boreholes, reaching mostly to depths of 5-20 m below surface, exceptionally down to 400-600 m below surface. The logs of these boreholes are collected by the Vienna City Administration (MA29). The data include the location of drilling, the material description of geological units (thickness, grain size, packing density, consistency, water content) and references to the depths where samples were taken for material testing. Analysis and evaluation of all borehole logs with respect to their geological information has been performed by the Geological Survey of Austria over the last three years (Hofmann & Pfleiderer, 2003).

3 MODEL CONSTRUCTION

Geological maps represent 2D-models of the regional distribution of geological units at the surface whereas borehole logs denote the distribution of geological units from the surface down along a vertical line (1D). By combining geological maps with borehole logs, a three-dimensional model of the subsurface can be constructed in three steps. First, the boundaries of geological layers are marked in borehole logs and the markers are correlated to build 2D-surfaces (interpolation). Then, these surfaces are stacked upon each other like a series of "flying carpets". Finally, the volumes between the surfaces are filled to construct a layer model of the subsurface. While the first two of these steps are carried out within a geographic information system (ArcGIS) the layer model is built using a geo-viewer.

The following surfaces (ordered from top to bottom) were imported into the layer model (Fig. 1):

- The topmost surface (A) represents a digital elevation model (DEM) of the city of Vienna. This surface was created using geodetic points measured by the Urban Survey Department (Municipal Department MA41), and including some additional information on altitude and surface morphology.
- The second surface (B) represents the bottom of the fine-grained cover overlying the gravel unit. It occurs as isolated patches mainly in the eastern half of the city area and lies on average 2 m, at most 23 m below ground. Almost all boreholes penetrate this surface.
- The third surface (C) corresponds to the bottom of the gravel unit, covers the central and eastern part of the Vienna basin continuously and lies 10-30 m below ground. Approximately one third of the boreholes reach down to this level. Therefore, the surface is less exactly defined as the previous one.
- Next, an intermediate (stratigraphic) surface (D) within the unit of clay and silt was constructed from maps published in the literature (Unterwelz, 1993) to demonstrate the tectonic structure at greater depths (100 m below ground in central Vienna, descending in a step-wise fashion to 1100 m below ground in the southeast).
- Finally, the bottom of the clay and silt unit (E) was also constructed from maps published in the literature (Wessely, 1993). It reaches down to 5000 m and more below ground. The material underlying this surface constitutes flysch material in the north-western part and includes limestones and dolomites (carbonates) in the south-eastern part of the city area.

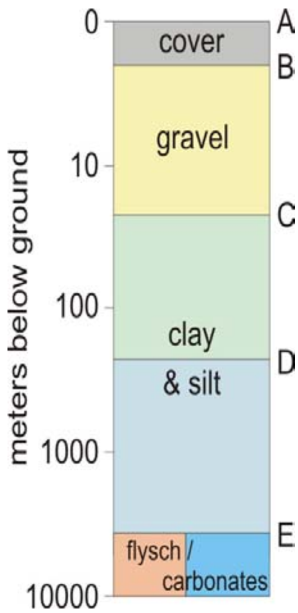

Fig. 1: Schematic sequence of modelled layers

For most purposes, the lowest two surfaces (D and E) are of little importance, as construction activities in urban areas are usually limited to the uppermost 40-50 m below ground (Rogers & Horseman, 1999).

4 GEO-VIEWER

The viewer used to visualize the layer model was developed at the Netherlands Institute of Applied Geoscience (TNO-NITG; http://dinoloket.nitg.tno.nl). It makes use of Java 3D technology to display three-dimensional data sets such as raster surfaces, 3D-polylines and scattered 3D-points imported from SURFER, ZYCOR or ARCINFO. The program performs 3D-rendering, offers free customization of colour display, illumination and shading and includes a wide range of user-friendly interactive features such as mouse-driven real-time rotation, vertical scaling, contouring and clipping (TNO-NITG, 2003). A public version of the viewer is available free of charge at the above mentioned website.

Figure 2 displays the surfaces modelled by interpolating geodetic points (surface A) and correlation markers from borehole logs (surfaces B and C) and by digitizing published maps (surfaces D and E). The units along axes X (easting), Y (northing) and Z (altitude above sea level) are given in meters. (The same holds for Figures 3 – 6.) For reference, surface rivers (blue) and district borders (red) are draped over the digital elevation model (surface A). The step-wise morphology of surface D resulting from tectonic faulting becomes apparent.

Due to the scale and resolution, surfaces B and C are not visible in Figure 2. The large map extent of app. 20 x 20 km² and the small thickness of the fine-grained cover and the gravel layer (2 – 20 m) prohibit their presentation in the block diagram if deep layers are to be displayed at the same time.

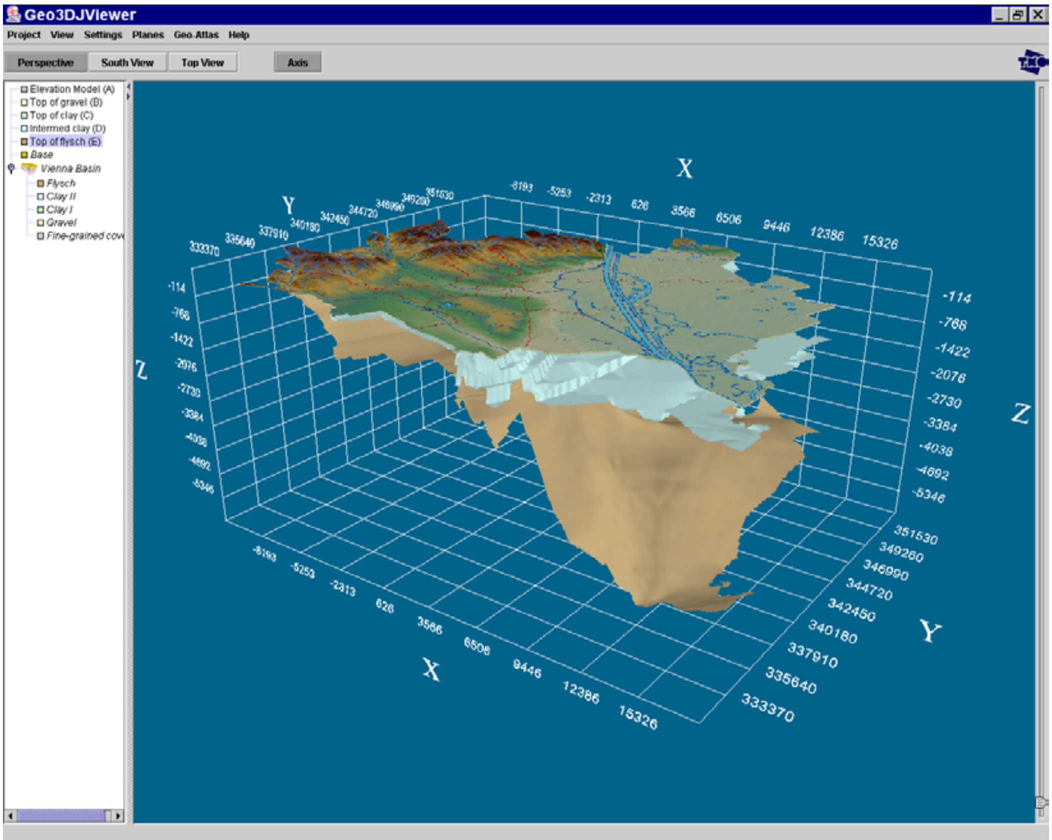

Fig. 2: Surfaces constructed for the layer model

Filling the volumes between these surfaces leads to a layer model of the subsurface geology of Vienna displayed as a block diagram in Figure 3.

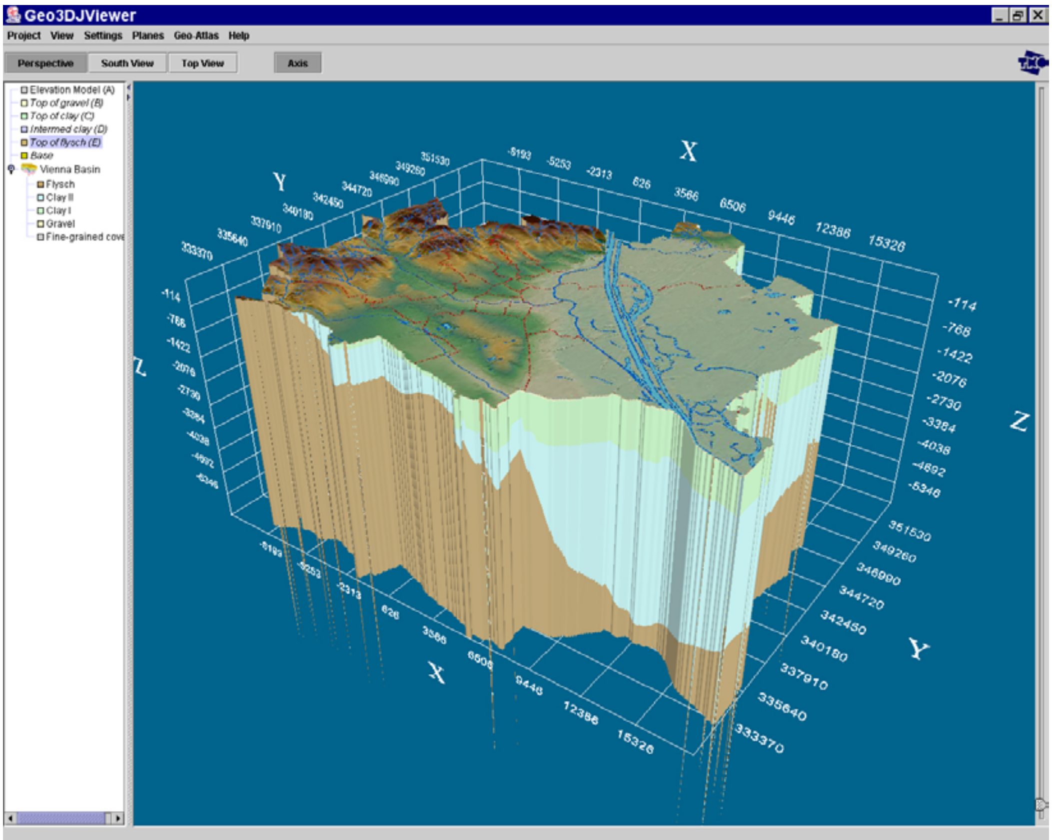

Fig. 3: Block diagram of the subsurface geology of Vienna seen from south-east

The same diagram is shown in Figure 4 dissected by two vertical clip planes trending north-south and east-west. The activation of clip planes represents a quick and user-friendly means to construct geological cross-sections of any orientation and at any location. In Figure 4 the shape of the Vienna basin at depth becomes immediately apparent.

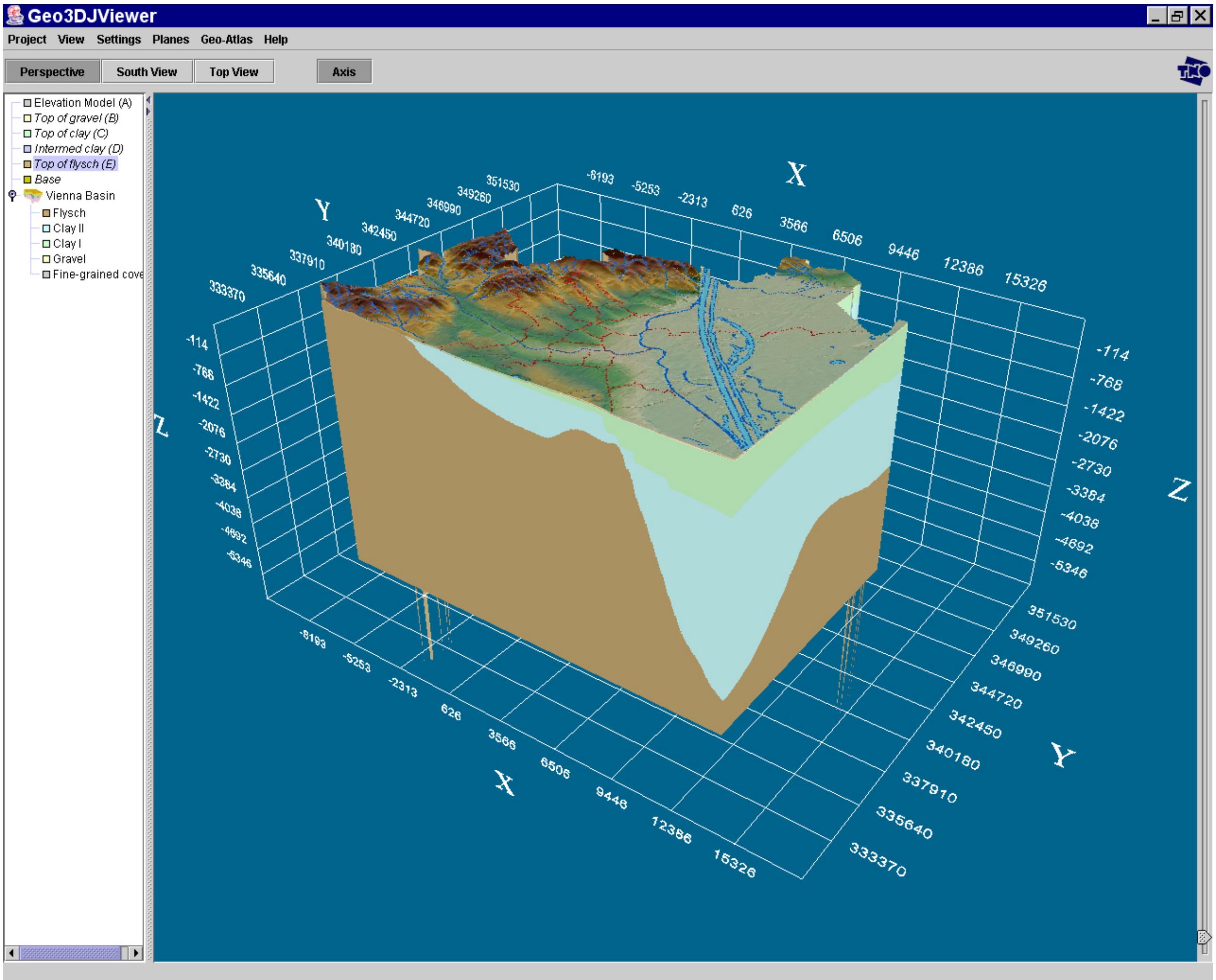

Fig. 4: Block diagram of Fig. 3 dissected by two clip planes trending N-S and E-W

For most underground activities in urban areas, representation of the thin gravel layer and its overlying fine-grained cover is much more relevant than the deep structure of the Vienna basin. Construction projects such as major buildings, road or subway tunnels, waste water treatment plants or fuel storage facilities are situated at depths of 10-50 m below ground.

In order to present the thin layers (between surfaces A, B and C), Figure 5 zooms into a small area in the central part of Vienna. The close-up extends over an area of 1 x 0.8 km² and displays the top three layers of the model. Here, the city map of Vienna is draped over the digital elevation model to show individual housing blocks (dark grey), traffic routes (light grey) and recreational areas (green).

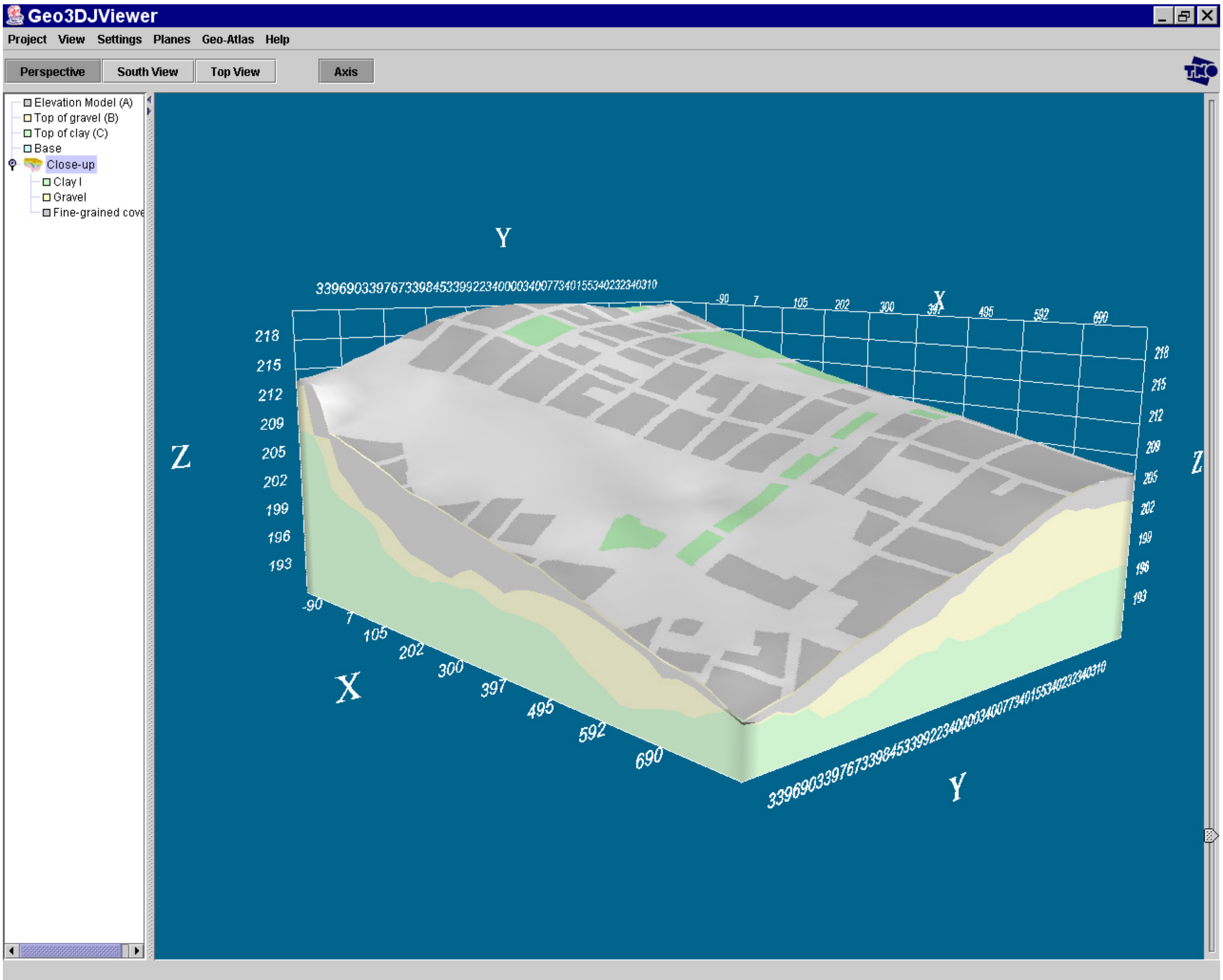

Fig. 5: Close-up view of the geological layer model in the central part of Vienna

Activating some clip planes reveals the structure and depths of geological layers in form of a fence diagram (Fig. 6). This way, the preview of a planned excavation for a construction site including the faces of pit walls can be simulated. Such a simulation is of vital importance to engineers assigned, for example, the task of planning the foundation of a building. Together with material properties of the geological layers, it allows not only to predict which material will be found at what depth but also to plan the design of the excavation, to forecast safety measures with respect to the stability of pit walls and to estimate the costs of operation. Therefore, analysing the layer model with the aid of a geo-viewer represents a fast, inexpensive and powerful tool to assist city planners and engineers with their day-to-day work.

Increasingly, the City Administration of Vienna is required to communicate planned building projects to the broader public. The Municipal Department MA18 - Urban Development and Planning, for example, is in charge of coordinating the public information and documentation during the planning process of major projects. For this purpose, our visualisation of the geological model with a geo-viewer is equally well suited, offering graphic and easy-to-understand illustrations of underground ventures.

5 FUTURE WORK

Ongoing collaboration with the City Administration of Vienna (MA29 and Municipal Department MA45 - Water Engineering) focuses on the integration of hydraulic and engineering parameters such as permeability, grain size and water content into the model. Data on these material properties exist in various data bases and simply need to be geo-referenced and linked to the geological layers. Retrieving this information per mouse-click is envisaged in order to further facilitate the communication among engineers, spatial planners and urban developers.

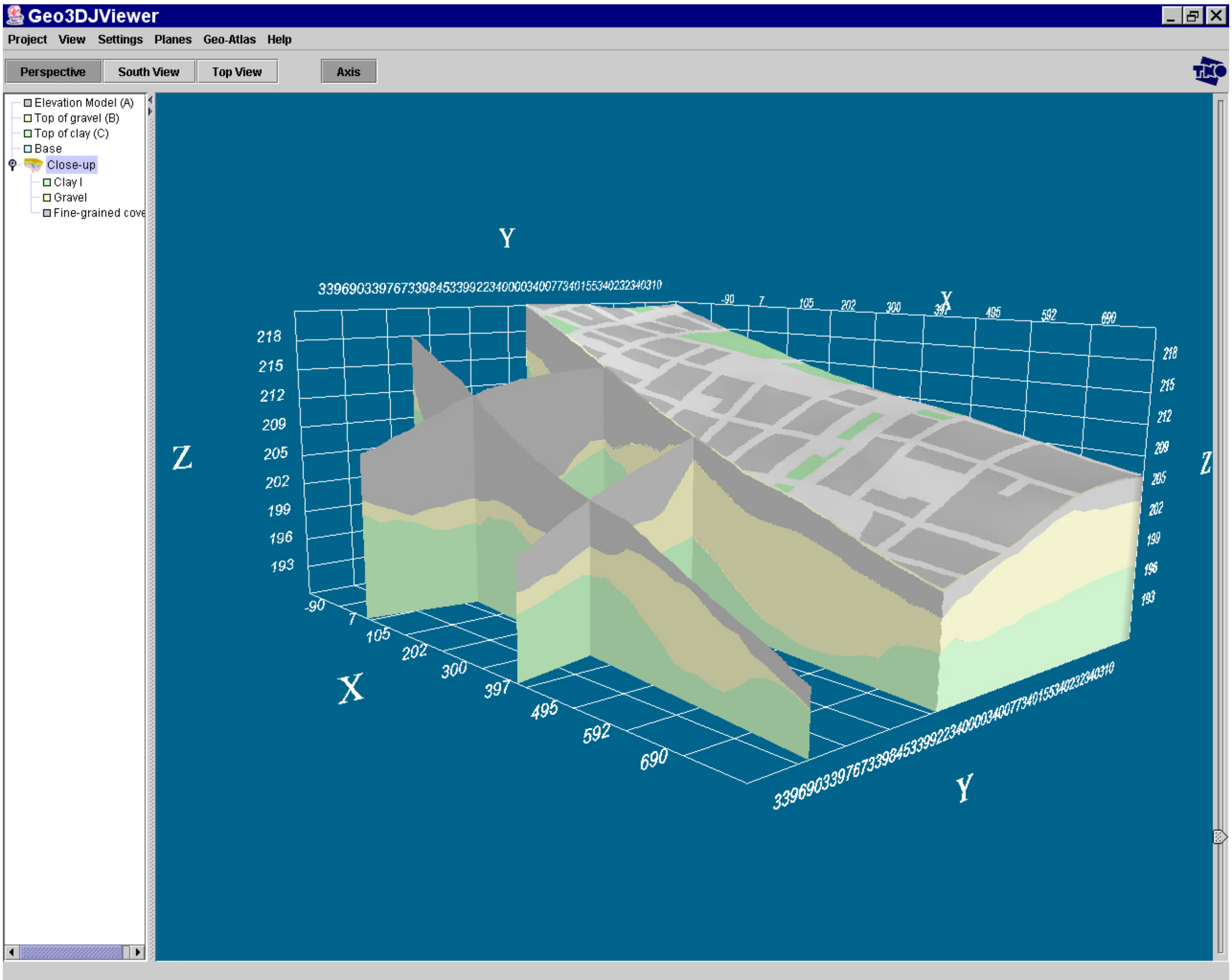

Fig. 6: Fence diagram of the close-up view of Figure 5

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Developing ICT Tools For Public Participation In Public Spaces Improvement Process - Public Art & Public Space (PAPS) Belgrade Pilot Project results -

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1 INTRODUCTION: PUBLIC ART, PUBLIC SPACE, PUBLIC PARTICIPATION

1.1 What is Public art?

Since concept of Public art has diverse meanings there is no simple definition of it. But one relation always exists: *Public art occupy Public space and therefore- public art is intended to be physically and freely accessible to the Public.* Other statements include: a) public art is or should be, site specific and relate to the context in which it is sited., b)Public art can be both permanent and temporary, internal and external and large or small scale c) public art can embrace all art forms and its parameters are continually expanding. Traditional definitions of Public art explore its meaning in relation with: art, urban design, landscape and social intervention. At the same time these thematic areas can be perceived as evaluation criteria for public art.

New IC technologies changed the concept of space and made *Virtual space become a Public space*. That certainly widens the possibilities in expressing public art in this new media. With a development of the new IC technologies and so many people using internet, virtual space becomes public space. It opened many possibilities for exploring non/classical forms of art and its communication with public. That includes not only telematic art and wide range of electronic possibilities in image manipulation, form generation, creation of virtual spaces... but also a possibility of space/independent interactive modeling of space and artworks from different participatians.

Public art is widely understood to have many benefits to urban quality: a) in helping to improve the quality of an environment and as a vehicle for involving the community in environmental improvements, b) in helping to create a sense of identity, uniqueness, and civic pride, c) as a way of celebrating place, historical heritage or of highlighting particular characteristics which relate to a specific site.

Traditional concepts of public art imposed to public disappear. Public art today asks for active public participation in order to be accepted and appreciated.

1.2 Public art and Public participation

In countries with long public art tradition (ex. USA, GB,...Percent for Art program)- public art is founded and realized through Public art programs that are mostly organized by City government. Public participation is a crucial element of any Public art program. It can be achieved in a variety of ways - from lectures and workshops that encourage public awareness of the public art program – to the involvement of interested residents in the actual planning, design, installation and maintenance of public art projects.

In order to stimulate and encourage public awareness of public art, the Public Art Programs initiate, or collaborate with other agencies on events and activities designed to provide a greater understanding of public art. These may include: a) conferences, symposia, workshops, artist's lectures, community meetings and public art tours, b) cooperative programs with arts groups, educational institutions and community organizations, c) distribution of promotional and publicity materials, d) Information about the public art program and opportunities for artists and community participation available on a web site, e) Exhibitions of proposals, and related works by selected artists ...

The other way of public participation is direct involvement of community representatives into evaluation process of public art proposals for their community. Community representatives are appointed to serve on artist selection panels or Project Advisory Committees to ensure community input into the planning for each public art project.

When possible, the public art programs identify projects with the potential for involvement of community representatives in the planning, design and installation of public art projects. On occasion, public art program staff may also facilitate creative collaborations between project artists and organizations that represent community stakeholders and who have expressed their interest in a public art collaboration. These organizations might include, but not be limited to, community organizations, educational institutions, arts organizations and non-profit agencies.

But, unfortunately, nothing of this exists in Serbia 2003.

2 SERBIAN CONTEXT AS A FRAMEWORK FOR ACTION

2.1 Public art in public spaces of Belgrade and Serbia

Public space is not a common word in Serbia. Public art is even less. Political background of our public spaces may be the reason for it. In last 50 years money was spent only for functional necessity or for celebrating history. Therefore there are only few forms of public art in Belgrade public spaces and they are very traditional in style: traditional monuments/ single sculptures, murals and some graffiti works that can be perceived as a public art. Only some main pedestrian streets were designed to have some aesthetic qualities. There were also some attempts to shape fountains in artistic way but unfortunately they were rare. Some ephemeral structures and temporary projects were realized from time to time but now we they exist only as memories.

Maintenance of public art is even worse problem. What was not obvious to most of citizens was left to die over time. Most of existing sculptures are demolished (though in recent years some are repaired), murals and fountains destroyed by non-maintenance.

Public awareness and public education on public art does not exist neither do the institutions that would promote it. There is no Public art program or strategy on National or Municipality level.

But there are some lovely public and semi-public spaces in Belgrade that waits to be rediscovered. There are some ordinary public spaces that can be improved. There are some historical and natural treasures that can be emphasized. There is a great potential for public art in Belgrade and Serbia. But people have to realize its importance for the quality of urban life and embrace it. *People have to participate in the process of making peoples places*.

2.2 Public participation in urban planning process in Serbia

Unfortunately, public participation in urban planning process in Serbia is in general on a very low level. Traditional ways of involving public in planning process are public presentations of strategic documents and urban and regional plans usually in final phases of their production. And the public response is very scarce and sporadic. It is higher on more detailed plans and lowers on strategic levels. This attitude can be observed as a consequence of our political and socio-economic past (and a slow process of urbanization (rural background of majority of population, lack of sense of belonging to a place...)

Therefore one of main efforts that has to be done in future will be to get stronger public awareness and participation in urban planning process and production of space. This cannot be overcome overnight. It is a process that goes along with political and economical changes in our society. People should be animated not only to participate in big, strategic plans that have low level of certainty to be realized. Modest, incremental strategy should be implemented: people should be able to see results of their participation as soon as possible to get more awareness and confidence that their participation is meaningful. S*mall but visible public art projects that improve public spaces are good chance for it*.

2.3 Educational reform process in Serbia

One of the main national development strategies considers educational reform. It started on basic levels but will be continued on academic level as well. Serbia is one of the countries that signed Bologna declaration and is reforming its academic institutions according to general principles of B. Declaration: System of easily readable and comparable degrees, System essentially based on two main cycles, undergraduate and graduate, Establishment of a system of credits as a means of promoting student mobility, Promotion of European co-operation in quality assurance, Promotion of the necessary European dimensions in higher education, particularly with regards to curricular development, inter-institutional co-operation, mobility schemes and integrated programs of study, training and research.

In this sense strong divisions among faculties at the University of Belgrade and some integrated interdisciplinary programs will occur. Being interdisciplinary by definition - *public art is certainly one of the fields that should be explored through this way of collaborative institutional work.*

2.4 Social, economical and political context of Serbia as a framework for action

Uncertainty is the only certain thing in Serbian everyday life. Due to unstable political situation, poor national economy and numerous problems of transition (unemployment, insecurity, restructuring of institutions and economy...) it is unrealistic to expect big public funding in public art.

Though some temporary projects were supported in recent years, permanent projects will probably have to wait for better days. Meanwhile, something could and should be done to gain more public attention on the field that can inevitably improve quality of urban life. Instead of sitting and waiting for better days to come - Public art and Public space (PAPS) project was established with an aim to prepare basis for stronger integration of public art in civic realm by working on human potentials and knowledge in a context of educational, social and economical reform in Serbia. According to this its task is to *explore potentials for public art in public spaces of Belgrade and Serbia as well as to educate students, practitioners, institutions and public in the field of public art.*

3 PUBLIC ART & PUBLIC SPACE (PAPS) - International Multidisciplinary Project

3.1 Motive

Contemporary public art and urban design practice is most often fragmented between different professions using public only as the audience. However, there are new approaches and practices for designing cities that *consider various scales* (the planning scale, the infrastructure scale and the scale of the single project in public art and urban design) and *include different design professionals* (artists, architects, planners, urban designers, landscape architects...) *who collaborate during overall design process*. This, both old and new, public art and urban design approach is characterized by comprehensive and complex collaboration of different design disciplines which work together on equal basis on projects that aims to enhance the quality of urban environment.

Aiming to initiate this approach in Belgrade context we organized the workshop that took place in November 2002. Faculty of Architecture, University of Belgrade and New York City Percent for Art program organized it. Several eminent professionals from

New York, Philadelphia and Belgrade took part in it. One of the most important results of this workshop is the framework of Public art and Public design (PAPS) project.

3.2 Theme

PAPS project explores possibilities for redefinition of public spaces use and design. Therefore it promotes interdisciplinary work of different professions and their strong collaboration with the local community on different projects in the civic realm. Through active participation domestic and foreign experts that work together with students of University of Belgrade on different small projects - it tends to explore important themes in development of city of Belgrade such as: connection of the city center with river, revitalization of specific central areas, etc.

3.3 Methodology

Opposite to linear process of designing public spaces through hierarchy of design disciplines - interdisciplinary public art and urban design process respects the skills of professionals from complementary design disciplines working together to initiate projects for the city. Therefore hierarchy of disciplines disappears.

"This method of working is both old and new: it follows in the footsteps of the beaux-arts tradition and the United State's WPA method for civic design. In United States, public art is often used to energize urban design – to comment on sites in order to help one see and experience them in new ways. Artists often collaborate on infrastructure for utilitarian purposes, and work with architects, landscape architects, urban designers and engineers to execute their projects. There is also tradition in the United States of community participation on projects in the civic realm. Design professionals ask the general public how they use or experience a place, what their memories and sensibilities are about and urban space, and what they would like to see there. This communication informs the designer's perspective and helps him/her design a new site, or redesign an old site without destroying the traditions and histories associated there." (Cohen Ch, Bressi T., Pinto J.)

This tradition was used as the base for PAPS work.

3.4 Goals

First general objective of PaPs is *establishing new procedures in public art and public space design process* in Serbia and Montenegro. This means (a) *collaborative interdisciplinary work* of public artists, urban designers, planners, landscape architects, engineers... that *work along with local citizens, local groups and referent governmental levels on projects in the civic realm.*

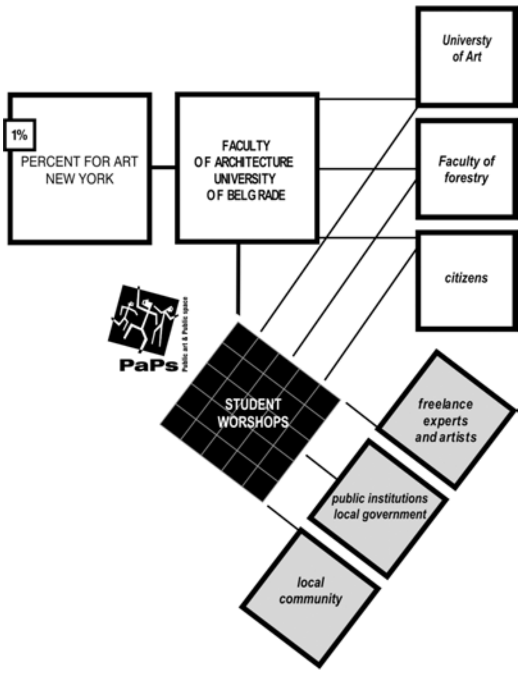
Besides the *affirmation of interdisciplinary approach* - this project has another but certainly not less important goal: *academic education of a new generation of design professionals* who'll accept this collaborative approach and apply it their future professional practice. This was an excellent basis for collaboration between Faculties of architecture, fine arts, applied arts, landscape design, performing arts, etc. that happened for the first time in the history of University of Belgrade.

Finally, since public art has scarce tradition in Serbia, there is a need to gain public attention and *more intensive public participation* thorough local initiatives and public institutions through *developing public knowledge and awareness about their role in public space design process.*

3.5 Objectives

Objectives of Public art Public space project are:

- Integration of art in process of urban planning and urban design with a purpose to establish new framework for evaluation and improvement of public spaces in Beograd and Serbia
- Public participation: activate and involve local community and City government into urban design process
- Identification, evaluation and improvement of public spaces in Belgrade.
- Establishing a searchable database of public spaces in Belgrade (input for future action).
- Activation of spaces with cultural, historical an representative potentials
- Education of new generation of professionals



tab. 1: Public art Public space (PAPS) organization scheme

3.6 Project Organization

PAPS project is founded and organized by Faculty of Architecture in Belgrade and was coordinated by New York City Percent for Art program. The project gathered large number of participants from different levels: academic (students and teachers from several faculties of Belgrade University and University of Art)), governmental (Ministries, City of Belgrade, municipality), public institution (cultural institutions, public communal enterprises,...), local community groups and freelance experts from different fields of work.

Table 1 presents initial Public art Public space (PAPS) organizational scheme. Though academic and cultural institutions made the initial steps, the idea is to turn this scheme upside down. Our aim is to do all that is necessary to gain strong public participation in public art and urban design process, make local community initiate projects and work thorough local government on different projects in the civic realm. In this way, professionals will no longer be leaders that impose their visions of public space treating public only as the audience but will become public service in a way that they'll have to produce kind of space that people need, appreciate and accept.

3.7 PAPS 2003 pilot project

PAPS 2003 pilot project was exploring possibilities of using public art to bring citizens of Belgrade to the river Sava. It was focused on central historical core of Belgrade. It was realized through 3 stages of work: initiation, conceptualization-design and realization. Each of these stages had results in a form of projects that were presented to public institutions and local citizens with and idea to gain their active participation in working process. Several lectures on public space and public art were organized for the same purpose.

- <u>initiation:</u> initial workshop was held at the Faculty of Architecture as a presentation of interdisciplinary work; On a second level identification of public spaces in chosen area and analysis of its potentials for public art was done by students of Faculty of Architecture. *Presentation: Catalogue of public spaces in central core, Presentation of PAPS for public*
- <u>conceptualization and design</u>: 10 workshops were organized as interdisciplinary teams of students who worked together with interdisciplinary team of mentors on developing design solutions for chosen sites. *Presentation: Catalog of project presentation: digital simulation of public art interventions in space. Presentation of PAPS for public*
- <u>realization</u>: Design projects were modified due to chosen path to the river and budget. Different forms of public art was presented to public: video and sculptural installations, lightening, coloring the trees, artistically greening of streets, street theatre, projections, music, fashion shows, street car graffiti, musical performance in streetcar...

All workshops had simultaneous presentations that energized path to the river. Several thousand people took part in procession that connected all workshops. *Presentation took place on July 12th 2003. titled "Step to the river Sava" and was highly accepted by citizens.*

3.8 Experiences in using ICT in PaPs 2003 project

Use of ICT tools was indispensable in realization of this project. It was used in two ways and:

- For *public presentation* at different levels of work process. For the purpose of getting public attention and awareness, several procedures were done that enhanced the quality of presentation: 3d modeling of subject area, digital manipulation of real space, digital simulation of lighting and photo montage of public art projects in real space...
- For *on-line work:* internet was used as an organizational tool with a purpose to *accelerate communication* and *enable work* with experts from abroad. Documentation data bases were formed that could be shared among users. Project database was formed for evaluating design projects and enable improvement of students work. Finally, project realization database was formed for further presentation and exchange of experiences.

These two main areas of using ICT in PAPS 2003 project formed the basis for our plans for future work in this field. But what is even more important is that ICT are recognized as very important part of PAPS future work. In the context of economical poverty and political uncertainty for realization of public art in real space - important part of PAPS work in future will be based on developing a platform for on-line work on different projects in virtual space. Some possibilities and fields for integrating ICT with PAPS model for Public art project will be presented in next chapter.

4 DEVELOPING ICT TOOLS FOR PUBLIC PARTICIPATION IN PUBLIC SPACES IMPROVEMENT PROCESS: PAPS MODEL

4.1 ICT in Serbia

Period of 10 years of Serbian isolation from international organizations and lows provided specific environment for spontaneous development of the IC technologies. On one hand there was an economic decline that caused national poverty and excluded most of nation from changes of everyday life that Internet and ICT brought to developed countries. Therefore widespread of Internet is on the low level in Serbia comparing to USA and EU but we can expect that this situation will change in time that comes.

On the other hand during this period our market was occupied with no tax paid-inexpensive- low quality- computer hardware and extremely cheep pirate software. Therefore lot of our citizens was able to by commuter and work with newest software's. This led to present situation when we have certain number of companies well equipped for dealing with digital information a *large number of mostly young academic individuals highly educated in field of IT*.

This brought us to exploration of the possibilities to use this knowledge of young academic people for PAPS future work.

4.2 PAPS model for Public art project

Public art project is based on 4 project phases - fields of work that can be implemented in various environments. (tab.2)

<u>documentation</u>: identification and documentation on public spaces. analysis of their potentials for artistic improvement

design: ideas conceptualization and project design

evaluation : selection of project that reaches certain criteria

realization: chosen project is produced in public space.

These project phases coincide with different time sequences and allows realization of separated phases as separate integral projects. These results can be: documentation, project or realized databases, project presentation...

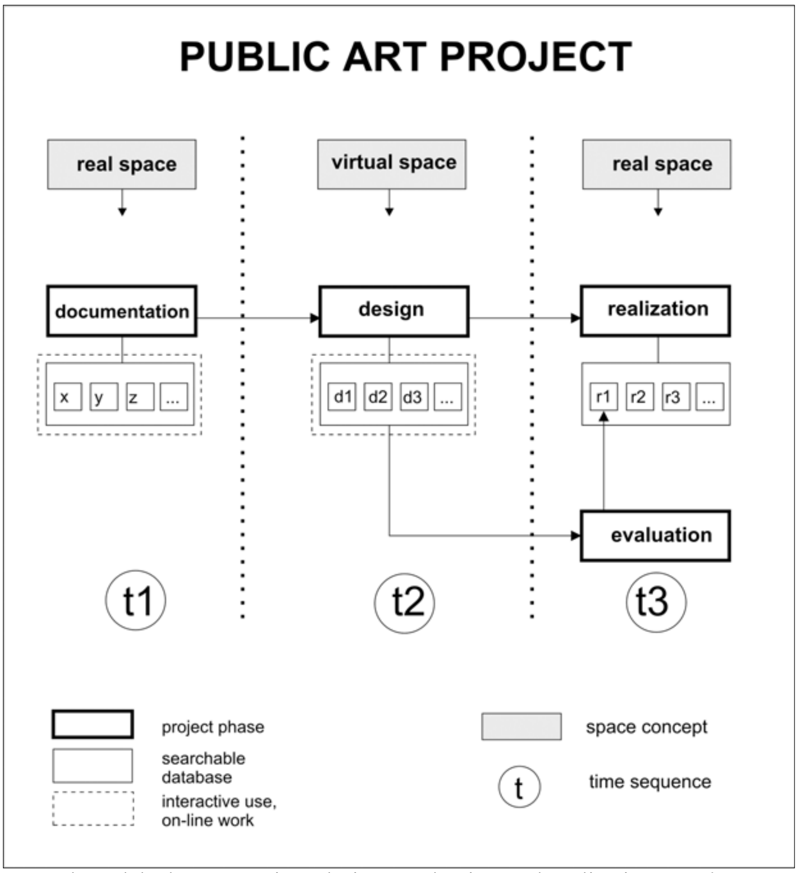
Public art project allows realization in different space concepts.

Different participants can participate in different stages of work: students, professionals, public and institutions... and can have different impact on project. They can *use it as a data source or educational tool or they can take an active participation in it*.

4.3 Possibilities for use of ICT in PAPS model for Public art project

Experiences of using ICT in PAPS 2003 pilot project showed that there are many things yet to be explored. Specific social, economical and political context in our country and uncertainties in funding of Public art projects in presence and future brought us to idea of further developing possibilities of use ICT in PAPS for the purpose of *getting stronger public participation in public spaces improvement process.* Earlier presented model of Public art project was used as a basis for that work.

Model is presented on tab. 2. The main idea is to *use human potential and motivation and develop different forms of possible public participation* and to use advantages of new ICT (internet, web, ...) for gaining wider public participation. Therefore model is structured through space concept, time sequences, different project phases and fields of using ICT according to people *motivation*.



1) Project phases are, as previously presented in general model: documentation, design, evaluation and realization. *Each project phase can be developed as a separate sub project.* This is important because it allows independent work and upgrading of each phase due to growth of knowledge on particular subject.

ttab 2: Possibilities for ICT in Public art project

2) Expected user groups are: students and mentors, professionals, general public and institutions. Each project phase can have differentiated accessibility to different user groups. Each user group can also participate and contribute in both user and formation phases of project. Using *Internet* allows possible participation of a large population of Serbian high-educated emigrants throughout the world that can have strong motivation to contribute to the project. Also it makes possible for foreign students and professionals to participate in project or use databases.

3) There are two main fields of using ICT in this model. It can be used for:

- Creation of on-line searchable databases on different project phases: documentation database (x, y y...), design database, realization database. This will allow knowledge share on different levels among different institutions, experts... and be used for further study or evaluation.
- Creation of a combined platform that use ICT for the development of interacitive use and on-line work on different project phases. Documentation phase can be developed not only by students but also by general public or local citizens. They can contribute by different documents and memories and suggestions that can further be used as a basis for public art proposals. On the other hand public participation can be gained also by their involvment in design and evaluation phase. This also stands for public institutions and proffesionals.

4) By *structuring project both through space and time* different levels of implementation are possible: it is possible to develop both documentation and work on theoretical basis of evaluation of public art and also to design public art projects in virtual space without necessity of producing it in real space.

5) By using a *concept of virtual, Internet space as a public space* different possibilities emerge:

- to use documentation on real space and use virtual space (3d modeling, image manipulation...) for simulation of implementation of public art in virutal space . Projects of this kind can form design database and wait for the time when money will be spend on evaluated and chosen public art project in real space.
- to use documentation on real space, create virtual space (3d modeling, image manipulation...) as a respond to it and than develop new forms of public art that refers to vrtual public space as a medium. This will be overlap design and realiyation space though it is possible to evaluate and then choose vrtual public art project that will be presented on Web.

5 CONCLUSION: BENEFITS OF USING ICT TOOLS FOR PAPS PUBLIC ART PROJECT

Contemporary IC technologies are widely used in public service domain in developed countries. Since Public art is not institutionalized in Serbia and it is difficult to predict bigger investments in this field of public spaces improvement are due to many reasons: system o planning and managing urban space is inert and should be reformed as well, professionals are not educated in the field of public art and it will take time and effort to change that, general public is not aware of benefits of quality public art and possibilities to take a part in process of space improvement, and most of all economic decline that will put forward investments in basic infrastructure before investments in public art....

Therefore we see the realization of ICT *using model for public art project* as a possibility to gain numerous *benefits in various fields*:

- It can be used as *a basis for institutionalization and formation of Public art program* on municipality level. It can be directly linked with governmental ICT system or can be formed as a part of it.
- It can contribute to general public participation in urban planning especially in public spaces improvement process by developing different modes of public participation in each of project phases*: public can use data from documentation, design or produced project database or can actively participate in formation of each project.*
- It can be used for *establishing experts, professional network* in the field o Public art on both national and international level
- It can *enforce sense of belonging to place* by forming a network of ex- citizens that take active part in new, virtual reconstruction of city public spaces.
- It can serve as and *educational platform for national and international exchange of knowledge* through: 1. - creation of a combined platform that use ICT , for the development of shared courses and on-line work, with a purpose to maximize the exchange of educational experiences. 2. - creation of an on-line searchable database that allows a improvement of knowledge about experiences in Public Art in the diverse cities/regions and under the influence of the different Institutions
- Support in *creating new forms of Public Art* while conceptualizing *internet virtual space as a public space*
- *Formation of databases* that can help urban space improvement process when budget occurs but that can also serve as educational tool for general public as well as institutions and active professionals.
- *Possibility to check out and discuss public art projects* (by their simulation in virtual space) with experts and general public- before there are actually produced in real space

Using ICT in Public art and Public space (PAPS) project can help us to prepare basis for stronger integration of public art in civic realm by working on human potentials and knowledge in a context of educational, social and economical reform in Serbia. According to this, potentials for public art in public spaces of Belgrade and Serbia will be explored as well as the educational process in two main fields: *education of institutions, active professionals and general public and education of future professionals/ students*. This can lead us to development of academic educational program in the field of public art that would be based on using ICT as a framework for action. *Use of ICT would help managing communication, knowledge exchange and on-line work on different levels*: between students and professors from different faculties in Belgrade university, between students and professionals from country and abroad and in context of international academic exchange - communication, knowledge exchange and on-line work on common public art projects.

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Development of GIS in urban planning agencies in Serbia – experiences of town Planning Institute of Belgrade

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1 INTRODUCTION

Transition reforming processes in Serbia during past two years created prosperous environment for very complex activities of numerous aid agencies. Owing to some of them the knowledge level about modern concepts and approaches in the field of strategic and urban development is significantly raised in big cities. Especially important was the impact and the effect of building governmental capacities action. During the last year on the highest governmental levels and in some prosperous local governments consciousness of ICT support importance in contemporary urban development management process is higher than ever. Now the problem is lack of capabilities for defining of comprehensive and coordinated action plan, which will initiate the development of primary ICT tools on a city level. On the other hand a large number of local planning agencies started with their own reorganization trying to increase efficiency and effectiveness, and most often they recognized an ICT support as a right way to do it. In many cases local GIS is initiated and basically performed by the planning agency without of local government initial support, but soon after had a acceleration role in further institutional ICT development.

In a first place, this paper will provide the oversight of ICT development levels in municipalities of Serbia. Interesting is that public institution ICT development is more rapid in some smaller municipalities than in Belgrade. Therefore, the paper will be more concentrated on presenting the process and problems of ICT development of City of Belgrade public institutions and governmental levels. Under the very difficult conditions Town Planning Institute as a major planning agency in Belgrade is making the big effort to increase work efficiency and effectiveness by using ICT tools. Of course, on an agency organization level the process of ICT implementation is suppressed with new problems. This paper will at the end present the overview of 6 month pilot project of initializing and conceptualizing the IS of planning agency and the results that ICT team succeeded to achieve. As a conclusion the action program for 2004. will be presented.

2 PROVIDING GOOD INFORMATION BASE – GIS WORLD EXPERIENCE

Operational support to the Strategic Planning and Management process is founded in modern ICT - Information and Communication Technologies tools. Usability of ICT tools is based on their capability to perform fast and complicated processing of spatially defined data and on their flexibility towards specification of real problems that are to be solved. In contemporary context, usage of ICT tools is imperative of successful strategic development planning and management.

Over last ten years a major development of ICT tools in a field of managing and planning urban development is observed worldwide. It lead to development of a wide range of specific information system solutions, producing numerous software applications, encouraging hardware innovations, and above all performing the serious impact to organizational changes of public service and governmental institutions. Variations between them occur as a result of differences in institutional and organizational capacities and developing policies in each specific urban environment.

2.1 What is GIS?

A Geographic Information System is the combination of skilled persons, spatial and descriptive data, analytic methods, and computer software and hardware - all organized in a system to automate, manage and deliver information through geographic presentation (Zeiler, 1999).

All GIS are built using formal models that describe how things are located in space. This kind of information system of object-oriented data modeling lets you characterize features more naturally by letting you define your own types of objects, by defining topological, spatial, and general relationships, and by capturing how these objects interact with other objects. A geographic data model is a representation of the real world that can be used in a GIS to produce maps, perform interactive queries, and execute analysis. Once we construct a map, we can use it to answer questions about the reality it represents on the questions, which cannot be answered by the pure environment observation.

Our interaction with objects in the world is diverse, and you can model them in many ways. It is clear that even a common type of geographic feature can be represented in a GIS in a variety of ways. No model is intrinsically superior; the type of map you want to create and the context of the problems to be solved will guide which model is best. The purpose of a GIS is to provide a spatial framework to support decisions for the intelligent use of earth's resources and to manage the man-made environment.

Geographic Data Models – GDM serve as the foundation on which all geographic information systems are built. A geographic data model defines the vocabulary for describing and reasoning about the things that are located on the earth. A unique quality of a GIS is its ability to integrate diverse types of data into a common geographic framework. Tying diverse data together gives you considerable freedom to explore the relationships between entities such as people, highways, land, stores, and natural features... A principal advantage of the geo database data model is that it includes a framework to make it as easy as possible to create intelligent features that mimic the interactions and behaviors of real-world objects. Some of the benefits of the geo database data model are:

- Users work with more intuitive data objects - Properly designed, a geo database contains data objects that correspond to the user's model of data. Instead of generic points, lines, and areas, the users work with objects of interest, such as transformers, roads, and lakes.
- Features have a richer context. With topological associations, spatial representation, and general relationships, you not only define a feature's qualities, but its context with other features. This lets you specify what happens to features when a related feature is moved, changed, or deleted. This context also lets you locate and inspect a feature that is related to another.
- Features on a map display are dynamic. When you work with features, they can respond to changes in neighboring features. You can also associate custom queries or analytic tools with features.
- Better maps can be made. You have more control over how features are drawn and you can add intelligent drawing behavior. Highly specialized drawing methods can be executed by writing software code.
- A uniform repository of geographic data. All of your geographic data can be stored and centrally managed in one database, whether it is locally centralized or spread on Internet,
- Many users can edit geographic data simultaneously. The geo database data model permits workflows where many people can edit features in a local area, and then reconcile any conflicts that emerge.
- Data entry and editing is more accurate. Fewer mistakes are made because most of them can be prevented by intelligent validation behavior.

2.2 What are the benefits of GIS use ication

GIS supports the strategic planning process in all phases, by providing good and proper information patterns referring to the questions than has been asked, in a flexible way. On the other side, GIS cannot be supportive if problem definition is not valid – it is not a tool for overcoming the planning concept weaknesses.

GIS enables permanent, efficient and valuable environmental data gathering, what is the one of the primary conditions for successful strategic planning model implementation. Spread network of data collecting units provide a significant time saving and than even more with ability of fast data overlapping. Than with inner validity control and generic capabilities provide effectiveness arise in sense of using more accurate and right information in specific problem solving. GIS provides appropriate problem identification information base. Its possibility to generate a wide range of data patterns related and understandable to all participants in a planning process makes possible accurate problem definition. GIS is substantive tool for providing information base for all necessary analysis methods witch has to be performed in strategic planning process.

Information systems of older generation ware union of linear databases abbot environment, which allowed search and processing of information. But, clear spatial visioning was missing. In that sense GIS made a significant progress. GIS technology has broadened our view of a map. Instead of a static entity, a map is now a dynamic presentation of geographic data. A map is the interface between geographic data and our perception. Maps utilize people's inherent cognitive abilities to identify spatial patterns and provide visual cues about the qualities of geographic objects and locations. Maps let you combine and overlay data to solve spatial problems.

2.3 Guidelines for initializing the GIS on the municipality government level

It is natural to start informatization with developing GIS, because it is fundamentally important for developing other of E-government ICT tools. That doesn't mean that other tools cannot be simultaneously developed. Basic principle of modern ICT tools development is: step by step, problem oriented development concept, client-server network oriented, on a unified common operational framework. Technological conditions in this moment are so flexible that development of ICT tools is actually independent from hardware and software. In operational sense, what makes GIS implementation effective is a good database design. And what makes a database design good is asking the right questions:

- How can GIS technology be implemented to streamline and improve existing government functions?
- How can GIS change the way a particular goal is achieved?
- What data will benefit the present organization most?
- What data can be gathered and stored?
- Who is, or should be, responsible for maintaining the database?
- What are data that we now possess and in what shape they are?
- Do we have professionals capable to develop GIS?
- Do our experts know what are benefits of using GIS?
- ...

How you answer these questions will deepen your understanding of GIS technology, as well as provide new insight into government organization and its functions. Database design for GIS implementation is like any other design. It starts with understanding goals and progresses through increasing levels of detail as information is gathered and you approach implementation. Designing GIS takes time and intensive work among all institutions, public services and their employees. The design process can be quite substantial. Here are some word experiences to ease the designing process and help ensure success:

- *Involve users*. By contributing, they will gain a sense of ownership and you will gain invaluable knowledge for your geodatabase design.
- *Take it one step at a time*. It is not necessary to create a complete detailed design all at once; design is an interactive and iterative process. You can progress in stages as appropriate for the needs of your organization.
- *Build a GIS team.* A wide range of information, skills, and decision making is required during this process. At different stages, your team will comprise various experts throughout your enterprise.

- *Be creative.* The initiation of a new project is a good opportunity to survey new technology and processes. There is considerable potential to enhance how GIS serves your organization's goals and objectives.
- *Create deliverables*. It is best to divide a large project into discrete and identifiable units of work. Project milestones should be defined to be no less frequent than two months or so. This will keep your project focused and earn management support.
- *Keep organizational goals and objectives in focus.* It is essential that the design and implementation process always be focused on the real requirements of your organization and its customers.
- *Do not add detail prematurely.* Add detail at the appropriate step. For example, do not try to define all of the validation rules for feature classes before geodatabases are constructed. Selectively introduce implementation details throughout the project so that the team can progress to the next step.
- *Document carefully.* The more complex the environment greater is the benefit from documenting your design. The use of business diagramming software is especially useful to communicate your design.
- *Be flexible.* The initial design will not be the final design as implemented. The design will evolve as your organization changes, new technology is introduced, and people become more adept with the technology.
- *Plan from your model*. Create an implementation plan that addresses your organization's key priorities in a manageable fashion. If you need to create new datasets, build the data management applications first.

World experience approve that, after more than 60 years of information and communication technology development, we finally come to the solutions of highest practical quality. Of course, we are still in the beginning of a new e-government era. But its importance is reflected in an international community decision to proclaim this field of work as a strategically important task.

Modern ICT tools are public sector product. In fact only 30% of GIS and DSS tools users are private companies whose business is related to spatial recourses. Their development is a result of all governmental levels needs to increase work efficiency and effectiveness. Nowadays development of these tools is a global activity, developers of ICT tools, although they are competitive, especially consider compatibility and adaptability of their products.

3 ACTUAL SITUATION IN SERBIA REFERRING TO DEVELOPMENT OF GIS

New Low on construction and building adopted in 2003 establishes Republic Agency for Spatial Planning that has authority, among others, to develop unique information system on environmental condition. Also in this low European standards of spatial units are mentioned, along with demand to produce planning solutions in digital form. This reflects aiming of government towards European and world standards in a field of developing GIS. Assumption can be made that in a further operational work of the Republic Agency closer definition and regulation of GIS development will be made.

3.1 Digital cadastre and spatial units register

One of the basic conditions of developing good and useful GIS is accurate cadastre. Cadastre evidence in Serbia is in very bad condition, since conducting of land register was divided from cadastre. So now we have a case that for big territorial parts we have cadastre evidence over seventy years old. Updating the cadastre leads toward numerous property and legal problems. Results of last year international conference on cadastre held in Belgrade, explain that world expert estimate work on updating cadastre to last for about 15 years with large amount of investment needed to accomplish it.

In this moment according to the expansion of Low on state measurement and cadastre from 2002, digital updating of cadastre is a task given to the Republic Geodetic Institute. This kind highly centralized organization of updating cadastre will slow down producing this essentially important part of Republic GIS. According to Low on spatial units register from 1989, and Low on Ministries, Republic Geodetic Institute is obligated to conduct graphic part of spatial units register, and for their unified coding is authorized Republic Institute for Statistic. Because of inaccuracy of single spatial unit register - cadastre parcel, validity of spatial units definition on all territorial levels is highly conditioned and has mostly administrative meaning. Therefore, of course, there is no accurate address register.

3.2 Geographic and topographic plans and statistical data

Republic Geodetic Institute has a primary task to produce all kind of geographic, topographic, orto-foto and other digital maps. It performs this activity by using the GIS tools. But, there are operational problems that occur. Mapping the data is done by the technology of making analog maps, which is not compatible with logic of GIS and DSS usage. In that way we get maps very hard to use in practice. Beside, this activity is managed in centralized way, and therefore is very slow and not compatible to the practice demands.

The same case is in a field of statistical data collection. Republic Institute for Statistic is authorized for performing the periodic collection of statistical data. The problem is that databases have the same linear shape as twenty years ago. For this large period the methodology of gathering the statistical data hasn't been changed, with excuse of providing the continuity with former data samples!? Anyhow a significant amount of data exists and, if a rather complicated procedure is passed, the data can be accessible to the public institutions.

3.3 ICT tools in public institutions for spatial planning and management

It is very interesting that inspire undefined legislative framework, there is a significant activity in usage of modern information and communication technologies in Serbia. These activities are not coordinated or conducted, but they produce results, which mustn't be underestimated.

Large number of public communal institutions and public institutions for spatial planning and management develops their own GIS tools, or uses already developed ones available on a global market. In that sense there is a significant number of local geographic databases, but they are, most often, not integrated, reliable or systematically developed. It is interesting that these institutions are concentrated mostly in a few big cities such as Belgrade, Nis, Kragujevac, Subotica, and Novi Sad.

Nevertheless there are some cases of local planning agencies or communal institutions that have some kind of geographical information systems. Usually those are communal institutions, mostly authorized for water supply and canalization management and sometimes the agencies (this is a result of very comprehensive actions of international agencies in this field) for city land construction.

In out context, actually, initiative for development and usage of ICT tools is not governmental, but result of practical needs, and aiming of public institutions increase their efficiency and effectives. This trend will be even more increased by implementing the new Low on construction and building, according to whom, planning activities are put on the market.

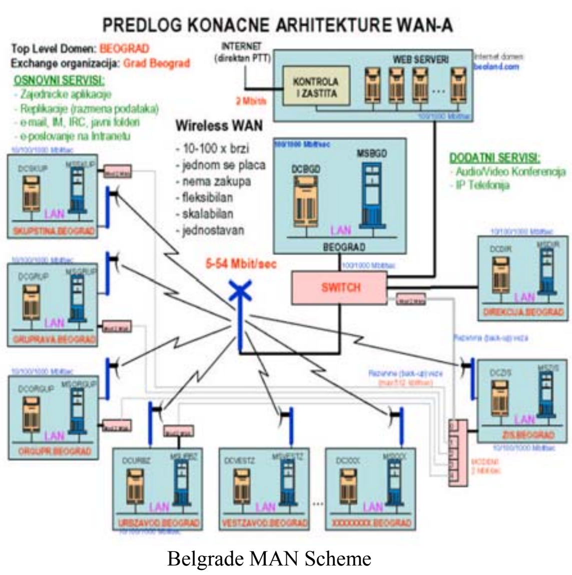
4 THE CASE OF CITY OF BELGRADE GIS

According the mentioned circumstances City of Belgrade started a certain activities on developing GIS. These activities have an enormous importance for all Serbia because the experiences of the capital city will be used as an example to all other towns. The problem is that in spite of the fact that Belgrade’s public institutions are mostly ICT developed the governmental structure of Belgrade is highly complicated and complex, so management of GIS development is very difficult.

One of the very important public institutions is Town Planning Institute of Belgrade, as a most developed planning agency in country. For over 50 years it was the only planning agency officially authorized for Belgrade development planning. According to the new Low on construction and building a new legal working environment for planning agencies is established. Now planning activities should be done in a free market of planning agencies competition. Therefore the top management of Town planning institute started with strong ICT development of its business organization to increase the competitive advances in working market. At the beginning of 2003 the initialization of Information System of Town Planning Institute started.

4.1 Belgrade’s Metropolitan Area Network

In last couple of years on high governmental level of City of Belgrade occurred an initiative for ICT development of city governance. This initiative included all governmental institutions, public communal enterprises, public planning agencies and municipality governmental structures (Belgrade has 16 municipalities).



Belgrade MAN Scheme

The Belgrade City government in 2002 financed the metropolitan hardware infrastructure establishment. In that sense an MAN is implemented, connecting the City Assembly, Secretariat for Urbanism and property, Directorate for city construction land and building, Town Planning Institute and Republic Institute for Statistic. According to future plans the MAN should be expanded on other public Secretariats, Directorates and municipality governances. Since that this network was in very low level of exploitation. The problem occurred because of undefined protocols of information collaboration and exchange. Therefore the MAN was used only for e-mail and Internet.

In 2003 a new initiative for MAN development came from Directorate for city construction land and building. Since there is no city governmental body authorized for Belgrade ICT development a Committee for MAN was established. This committee was consisted from representatives of all public institutions of Belgrade and had a purpose to define initiatives in a field of ICT development and to propose them to the City executive board. So on the committee imitative a MAN in April 2003 infrastructure concept was accepted along with general criteria for development and usage of software.

At that moment the executive board of City of Belgrade made the decision that official software in public institutions should be: Microsoft Windows as operational system, AutoDesk – Acad, AcadMAP, PTW – Visum (software applications for traffic planning and design), ESRI – ArcView, ... ArcInfo, (GIS tools). According to that decision the buying contract between the software companies and City of Belgrade was accomplished.

This concept consisted only infrastructure definitions and it was concluded that next very important task is to define working polices, regulations and protocols of information collection, exchange and storage. Unfortunately this task got no time limits since there is no clear vision on city governmental level whose authority it is. So all further activities on developing Belgrade’s MAN collapsed for some time. On the other side the institutions continued their own ICT development waiting for the moment when MAN issue will be in focus again. Therefore the Town Planning Institute took a strong action towards ICT increasing capacities trying to establish competitive advantage among other public institutions.

4.2 Town planning Institute GIS efforts

Information development of Town Planning Institute Business is the result of top management strategic decision to increase business efficiency and effectiveness with modern ICT usage. In 2001 producing the Master plan for Belgrade work was performed by using the modern ICT. On that occasion a big investment in hardware, software and employees knowledge was made. The aim was to produce a GIS of Master plan until 2003. Unfortunately this task was not fore filled. The reason is that there were not enough ICT knowledge capacities in the Institute especially in ICT development management. There was no employee with clear picture how ICT support the working process, what are the benefits of that and how the results can be achieved. In that sense the special team for ICT development of Town Planning Institute was established consisting of current employees and outside experts in this field.

In spring of 2003 a decision was made to produce a Program concept of Information System initializing and development. The program concept should consist of consideration results of several major topics: - diversity and complexity of working processes, - structures and quality of the analog and digital data, - inside and outside framework context, - existing infrastructure and human recourses, - possibilities of step by step implementation and investment, ...

After the six months of scanning and assessing the current resources a program concept was done and accepted on all management levels and at the beginning of 2004 the initialization of the information system started. During the Program concept definition some very interesting things and problems occurred:

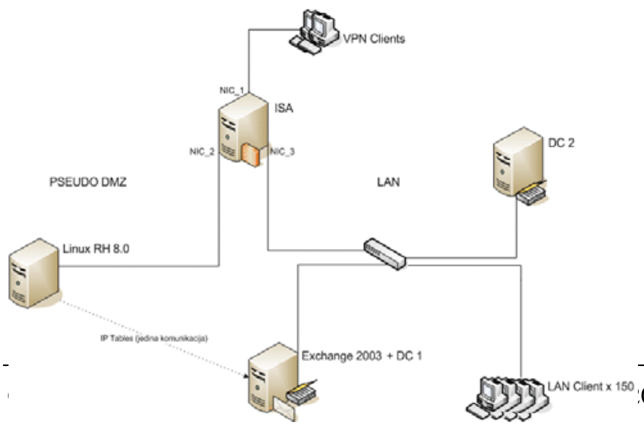
- Diversification of problems hierarchy according to the employee’s position in the company organizational structure. For example the management structures main problems ware in a field of information support to the organization and monitoring the working processes (document management, project management, monitoring the working progress, information security, etc.) and than in a second place the issues of developing the GIS as a working process supportive tool. On the other side the employees complained on management organization and working information difficult accessibility. This kind of situation is on one side natural, but it produces difficulties in implementation action plan definition because conflict of interest between management and employees supposes different course of development.
- General resistance to the working process and organizational change. Interesting is that in spite of willingness to improve their working results the resistance towards reorganization was more expressed on an management level than among the employees. Probably because of losing job fear employees are ready to make an effort for increasing the knowledge and accept a new procedures. The management on the other side has a big reserve that necessary changes can be implemented. It seems that larger problem is in low knowledge capacities of management structures and actually necessity of their much larger working efforts that they had before.
- Problem of absence of adequate ICT management resources. In current situation in the Town planning institute there is no person educated enough in bought management and in ICT in urban development planning. In the same time there are no such human profiles on labor market. On the other side the tom management doesn’t trust enough the outside experts. So this is a situation which slows very much the ICT development process and realization of GIS.

On the other side considering the GIS initialization potentials there are enough infrastructure and human resources. Producing the Master plan lead to the complete digitalization of Belgrade’s territory on an accurate city block level. This is a result of accurate cadastre absence so parcels are not accurately defined. But block definitions are coordinated with statistical territory units and also an address system is aided to geographic entities. So far there are no relations between the graphical vector entities and statistical databases but because there was not enough developed infrastructure for GIS data base design (no data base software, not domain network, ...). Beside there is a large number of regulatory plans and other planning documents that are digitalized, then accessible data bases in other institutions, ...

In this moment the GIS development is just a task on the paper because the management still doesn’t have a picture how to organize this activity and how to market then with it on a city level. So paralyzed with fear of changes officially nothing is going on...

4.3 Plans for further actions

Nevertheless, The Program concept of ICT development of Town Planning Institute proposed a strategic ICT development plan and the action plan for 2004. In spite that there was no clear respond from the management about them the budget for the first implementation action was approved thanks to the IS team effort. In this moment the project of finishing the local network infrastructure is in progress (150 clients). It means that in a month the domain client-server network will be established wit all necessary server services. Especially important is that SQL server will be installed which is basically important for further development of GIS.



According to he IS team 2004 Action plan proposal next step will be designing the database and restructuring the existing digital data. Than the operational work will be done in sense of relational connection of geographic and alphanumeric data.

In the same time the business management applications will be developed in order to assess management demands. The main strategy is to try the step by step implementation process providing a concrete results which will immediately lead to the efficiency appraisal. Whole this process must be followed with formal and informal educational programs of all employees, especially management.

It is very promising that IS teamwork initialized some organizational restructuring. In this moment the establishment of new organizational unit is in the progress - Sector for informatics with definitions of new employment places. That is the opportunity for management problem to be overcome and to accelerate the GIS development.

5 CONCLUSION

It is very interesting conclusion that can be made according the experience of Town Planning Institute of Belgrade. Its case is referent because it is the planning Agency with largest ICT resources. It seems that in this planning agency the general Serbian problem is reflected in a smaller scale. That is the fact that there is not enough knowledge about modern concepts of strategic or urban development planning and management, especially among the people who are officially authorized to perform the management tasks. In the same time there are rather good potentials in infrastructure and human resources to perform ICT improvement.

Maybe the reason of this kind of situation lies in the fact that after the first victory of democratic forces in Serbia governmental restructuring was done by the "political trust" criteria, not "competent enough" one. So we have situation that governance leaders are only politicians not mangers. Fear of political traps force them to control and decide upon every action and when it is a question unknown for them than it is better not to decide than to make mistake, which will imperil theirs political position. It seams that as long as our transition process is conducted with leaders - they decide what is supposed to be done according to they knowledge and perception) not managers of participatory decision making process, our prosperity will have small tempo.

On the other side it is a question of time when the GIS will become a common tool, because the resources already exist. The planning agencies and public institutions that understand and see this fact can profit enormously from this situation. The question is who will be the one?

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Building the ICT fundament for local E-government in Serbia - Municipality of Loznica example

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1 INTRODUCTION

Recent legislative changes in Serbia, directed toward European integration, established basic framework for implementing the E-government management concept in municipalities of Serbia. In spite of the fact that there are significant ICT potentials (available technological solutions and personal expert knowledge), there is no awareness among the local governmental structures of benefits that this model can provide. So there is no strategy or programs for ICT central and municipality development.

New Low on planning and construction initiated a production of numerous local municipality Spatial and Master development plans. One of these is Spatial and Master plan of municipality of Loznica, which is managed and performed by the team from Faculty of Architecture University of Belgrade. Since there are no actual obstacles for ICT governmental development, except lack of political willingness and determination, we recognized actual circumstances and our work on this plan as a grate challenge in sense of finding a "side" way for ICT implementation in municipal governmental work.

This paper, at the beginning, will present our ICT local development plan and methodological concept of its implementation in governmental and local public structures (except in Loznica we also started with its implementation in more municipalities). In the next chapter the practical results will be presented along with analytical reviews of collected experience. After a first working year we can conclude that we successfully managed to make a first major step in municipality ICT development. We succeeded to get very positive reactions of all governmental and public structures. The planning process become publicly acceptable and transparent... On the achieved results base we made a new action plan for next working period. We hope that after finishing those pilot actions we will be able to produce a practical guidebook for ICT development of municipalities in Serbia under the local actual conditions. This can be one way to ensure more intensive decentralized local development and to increase local initiatives to the central governmental levels towards implementation of E-government management concept.

2 ACTUAL SITUATION IN SERBIA REFERRING TO DEVELOPMENT OF MODERN E-GOVERNMENT ICT TOOLS

In order to achieve maximum of capabilities of ICT tools in E-government practice problem solving it is necessary to adjust their structure and usage to the: a) actual legal and socioeconomic context in which strategic development planning process is to be performed, b) practical demands that managing of urban development has to fore fill, c) all participants in urban management process, d) institutional capacities and procedures.

2.1 Legal and socioeconomic context in Serbia

The social and economic conditions in Serbia were significantly changed throw three major phases in last 50 years. According to the social and economic changes, the approach to the management of urban resources also has changed. Now, in a developed stage of transition (since last democratic elections), we are in the phase of recognition of necessity for applying modern strategic development planning and management concepts in context of more intensive process of privatization, along with serious legislation and regulation modifications, ...

Aware of necessity of significant changes in planning concept approach, we are nowadays dealing with problem of defining how to adjust our existing institutional and government capacities and their activities to the planning strategic development model demands. The major problems are appearing from incompatibility of existing institutional and governmental capacities and their activities, established 50 ago, in comparison to the organizational demands derived from new modern democratic government model. Changes that are to be made mean *fundamental reorganization of public sector*. Among other, questions of how to develop and use the ICT support in actual conditions are being one of the highest importance.

Large problem is undeveloped legislative framework defining and considering development and usage of ICT tools. Legislative base is founded in Low on Information System of Republic of Serbia proclaimed in 1996. Essentially, this Low defines general principles of initializing the State Information System and obligations of governmental institutions to collect and process relevant data, to digitalize and process them and feely exchange. This low is not instructive enough, and therefore requires logistic in a numerous additional regulations, which will make closer definition of this activities.

In absence of other legislative and regulatory documents, performing practice leads to inconsistent informational activities on all governmental and public service levels. In a first place a clear National strategy for developing state GIS is missing. Also there are no instructive action plans for all governmental levels, and at the end no operational regulations witch will define rules, conditions and responsibilities of data exchange and instruments of their validity identification, ...

New Low on construction and building adopted in 2003 establishes Republic Agency for Spatial Planning, which has, among others, authority to establish unique Information System on Environmental condition in Serbia. By this low usage of European standards of spatial units, along with demand that planning solutions are to be produced in digital form is required. This reflects aiming of Serbian

Government towards European and world standards in a field of developing ICT support to governance. Assumption can be made that in a further operational work of the Republic Agency closer strategy definition and regulation of GIS development will be made.

On the other hand, according to the new Low on Local Self-government, adopted in 2002, authorities in a field of spatial and urban planning are mostly transferred on a municipal level. This low, nevertheless, does not clearly referrers to the questions of implementing of information and communication activities on a local level – it does not encourage it, or restrict it. At the end, still there are no legal solutions, which will define E-business in general, and accordingly in public services and governmental institutions. In operational sense this solutions should provide a base for establishing rights, responsibilities and verification instruments in electronic data exchange, witch will also provide security and reliability of E-business.

2.2 Actual ICT activities of local government institutions and public sector

Large number of institutions on all government levels in Serbia works with digital data. Enormous number of evidences about inhabitants, economy subjects and spatial resources is done electronically (for instance, unique evidence of inhabitants, statistical data about spatial resources, registers of companies and enterprises, register of tax tributaries,...). Nevertheless the problem is that gathering information activity is not coordinated or related to each other. Therefore information gathering in practice is usually in internal use of each specific institution of local public sector. In addition, there is anxiety in free exchanging data process (in spite it is required by the low) therefore many institutions have separate evidences on the same data. That increases redundancy of goatherd data and questions their accuracy and reliability. At the end, most frequently this information databases ware designed upon linear data models, which haven't been changed in last over ten years. In present organization in a transition process, it is very unlikely that this data bases can answer to the new needs and demands without serious structural change. *This means that in this moment Serbian government has significant information potential, which is not utilized in spatial and urban management process in maximized way.*

It is very interesting that there is a significant activity in usage of modern ICT in Serbian municipalities. In some municipalities a big efforts are being made toward development and constituting information systems and tools in order to improve public service. Since legislative framework and strategy is missing, these activities are not highly coordinated or conducted, but they produce results, which mustn't be underestimated. It is possible to make observation that ICT knowledge is highly diversified among the people and companies. Of course, concentration of ICT knowledge potentials is especially high in big cities and in a large disproportion to the ICT presence in small municipalities.

According to municipalities ICT potentials preliminary research, there are no rules how people educated in field of ICT are being included in development of local public service. For instance, in some very small and most undeveloped municipalities, where is expected to find no ICT experts in public institutions, occurs group dealing with digital cadastre with accurate database. On the other hand, in some very large municipalities, with very important strategic resources, local institutions have, all together, a couple of old computers with no serious use. What is the nature of this?

Actually, this kind of situation is a result of the fact that modern ICT tools implementation in public service is most often consequence of single or group of persons initiative. Previous period of isolation of our country from international organizations and lows provided good environment for spontaneous development of the ICT. This paradox fact is a result of uncontrolled market of hardware and software. In last ten years our market was overflowed with inexpensive computer hardware and what is even more important, with cheep pirate software. So, our citizens ware in situation to by computer and work with newest software's. If they are, bay any chance, employed in local government or public institution, and if they were persistent enough, modern ICT would occur in governance activities. If the situation is opposite, ICT becomes completely unknown zone.

This fact enlightens that the problem is derived in governance management structures. If local leading government structures consist of people who understand and accept the importance of ICT in modern governance, than activities in this field will occur and be supported. The other situation is when the initiative comes from ICT educated employees. In this cases the initiative is most often accepted by high management levels (because the computers are something very popular, modern and respectful,...) but their usage is restricted to performing the standard old procedures in a faster way, not as a supportive tool for transition and reform. The fact is that in among of 160 Serbian municipalities, just about 5% of them are fist case examples, 30% are second case examples and the rest are in ICT unknown zone.

2.3 Practice problem identification

According to the previous, it can be concluded that in this moment Serbian government has significant information potential, which is not utilized because of lack of knowledge among all governance structures. To be exact, lack of knowledge in a field of modern governance models, strategic development planning and management, the role of ICT tools in it, and the ways to implement it in practice. *So, we are in the situation of performing the process of transition with the government organization and structure not linked in any way with the society concepts we are transitioning to.*

Still, even in a context of inconsistently performed necessary legislative changes there is a need and possibility for usage of ICT and E-government methods development. What is especially optimistic and satisfying in sense of remodeling of urban development planning and managing discipline in our context, which was in last ten years completely discredited, is the fact that our society is not completely divided from global development processes. In spite of the institutional conditions (except on the top of governance they are mostly remained from previous social establishment and not friendly toward active applying of E-management concepts and ICT technologies in practice), informal conditions are much more positive: on bottom of governance hierarchy there are numerous young experts very well educated in ICT support to modern environmental planning and management who are trying to initiate more intensive transition changes.

3 GUIDELINES FOR DEVELOPING THE ICT FUNDAMENT FOR E-GOVERNMENT IN SERBIAN CONTEXT

According to the previous facts it seems that the primary tool in this moment is the multi level education referring to those whose participation in development process is inevitable. In context of Serbia that means in a first place education of governmental structures along with citizens groups and organizations, and than in a second place experts employed in a public service. The main reason is that on academic level modernization of education program towards modern theories and practice started ten years ago, so there is some know how potential in this group of actors. But obviously that is not enough to accelerate the transition process, mostly because young educated experts have no authorities in the highest government levels. The problem are those who already spent significant number of years working by the old routines, based on a education programs developed in socialistic context, with resistance towards changing and with either fear or unconditional acceptance of everything than comes from "west".

So, as the group of professors which primer profession is to educate, we started to examine phenomenon of education the public structures, excluding the young experts, which are already being educated on academic level. In this moment there are many ongoing education and training programs conducted by numerous international organizations and NGO (UN Habitat, US AID, DAI,...) with objective to increase local capacities in strategic planning, e-government, ICT etc. In spite of the fact that they provide very important knowledge and technology support in some municipalities, in every day life there are no significant results. Obviously more comprehensive activity is needed. Therefore, we decided to make an experimental program of informal education throw practical projects in order to define inner educational and action strategy that local well-educated experts can perform.

3.1 Influencing the high governmental levels

Referring to the previous considerations its possible to make conclusion that it is necessary to define National information strategy, and build and develop the National ICT infrastructure for spatial data gathering and GIS (for start) development. It should define framework for all participants in ICT development. In most of highly developed countries this kind of document already have been made. This document defines information activities as a decentralized and distributed work, which produces results from the practice on the bottom to the E-government on the top. Basic governmental units - municipalities and their network of agencies, with the rest of economic subjects, actually carry out the GIS development process. Government is providing the control, coordination and monitoring of the process, and with mechanisms of subvention stimulates the activities. National information strategies are dealing with next topics:

- Defining of authority and protocols of gathering spatial data,
- Defining of protocol of exchanging and data verification on all levels, which will provide free institutional data flow,
- Defining the mechanisms for efficient structuring and spatial data and information's research - developing of metadata base,
- Defining the working policies and standards of technological equipping on all institutional levels, private companies, nongovernmental agencies and academicals levels that will be included in this activities.
- *Process of defining the National strategy must be initiated from the top level of state government, but also must be performed and submitted by active participating of all potential actors in information activities.*

Although general legal framework is established, it seems that on a highest Serbian governmental levels there is no clear vision how and with whom the this task should be performed. Therefore, the communication with the international institutions is established, but in practice the results are poor. So far the activities of our ministries are very slow, highly centralized and not inclusive enough towards local experiences and expert potentials. Since in our context National information strategy is still missing (after four years of intensive transition process), it possible to conclude that even on a highest levels there is no enough capacities (or even motivation) to perform this task. In that sense, we stand for opinion that actual work on a local level is essential input for National information strategy definition. So, the assumption is that if we would have the practical results on a local level and finally increased local knowledge and experience capacities, the initiatives from local level can influence on top governance.

3.2 Building the Local governance ICT capacities

According to previously explained context we decided to start with educational influence on a local level. Since we already have significant experience from implementing the Permanent education program in Town Planning Institute of Belgrade, we decided to implement education programs in a different way, than using classic educational form of lectures and exercises.

The method actually bases on *learning with practice*. Since new Low on construction and building proclaimed local obligation to produce new Spatial and Master plans for municipality territories, the expert's activities have been accelerated. That is, by our opinion, a *perfect chance for planners to make positive influence on all public levels*. Fortunately, as team of planners from Faculty of Architecture we succeeded to get a several plans to conduct and perform in different municipalities. Our main strategy is to change the *procedure* of plan production as much as legal framework enables. Procedure used so far is very simple: planners make plan without consulting anyone, or maybe highest authorities in municipality, than finished plan, after a long time of work, is put on public judgment, but people really react on it and than plan is accepted in local assembly where delegates vote for beautiful colored maps and fat books, which finally get a nice place in shelf of municipality president.

In spite the fact that the plan budget is calculated according the expenses of usually used procedure, we decided to make an extra effort and to propose a new procedures, which would finally by our assumption lead to participants change of attitudes and knowledge widening. In that sense we used two essential advantages: 1) remaining respect that academic authority still have among local people, 2) informal respect that modern ICT generates in common people. First one we use as a necessary base to establish mutual trust and chance to perform a procedure changes, and the other one, we used as medium that enables effective methodological improvement of plan production. The main objectives of our experiment are:

1. Establish participatory planning process introducing the sensitivity of all participants in to the plan, trying to built up their consciousness and acceptance of proposed plan alternatives, (discoursing the role of experts from instructive toward public service),
   How?

   In spite that there is no law obligation to define the stakeholders and to perform communication between them, we decided to pursuit the high local authorities to establish formal communication with upraise all local social subjects. According to resources that they have it could be: -organizing several workshops and round tables about environmental and urban topics supported with ICT, - organizing the info-service in the municipality supported with ICT, - public questionnaires, - WEB site, ...

2. Introduce the strategic planning by providing numerous spatial or master plan alternatives, to be exact - plan as a wide field of possibilities for potential stake holders (the local government most often don't have clear strategies or budget plans for project implementation),
   How?

   Using the differences between point of views of different stakeholders we are trying to improve knowledge capacities of local governmental employment structures aiming to discourse their usual prejudice about their role: from the role of implementing some regulations done by the mighty experts to the role of development managers. According to resources that they have it could be: - producing the numerous public friendly simulated project solutions from the stakeholders point of view just to show that they are not unacceptable and deserve consideration, - producing the development process simulations to show that development depends on local people and local government not to experts, - showing the how better it would be if could use more information from the other institutions and than transform them in to for example cost benefit study with expert system analytical tools, ...

3. Establish complex spatial digital data base as an practical example what GIS is and how can it be used, with aim to illustrate what are the essential methodological planning and management improvements and to produce an interest of local governance to invest in ICT,
   How?

   Simulating creation of spatial information system aiming to show that this work is not impossible, encourage channeling they visioning of necessary organization changes, to understand the role of managing the development in a different way. According to resources that they have it could be: - activating their existing information in a different way, either in our Faculty lab if they have no ICT infrastructure or by the reorganization of they ICT infrastructure usage, - encouraging the public institutions communication on a subject of information exchange, - showing how much easier is to produce the plan presentation in more understandable way for different participants, ...

4. Establish basic ICT infrastructure and knowledge, for further development of information and decision support systems aiming to reorganize existing ICT resources and to initialize further ICT education of employees.
   How?

   Helping the local authorities to understand that ICT development is very important and basic component of good governance, and that investing in it is for the future benefit. On the other hand we show them that investment will not necessary be a big burden to the municipality budget, and that can be implemented step by step in long terms. According to resources that they have it could be: - activating the existing ICT resources in different way, - building the local information teams, - organizing the basic ICT education, - establishing the connection between other international organization activities to the project that we are on, ...

This experiment does not have the idealistic aim to overcome all problems of our current planning concept (because our legal framework doesn't allow it) but to *introduce new methods to all local governance structures* in order to establish critical point of view about our current urban development disciplinary context.

3.3 Guidelines for initializing the ICT development on local government level

In 2003 we started with implementing this experimental approach in several municipalities of Serbia (Bajina Basta, Pozarevac, Loznica, Lazarevac, ...) and each time we improved our methods and techniques. The final idea is that on the base of these case studies, we produce practical guidelines for local ICT development based on actual local resources. These guidelines could help establishing a Local information strategy. In this actual moment work on Local information strategies would first of all include assessing the local potentials and defining of program activities, which could be implemented in current legal framework. In addition clear problem identification of local governmental level in a field of ICT activities can be made. All of these preparatory documents could be used for initialization of further considerations on higher governmental levels.

In that sense we considered several major ICT topics on a local municipality level:

- What is the organizational structure of the municipality in domain of ICT activities and work?

This topic includes question of organizational structure of public sector in domain of collecting, updating and exchanging the data, such us: defining procedures and working protocols, existence of public information services, accuracy and quality level of data sets used in working process,...

- What are the actual municipal capacities in domain of performing information and communication activities?

This topic includes questions of structure of inner material, human and organizational resources in public sector, such us: number of skilled employees in public sector that can work on ICT tools, what is technological equipment (software and hardware) that public institutions posses, what are current activities on automatization and digitalizing of working process, current structure of possessed digital data...

- What are the practical problems that municipality has to deal with in a field of ICT?

This topic includes questions of practical problems nature in a field of current information and communication municipality activities, such us: what are the problem of informing the citizens (what are they complaining for)?, what are the problems that appear in decision making process considering accuracy and reliability of information's to decide upon?, what are they information problems that usually slow down the working processes in public sector?, ...

- What is necessary to be done, by the opinion of municipality, to overcome existing problems and increase internal capacities?

This topic includes questions of specification the needs for changes in practice, such us: organizational changes, necessary changes in authority and responsibilities, needs for more skilled and educated employees, needs for improving the technological capacities, needs for public education, ...

- What are the visions and benefits assumptions of increasing the internal municipality's ICT capacities?

This topic includes questions of specification the visions of improved work of local public sector, such us: making the procedures simpler, effectiveness arise, better servicing the citizens needs, solving urgent social, ecological and other problems, effectiveness of government in compression to pre election promises, ...

- What is a funding feasibility assumption in of ICT municipality's public service work?

This topic includes question of cost benefit analysis on applying the ICT tools in public service, such us: how municipality estimates necessary funding for the initial stage, what is funding capability of municipality and other public institutions, what are amounts of funding that already been spent and what mechanisms they have been implemented with, how they evaluate benefits from financing ICT so far,...

After the primary local scanning we make our own action plan about how we would manage the Spatial or Master plan producing process aiming to for fill our education objectives. Action plans ware different according to the particular local context. We believe that this kind of adjustment mast be done if we expect practical results.

4 MUNICIPALITY OF LOZNICA CASE STUDY RESULTS

The case of Loznica is very interesting because in a field of ICT resources there was a very polarized situation:

- Among all local institutions only the local planning agency had some ICT infrastructure (hardware and software) and basically trained employees,
- Local governmental structures at the beginning didn't have any ICT recourses. On the other hand there was a positive attitude toward using the modern ICT tools, so they ordered a digital cadastre and ortofoto maps for spatial and master plan production.
- Inhabitants of Loznica municipality are mostly occupied with agriculture or employed in local industry. Low living standards and education levels imply their no connection wit ICT,
- Municipality has no budget for primary investment in ICT, and has no visions how it would improve their work.
- On the other side they are in the DAI Strategic planning program, so they ware donated with the some hardware and software and also education programs,

Starting in this context we decided to perform next activities (most important for paper subject):

- Establishing close collaboration with local planning agency including them in all producing plan process, especially in a field of using the ICT planning tools. Very important was to share all our knowledge and information (analog and digital) with them so they can improve their work from the collaboration and, we could better understand local procedures and customs,
- Opening our working methods to local governance structures. We organized as frequently as possible ICT supported presentations of planning progress to all relevant employees in local public service and local experts. Except the standard information results the presentations showed adaptability and efficiency in changing and adjusting the data, showed the increased possibility to work with a significantly large amount of data, ...
- Establish public discussions in municipality with ICT supported presentation as a discussion initiation. Since there are a small number of citizens that can use ICT establishing the web site was ineffective at the moment. We decided to organize several meetings with citizens and local community groups, trying to establish their trust and interest for planning process by using the visualizing ICT tools,
- Activating the ICT infrastructure that was donated by DAI. Since initially there was no ICT resources in the municipality all ICT work was done in the Faculty of Architecture, but as soon as donated ICT equipment was in use we made the plan working results accessible to municipality employees aim to provoke their own initiatives to deal with strategic development issues...
- ...

At this moment we finished first phase of plans production – presenting the information base about current environment condition, expressed local needs and initiatives, identified recourses improvement or change potentials... We made a comprehensive inventory digital atlas of Municipality of Loznica. In past six months all our team members ware in direct contact with all participants (we invited to our numerous presentations all authorized groups and common citizens).

The six-month working results are:

- We established very close and trusting bond with municipality authorities. They sensed the benefit from numerous public presentations, which entitled them as transparent democratic, not autocratic, governance. They are very satisfied with a fact that they don't have to decide upon all problems by them selves but to share decision with other participants. They are satisfied wit the fact that people not only attack them but started to communicate with them about their problems...
- We established very close communication with local citizens groups, and incourige some of them to organize and perform in a formal way. At first public reaction was comlplitly suprise and disbelif that they are asked something about. Than more trusting communication was established and they hade no fear to experts they vision or demands for urban environment. We succeeded to encourage the local stakeholders to show interest for the plan proposals establishing the trust in our willingness to provide the optimal fast solutions for their investment...
- We succeeded to promote the local planning agency to the informal information coordinator of municipality. Since they had curtain ICT potentials it was most appropriate to start with them. On the other side they opened their view about what are the available information, how they can be used in planning process, and now they started to create their own analysis and to present them in a common people more acceptable ways
- ....

Since we, by our criteria, successfully finished first phase of this experiment we are gong to continue to operate until we finish the plans. The question is what will happen than? We are determined to monitor the transition of local governance in these municipalities. We hope that they will change their attitude toward the transiting process. We plan to offer them a vision of how their future activities can be managed. The partial side indicators of our success are the fact that there are new municipalities interested in our mythology of planning. Until the end of this year we will have complete experiment results, hoping that we contributed to our country transition process.

5 CONCLUSION

In our context in spite the fact that information and communication technologies and tools are significantly present in working processes, their is a large number of people whose knowledge of GIS and DSS tools and their capabilities, working principles and usage benefits are very narrow. This knowledge deficiencies can be observed bought with governmental and public service employees and with common citizens.

Especial problem are people with no basic information knowledge, who have difficulties to follow logic of contemporary computer tools. This people often interpret computer as a black box, and therefore eider fear from them or think that computers have unlimited abilities. Bought of these common attitudes have bad influence on ICT development process in a specific environment.

It is clear that, in spite of present limited institutional capacities and lack of adequate legal framework for ICT activities, they slowly but surely involve all our social structures. *In that sense it is important to continually work on this meters as far as context allows*.

In that sense, it is necessary to begin multilevel education *learning with practice* process. This process should be structured from basically and informative programs to very operationally instructive ones, graduated by the level existing knowledge of participants. Also, these educational programs should be structured by the major topics directed toward roles that participants have in strategic development planning and management process.

Educational and training programs should be organized in a way to enable cooperation of local experiences with other from some different context. It is very important for development of ICT tools to correctly understand developing whole process and the structure of context where it is developed. In that sense, educational programs must be supported with additional informative material witch will provide cooperation between generic processes of GIS in different contexts. In that sense it is necessary to establish scientific and academic monitoring of this process aiming to provide link between theory and practice and to define policies, guidelines and help instructions for every day life support.

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The driving forces of IT Regions - Innovation und Technologie als Motoren der Regionalentwicklung - Best Practise in Oberösterreich

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An der Schwelle ins 2. Jahrtausend sind wir durch die Informationsrevolution und den Übergang vom Postfordistischen Paradigma zu einem Techno-Ökonomischen Paradigma mit einem umfassenden technologischen, wirtschaftlichen und gesellschaftlichen Wandel konfrontiert. Dieser Wandel vollzieht sich auf allen Wirtschaftsebenen, von der Metaebene der globalen Weltwirtschaft über die Volkswirtschaften einzelner Länder und Regionen bis hin zur zwischen- und innerbetrieblichen Wirtschaftsweise einzelner Unternehmen. Vielfach unter dem Namen Globalisierung subsumiert bestimmt dieser Wandel maßgeblich die Entwicklung von Regionen, Gemeinden und Unternehmen.

Auslöser dieses Wandels sind technische Innovationen, die alle Bereiche der Individual-, Gruppen- und Massenkommunikation betreffen. Eine Schlüsselrolle kommt dabei der Digitalisierung von Informationen vor dem Hintergrund neuer Informations- und Kommunikationstechnologien zu. War das Fordistische Paradigma durch die fordistische bzw. tayloristische Produktionsweise (Rationalisierung durch Mechanisierung, Massenproduktion, Zentralisierung der Produktionsleitung, vertikale Integration mit Ringen von Zulieferern, etc.) vor dem Hintergrund herkömmlicher Informations- und Kommunikationsmedien gekennzeichnet, so werden heute für den Wettbewerb folgende Anforderungen betont: erhöhte Innovationsfähigkeit, kürzere Produkt- und Modellzyklen, größere Produkt- und Modellvielfalt, maßgeschneiderte Kundenlösungen, gesteigerte Produktqualität und reduzierte Entwicklungs-, Durchlauf- und Lieferzeiten. Die nachfolgende Gegenüberstellung des ursprg. Fordschen Modells und des neuen techno-ökonomischen Modells soll den bereits sich vollziehenden wirtschaftlichen Strukturwandel vor dem Hintergrund der Veränderung und Umstrukturierung der Wertschöpfungsketten verdeutlichen und einige wesentliche Auswirkungen aufzeigen.

Fordsches Modell	Techno-ökonomisches Modell
Rationalisierung der Arbeit durch Mechanisierung	Globale Optimierung des gesamten Produktionsflusses
Erst konstruieren, dann fertigen und Arbeit organisieren	Versuch der Integration von FuE, Konstruktion und Produkten
Indirekt vermittelte Verbindungen zum Verbraucher	Enge Bindungen zwischen Herstellern und Verbrauchern
Geringe Kosten durch Standardisierung, Qualität an 2. Stelle	Ziel der „Nullfehler-Quote“ auf jeder Stufe
Massenproduktion für stabile und steigende Nachfrage, Losproduktion für instabile Nachfrage	Flexible, schnelle Reaktion auf den Markt, unabhängig davon, ob Los- oder Massenproduktion
Zentralisierung der Produktionsleitung	Dezentralisierung der Produktionsentscheidungen
Vertikale Integration mit Ringen von Zulieferern	Netzbildung und „Joint ventures“, um die Früchte der Spezialisierung und Koordinierung zu ernten
Arbeit mit Zulieferern, um zyklische Nachfrageschwankungen zu stabilisieren	Langfristige Zusammenarbeit mit ausgewählten Zulieferern
Aufteilung und Spezialisierung der Produktionsaufgaben mit dem Ziel von Produktivitätsgewinnen	Integration einiger Produktions-, Instandhaltungs- und Managementaufgaben (Umgruppierung)
Mindestanforderungen an Qualifikationen sowie an die allgemein und die berufliche Bildung	Maximierung der Kompetenz durch effektive Berufsbildung plus gute Allgemeinbildung
Hierarchische Kontrolle und höhere Löhne, um Arbeitskräfte für eintönige Jobs zu gewinnen	Menschenführung mit dem Ziel die Kompetenz und das Engagement der Arbeitnehmern zu steigern
Arbeitgeber und Arbeitnehmer betrachten sich als Gegner; Betriebsvereinbarungen gelten als provisorischer Waffenstillstand	Ausdrückliche langfristige Kompromisse zwischen Unternehmensleitung und Beschäftigten; Arbeitsplatzgarantie und / oder Gewinnbeteiligung
Technischer Fortschritt von oben nach unten	Implementierung des technischen Fortschrittes durch Konsultation und Mitbestimmung

Quelle: H. Hofmann u. C. Saul, 1996, S. 39

Widerstände in diesem Umstellungsprozeß sind vor allem durch die Beharrlichkeit bestehender Strukturen bei Unternehmen, durch schleichende und durch Subventionierung noch verzögerte, industrielle Strukturwandlungen, fehlende Anpassung von Normen, Infrastruktur, technische Rahmenbedingungen und fehlende Ausbildung durch den Staat gegeben.

Als eigentliche Vorteile des Umstellungsprozesses werden weder Produktivitätssteigerungen noch Kostenreduktionen sondern Qualitätsverbesserungen und neue Marktchancen genannt. Entscheidende Produktivitätssprünge sind erst dann zu erwarten, wenn durch die Anpassung der Arbeitsprozesse und der Organisation eine Optimierung der gesamten Wertschöpfungskette gelingt (vgl. M. Porter, 1996 oder H. Hofmann u. C. Saul, 1996).

Zu betonen ist der ausdrückliche Hinweis zahlreicher Autoren auf die Komplementarität der informations- und kommunikationstechnologischen Innovationen zu weiteren technischen Innovationen, zu organisatorischen Innovationen und der Verfügbarkeit neuer Qualifikationen der Beschäftigten (vgl. Antonelli, o.J. oder H. Hofmann u. C. Saul, 1996). So sind mit der Umstellung auf neue Informations- und Kommunikationstechnologien längerfristig immer Veränderungen in innerbetrieblichen Organisationsbeziehungen, aber auch Umstrukturierungen bzw. Neuorganisationen der Beziehungen in der Wirtschaft verbunden. Informationstechnologien sind immer im Spannungsdreieck Unternehmensorganisation, Strategie und neue Technologien zu sehen.

Für Unternehmen können insbesondere folgende Wettbewerbsvorteile durch die Nutzung neuer Informations- und Kommunikationstechnologien genannt werden (siehe H. Hofmann u. C. Saul, 1996, S. 41):

- Zugang zu weltweit vorhandenem technologischem Know-how und Expertenwissen
- Verbesserte Koordination zwischen den Bereichen Forschung und Entwicklung, Produktion sowie Marketing
- Erhöhung der Geschwindigkeit der Informationsübertragung, Informationsumfang und –qualität
- Bessere Ausrichtung der Produktion und der Innovationskapazitäten an Kundenbedürfnisse durch verbesserte Unternehmens-Kunden-Beziehungen.
- Verringerung der Vorleistungskosten durch Multisourcing und Global Sourcing.
- Verringerung des Umlaufvermögens und damit sinkende Lagerhaltungskosten in Folge von Just-in-Time Konzepten.
- Reduzierung der Time-to-Market.
- Bessere Kontrolle von Qualitätsstandards.
- Verringerung von Verwaltungs-, Koordinations- und Kontrollkosten.
- Verringerung von Informations-, Verhandlungs- und Vertragskosten.
- Senkung der minimalen effizienten Losgrößen in der Serienfertigung.
- Verbesserte Möglichkeiten zur kostengünstigen Produktdifferenzierung.
- Erhöhte räumliche Ungebundenheit bei Wahl von Produktionsstätten, die eine stärkere Ausnutzung regionaler Kostenvorteile ermöglicht.
- Höhere Auslastung des Anlagevermögens durch Verkürzung von Durchlauf- und Umrüstkosten.
- Verbesserung des Unternehmensimages.

Für die wirtschaftlich erfolgreiche Umsetzung der Informations- und Kommunikationsinnovationen und deren Durchsetzung am Markt ergeben sich folgende Technology-push und Demand-pull Faktoren:

Technology-push Faktoren
Allumfassende Digitalisierung
Unerschöpfliche Bandbreite
Erleichterter, kostengünstiger Zugang zurVernetzung
Moores Gesetz
Offene Systeme und Interkonnektivität

Demand-pull Faktoren
Globalisierung des Wettbewerbs auf Güter- und Faktormärkten (Global Sourcing)
Intensivierung der internationalen Arbeitsteilung
Verkürzung von Innovationszyklen
Veränderung der Produktionsstrukturen (Outsourcing, Lean Production)
Tertiärisierung/ Quartiärisierung
Flexible Spezialisierung
Steigende Komplexität von Produkten
Steigende Anforderung an beständige Weiterbildung und Qualifizierung

Die Technology push Faktoren ermöglichen globales Wirtschaften. Wir sprechen von der Globalökonomie, die insbesondere folgende Kennzeichen aufweist:

- Die Möglichkeiten der modernen Datenverarbeitung und Telekommunikation fordern unser gewohntes Denken über Raum, Zeit und Grenzen heraus und bringen bislang unbekannten weltweiten Wettbewerb zu einer großen Zahl von Dienstleistern.
- Es entstand ein liberales Handelsregime, welches sich über den gesamten Globus ausweitet - immer mehr Länder treten der WTO bei
- Immer mehr Länder ziehen mit dem westlichen technologischen Standard gleich. Dies macht sie zu ernsthaften Konkurrenten in nunmehr globalen Märkten.
- Die Wirtschaft ist gekennzeichnet durch globale Wirtschaftsströme und globale Finanzströme.
- Auf Unternehmensebene sind weltweite Unternehmensfusionierungen die Antwort.

Die Geschwindigkeit des Wandels ist ständig im Zunehmen begriffen und sie erzeugt bei den Unternehmen einen enormen Bedarf an Anpassung. Die Liberalisierung der Weltwirtschaft führt dazu, daß Wettbewerbsvorteile heute immer mehr auf Know-how-Vorteilen und nicht mehr nur auf Kostenvorteilen basieren. Permanente Innovation und Technologieentwicklung d.h. die Fähigkeit, Wissen in der Form umzusetzen, dass ein Marktvorteil durch die Entwicklung eines neuen Produktes, Verfahrens oder Managementsystems generiert wird, sind Voraussetzungen, um am Markt bestehen bleiben zu können. Der Umgang mit diesen Herausforderungen wird der Schlüssel für eine Wettbewerbsfähigkeit sein, die auch in den nächsten Jahren Bestand hat. Und dieser Schlüssel liegt in einer Gegenbewegung, nämlich der Regionalisierung. DeBesson stellt fest: „Firms almost never innovate in isolation". Und Michael Porter reüssiert 1998: „Paradoxerweise liegen die nachhaltigen Wettbewerbsvorteile einer globalen Wirtschaft zunehmend in lokalen

Gegebenheiten – Wissen, Beziehungen, Motivation – mit denen weiter entfernte Rivalen nicht mithalten können".Komplementär zur Globalisierung gewinnt die Regionalökonomie an Bedeutung.

Wachstumsregionen in Europa haben erkannt, dass die nachhaltigen Wettbewerbsvorteile eines globalen Werte- und Wirtschaftssystems zunehmend in lokalen Faktoren liegen, die Innovation und Technologieführerschaft begünstigen. Eine schlechte Standortpolitik wird durch Abwanderung bestraft, eine gute durch Zuwanderung belohnt. Die Beschleunigung von Innovationsprozessen und die Steuerungsfähigkeit von Regionalökonomie sind Schlüsselkriterien für den wirtschaftlichen Erfolg einer Region.

STRUKTURMERKMALE ERFOLGREICHER REGIONEN UND REGIONALER INNOVATIONSSYSTEME

- Koopkurrenz zwischen Unternehmen und Gemeinden
- Hohe Innovationsfreudigkeit, -tätigkeit und hoher Innovationsgrad
- Intensive Forschungs- und Entwicklungstätigkeit
- „Institutional thickness" - durchlässige Schnittstellen zwischen allen Akteuren wie Regionalmanagements, Unternehmen, öffentliche Institutionen, Qualifizierungseinrichtungen, Kompetenzzentren, Technologiezentren, Clustern
- Hohe regionale Identität
- Kreative Milieus
- Kreative Netzwerke
- Regionale Entwicklungsagenturen/ Regionalmanagements
- Unternehmenskooperationen vertikal, horizontal und branchenübergreifend
- Cluster
- Technologiezentren
- Effiziente und innovative Qualifizierungseinrichtungen
- Wissenschaftliche Kompetenzzentren
- Harte Standortfaktoren (gut ausgebildet)
    - Angebot an Standortflächen
    - technische Infrastruktur
    - Angebot an Arbeitskräften
    - Verkehrsnetz
    - Bodenpreise
- Weiche Standortfaktoren (gut ausgebildet)
    - regionale Informations- und Wissensnetzwerke
    - Arbeitnehmermentalität
    - sozialpartnerschaftliche Diskurskultur
    - Genehmigungs-und Verfahrenstempo
    - Image als Wirtschaftsstandort
    - Dichte und Qualität der Wirtschaftsdienste
    - Qualität und Kompetenz von Interessenvertretungen der Wirtschaft
    - kulturelle Einrichtungen
    - Sport- und Freizeitinfrastruktur
    - Naherholungsmöglichkeiten und Freizeitinfrastruktur
    - Versorgungsinfrastruktur
    - Stadtbild und Attraktivität der Innenstädte
    - Wohnkosten
    - Lebenshaltungskosten
    - Image der Region
- Generelle Wirtschaftsfreundlichkeit
- Innovative Wirtschaftsfördermodelle
- Public-Private Partnership

PORTFOLIO EINER ZUKUNFTSORIENTIERTEN REGIONALENTWICKLUNG

Das Erfolgsgeheimnis von Wachstumsregionen beruht auf dem Aufbau von Strukturen, die einen Beitrag zur Effizienzsteigerung der Wirtschaft leisten. Hierzu zählen die Installierung von Regionalmanagements und technologiepolitischen Instrumenten wie Cluster, Kompetenzzentren, Technologiezentren oder FH-Studiengänge. Anhand des Best Practise Beispiel Oberösterreich soll ein Einblick in innovations- und technologieorientierte Regionalentwicklung gegeben werden.

Oberösterreich, das industrielle Kernland Österreich, kann als Musterbeispiel für eine innovative und zukunftsorientierte Regionalentwicklung angeführt werden. Mitte der 90er Jahre gekennzeichnet durch starke strukturelle und wirtschaftsorientierte Probleme resultierend aus einer starken Abhängigkeit von der Stahl- und Metallindustrie, schaffte im Jahr 2000 einen äusserst erfolgreichen Turn around. Mit einer Arbeitslosenquote von 3,6 % zählt Oberösterreich zu den besten 3 Regionen in Europa. Alleine im Jahr 2000 sind 7.700 neue Arbeitsplätze entstanden. Gemessen am Bruttoregionalprodukt pro Kopf liegt es nunmehr an 52. Stelle unter den 210 EU NUTS 2 Regionen.

1995/ 1996 wurden im Zuge der Neudefinition österreichischer EU-Fördergebiete 3 OÖ Regionalmanagementorganisationen eingerichtet: das Regionalforum Steyr-Kirchdorf, zuständig für die Bezirke Steyr Stadt, Steyr-Land und Kirchdorf; das Regionalmanagement Innviertel-Hausruck, zuständig für die Bezirke Schärding, Ried, Braunau und Grieskirchen sowie für die Inn-Salzach Euregio und das Regionalmanagement Mühlviertel, zuständig für die Bezirke Freistadt, Rohrbach, Perg und Urfahr-Umgebung sowie für die Euregio Bayrischer Wald – Böhmerwald.

Intention war die aktive Strukturentwicklung der ehemaligen EU-Ziel 5b/ Ziel 2-Gebiete, die koordinierte Ausschöpfung der EU-Fördermittel und die Steigerung der regionalen Wertschöpfung und Wettbewerbsfähigkeit dieser 3 Regionen. Das Aufgabengebiet der RM umfasste insbesondere die Koordination regionaler Interessen, die Initiierung von Projekten und Förder- und Projektberatung. 1998 wurde das Strategische Programm Oberösterreich 2000+ beschlossen, welches seither konsequent umgesetzt wird. Im Zeitraum 1998 – 2003 fliessen zusätzlich 1 Milliarde Schilling an OÖ Landesmittel zur Verbesserung der OÖ Standortbedingungen, insbesondere im Bereich der technologischen Infrastruktur, und hier vor allem bei den wirtschaftsbezogenen Bildungs- und F& E- Einrichtungen sowie beim Technologietransfer (vgl. TZ´s in den Bezirken, Kompetenzzentren, Fachhochschulen, Cluster als thematische Branchennetzwerke).

Die technologiepolitische Matrix mit den wesentlichen Technologiefeldern (Stärkefelder) der oö. Wirtschaft veranschaulicht wichtige technologiepolitische Massnahmen.

Instrumente / Stärkefelder	Cluster	F&E	Univ.-Studienrichtungen	FH-Studiengänge	HTL's	Technologiezentren
Automobil	AC, CDT	LKR, LCM, PROFACTOR		●●	Steyr	Steyr
Kunststoff	KC	PCCL, TC_{KT}	●●	○	Andorf, Vöcklabruck, Wels	Kirchdorf, Ried, Wels
Holz / Möbel	MHC	WOOD	●●●		Hallstatt	Freistadt, Ried
Ökoenergie	OEC	ASIC		●		Attnang, Wels
Lebensmittel	LC				Wels	Wels
Life Sciences	GC	Life Tool, MAZ, LBF, Biomed. Nanotechn.	●	●●	Braunau	Freistadt, TECHCENTER
Mechatronik	MC	IKMA, LCM, PROFACTOR	●	●●●	Braunau, Linz, Neufelden, Wels, Steyr, Vöcklabruck	Attnang, Braunau, Kirchdorf, TECHCENTER, Wels
Umwelt-technologie	In Prüfung			●	Vöcklabruck, Wels	Attnang, Freistadt, Gmunden, Steyr
Informations-technologie	Querschnitts-funktion	SCCH	●●	●●●●● ●●●○	Braunau, Leonding, Linz, Wels u.a.	Hagenberg, St. Florian, Schärding, Gmunden u.a.

Der bisherige Erfolg des Programms basiert laut J. Mahlich et al auf vier Eckpfeilern: (i) der Mobilisierung überkritischer finanzieller Ressourcen. Verteilt auf fünf Jahre werden Geldmittel in Höhe von 72,7 Mio. € eingesetzt. (ii) Ziele, Strategien und Maßnahmen werden von einer breiten politischen Basis mitgetragen, d.h. Landtag, Landesregierung und Interessenvertretungen haben dieses Programmgemeinsam formuliert. (iii) Die Architektur des Programms gewährleistet ein hohes Maß an strategischer und organisatorischer Intelligenz des Mitteleinsatzes. (iv) Die klare Vorgabe von Zahlen, Zeithorizonten und Zuständigkeiten unterstützt die effiziente und in seiner Wirksamkeit überprüfbare Programmumsetzung. Nach 3,5 Jahren der fünfjährigen Laufzeit des Programms hat die oberösterreichische Forschungs- und Innovationsinfrastruktur einen beachtlichen Entwicklungsschub absolviert.

Dahinter steht eine Reihe gezielter und untereinander abgestimmter Maßnahmen. Unter die bisherige Bilanz des 'Strategischen Programms OÖ 2000+' fallen im Bereich Kapazitäts- und Infrastrukturaufbau u.a. die **Gründung der Upper Austrian Research** als oö. Forschungs- und Technologietransferholding sowie die **Errichtung weiterer 11 Technologie-, Innovations- und Gründerzentren**. Eindeutig positiv ist die bisherige Bilanz der Programmumsetzung in der gezielten Nutzung der einschlägigen Förderprogramme des Bundes zum Aufbau von Kompetenzzentren und Kompetenznetzwerken. So verfügt Oberösterreich per Dezember 2001 über **vier K*plus*-Kompetenzzentren** (Leichtmetalle Ranshofen, Software Hagenberg, Holz Linz/Lenzing, Mechatronik Linz), **ein industrielles Kompetenzzentrum** (K*ind* Mechatronik und Automation) und ist zudem beim **Kompetenznetzwerk** (K*net)* für metallurgische und umwelttechnische Verfahrensentwicklung beteiligt. Für die Verbesserung des Innovations- und Kooperationsniveaus der oberösterreichischen Unternehmen sind zunächst die im Rahmen des 'Strategischen Programms OÖ 2000+' etablierten **Cluster** (Automobil, Diesel- Technologie, Kunststoffe, Holz, Ökoenergie und Lebensmittel) als innovationsverstärkende Branchennetzwerke anzuführen. Schließlich ist an dieser Stelle noch das **Innovationsassistenten-Programm** mit bisher vier Jahrgängen zu erwähnen. Hinter den angeführten Maßnahmen steht eine substantielle Ausweitung der F&E-Kapazitäten. So hat sich im Berichtszeitraum die Anzahl der in außeruniversitären F&E-Einrichtungen Beschäftigten von 50 auf 230 mehr als vervierfacht; bis 2003 ist eine Versechsfachung geplant. Die F&E-Aufwendungen dieser Einrichtungen werden sich im gleichen Zeitraum verneunfachen.

Die Umsetzung des 'Strategischen Programms OÖ 2000+' liegt in den Händen der OÖ. Technologie- und Marketinggesellschaft mbH (TMG). Neben diesen auf die Weiterentwicklung der Forschungs- und Innovationsinfrastruktur ausgerichteten Aktivitäten bewirbt und begleitet die TMG Betriebsansiedlungs- und Standortentwicklungsprojekte. In den Jahren 2000 und 2001 hat die TMG 70 Unternehmen in der Ansiedlung, Erweiterung und Umsiedlung beratend unterstützt. Knapp die Hälfte (33) davon entfallen auf Betriebsansiedlungen ausländischer Unternehmen. Insgesamt steht hinter diesen Ansiedlungsaktivitäten ein Investitionsvolumen von rund 160 Mio. € und ca. 2.500 neue Arbeitsplätze.

Als Ergänzung zu den bestehenden Programmen (insbesondere Strategisches Programm OÖ 2000+) erfolgte 2000 die Erstellung und der Beschluss des oberösterreichweiten Regionalwirtschaftlichen Entwicklungsleitbildes. Jede Region Oberösterreichs soll ihre wirtschaftlichen Kräfte dahin ausrichten, wofür sie die besten Standortvoraussetzungen aufweist. Nur so kann eine flächendeckende wirtschaftliche Weiterentwicklung Oberösterreichs gewährleistet werden. Dieses Entwicklungsleitbild bildet die Grundlage für die oberösterreichische Regionalpolitik und die wirtschaftliche Entwicklung der Teilregionen. Derzeit werden in den einzelnen Teilregionen Regionalwirtschaftliche Entwicklungsleitbilder – abgestimmt auf das gesamtoberösterreichische Leitbild - erarbeitet.

Die konsequente Verfolgung des offensiven Zieles, Oberösterreich unter den europäischen Top-Regionen zu etablieren sowie der Erfolg der Regionalmanagements Steyr-Kirchdorf, Innviertel-Hausruck und Mühlviertel veranlassten die oberösterreichische Landesregierung weiters, Regionalmanagements flächendeckend in allen oberösterreichischen Regionen einzurichten. Folgende neue RM-Organisationen wurden seit 2000 installiert: das Regionalmanagement Vöcklabruck, zuständig für den Bezirk Vöcklabruck (09/2001); das Regionalmanagement Salzkammergut, zuständig für den Bezirk Gmunden (02/2002); das Regionalmanagement Linz /Linz-Land, zuständig für die Bezirke Linz-Stadt und Linz-Land (Anfang 2003).

DAS BEISPIEL SALZKAMMERGUT

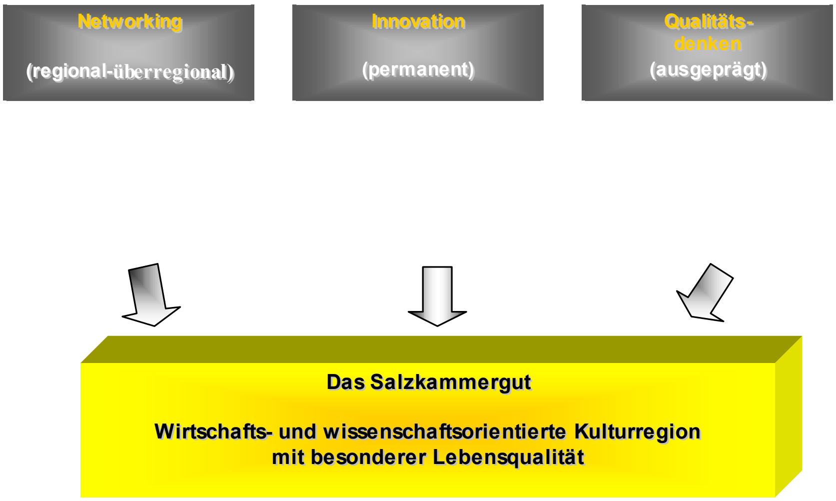
Das Salzkammergut, drittgrösste Wirtschaftsregion und grösste Tourismusregion Oberösterreichs, ist strukturell und funktional aufgeteilt in 2 Teilregionen, eine Nord- und eine Südregion (vgl. mit der Struktur Italiens). Die ausgeprägten kleinregionalen Identitäten differenzieren sich auf 4 Subregionen, regionales „Hauptthema“ ist der Tourismus.

20 Bürgermeister – 1 Konzept

Die Zeichen der Zeit erkannt, installierten die 20 Gemeinden im Bezirk Gmunden mit Februar 2002 ein professionelles Management. Somit gelang der Brückenschlag von teilregionaler Zusammenarbeit beispielsweise über die Planungs- und Projektplattform REGIS (gegründet 1994, 7 Gemeinden) oder den Förderverein für ein Technologiezentrum (gegründet 1997, 13 Gemeinden) zu einer gesamtregionalen Koordination. In nur 9 Monaten wurde ein gemeinsames Zukunftskonzept erarbeitet. Der kurze Erstellungszeitraum gewährleistete die Kontinuierlichkeit des Prozesses, der Akteure und der Inhalte.

Neuen Ansatz und Methodik entwickelt

Unter Federführung der Geschäftsführung war man sich aufgrund der sich ändernden wirtschaftlichen Rahmenbedingungen und der spezifischen „Salzkammergut Gegebenheiten“ von Beginn an einig, eine neue Ära in der Regionalentwicklung beschreiten zu wollen. Wirtschaftsorientierung, Prozessorientierung und Integration von „top down“ und „bottom up“ sind die drei Schlagworte. Vergleichbar mit der Entwicklung eines industriellen Leitunternehmens wurden das Produkt bzw. die Produktgruppe Region und die Regionsprozesse unter die Lupe genommen, Alleinstellungsmerkmale herausgearbeitet, in ein regionales Stärken/ Schwächen/ Chancen/ Risiken –Profil übergeführt, der Marktplatz der Regionen analysiert und ein Gesamtkonzept entwickelt, welches dynamisch genug ist, den Weg bis 2017 vorzugeben.



Quelle: Regionalwirtschaftliches Entwicklungskonzept Salzkammergut, 2003

Grundlage für die gesamtregionale Positionierung bilden die drei Werthaltungen permanente Innovation, regionales und überregionales Networking und ausgeprägtes Qualitätsdenken. Entwicklungsstrategien, Ziele und Schlüsselprojekte für die Themenfelder Standortentwicklung, Industrie/ Handwerk/ Gewerbe, Handel/ Dienstleistung, Technologie, Tourismus, Kommunalwirtschaft, Raumplanung, Bildung, Kultur, Verkehr und Landwirtschaft.

PROZESSORIENTIERTE REGIONALENTWICKLUNG

Der äußerst intensive und spannende Prozess und die Einbeziehung von ca. 300 Akteuren von der Analyse bis zur Entwicklung der Ziele und Schlüsselprojekte forderten viel Einsatz, Engagement und Konfliktlösungspotenzial. Die erarbeiteten Maßnahmen werden im Sinne einer nachhaltigen, innovativen und umsetzungsorientierten Regional- und Entwicklungspolitik von den Akteuren und Bürgern mitgetragen und – unterstützt mit öffentlichen Mitteln – durch regional abgestimmte Maßnahmen vor Ort verwirklicht.

In Zeiten des steigenden Wettbewerbes ist eine gemeinsame Positionierung einer Region lebensnotwendig. Nur so können wir die bestehenden Strukturen gesichert, neue Arbeitsplätze geschaffen und Zukunftsentwicklungen vorangetrieben werden.

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Vienna IT Enterprises „Das innovative IT_Netzwerk"

Bernhard SCHMID & Heinrich WEBER

Bernhard Schmid, Wiener Wirtschaftsförderungsfond; Heinrich Weber, Magistrat der Stadt Wien, MA27

ZIELE

Vienna IT-Enterprises ist das Netzwerk für innovative Unternehmen, sowie Forschungs- und Bildungseinrichtungen aus dem IT-Bereich. Mittel bis längerfristige Ziele von Vienna IT-Enterprises sind die Stärkung der Innovationskraft und der Wettbewerbsfähigkeit der Partner, die Stärkung der internationalen Wettbewerbsfähigkeit, sowie die Steigerung des Bekanntheitsgrades sowohl der Mitglieder als auch Wiens als hervorragender IT Standort im In- und Ausland. Vienna IT Enterprises zielt insbesondere darauf ab, den Standort Höchstädtplatz im Ziel 2 Gebiet als IT Drehscheibe zu etablieren und somit für das Gebiet einen wirtschaftlichen Aufschwung zu erzielen. Vienna IT Enterprises ist ein Projekt des Wiener Wirtschaftsförderungsfonds.

Vorrangiges Ziel ist es, das Bewusstsein zur Notwendigkeit für Kooperationen zu stärken, die vorhandenen Kompetenzen der Mitglieder zu vernetzen um damit neue und innovative Projekte zu initiieren.

Vienna IT-Enterprises stellt umfangreiche Serviceleistungen zur Verfügung und soll die Plattform und Basis zur Umsetzung von Ideen, Initiativen und Projekte direkt aus der Wirtschaft darstellen. Die Hauptaktivitäten werden die Bereiche Weiterbildung, Internationalisierung, Marketing, Forschungs- und Entwicklungskooperationen und Finanzierung sein. Eine weitere Tätigkeit ist die Unterstützung bei der Akquisition von geeigneten Unternehmen für das Business & Research Center am Höchstädtplatz in 1200 Wien, welches im Jahr 2005 eröffnet wird.

Mitglieder von Vienna IT-Enterprises können Unternehmen, Forschungs-, Entwicklungs- und Bildungseinrichtungen aus dem Bereich der Informations- und Telekommunikationstechnologien, sowie relevante Dienstleistungsunternehmen sein.

Homepage: http://www.vite.at

EU ZIEL 2 PROJEKT

Der Sitz von Vienna IT Enterprises ist in der FH Technikum Wien am Höchstädtplatz und liegt somit in jenem Teil der Brigittenau, der neben Teilen der Leopoldstadt zum Ziel 2-Gebiet gehört. Nach Fertigstellung des Technologiezentrums am Höchstädtplatz in unmittelbarer Nachbarschaft zur FH Technikum Wien wird Vienna IT Enterprises in dieses Gebäude übersiedeln.

Bis Mitte 2008 erhält Vienna IT Enterprises Fördergelder aus den EU-Strukturfonds und öffentlich/nationalen Mitteln. Das Gesamtbudget des Projektes beträgt rund 2,6 Mio €, rund 500.000,-- € pro Jahr. Unternehmen und Mitglieder, die sich am Höchstädtplatz ansiedeln, bzw. ihren Firmensitz im Ziel 2 Gebiet haben, erhalten Sonderkonditionen und spezielle Förderungen, die für kleine Unternehmen maßgeschneidert sind.

Das EU Projekt Vienna IT Enterprises wird vom Wiener Wirtschaftsförderungsfonds als Projektträger gemeinsam mit 6 Partnerunternehmen durchgeführt und hat am 1. Oktober 2003 gestartet, offizieller Start der Plattform war Anfang Jänner 2004.

Vorteile für Partner

- stärkt die nationale und internationale Wettbewerbsfähigkeit
- steigert den Bekanntheitsgrad der Unternehmen
- vernetzt Kompetenzen
- initiiert und unterstützt neue, innovative Projekte
- dient als Plattform für Ideen und Initiativen
- ermöglicht gemeinsame Marketingaktivitäten
- veranstaltet Diskussionen, Seminare, Qualifizierungsmaßnahmen
- bietet eine Reihe von Serviceleistungen wie Homepage, Newsletter u.v.m.
- verhilft zu Präsentationen im In- und Ausland
- lebt von den Ideen seiner Mitglieder
- spezielle Förderungen für Unternehmen mit Firmensitz im Ziel 2 Gebiet
- vielfältige Services für Partner von Vienna IT Enterprises

Zahlen zum IT Standort Wien

In Österreich haben rund 26.000 Unternehmen einen Gewerbeschein für Informations- und Kommunikationstechnologien (IKT). Mehr als 8.000 davon sind in Wien angesiedelt. Wien ist damit bei weitem der größte IT-Standort Zentral- und Osteuropas. Die hier angesiedelten Unternehmen erwirtschaften 70 Prozent des österreichischen Gesamtumsatzes, der im vergangenen Jahr 25 Mrd. Euro (Inland etwa 20 Mrd. Euro, Auslandsumsätze etwa 5 Mrd.) ausgemacht hat.

Auch die meisten multinationalen Unternehmen sind bereits in Wien angesiedelt, viele davon mit Verantwortung für die Geschäftstätigkeit in Mittel- und Osteuropa. Die Qualität des Standortes machen vor allem Technologie, Innovationskraft und die bearbeiteten Märkte aus.

Beschäftigte:	2001: 90.000	Österreich:	120.000
	2002: 78.000		105.000

Arbeitslose: 2.200 ganz Österreich (Wien ca. 70%), diese relativ niedrige Zahl ergibt sich durch den Umstand, dass sich viele freigesetzte Mitarbeiter selbstständig machen.

DIENSTLEISTUNGEN VON VIENNA IT ENTERPRISES

Kooperationsworkshop

Der Einstiegsworkshop Get in Touch zeigt, wie man Vienna IT Enterprises am besten nutzt.

Inhalte:

- Wie wirken Kooperationen und Netzwerke auf die Wettbewerbsfähigkeit von IT Unternehmen?
- Interkulturelle und soziale Kompetenz
- Kooperation beginnt hier und jetzt – wie funktioniert Matchmaking?
- Kommunikation im Netz – Wie nutze ich die Vienna Virtual Hightech City (Zugang exklusiv für Vienna IT Enterprises)?

Man erfährt beim Workshop

- Wie wichtig Kooperationen sind, um wettbewerbsfähig zu sein und was Sie von einer Mitgliedschaft bei Vienna IT Enterprises erwarten dürfen.

Der Workshop ist für Mitglieder von Vienna IT Enterprises kostenlos!

Vienna High Tech City

Vienna High Tech City, das virtuelle Netzwerk von Vienna IT Enterprises, unterstützt Kooperationen und Kommunikationswege online. Ein Kernstück der virtuellen Plattform sind Live-Vorträge von Spezialisten und Experten via Webkonferenzen und eine Kunden- und Kontaktdatenbank zur Unterstützung gemeinsamer vertrieblicher Kooperationen.

Profitieren Sie von:

- Matchmaking Engine für gezielte Kooperationen
- Live-Vorträgen von Spezialisten per Webkonferenz
- Onlinemarktplatz zur Vermarktung standardisierter Produkte, Lizenzen und Patente im Ausland
- e-Learning und Wissensmanagement zur Erarbeitung neuer Wissensgebiete
- Kunden- und Kontaktdatenbank
- virtuellen Messen
- Matchmaking Engine zur gezielten Koordination von Firmen Partnern vor Veranstaltungen
- Chats und Foren für Mitglieder
- Online Terminkalender und Datenbanken

Damit es auch Partnerunternehmen aus den neuen EU-Mitgliedstaaten leichter haben, die Plattform zu benutzen, sind die Module der virtuellen Plattform neben Deutsch und Englisch auch in Ungarisch, Slowenisch, Kroatisch und Polnisch abrufbar. Weitere Sprachen können nach Bedarf jederzeit hinzugefügt werden.

Kontakte können über Vienna High Tech City intensiviert, ausgebaut und gepflegt werden.

Kooperationsservices

Vienna IT Enterprises intensiviert die Kooperation zwischen Wirtschaft und Wissenschaft. So soll schon im Vorfeld sichergestellt werden, dass sich angewandte Forschung auf wirtschaftlich verwertbare Themen konzentriert und auf die Bedürfnisse der Unternehmen eingeht. Vienna IT Enterprises wird Kooperationen initiieren, entwickeln und betreuen und auch die Möglichkeit von Förderungen und gemeinsamen Einreichungen unterstützen.

Internationalisierung

f) Messepräsenz

Mit günstigen Gemeinschaftsauftritten auf internationalen Messen unterstützt Vienna IT Enterprises bei Exportambitionen. Dabei wird speziell von den Bedürfnissen und Interessen der jeweils teilnehmenden Aussteller ausgegangen. Workshops bereiten auf internationale Messen vor, Monitoring europäischer Messen auf der virtuellen Plattform informieren interaktiv über laufende Veränderungen der Messe-Profile.

g) Central Eastern Europe

Vienna IT Enterprises arbeitet am Aufbau eines Netzwerkes von Multiplikatoren in Central Europe, die nicht nur das Netzwerk und damit die Partnerunternehmen bekannt machen, sondern relevante und verlässliche Marktinformationen und profitable Kontakte bringen.

h) Präsentationen im Ausland

Vienna IT Enterprises bietet die Möglichkeit zur Teilnahme an Präsentationen im Ausland. Im Mai 2004 steht Bukarest auf dem Programm. Weitere Präsentationen sind geplant.

PR und Marketingaktivitäten

Laufende PR-, Image- und Werbemaßnahmen im In- und Ausland, Vorstellung von Vienna IT Enterprises und deren Partner bei relevanten Veranstaltungen.

Partner von Vienna IT Enterprises haben die Möglichkeit, professionelle Public Relations-Leistungen mit Sonderrabatt in Anspruch zu nehmen.

Aus- und Weiterbildung

Partner erhalten kostengünstige, maßgeschneiderte Schulungsmaßnahmen. Qualifizierungsprojekte im Verbund garantieren den effizienten Einsatz der Ressourcen und sichern die Wettbewerbsfähigkeit der Unternehmen. Vergünstigte Kursangebote und Fachvorträge ergänzen das Angebot.

Web-Unterstütztes Rechnungswesen

Partnerunternehmen von Vienna IT Enterprises bieten Mitgliedern ein internetbasiertes Paket für Rechnungswesen, Buchhaltung, Kostenrechnung und Liquiditätsmanagement an, das jederzeit umkompliziert Zugang zu aktuellen Unternehmensdaten liefert.

Management Services

Eine neuartige und zugleich bewährte Kombination aus Beratung und Co-Management wird von einem Netzwerk-Partner angeboten. Management-Insourcing/Outsourcing im Finanz- und Vertriebsbereich unterstützt bei speziellen Fragen oder Aufgabenstellungen.

Standortangebote/Virtueller Firmensitz

Vienna IT Enterprises unterstützt bei der Suche nach einem geeigneten Firmenstandort. Ein gemanagter Standort am Höchstädtplatz im Ziel 2-Gebiet steht ab 2005 zur Verfügung, wo auch ein reichhaltiges Dienstleistungs- und Infrastrukturangebot direkt verfügbar ist.

Wer viel unterwegs ist und aus dem Ausland oder den Bundesländern eine Zweigstelle in Wien errichten will, dem bietet Vienna IT Enterprises auch virtuelle Firmensitze ohne hohe Fixkosten an. Ein eigenes Telefon- und Sekretariatscenter betreut die Unternehmen.

Arbeitsgruppen

Aufgabe und Inhalt der Arbeitsgruppen sind, das jeweilige Thema zu entwickeln bzw. die Bearbeitung des Themas voranzutreiben. Die Ergebnisse werden im Web dokumentiert, in die Knowledge-Base von VITE eingespeist und können als Basis für einzelne Projekte dienen. Zugleich dient das gesammelte Wissen als Hintergrund für strategische Entscheidungen.

Arbeitsgruppen sind zu den Themen Internationale Märkte, Vertrieb/Support, Qualifizierung, F+E Kooperationen und Finanzierung geplant. Weitere können je nach Bedarf oder Vorschlägen von Partnern jederzeit eingesetzt werden.

GENDER ALP! Qualitätssicherung in der Raumplanung: Methoden und Umsetzung von bedarfs- und geschlechtergerechter Planung im Alpenraum

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7 ABSTRACT – KURZFASSUNG FÜR DIE EILIGE LESERIN

Auf Initiative von Romana Rotschopf vom Büro für Frauenfragen und Gleichbehandlung der Salzburger Landesregierung wird derzeit gemeinsam mit der Raumplanungsabteilung (überörtliche Raumplanung – C. Itzlinger) und der Wirtschaftsabteilung des Landes ein Projekt zur gendersensiblen Regionsentwicklung und zur Qualitätssicherung in der Raumplanung entwickelt. Am Beginn stand die Tagung „Wir planen für Männer und Frauen – Gender Mainstreaming in der Regionalentwicklung[1]" im September 2002, geplant ist die Einreichung und Durchführung des Projekts „GENDERALP! Das Projekt ist im Bereich der großen Strategien der EU in den Verwaltungsabteilungen von Ländern und Städten angesiedelt und strebt „einen wettbewerbsfähigen und attraktiven Lebens- und Wirtschaftsraum im Rahmen der polyzentrischen räumlichen Entwicklung in der EU an (Priorität 1, Maßnahme 1).

Es wird 2004 im Rahmen der EU-Programminitative INTERREG IIIB in der Gebietskulisse „Alpenraum" eingereicht und soll innerhalb von drei Jahren Gute Praxis aus den Städten und Regionen austauschen, im Rahmen von Pilotprojekten Methoden und Instrumente einer bedürfnis- und gendergerechten Raumentwicklung (einschließlich Indikatoren und Meßgrößen) sowie begleitende Aus- und Fortbildungsangebote für die Verwaltung durchführen, sodass zuletzt praxisnahe Handreichungen für die AkteurInnen in Verwaltung und Planung für die Sicherstellung einer qualitätvollen und treffsicheren Raumentwicklung für Frauen und Männer angeboten werden können.

8 ANLASS UND MOTIVATION DER LEADPARNTER ZU EINEM INTERREG-PROJEKT

Aus der Auseinandersetzung mit dem Thema „Gender Mainstreaming in der Regionalplanung" im Rahmen der Veranstaltung „Wir planen für Männer und Frauen", welche gemeinsam mit der Raumplanungsabteilung des Landes Salzburg (Abt. 7) organisiert wurde, ist dann der Wunsch nach konkreter Umsetzung entstanden.

Ein direktes Ergebnis der Tagung war die Einladung der Abteilung Landesplanung an das Büro für Frauenfragen zu einer Stellungnahme zum neu überarbeiteten Landesentwicklungsprogramm: Der Wunsch nach mehr Praxis und mehr umsetzbaren Handreichungen vor allem im Rahmen der Arbeit der beiden Regionalbeauftragten für Chancengleichheit in den EU-Fördergebieten Lungau (Pol. Bezirk Tamsweg) und Pinzgau (Pol. Bezirk Zell am See) ließ bei Romana Rotschopf die Idee eines EU-Projekts reifen. Dazu brachte sie die beiden Fachabteilungen des Landes „Landesplanung – überörtliche Raumplanung" und „Wirtschaft (für die Regionlentwicklung)" ins Boot.

Die Motivation und die Rahmenbedingungen für die einzelnen Fachabteilungen lassen sich wie folgt beschreiben:

8.1 Büro für Frauenfragen und Chancengleichheit (Abt. 2/04)

Die Berücksichtigung von Gender Mainstreaming ist ja seit 1997 im Vertrag von Amsterdam und seit 1999 in der Salzburger Landesverfassung (im Nachvollzug der Novelle der Bundesverfassung 1998) für das Verwaltungshandeln ein verbindliches Prinzip. D.h. auf der Ebene der EU-Projekte und Programme ist diesem Prinzip – zumindest in der Präambel – Rechnung getragen.

Das Bekenntnis zu GM ist vorhanden, insbesondere dann, wenn es sich um hierarchisch hochstehende Ziele handelt, die einer Prüfung auf Umsetzbarkeit nicht standhalten müssen: Das 2002-2003 überarbeitete Landesentwicklungsprogramm Salzburg hat die Forderung des Büros für Frauenfragen und Gleichstellung nach einer Verankerung von GM in den Leitzielen erfüllt und stellt nun im verordneten Programm im 1. Kapitel „Grundsätze und Leitlinien der Landesentwicklung" Folgendes fest:

> *„(2) Die Landesentwicklung hat die Raumordnungsziele und –grundsätze gemäß § 2 ROG 1998 zu berücksichtigen und orientiert sich an folgenden Leitbildern:*
>
> - *(taxative Aufzählung von 8 Leitbildern)*
>
> *Diese Leitbilder werden unter Bezug auf die Strategie des Gender Mainstreamings mit der allgemeinen Zielsetzung zur Errichtung von Chancengleichheit zwischen Männern und Frauen ergänzt."*

Das Büro für Frauenfragen und Gleichstellung gibt sich aber schon länger nicht mit dem Bekenntnis zu GM in Präambeln und Leitzielen zufrieden, sondern hat bereits für Interreg IIIA-Projekte einen Leitfaden „Wie gender ich Projekte" ausgearbeitet,[2] um die Geschlechtergerechtigkeit auf die Projektebene herunterzubrechen. Weiters wurden Politiklehrgänge in den Regionen initiiert, um

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1 Wir planen für Männer und Frauen. Gender Mainstreaming in der Regionalentwicklung. Download auf www.salzburg.gv.at/frauen

2 Auflage 4000 Stück. Zu beziehen über das gemeinsame technische Sekretariat Interreg IIIA Bayern-Österreich gts.interregbayaut@salzburg.gv.at

mehr Frauen in die Entscheidungsgremien der Gemeinden und Regionen zu bringen. Immerhin ist Salzburg das letzte Bundesland (außer Wien), welches über keine Bürgermeisterin und damit auch über keine Regionalverbandsobfrau verfügt!

8.2 Raumplanungsabteilung – Regionalplanung (Abt. 7)

Eigentlich müsste sich die Raumplanung nicht um Gender Mainstreaming kümmern. Denn: nimmt man die gesetzlichen Vorgaben im Raumordnungsgesetz ernst, so müssten die gesellschaftlichen Gruppen, die Frauen und Männer aller Altersklassen bei den Planungen berücksichtigt werden:

> *Raumplanung und Landesplanung im Sinne des Gesetztes muss sich mit der planmäßigen Gestaltung eines Gebietes befassen mit dem Ziel der* ***Herstellung möglichst gleichwertiger Lebensbedingungen durch die Schaffung einer ausgeglichenen Wirtschafts- und Sozialstruktur Dabei müssen die unterschiedlichen Bedürfnisse von gesellschaftlichen Gruppen in regionaler, sozialer und geschlechtsspezifischer Differenzierung*** *berücksichtigt werden.* (Ziele und Grundsätze der Raumordnung gem. SROG 98).
>
> *Raumplanung orientiert sich dabei an den* ***(Grund-) Bedürfnissen der Bevölkerung****: genannt werden insbesondere Wohnen, Erwerbsmöglichkeiten, Versorgung mit Gütern und Dienstleistungen, Kultur-, Sozial-, Bildungs- Sport- und sonstige Freizeit-, Informations-, Kommunikations- und Verkehrseinrichtungen. Diese müssen* ***in ausreichendem Umfang und in angemessener Qualität*** *bereitgestellt werden. Ein wichtiger Grundsatz ist auch die Respektierung der freien Entfaltung der Persönlichkeit in der Gemeinschaft.*

An welchen Bedürfnissen orientiert sich also die Raumplanung und Regionalpolitik?

Die Bedürfnisse gibt es natürlich nicht, wie es auch **die** Bevölkerung nicht gibt. Es gibt unterschiedlich differenzierte Bedürfnisse, die sowohl nach Alter, Geschlecht, Bildung, Erwerbstätigkeit, Lebensstil und Lebensphase, wie z.B. in Familie lebend oder Single, mit Betreuungspflichten (für Kinder oder ältere Pflegebedürftige) variieren können.

Die Praxis und Umsetzung ist dieser bedürfnisgerechten, vorausschauenden Planung ist jedoch vielfach ernüchternd:

10 Jahre nach der ambitionierten Raumordnungsgesetznovelle in Salzburg und der daran anschließender Neuordnung in der Landesplanung und der Regionalplanung kämpft die Raumordnung derzeit mit starkem Gegenwind: Im Zeitalter immer knapper werdender öffentlicher Haushalte wurde schon mehrmals die Frage gestellt, ob man Regionalplanung / Raumplanung überhaupt brauche. Salzburg ist hier nicht alleine: die bayerische Verwaltungsreform hat nun die Raumordnung dem Wirtschaftsministerium zugeordnet und wird von vielen nur mehr „als Wegbereiterin für wirtschaftliche Aktivitäten“ gesehen.

Viele der sehr konkreten Ziele und Maßnahmen des Landesentwicklungsprogrammes (1994), des Sachprogrammes für den Salzburger Zentralraum „Siedlungsentwicklung und Betriebsstandorte“ (1995) konnten nur zum Teil umgesetzt werden und somit wurden letztlich auch nicht die Ziele und Grundsätze des Raumordnungsgesetzes umgesetzt: eine am ÖV-orientierte Siedlungsentwicklung mit höheren Dichten im Einzugsbereich von leistungsfähigen Verkehrsangeboten scheitert z.B. an der fehlenden Durchsetzbarkeit von Mindestdichten in Teil-Bebauungsplänen; die Region der kurzen Wege (nach dem Muster der „Stadt der kurzen Wege“) ist weit von einer Realisierung entfernt; die wachsenden Verkehrszahlen für die täglichen Wege für Arbeit, Einkauf, Bildung, Kinderbetreuung und Freizeit zeigen, dass keine wirksame Trendwende bei der Standortwahl und Standortverteilung erfolgt ist. Sie wissen, dass diese Trends nicht nur in Salzburg zutreffen!!!

So hat die Raumplanung in ihrem Kernbereich wohl bereits ein wenig das Thema verfehlt. Ganz zu schweigen von der von Vielen als „Luxus“ oder „Randthema“ bezeichneten Frage nach der Einbeziehung der Bedürfnisse beider Geschlechte. Im Gegenteil:

> *„Frauen werden [in Leitbildern, Programmen und Konzepten] in erster Linie als Problemgruppe des Erwerbsarbeitsmarktes behandelt, in Zusammenhang mit unzureichenden Kinder- und Altenbetreuungseinrichtungen genannt oder in Verbindung mit geringer Mobilität gesehen. Es wird dabei nicht auf die Unterschiedlichkeiten und die Vielfalt von Frauenleben in den Regionen Bezug genommen, sondern lediglich ihr Anders-Sein im Vergleich zu den Männern thematisiert und festgeschrieben“ (Aufhauser et al 2003)*

Ergänzend dazu möchten wir noch hervorheben, dass es natürlich nicht „die Frauen“ als homogene Gruppe gibt und damit auch nicht die Bedürfnisse von Frauen: Soziologische Analysen zeigen, dass in vielen Bereichen die Merkmale „Bildung“ und „Lebensphase“ signifikant unterschiedliche Bedürfnisse nach sich ziehen, das Merkmal „Geschlecht“ jedoch nicht per se eine Differenzierung mit sich bringt. Sehr häufig korrelieren mit dem Geschlecht weiblich jedoch hohe Belastungen durch Hausarbeit und dazugehörige Betreuungsdienste (Hol- und Bringdienste, Einkauf u.a.), damit verbunden geringere Freizeit, niedrigere Erwerbseinkommen und niedrigere Erwerbsquoten, höhere Benutzerfrequenz von Bus und Bahn und natürlich auch eine höhere Lebenserwartung.

Es muss also ein qualitativer Sprung im Wissen um die Bedürfnisse und Alltagsrealitäten unterschiedlicher Gruppen, Frauen und Männern in regionaler Differenzierung erfolgen. Damit kann ers die Frage nach Qualitätszielen und Qualitäten für Regionen gestellt werden: Lebensqualität – Wellness etc. sind die dazu gehörigen aktuellen Schlagworte.

Weiters müssen die Wirksamkeit von Planungsfestlegungen und die Methoden und Umsetzungs-Instrumente verbessert werden.

Die zuletzt in der Regionsentwicklung forcierte Errichtung von Innovations- und Gründerzentren hat zum überwiegenden Teil Erwerbsmöglichkeiten für Männer geschaffen (siehe auch Aufhauser 2003). Ohne flankierende Qualifizierung und Förderung der Frauen im Hinblick auf die Berufswahl und die spätere Karrierechancen in Technikbereichen ist diese Form der Regionalförderung also eine Männerförderung!

Die Raumordnung und das Büro für Frauenfragen treffen sich daher auf der Ebene der Umsetzungs-Instrumente und der notwendigen Sensibilisierung für das Thema „Qualitätssicherung für eine bedürfnis- und geschlechtergerechten Raumplanung“.

Als Kernthemen stellen wir also folgende Fragen:

- Wie kann eine bedürfnisgerechte und vorsorgende Raumordnung realisiert werden? Eine Raumordnung, die nicht nur auf der Ebene der Konzepte ökonomisch-ressourcenschonend, sozial ausgewogen und geschlechtergerecht ist?
- Woran merkt man gute Planung? Wie lässt sich qualitätvolle Planung und Regionsentwicklung messen?
- Wie muss Raumordnung und Regionalentwicklung in der globalisierten Welt neu organisiert werden, um überhaupt noch Wirkung zu entfalten? Oder haben wir schon längst das Heft aus der Hand gegeben und lassen uns im globalen Standortwettbewerb zwischen den aktuellen und künftigen Metropolregionen der Welt von Konzernen ausspielen und buhlen um die Gunst des Kapitals?

Womit wir beim zentralen Thema der corp 2004 gelandet sind, nämlich die Frage nach zeitgemäßen Antworten in den „IT-Regionen" auf den weltpolitischen und ökonomischen „Mainstream".

8.3 Wirtschaftsabteilung und Regionalentwicklung (Abt. 15)

Da in Salzburgs Verwaltung die Raumplanungsabteilung nicht über die Zuteilung von Mitteln für die regionale Wirtschaftsförderung entscheiden kann – diese ist in der Fachabteilung „Wirtschaft, Tourismus, Energie" angesiedelt – war eine Einbeziehung dieser Abteilung in das Projekt unabdingbar: wenn die bedürfnis- und gendergerechte Regionsentwicklung ernst genommen wird, ist die punktgenaue Zuteilung von Ressourcen (in Form von Geld oder Personal – Stichwort „GENDER BUDGETING") entscheidend für die Wirkung von Festlegungen erforderlich.

Im Projekt GENDER ALP! arbeiten daher drei Verwaltungsabteilungen des Landes Salzburg, nämlich das Büro für Frauenfragen und Chancengleichheit, die Raumplanungsabteilung und die Wirtschaftsabteilung an der Projektkonzeption und werden die künftige Lead-Partnerschaft organisieren.

9 PROJEKTKONZEPTION UND PARTNERSCHAFT

9.1 Stand der Projektentwicklung und der Partnerschaften

9.1.1 Programmschiene „Interreg IIIB-Alpenraum"

Das Projekt wird im Rahmem des EU-Programmes Interreg IIIB innerhalb der Gebietskulisse „Alpenraum" eingereicht. Dieses Programm ist darauf ausgerichtet, den ökonomischen und sozialen Zusammenhalt in der gesamten Union zu stärken. Dotiert wird das Programm aus EFRE – Mitteln.

Innerhalb der Programmziele und Prioritäten wird unter Priorität 1, Maßnahme 1 eingereicht[3]:

Priorität 1 Förderung der Wettbewerbsfähigkeit des Lebens- und Wirtschaftsraumes Alpen in seinen europäischen räumlichen Verflechtungen
Maßnahme 1: Wissensaustausch und gemeinsame Perspektiven

Unter dieser Maßnahme werden Kontakte und Netzwerke zwischen verschiedenen Gebieten des Alpenraums gefördert, mithilfe derer gemeinsame Vorstellungen und Visionen definiert werden sollen sowie um bestimmte Themen zur Entwicklung im Kontext sozialer und wirtschaftlicher Integration aufzugreifen.

Die allgemeinen Ziele dieser Maßnahme sind u.a.:

- *Die Entwicklung eines gemeinsamen Verständnisses von Raumentwicklungsstrategien, die den gesamten Alpenraum als gemeinsame Raumeinheit - gemäss den Zielen des Europäischen Raumentwicklungskonzepts und innerhalb einer vergrößerten Europäischen Union - abdecken.*
- *Die Verbesserung des Wissenstandes, die Unterstützung umfassender Informationsverbreitung sowie die Entwicklung und Anwendung von Indikatoren für und vergleichender Analysen von Raumentwicklungsphänomenen.*
- *Die Entwicklung von Netzwerken und der Austausch von Best-practice zwischen verschiedenen alpinen Akteuren.*
- *Die Stärkung des inneren Zusammenhalts und der Identität der Bevölkerung im Alpenraum*
- *Die Verstärkung der transnationalen Zusammenarbeit zwischen den Alpenstaaten und die Förderung von Netzwerken, die den gesamten Alpenraum umfassen*[4].

Der Austausch von „Good & Best Practice" sowie der Aufbau eines Wissensnetzwerks zu Instrumenten der Raumordnung und der Regionalentwicklung ist daher ein zentrales Anliegen von GENDER ALP!

Ebenso wird der Sensibilisierung, Aus- und Fortbildung, also dem Austausch und der zielgruppenorientierten Verbreitung des Wissens über Methoden und Instrumente von Gender Planning große Bedeutung beigemessen: im Rahmen des Projekts

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[3] Interreg IIIB-Programm Alpine Space - Programm dokumente, Ziele und Bedingungen aus der Homepage des Programmes www.alpinespace.org, letzter Zugriff am 18.12.03

[4] ebenda.

9.1.2 Zentrale Fragestellungen des Projekts GENDERALP!

Handlungsleitendes Ziel ist eine Regionsentwicklung, die auf eine Verbesserung der Standort- und Lebensqualität, auf Imagebildung bzw. -verbesserung, (wenn möglich) Verhinderung von Abwanderung, Benennung von Faktoren für das soziale Zusammenleben, Sicherstellung der Grundversorgung etc. abzielt.

Adäquate Planungsantworten auf o.a. Fragestellungen sollen unter Anwendung von gendergerechten Planungsansätzen im Mittelpunkt der Forschung stehen und einen Beitrag dazu leisten, dass die Raumplanungspraxis mehr als bisher die Bedürfnisse aller Bevölkerungsgruppen mit dem Ziel der Sicherung und Verbesserung von Lebensqualität aufsucht. Dabei soll jedoch nicht unberücksichtigt bleiben, dass Problemstellungen von ländlichen Regionen sich von jenen der städtischen Regionen unterscheiden, weshalb durch begleitende Pilotprojekte die Umsetzbarkeit von Planungslösungen geprüft werden soll und praxisorientierte Ergebnisse das Ziel sind. Die im Projekt angestrebte Vernetzung von städtischen und ländlichen Regionen verfolgt jedoch nicht das ohnehin unerreichbare Ziel einer Annäherung von Standortqualitäten, sondern die Absicht einer gegenseitig befruchtenden und nicht konkurrenzierenden Polarisierung, beispielsweise, und sich mit einem wichtigen Ziel des Europäischen Raumordnungskonzeptes deckend, durch die Entwicklung neuer Formen der partnerschaftlichen Zusammenarbeit von Stadt und Land.

Im Rahmen von „GENDERALP! sollen für verschiedene Anwendungsgebiete (Örtliche Raumplanung, Überörtliche Raumplanung, Regionale Entwicklungsstrategien etc.) unter Bezugnahme auf „best-practice Beispiele“ und bestehende Leitfäden (Gender)Indikatoren entwickelt werden: wie misst man gute, qualitätvolle, bedürfnisgerechte und gendergerechte Raumplanung und Regionalpolitik?

Als weiterer Schritt erfolgt die Evaluierung dieser entwickelten Leitfäden anhand von Pilotprojekten, welche vom einzelnen Partnerländern durchgeführt werden.

Aufgrund der Ergebnisse der Evaluierung entstehen als Endprodukt die jeweiligen Indikatorenmodelle, die bedingt durch ihre Überprüfung im Rahmen der Pilotprojekte praxisorientierte Lösungen erwarten lassen. Wichtige Nebenprodukte des Projektes stellen die transnationale Erhebung erfolgreicher Praxisbeispiele, die Sensibilisierung und Bewusstseinsbildung in Form von Weiterbildungs- und Schulungsprogrammen und der Aufbau von internationalen ExpertInnennetzwerken und Datenbanken zur bedürfnissensiblen Planung dar.

9.1.3 Stadt-Land-Partnerschaften bzw. von Städten zu ländlichen Regionen

Nicht ganz überraschend wurden die meisten Erfahrung in geschlechtersensibler Planung in den städtischen Zentren des Alpenraums gemacht. Ein Teil unserer Partnerschaften im Projekt ist daher in Groß- und Mittelstädten angesiedelt (München, Genua, Salzburg, Freiburg i.Br.).

Demgebenüber gibt es jedoch in der Wirtschafts- und Arbeitsmarktförderung gerade in der Regionalentwicklung Erfahrungen mit geschlechtsspezifischen Bedürfnissen, Strategien und Programmen. Gerade im Feld des Arbeitsmarktes ist ja die Notwendigkeit zu einer geschlechtsspezifischen Betrachtung und Förderung deutlich stärker verankert (Im EU-Feld die ESF-nahen Programme, wo eine Maßnahe zumindest zu 50% den Frauen wie den Männern zugute kommen soll), als in EFRE-geförderten Projekten. Ein Teil unserer Partnerschaften kommt daher aus der wirtschaftsnahen Regionalentwicklung der Länder und Regionalentwicklungsagenturen. Einige Bundesländer – nicht jedoch Salzburg – habe ja die Agenden der Raumplanung und der Regionalentwicklung / Wirtschaftsförderung zumindest administrativ gebündelt.

10 BEOBACHTUNGEN BEI DER PROJEKTENTWICKLUNG – OFENE FRAGEN

- Warum wird alle 6 Monate über das Versagen der Raumplanung anläßlich einer EKZ-Eröffnung diskutiert, aber nie über die Definition von Stadtteil- und Regionsqualität?
- Warum findet so wenig öffentliche Diskussion über Qualitätsziele in der Raumordnung statt? Hingegen ist Radio und Fernsehen voll von Diskussionen über die (fehlende) Qualität der neuesten Inszenierungen oder die (fehlende) Qualität der literarischen Neuerscheinungen? Wie mißt man erfolgreiche Raumordnung?
- Warum wird die Raumwirksamkeit von Wirtschaftsförderung und Regionalförderung nicht öffentlich diskutiert? Wird diese überhaupt evaluiert im Hinblick auf regionale Disparitäten bei Arbeitsplätzen, Einkommen, Lebensqualität?
- Warum interessieren sich (fast) nur Frauen für Gender Planning und Gender Mainstreaming? Was können die männlichen Planer, Politiker und Regionalentwickler verlieren, was könnten sie gewinnen?
- Wie lassen sich die Daseinsgrundfunktionen in diesem Feld so nachhaltig organisieren, dass Lebensqualität entsteht? Wer definiert die Bedürfnisse unterschiedlicher gesellschaftlicher Gruppen? Unterscheiden sich diese zwischen Männern und Frauen?
- Wie muss Raumordnung und Regionalentwicklung in der globalisierten Welt organisiert werden, um überhaupt noch Wirkung zu entfalten? Können sich Regionen auch in Hinkunft leisten, auf die Erfahrung und das Expertinnenwissen ihrer Bewohnerinnen über die Lebenswelten und Lebenqualitäten der Region in Zukunftsprogrammen, Regionalplanung, Regionsentwicklung zu verzichten?

11 LITERATURVERZEICHNIS

Aufhauser et al 2003: Grundlagen für eine Gleichstellungsorientierte Regionalentwicklung. Juni 2003.
Büro für Frauenfragen und Gleichstellung 2002: Tagungsdokumentation „Wir planen für Männer und Frauen“ Gender Mainstreaming in der Regionalentwicklung 19.-20.9.2002, Salzburg
Büro für Frauenfragen und Gleichstellung 2003: Wie „gender“ ich Projekte? Ein praktischer Leitfaden zu Gender Mainstream in EU-Projekten.

Dokumentation Eisenstraße – eine Region ist auf Schatzsuche. www.eisenstrasse.info
Internetportal & Dokumentation bringen den Kulturpark Eisenstraße-Ötscherland zum Blühen

Heidemarie THONHOFER & Manfred SCHRENK

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ABSTRACT

E: Globalization meanwhile influences the development of every region and rises the question, if spatial planning still makes sense in am more globalized world. An interesting task for planners can be to find ways for cities and regions to use the advantages of globalization but avoid the disadvanteges, to integrate regions and it´s people into "global community" and at the same time strenghten the specific regional specifica like culture and tradition.

The region of the "Austrian Iron-Route" establishes a regional web-portal and a regional knowledge database to strenghten it´s competetiveness and make the region more attractive as well for people living there as for tourists. Local and global developments are not seen as contradictions but have to be combined for a optimal positioning of a region - regional innovation and information & communication technologies are important tools for successful example of gLOCALize.IT!.

D: Keine Region kann sich heute dem Einfluss der Globalisierung entziehen und es stellt sich die Frage, ob „räumliche Planung" in einer immer stärker globalisierten Welt noch eine Berechtigung hat. Die Herausforderung lautet, die sich aus globalen Entwicklungen ergebende Vorteile konsequent zu nutzen und Nachteile zu vermeiden, also an der globalen Entwicklung teilzuhaben und gleichzeitig lokale Kultur und Tradition zu stärken.

In der Region Kulturpark Eisenstraße-Ötscherland wurde das Projekt "Dokumentation Eisenstrasse" gestartet, um die regionale kulturelle Identität zu stärken und die Region sowohl für ihre Bewohner wie auch für Touristen noch attraktiver zu machen. Basierend auf Erhaltung und Weiterentwicklung des kulturellen Potentials werden wertschöpfende Maßnahmen durchgeführt. Ein Teilprojekt hatte die Entwicklung eines Web-Portals inklusive Wissensdatenbank zum Inhalt, das der Stärkung der Region in der Außendarstellung, v.a. aber einer besseren inner-regionalen Kommunikation und Bewusstseinsbildung dienen soll. Lokale und globale Entwicklungen werden nicht als Gegensätze gesehen, sondern müssen für die erfolgreiche Positionierung einer Region kombiniert werden – Informations- und Kommunikationstechnologien spielen eine wichtige Rolle im Prozess der „gLOKALisierung".

1 GLOBALISIERUNG: DAS ENDE ODER DIE RENAISSANCE FÜR LOKALES WISSEN UND TRADITION ?

Die gleichen Waren in den gleichen Supermarktregalen vom Nordkap bis Feuerland, die „business districts" der Städte gleichen einander wie ein Ei dem anderen und der Preis für das globale Produkt „gebratenes Fleischlaberl" gibt Auskunft über die Wirtschaftskraft von Ländern. Auch der Traum vom Glück im Eigenheim mit Garten ist offenbar fast überall gleich.

Kommunikationstechnologien ermöglichen eine grenzenlose „Netzwerkgesellschaft", neben der „realen", gebauten Welt existieren zahllose „virtuelle Welten" und Gemeinschaften, räumliche Nähe bzw. Distanz spielt für viele Aktivitäten nur mehr eine untergeordnete Rolle.

Verschwindet die Bedeutung lokaler und regionaler Besonderheiten angesichts globaler Entwicklungen gänzlich? Wird sie auf wenige vermarktbare folkloristische Aspekte reduziert? Oder gewinnt die lokale und regionale Ebene gerade angesichts globaler und internationaler Entwicklungen wieder an Bedeutung? Ist die Parole „Global denken, lokal handeln!" längst über-holt oder wichtiger denn je? Ist eine gezielte Stadtplanung und Regionalentwicklung mit dem Ziel der Weichenstellung für eine positive künftige Entwicklung unter diesen Rahmenbedingungen noch möglich? Welche Instrumente benötigt sie dazu?

Keine Region kann sich heute dem Einfluss der Globalisierung entziehen. Die Herausforderung für Städte und Regionen und damit auch für PlanerInnen ist es, Möglichkeiten zu finden, die sich daraus ergebenden Vorteile konsequent zu nutzen und Nachteile weitgehend zu vermeiden - an der globalen Entwicklung teilzuhaben und gleichzeitig lokale Kultur und Tradition zu stärken. Anhand eines Beispieles sei gezeigt, wie eine Region selbstbewußt den Weg in die Informationsgesellschaft geht.

2 DAS BEISPIEL DES KULTURPARKS EISENSTRASSE-ÖTSCHERLAND IM MOSTVIERTEL

2.1 Dokumentation Eisenstraße – eine Region ist auf Schatzsuche.

Die Region um die es geht, ist die Eisenstraße. Lokalisiert im Dreiländereck von NÖ, Stmk und OÖ ist diese Region geprägt von der Industrie- und Wirtschaftsgeschichte des Eisens. Das Eisenwesen, das sich um den Erzberg ausbreitete deckte im 16. Jhdt. 25% des europäischen Eisenbedarfs.

Klingt doch die Zeile der Bundeshymne im Ohr: „....Land der Hämmer, zukunftsreich!"

Schmieden, Feuer, Handwerk sind wesentliche Elemente der regionalen Identität. Privilegien und Reichtum formten die Eisenwurzen derart, dass heute noch die Kulturlandschaft und die Kultur der Bewohner davon geprägt sind.

Im niederösterreichischen Teil der Eisenstraße ist der Verein Kulturpark Eisenstraße-Ötscherland aktiv. 1990 gegründet, weist er 26 Mitgliedsgemeinden auf und betreibt Regionalentwicklung mit der Zusatzaufgabe eines Tourismusverbands unter dem Motto:

„Wir bringen den Kulturpark Eisenstraße im Mostviertel zum Blühen!".

Der Verein Kulturpark Eisenstraße-Ötscherland verfolgt ein ehrgeiziges Ziel, nämlich das kulturelle Erbe der Region nach-haltig zu erschließen. Seine Mitglieder und die aktiven Menschen der Region haben erkannt, dass die Identität der Region, nämlich die Wirtschaftsgeschichte der Eisenwurzen der Stoff für die gemeinsame Entwicklung ist. Bereits im Gründungs-statut des Vereins steht geschrieben, dass als Ziel die Errichtung einer wissenschaftlichen Dokumentation anzustreben sei.

2.2 Dokumentation Eisenstraße - die Idee

Jede Form der Entwicklung braucht vorweg Grundlagen, auf die man aufbauen kann. Das Modell der endogenen Regionalenwicklung, also mit den Menschen der Region und den von ihnen identifizierten Stärken der Region, war dafür der strategische Begleiter.

So hat das Projekt Dokumentation Eisenstraße seine Wurzeln in den Anfängen des Vereins. Und diese Zeit im Vorfeld ist auch maßgebend für den Erfolg. Warum? Weil das Projekt aus der Bevölkerung selbst entstanden ist. Aktivisten der Region, v.a. ehrenamtlich Tätige waren an der Realisierung dieses grundlegenden Zielgedankens des Vereins interessiert.

1999/2000 wurde Grundlagenforschung für das Projekt durchgeführt und die Konzepterstellung erfolgte 2000/01 unter Leader II. Seit September 2002 wird das Konzept umgesetzt, unter Förderung der Kulturabteilung des Landes NÖ und durch das EU-Förderprogramm Leader Plus.

Wie sieht das Projekt konkret aus? Was ist gemeint mit: „eine Region geht auf Schatzsuche“? Welche Schätze werden gesucht? Nun, es geht um Wissensschätze. Das wertvollste Kapital einer Region. Sprach man in den Anfangsjahren noch von der Errichtung eines wissenschaftlichen Dokumentationszentrums so wurde bald deutlich, dass diese Dokumentation Eisenstraße eine virtuelle Dokumentation werden wird.

Eine virtuelle Vernetzung von Wissensträger: Institutionen und Menschen der Region. Das Wissen der Region zu dokumentieren, zu aktivieren, zu erweitern und zu vernetzen ist das Ziel. So sind am Projekt Museen, Bibliotheken, Archive und ca. 600 Experten aus unterschiedlichen Disziplinen von Geschichte über Volkskultur bis zur Naturkunde beteiligt. Durch die virtuelle Vernetzung bleiben alle gegenständlichen Objekte an ihrem Ort, mit dem Vorteil der inhaltlichen Verknüpfung und der weltweiten, unkomplizierten Zugänglichkeit.

2.3 Die Elemente des Projekts

Herzstück ist sicher die regionale Wissensdatenbank. In ihr vereint sind die Daten aus den unterschiedlichen Bereichen. Interdisziplinäre Suchabfragen der Wissensinhalte bzw. der Personen sind ebenso möglich, wie Detailrecherchen in einem speziellen Sachgebiet, wie z.B. in Literaturbeständen, in Archivalien, in Museumsobjekten usw. Die regionale Wissensdatenbank ist eingebettet in ein regionales Internetportal - www.eisenstrasse.info. Diese Portal umfasst neben der oben beschriebenen „Schatzsuche“, auch den touristischen, den wirtschaftlichen und den regionalplanerischen Sektor.

Eine der zentralen Fragen bei einem regionalen Portal, insbesondere mit dem Anspruch der Aufnahme von Wissensdaten ist: Wie kommt Wissen in die interdisziplinäre regionale Wissensdatenbank?

Zum einen durch die Verwendung von Daten wie sie in den Institutionen (Museen, Archive, Bibliotheken) durch Inventarisierung der Bestände vorhanden sind. Dazu hat es bereits vor 4 Jahren die Initiative gegeben, Museen bei der Inventarisierung ihrer Bestände zu unterstützen. Hier zeigt sich wiederum der positive Effekt der langen Vorlaufzeit.

Ca. 600 Experten sind, die Basis der Grundlagenforschung nutzend, in der Expertendatenbank erfasst. Über Internet gibt es für die Experten die Möglichkeit zum Selbsteintrag und auch zur Aktualisierung ihrer Daten.

Zudem können Nutzer des Internetportals en passant ihr Wissen unter „Ich weiß was“, der entsprechenden Kategorie von Geschichte über Zeitgeschehen bis zur Naturkunde zugeordnet, kundtun. Diese Inhalte, werden wiederum in die regionale Wissensdatenbank eingegliedert.

Andererseits wurde v.a. für private „Schatzsucher“, für die vielen Menschen die sich jahrelang mit unterschiedlichen Themen und Wissensgebiete beschäftigen und dadurch großes Wissen angesammelt haben, ein entsprechendes Werkzeug geschaffen, um dieses Wissen dokumentieren zu können. Es ist dies die sog. Experten-Schatzsucherdatenbank, die individuell an die Erfordernisse des jeweiligen Erfassungsthemas angepasst werden kann.

Spannend ist es, dass die Dokumentation Eisenstraße Menschen unabhängig von ihrem Lebensalter erreicht. Und sie werden durch das Internet auch unabhängig von ihrem Lebensraum erreicht. Als ein Beispiel möge folgendes Zitat dienen: *„Ich bekomme immer mehr Freude an der Bearbeitung der Krippendokumentation mit der Schatzsucherdatenbank.“* F.Almer 80 Jahre

Zusätzlich wurde ein Forschungsfonds eingerichtet, der die wissenschaftliche Bearbeitung von interessanten Fragenstellungen für die Region, auch finanziell unterstützt.

Doch ist es besonders für Netzwerke wichtig, neben der „virtuellen“ Welt eine „reale“ Entsprechung vorzufinden, wo Platz für die persönliche Begegnung ist. Dazu gibt es die „DokuZ –s“ die Servicestellen der Region. Es sind dies schon bestehende Einrichtungen, im speziellen Fall Bibliotheken, die mit der Funktion eines DokuZs erweitert wurden.

Das bedeutet, z.Z. bieten das DokuZ in Waidhofen/Ybbs und das DokuZ Lunz/See Platz für persönliche Begegnung, Service und individuelle Beratung. PC-Stationen mit Internetzugang stehen zur Verfügung, Dienstleistungen (Vorträge, Exkursionen) werden angeboten und interessante Veranstaltungen bieten persönlichen Begegnungsraum.

Ziel der Dokumentation Eisenstraße, der Schatzsuche ist es, ein kompetentes Netzwerk zu sein, das von sich aus aktiv ist und sich aus eigener Kraft weiterentwickelt. Ein aktives regionales Netzwerk. Auch mit dem Ziel des gegenseitigen Lernens, dem Know How

Transfer, sei es zwischen den einzelnen Institutionen oder zwischen den Personen, die ein bestimmtes Interesse, Hobby oder Wissen miteinander verbindet.

Dieses vernetzte von einander lernen wird gestützt durch neue Technologien. Denn das Internetportal, welches Informations- und Wissenspool ist, ist ebenso Arbeits- und Kommunikationsplattform. Für Gruppierungen, Institutionen, Vereine ist es möglich, in einem internen Bereich (Club) miteinander zu kommunizieren, sich auszutauschen und sich zu verwalten.

2.4 Technische Realisierung

Bei der Umsetzung kamen v.a. folgende Produkte / Technologien zum Einsatz:

- Content Management System (CMS): im vorliegenden Fall wurde „CitySite" der Fa. Sitepark verwendet, ein sehr leistungsfähiges System, allerdings aus der Sicht des Auftragnehmers mit dem Problem, dass es keine „offene Community" gibt, wo Erfahrungen bei ähnlichen Aufgabenstellungen ausgetauscht Teilbereiche auch extern vergeben werden können. Die Wahl des Produktes war zum Zeitpunkt der Entscheidungsfindung sicher richtig, bevor jedoch ein neues Projekt begonnen wird, sollte das in rasantem Wandel befindliche Angebot an Systemen auf jeden Fall genau analysiert werden. Open Source Systeme werden nicht nur Aufgrund der immer besseren Leistungsfähigkeit eine immer interessantere Alternative, sonder v.a. auch aufgrund der Möglichkeit des offenen Informations- und Applikations-Austausches.
- PHP und MySQL-Datenbanken, die für die umfangreichen Datenbestände der „Schatzsucher-Datenbank" die beste Lösung darstellten. Die Aufbereitung der Daten, die aus unterschiedlichen Bibliotheks- und Archiv-Systemen kamen, erfolgte großteils mit MS Access. Für diesen Punkt ist anzumerken, dass zum Zeitpunkt der Projekt-Umsetzung die in der Region im Einsatz stehenden Lösungen nur bedingt Standard-Schnittstellen anboten, hier ist durch inzwischen realisierte oder zumindest angekündigte XML-Import/Export-Funktionen künftig mit deutlichen Erleichterungen zu rechnen. Generell sollte sich ein Update der im Einsatz stehenden Programmpakete auf aktuelle Versionen mit entsprechender Datenaustausch-Funktionalität sehr rasch bezahlt machen.
- Map-Server zur kartographischen Darstellung der „Points of Interest" (POI) sowie von Übersichtskarten – hier kam degree zum Einsatz. Der Bereich der Informationserschließung über ihren räumlichen Bezug ist jedenfalls noch ausbaufähig und sollte bei neu konzipierten Projekten von vornherein stärker berücksichtigt werden.

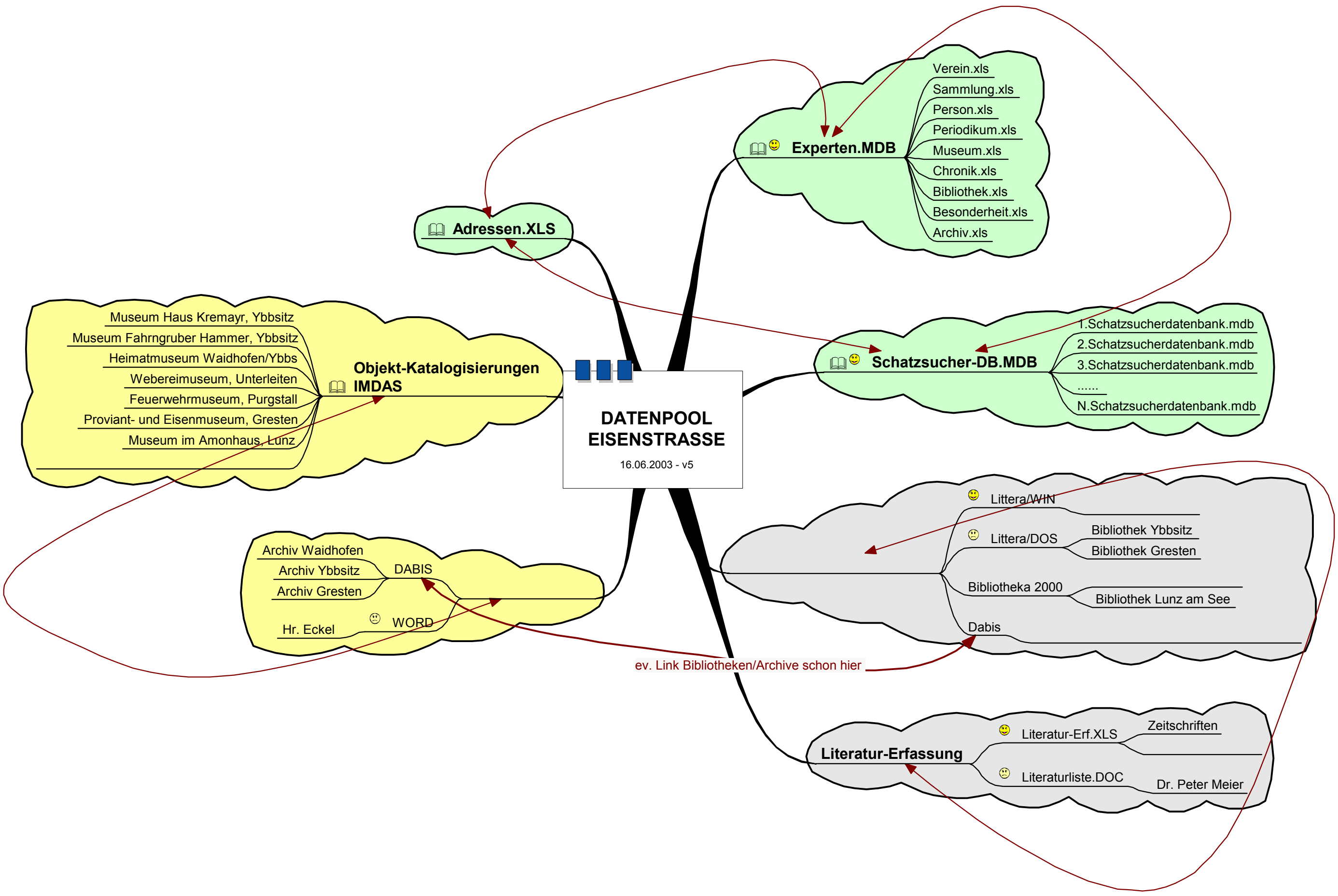
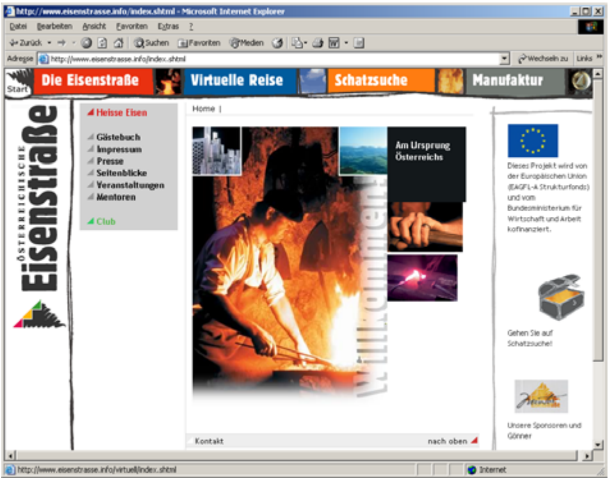


Abb. 1: Ausgangs-Daten für die "Schatzsucher-Datenbank"

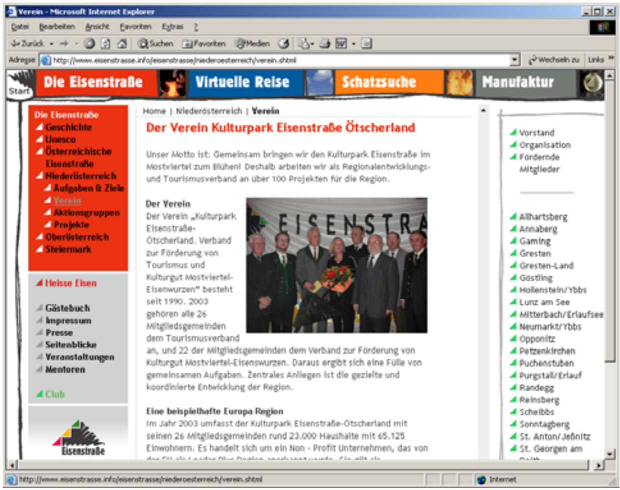
3 AUFBAU VON PORTAL UND WISSENSDATENBANK

Beim Aufbau des Portals ging es darum, möglichst einfach und für die Benutzer leicht durchschaubar ein sehr breites Informationsangebot zu erschließen, das noch dazu weiterhin ständig anwachsen wird. Von der Einstiegsseite unter www.eisenstrasse.info erfolgt der Einstieg über 5 Hauptpunkte und einige Direkt-Links:

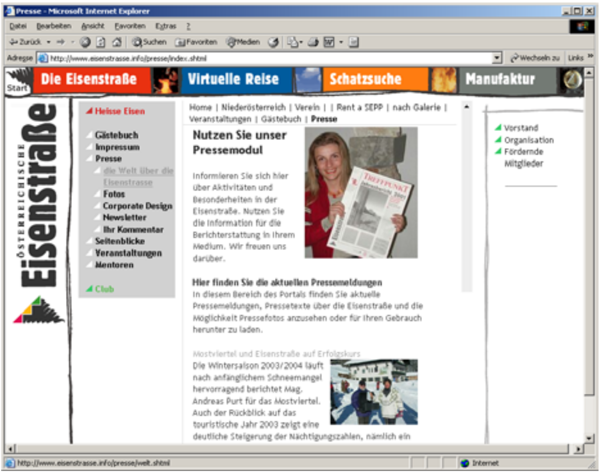
- „Die Eisenstraße" mit Infos zu Geschichte, Verein, Mitgliedern etc.
- „Virtuelle Reise", die sowohl den Einwohner der Region als auch Touristen das Erkunden der Eisenstraße erlaubt
- „Schatzsuche", die die „Schätze der Region" erschließt und wo auch neue Beiträge hinzugefügt werden können
- „Manufaktur" mit dem Web-Shop für Produkte aus der Eisenstraße
- „Club", dem internen Bereich für Arbeits- und Interessensgemeinschaften



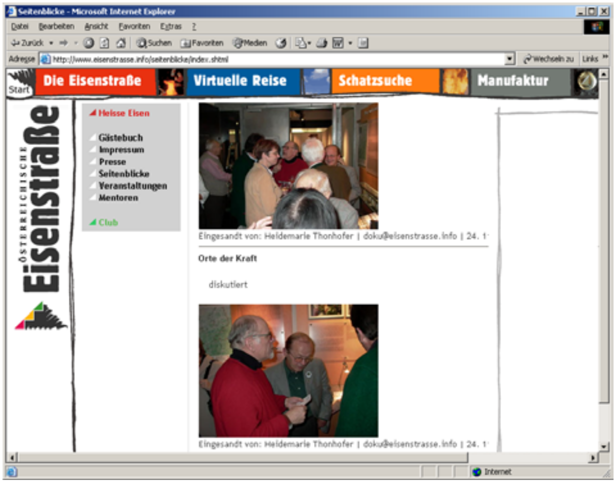
Der Einstieg in www.eisenstrasse.info



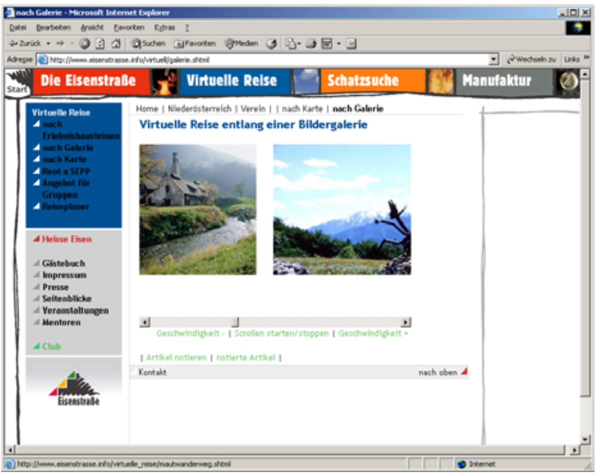
Wichtig ist, dass sich die Akteure mit ihren Aktivitäten wiederfinden



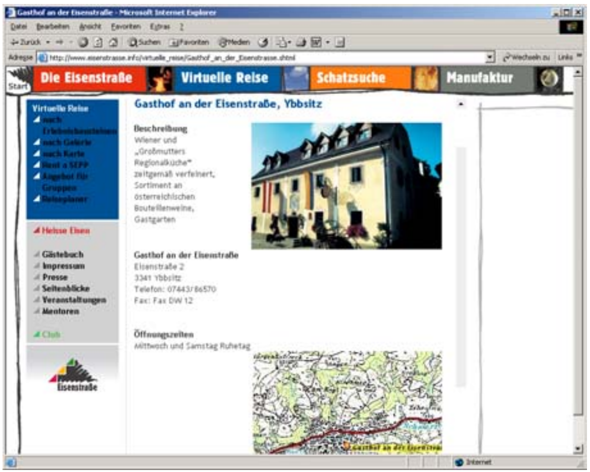
Das Pressemodul unterstützt bei der Öffentlichkeitsarbeit



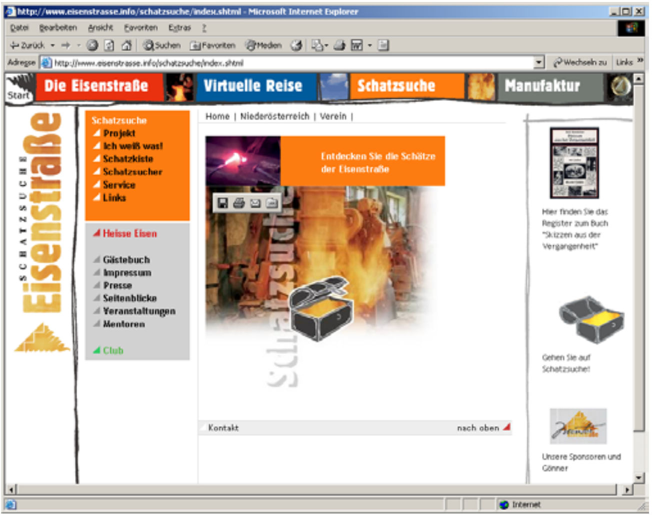
Aktivitäten und Events werden in den „Seitenblicken" dokumentiert



„Virtuelle Reise" – sowohl für Bewohner wie auch Touristen

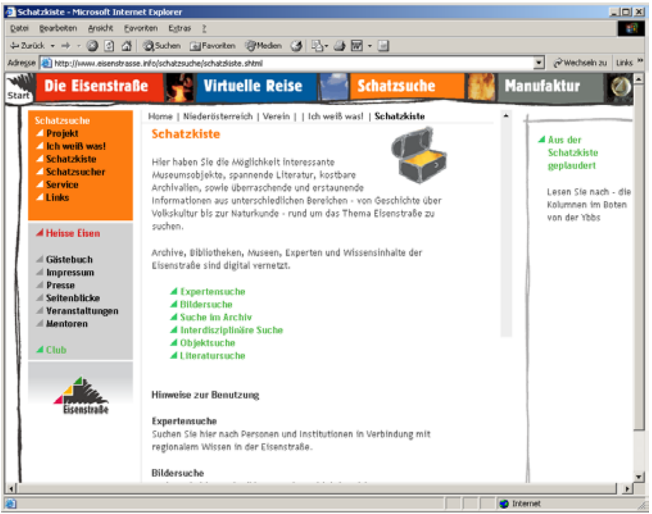


Präsentation der „Points of Interest" mit Text, Bild und Karten

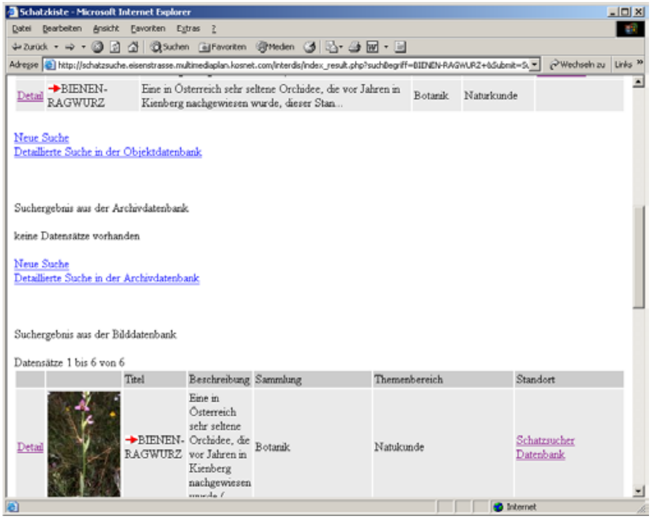


Die Schatzsuche erschließt die Schätze der Region

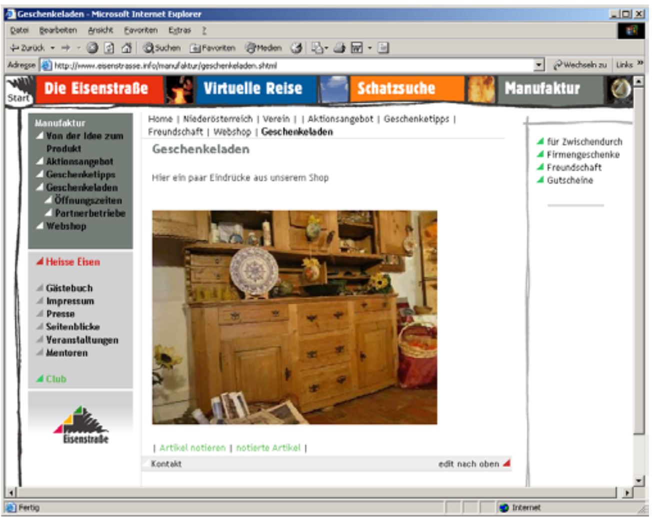
Alle Besucher haben die Gelegenheit, die Schatzkiste weiter zu befüllen



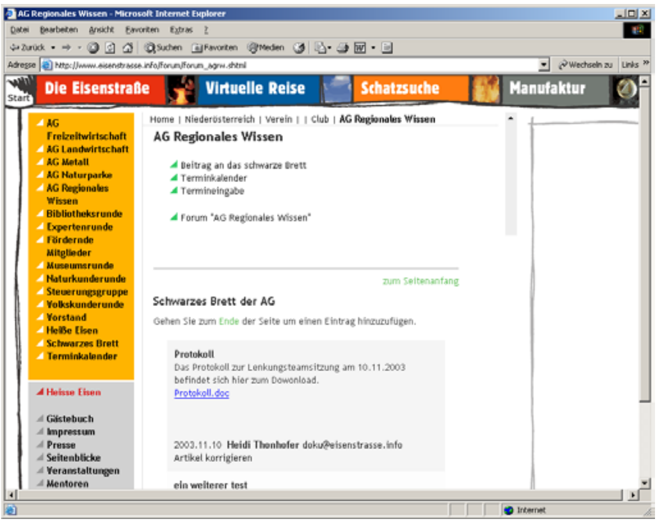
Es gibt unterschiedliche Möglichkeiten, die Schatzkiste zu durchsuchen



Detail-Suchergebnis



Selbstverständlich gibt es auch einen Shop



Der Club bietet Arbeitsgruppen und Interessensgemeinschaften eine Heimat

4 DAS UMKEHREN DES "BRAIN DRAIN" - ZURÜCKBRINGEN VON WISSEN IN DIE REGION

Ein besonderes Thema sei noch herausgegriffen:

Die Eisenstraße ist wie viele andere Regionen mit dem Problem der Abwanderung konfrontiert. Es sind nicht die älteren und weniger qualifizierten Menschen, die wegziehen, sondern die jungen, aktiven, gut ausgebildeten.

Sie ziehen nicht weg, weil sie Ihre Heimat nicht mögen oder sich dort nicht zuhause fühlen - aber sie sehen bessere Möglichkeiten, in den Zentren mit ihren Bildungs- und Kultureinrichtungen und in den "hot spots" der gesellschaftlichen und wirtschaftlichen Aktivität voranzukommen, ihr persönliches Glück zu finden. Die Region leidet damit am "Brain drain", dem Verlust des innovativen Potentials - wenn man so will, dem Abfließen des "Hirnschmalzes".

Läßt sich der *"Brain drain"* stoppen oder gar umkehren? Können die Energie, das Wissen und die Ideen der innovativsten Personen zurück in ihre Heimatregion geholt werden?

Junge Menschen werden nicht in Ihren Geburtsorten bleiben, nur weil sie dort Zugang zum Internet haben. Aber IKT erlauben es den Menschen, den Kontakt zu "den Daheimgebliebenen" aufrechtzuerhalten, ihre Lokalzeitung zu lesen und mit Freunden und Schulkameraden in Verbindung zu bleiben.

Die "Abgewanderten" können zu "Botschaftern" ihrer Region in der großen weiten Welt werden. Sie können von Ideen und Lösungsansätzen berichten, die sie anderswo sehen, und können die eigene Region in der Welt vertreten.

Durch das Verbundenbleiben mit ihren Wurzeln haben diese Menschen die Möglichkeit, das zu bleiben, was sie sind: erfolgreiche Weltbürger und die wertvollsten Ressourcen ihrer Heimatregion.

5 SCHLUSSFOLGERUNGEN

Innovative und zukunftsorientierte Regionalentwicklung stützt sich auf das Bewusstsein um regionale kulturelle Identität. IKT sind wichtige Werkzeuge bei der Wahrung und "Rückeroberung" dieses Wissens.

Bei diesem Ansatz geht es im "Wettbewerb der Regionen" nicht unbedingt darum, dass die Vorteile einer Region zu Nachteilen einer anderen führen - *Win-Win-Situationen* sind möglich, wenn sich Regionen ihrer Stärken bewusst sind und die Unterschiedlichkeiten gezielt nutzen.

Dadurch entsteht nicht Monotonie - es gibt überall exakt das gleiche - sondern Vielfalt: die Aufgabenstellungen sind ähnlich, werden aber den regionalen Erfahrungen und Traditionen gemäß unterschiedlich gelöst. Die Unterstützung beim Aufspüren der Stärken und Schwächen und die Entwicklung von Strategien zur optimalen Umsetzung ist eine ureigenste planerische Aufgabe.

Durch ihre strukturierte und aktivierende Arbeit ist die Dokumentation Eisenstraße auf einem guten Weg. Die Eisenstraße hat, wie fast jede Region, gute und schlechte Zeiten in ihrer langen Geschichte gesehen. Jetzt tritt sie in das Zeitalter der "gLOCALisierung" ein - als ein "lokaler globaler Spieler", der die Fähigkeiten seiner wundervollen Menschen im "kooperativen Wettbewerb" mit anderen Regionen der Welt ausnutzt. Eine wundervolle Zukunft hat gerade begonnen.

Unbedingt zu erwähnen ist, daß der Erfolg eines regionalen Informations- und Wissensportals ganz entscheidend davon abhängt, wie sehr es gelingt, die Menschen, die angesprochen werden sollen, einzubeziehen, für die aktive Mitarbeit zu gewinnen. Um dies zu erreichen, reicht die technische Realisierung einer entsprechenden Plattform bei weitem nicht aus. In der Region Kulturpark Eisenstraße – Ötscherland reichen die entsprechenden Vorarbeiten zum Aufbau eines solchen regionalen Portals mittlerweile mehr als 10 Jahre zurück – in eine Zeit, als die heute verwendeten Begriffe noch nicht existierten, sehr wohl aber die Ideen und der Weitblick, dass ein derartiges Instrument einmal zur Verfügung stehen wird. „Reale“ und „virtuelle“ Eisenstraße sollen einander optimal ergänzen.

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Webbasierte Vernetzung: Instrument einer integrierten Regionalentwicklung

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1 EINLEITUNG

Das Internet wird allgemein als ein Schrittmacher der ökonomischen und kulturellen Globalisierung angesehen. Die Vernetzungsinfrastruktur, die grundsätzlich alles mit allem verbindet, macht die Region partiell obsolet. Dabei wird allerdings übersehen, dass trotz der Möglichkeiten der weltweiten Vernetzung der geographische Raum – verstanden als räumliche Nähe zwischen den Transaktionspartnern und als Standort – zunehmend an Relevanz gewinnt. So sind viele Marktplätze, Kompetenzportale, internetgestützte Wertschöpfungsketten, Kooperationsbörsen, Collabrative Commerce Portale und Logistiksysteme im Kern lokal bzw. regional ausgerichtet. Wir gehen davon aus, dass sich ein ähnlicher Prozess, wie er im Rahmen der Globalisierung und Regionalisierung zu beobachten ist, auch im Internet vollzieht: von der Entortung zur Verortung im World Wide Web (WWW).

Diese Entwicklung bietet aus unserer Sicht Potenziale zur regionalen Kompetenz- und Profilbildung, zur Steigerung der internationalen Wettbewerbsfähigkeit eines Standortes sowie insgesamt zur integrierten Regionalentwicklung, indem der Standort im Sinne eines *Regional Wide Web* (RWW) entwickelt wird. Die Praxis zeigt allerdings, dass es einerseits trotz der Vielzahl von Einzelprojekten bundesweit nur wenige Beispiele gibt, die eine integrale Vernetzung der Geschäftsprozesse bewerkstelligen und dass andererseits kaum übergeordnete Strategien existieren, diese Netzwerke zur Profilierung des Standortes zu nutzen.

Grundlage unsere Idee vom Regional Wide Web bildet die integrierte Regionalentwicklung, d.h. die Entwicklung der Region entlang der vor Ort vorhandenen Kompetenzen, bei einem gleichzeitigen Verzicht auf überzogenen Regionalismus.

Der vorliegende Artikel diskutiert die ökonomische Bedeutung des geographischen Raums in der Regionalökonomie und die Funktionsmechanismen des WWW, das unter technischen Gesichtspunkten Regionen und räumliche Nähe unbedeutend werden lässt. Im weiteren Verlauf werden an Hand von Projekten – die wir derzeit im Forschungsschwerpunkt Innovative Räume am Institut Arbeit und Technik durchführen – die positiven Effekte, die eine webbasierte Vernetzungsstrategie und deren Einbindung in eine übergeordnete regionale Internetstrategie bedingen, aufgezeigt. Der Beitrag endet mit der Diskussion, ob sich angesichts der Vorteile und der veränderten Bedeutung von Infrastrukturen eine regionale webbasierte Vernetzungsstrategie als neue Form der Daseinsvorsorge (Public Service) darstellt und welche Umsetzungsbarrieren existieren.

2 ENTRÄUMLICHUNG VERSUS VERRÄUMLICHUNG

Haushalte, Unternehmen und Institutionen haben einen Standort und der ist immer an einem konkreten Ort. Unter Enträumlichung wird daher weniger die Auflösung des Ortes als Standort, als vielmehr der Bedeutungsverlust der räumlichen Nähe zu den Interaktionspartnern verstanden (Proximität), will sagen: es geht um die Abnahme der lokalen Einbindung und Einbettung von wirtschaftlichen Subjekten.

Dieses Kapitel geht auf die veränderte Bedeutung des Raumes in den Raumwirtschaftstheorien und -politiken ein, wobei ein besonderer Fokus gesetzt wird in Bezug auf die Fragen, welche Rolle der Raum – ortsgebunden und als soziale Dimension – im Internet spielt und welchen Einfluss das Internet auf Regionen und Orte hat.

2.1 Regionen und Orte in der Ökonomik

Die stärkere Berücksichtigung des Raumes in den regionalökonomischen Entwicklungskonzepten und die damit einhergehende gestiegene Komplexität – wie sie in den letzten Jahren zu beobachten ist – lässt sich an Hand der Diskurslinien um Globalisierung und Regionalisierung, der regionalökonomischen Theoriebildung und den angewandten Konzepten und Politiken aufzeigen. Die Debatte um Globalisierung und Regionalisierung lässt in Verbindung mit einschlägigen statistischen Daten auf einen Trend der zunehmenden Internationalisierung ökonomischer Transaktionen schließen. Die Entwicklung verläuft allerdings sowohl in geographischer als auch zeitlicher Hinsicht sehr unterschiedlich und sollte insofern in Teilen relativiert werden.

In der Produktionsorientierung gewinnen gleichzeitig das regionale Milieu und die räumliche Nähe zu Zulieferern an Relevanz. Räumliche Nähe als Qualität spielt auch oder gerade in einer weltweit vernetzen Welt eine zunehmend wichtige Rolle. In Bezug auf die Ökonomik, insbesondere der viel kritisierten neoklassischen Theoriebildung, wird seit langem eine Raumblindheit konstatiert, die seit der Mitte des vorigen Jahrhunderts mit der Forderung nach einer stärkeren Berücksichtigung des Raums bzw. der Region einhergeht.

Die *Theorie der regionalen Wachstumspole* von Mydral kann als eine der ersten Theorien bezeichnet werden, bei der der Raum vom Distanzmaß zum Wirkungsfeld lanciert (Mydral, 1957). Allerdings kann die Polarisationstheorie (Zentrum-Peripherie-Muster) die regionale Entwicklung ebenso wenig hinreichend erklären, wie die klassischen Theorien. Viele Regionen haben sich durch endogene Faktoren entwickelt.

Seit Ende der 1980er Jahre wurden in der Regionalökonomie daher verstärkt Entwicklungskonzepte diskutiert, die den Raum und insbesondere die Region stärker als Handlungsebene betrachten. Mittlerweile existieren vielfältige Ansätze, die in ihrer Gesamtheit aber weniger ein geschlossenes Modell als vielmehr eine Ansammlung verschiedener Erklärungsversuche darstellen. Als Stichworte können hier Konzepte wie *industrielle Distrikte* (Piore/Sabel, 1984), die auf einem Produktionsmodell der flexiblen Spezialisierungen in regional integrierten Unternehmensnetzwerken basieren, *innovative Milieus*, ein von der Groupe de Recherche Europèan sur les Milieux Innovateurs (Gremi) entwickelter Ansatz (vgl. z.B. Camagni, 1991), der ökonomische, technologische, institutionelle und kognitive Aspekte beinhaltet oder das *Konzept (Produktions-)Cluster* (vgl. Porter, 1993, 1998; Rehfeld, 1999), dass versucht regionale und sektorale Dimension von Innovationen zu integrieren, genannt werden. Trotz der Divergenzen zwischen den einzelnen Konzepten ist diesen gemein, dass der Raum als Handlungsebene eine zentrale Rolle einnimmt.

Neben den auf internationale Wettbewerbsfähigkeit der Regionen ausgerichteten Ansätzen entstanden in den 1970er Jahren aus einer kritischen Haltung gegenüber den am Wachstum orientierten Entwicklungsansätzen, Konzepte die sich unter dem Begriff *„Eigenständige Regionalökonomie“* subsumieren lassen. Als ein alternativer Ansatz für die Entwicklungsländer konzipiert, wurde das Konzept der Eigenständigen Regionalökonomie seit den 80er Jahren ergänzend auch auf die Industrienationen übertragen und insbesondere als Entwicklungsstrategie für periphere Regionen diskutiert. Eine dezentralere und basisgesteuerte Entwicklung wurde gefordert, um die negativen Folgen der am globalen Wachstum orientierten Wirtschaft abzuschwächen.

Gemeinsame Basis all dieser Ansätze ist die besondere Berücksichtigung des Raumes, der - wie Läpple es ausdrückt - vom „passiven Resonanzkörper zum aktiven sozioökonomischen Wirkungsfeld mit vielfältigen endogenen Potentialen“ (Läpple, 1998: 13) wird.

2.2 Angewandte Konzepte und Politiken

Diese neuen Ansätze haben in die verschiedenen Ebenen der bundesdeutschen Raumwirtschaftspolitik und der Strukturpolitik der EU Einzug gefunden. Im Laufe der 1990er Jahre hat der Prozess der regionalisierten Raumwirtschaftspolitik eine besondere Eigendynamik bekommen: Regionen, die keinen regionalen Kooperationsbedarf beim Wettbewerb um Fördermittel proklamieren konnten, gerieten bei deren Zuweisung ins Hintertreffen (Rehfeld, 1999: 30).

Nicht nur auf Bundes- und Länderebene ist ein Prozess der Regionalisierung zu beobachten, die Wirtschaftspolitik der Kommunen und Kreise, die i.d.R. als kommunale Wirtschaftsförderung bezeichnet wird, hat sich parallel zum Wandel der wirtschaftlichen Rahmenbedingungen und der Raumwirtschaftstheorien grundlegend verändert und dabei erheblich an Komplexität gewonnen. Nach einer Untersuchung des deutschen Instituts für Urbanistik, das 1995 170 Städte zum Thema Wirtschaftsförderung befragte, ist für mehr als 95 % der Befragten die Pflege des örtlichen Unternehmensbestands die wichtigste Aufgabe (Hollbach-Grömig, 1996: 8). Im Kern geht es bei einer zeitgemäßen Wirtschaftsförderung darum, an die in der Kommune/ Region vorhanden Kompetenzen anzuknüpfen, den Standort danach zu profilieren und intraregionale Netzwerke zu entwickeln bzw. auf vorhandene Netzwerke zurück zugreifen. In der Praxis zeigt sich allerdings, dass auf Grund fehlender personeller Ressourcen und der Affinität zu den wirtschaftlichen Akteuren, die sich hieraus ergebenden konzeptionellen und organisatorischen Konsequenzen nur unzureichend in integrierte Strategien umgesetzt werden. Gleichwohl wird die Wirtschaftsförderung mehr und mehr zu einem endogenen Ansatz verpflichtet, will sie auf die Förderprogramme der übergeordneten Ebenen zurückgreifen, in der internationalen Konkurrenz der Regionen bestehen und die Region nachhaltig entwickeln.

Insgesamt zeigt sich folglich ein zweigeteilter – jedoch nicht zwingend zweipoliger – Prozess, global und regional verhalten sich durchaus komplementär zueinander und laufen zeitlich und räumlich geschichtet ab: Einerseits hat die Globalisierung – hier verstanden als Auflösung der räumlichen Nähe zwischen Transaktionspartner – in den vergangen Jahren zugenommen und es kann davon ausgegangen werden, dass sich dieser Prozess durch den zunehmenden Einsatz informationstechnologischer Instrumente beschleunigen wird, andererseits gewinnt der Raum in der Wirtschafts-, Standorttheorie und Politik an Boden.

Das Ent- und Verräumlichung sich nicht ausschließen, zeigt sich im Rahmen der Internetökonomie: In der Vergangenheit beschrieben als Ökonomieraum in dem Transaktionen ohne Berücksichtigung der Geographie stattfinden, erhält der ortsgebundene Raum zumindest in Fragmenten Einzug, was im folgenden Kapitel thematisiert wird.

2.3 Virtualität und Raum: Auswirkungen des Internets auf den Raum

Die starke Verbreitung moderner Informations- und Kommunikationstechnologien (IKT) wird als eine der treibenden Kräfte des strukturellen Wandels der 90er Jahre angesehen (vgl. u.a. Castells, 1996). Diese Querschnittstechnologien eigenen sich in besonderer Weise zur Überwindung räumlicher Distanzen, so kann seit dem Ausbau der Kommunikationsnetze und insbesondere des Internets, potenziell von jedem Ort der Erde zum anderen kommuniziert werden. Daraus wird vielfach die Schlussfolgerung gezogen, dass räumliche Distanzen ihren beschränkenden Einfluss auf Interaktionen verlieren. Craincross proklamierte in diesem Zusammenhang „the death of distance“ bzw. das „das Ende der Distanz“ (vgl. Craincross, 1997) und Pawley rechnete mit einer Desurbanisierung (vgl. Pawley, 1997). Auch in der Internetforschung war das Argument der „Raumlosigkeit“ lange Zeit verbreitet. So argumentierte z.B. Castells, dass durch den technologischen Fortschritt der traditionelle „space of place“ durch einen „space of flows“ abgelöst werde (vgl. Castells, 1989, 1996): Prozesse wie Produktion oder Konsum könnten immer weniger an konkreten Orten identifiziert werden, sondern seien in die Kommunikationsflüsse innerhalb wachsender Informationsnetzwerke eingebettet. In diesem „space of flows“ entstünde also eine eigene, vom Ort losgelöste Form der sozialräumlichen Organisation.

Einhergehend mit der Verbreitung der IKT und der Entdeckung des Cyberspace ist der Begriff „Virtualität“ zu einem inflationär verwendeten Modewort aufgestiegen. In der Raumsoziologie manifestiert sich dies u.a. in der unterschiedlichen Verwendung von Stadtmethapern wie „Telepolis“, „Digital Cities“ oder „Global Cities“ zur Beschreibung virtueller Räume. Die vielfältige Verwendung des Begriffs Virtualität in einer auf Computertechnologie ausgerichteten Medien- und Informationsgesellschaft führt jedoch dazu, dass der Begriff konzeptionell immer einseitiger an den Computer als Medium einer technischen Wirklichkeitskonstruktion rückgebunden und dadurch – vor allem im alltäglichen Sprachgebrauch – ein Gegensatz zwischen Virtualität und Realität aufgebaut wird. *Virtuell* steht für „nicht wirklich“, „scheinbar“ bzw. „der Möglichkeit nach vorhanden“. Virtuell kann die Eigenschaft einer Sache bezeichnen, die zwar nicht real, aber doch der Möglichkeit nach existiert (vgl. Scholz, 1994). *Virtualität* spezifiziert also ein konkretes Objekt über Eigenschaften, die nicht physisch, aber doch der Möglichkeit nach vorhanden sind. Folgt man diesem Verständnis so ist der *virtuelle Raum* ein Möglichkeitsraum, dessen Ausgestaltung von den in ihm agierenden Akteuren determiniert wird. Mit der Nutzung des virtuellen Raums durch Akteure entsteht ein *sozialer Raum,* der sich über die Interaktionsbeziehungen der Akteure definiert und insofern als *relationaler Raum* bezeichnet werden kann. Dieser relationale Raum ist nicht an einen konkreten Ort gebunden. Im Unterschied zum herkömmlichen relationalen Raum erfolgt die Kommunikation in diesem Kontext elektronisch vermittelt. Es handelt sich also um einen elektronisch relationalen Raum, kurz *elationalen Raum* (elektronischer re**lationaler** Raum). Dieses Kunstwort wurde im Forschungsschwerpunkt „Innovative Räume" eingeführt, um die Diskussion um Virtualität und neue Raumkonzepte exakter und sachlicher führen zu können, denn nur weil eine soziale Beziehung digital vermittelt ist, ist sie nicht zwangsläufig virtuell. Damit gilt allgemein, dass für elationale Räume der Ortsbezug zunächst keine Rolle spielt.

Aus ökonomischer Perspektive zeigt sich infolge der starken Diffusion von IKT eine zunehmende elektronische Vernetzung von Unternehmen, die einhergeht mit der Transformation alter, physikalisch geprägter Wirtschaftsstrukturen zu neuen virtuell geprägten Formen des Wirtschaftens. Insbesondere für multinationale Großkonzerne ist das Internet zu einem unverzichtbaren Bestandteil der Unternehmensstrategie geworden, aber auch mittlere und kleine Unternehmen erkennen zunehmend die Relevanz der Internetnutzung als Wettbewerbsfaktor. Die elektronische Vernetzung von Unternehmen hat vielfach zu einer Reduzierung der Transaktions- und Kooperationskosten geführt. Zugleich wird das Internet aber auch als Schlüsseltechnologie für die Beschleunigung von Innovations- und Produktionszyklen angesehen, insbesondere infolge der schnelleren Diffusion von kodifiziertem Wissen und von Ideen. Diese Entwicklungen haben die Art und Weise, wie Unternehmen in einer globalen Wirtschaft, die gekennzeichnet ist durch Vernetzung, Kooperation sowie intra- und interorganisationalen Wissensaustausch, grenzüberschreitend agieren.

2.4 Neue Raumkategorien im Internet

Zwar eignen sich IKT in besonderer Weise zur Überwindung räumlicher Distanzen, es muss allerdings die Frage gestellt werden, ob infolgedessen neue Netzwerke nach einer modifizierter Logik geschaffen werden oder ob es sich nicht vielmehr um Konstitutionen handelt, die sich entlang von Branchen, Sektoren, Regionen entwickeln und deren Abwicklung lediglich durch den Einsatz von IKT unterstützt wird.

Wie in der nachfolgenden Tabelle dargestellt, können Netzwerke unterschiedlicher Raumkategorien unterschieden werden. Viele bekannte Netzwerke benötigen wie vermutet keinen Ortsbezug. Es zeigt sich, dass gerade sektorale / spezialisierte Netzwerke meist einen hohen Spezialisierungsgrad aufweisen und nicht regional gebunden sind. Beispielhaft lässt sich hier das Deutsche Forschungsnetz (DFN) nennen. Der DFN-Verein verbindet vorrangig Hochschulen und Forschungseinrichtungen, aber auch Vertreter aus Industrie und der öffentlichen Verwaltung miteinander, mit dem Ziel die Entwicklung und Erprobung innovativer Dienste und zukunftsweisender Netzwerkanwendungen/-technologien zu unterstützen.

	Netzwerk			
	ortslos	sektoral/spezialisiert	regional	integral
Beschreibung	Netzwerke konstituieren sich durch gemeinsame Interessen unabhängig vom geographischen Ort.	Netzwerke konstituieren sich aufgrund der sektoralen Zugehörigkeit der Akteure mit vielfach hoher Spezialisierung; räumliche Nähe ist nicht unbedingt erforderlich	Räumliche Nähe ist der zentrale Faktor für die Vernetzung wobei sich die Netzwerksstruktur vielfach durch eine sektorale Aus-richtung gekennzeichnet ist.	Portale, die verschiedne sektorale Netzwerke mit regionaler Ausrichtung verbinden.
Beispiele	Amazon eBay	DFN DLI	impuls-50plus.de mybird.de	
Vermittlung	nahezu 100% digital	vorwiegend digital	hybrid	hybrid

Tab. 1: Raumkategorien und Netzwerke

Jedoch gewinnen solche Netzwerke, die in einen regionalen Kontext eingebunden sind, zunehmend an Bedeutung. Für regionale Netzwerke im Sinne der Regionalentwicklung bzw. Wirtschaftsförderung stellt die räumliche Nähe der entscheidende Faktor für die Vernetzung dar. Aber auch diese Netzwerke sind vielfach durch eine sektorale Ausrichtung gekennzeichnet, wobei sich die Akteure oftmals aus der gesamten Wertschöpfungskette zusammensetzen und Zulieferer, Produzenten sowie spezialisierte Dienstleister umfassen. Diese Form von Netzwerken befindet sich derzeit vielerorts im Aufbau.

Die stetig zunehmende Netzwerkbildung in Verbindung mit einer sich weltweit liberalisierenden Ökonomie lässt verstärkt erkennen, dass das Agieren in diesen Kontexten einen stabilen und verlässlichen Rahmen benötigt. Auf der globalen Ebene könnte diese Funktion theoretisch der elationale Raum übernehmen. Der Trend zur Regionalisierung zeigt dagegen die Potenziale räumlicher Nähe und face-to-face Kontakte auf: Die Bildung und Stabilisierung beider Raumebenen – relationaler und elationaler Räume – wird daher für Regionen im internationalen Wettbewerb immer wichtiger. Eine Verknüpfung der elationalen Ebene mit der des geographischen Raumes erscheint daher nur konsequent.

Eine Idealvorstellung der internetgestützten Regionalentwicklung stellt insofern die Kombination aus verschiedenen regionalen Netzwerken dar. Ein solch *integrales Netzwerk* fasst auf regionaler Ebene verschiedene spezialisierte Netzwerke in einem Portal zusammen und bietet damit die Möglichkeit, aus der regionalen, sektoralen und zugleich globalen Vernetzung Synergien zu schöpfen.

Während das für das Agieren im Netzwerk erforderliche Vertrauen in ortslosen Netzwerken durch Faktoren wie Professionalität, Größe oder eine dynamische Community erzeugt werden kann (vgl. z.B. eBay und Amazon), erfolgt dies im regionalen Kontext über direkte Kontakte. Regionale Netzwerke verfügen somit in Bezug auf die Vertrauensbildung über enorme Vorteile, wie viele Beispiele zeigen. Die persönliche Begegnung und ein gemeinsamer kultureller Erfahrungshintergrund schaffen die Voraussetzung für eine vertrauensvolle Zusammenarbeit. Wie diese Vorteile genutzt werden können, um Konzepte der Regionalentwicklung durch Anwendung von IKT zu erweitern, zeigen die Beispiele im nächsten Kapitel.

3 WEBBASIERTE VERNETZUNG ALS INSTRUMENT DER REGIONALENTWICKLUNG

Eine webbasierte Vernetzung kann dann als Instrument einer nachhaltigen Regionalentwicklung besonders erfolgreich sein, wenn es gelingt, integrale Netzwerke zu bilden und die sich hieraus ergebenden Innovations- und Problemlösungspotenziale nutzbar zu machen.

Vor diesem Hintergrund stellt sich die Frage, wie integrale Netzwerke konkret auszugestalten sind, um ihre positive Wirkung zu entfalten. Ein erster Schritt in diese Richtung besteht ohne Frage in der Aktivierung und Koordination der regionalen Akteure. Derartige Maßnahmen erfordern in der Regel direkte Kontakte in Form persönlicher Gespräche. Es zeigt sich allerdings, dass internetbasierte Anwendungen geeignet sind diesen Prozess zu unterstützten. Aus informationstechnischer Perspektive gilt es daher ein Portal zu schaffen, das als singulärer Zugangspunkt zu allen relevanten Informationen – im Sinne eines One-Stop-Shops – dient. Mit Hilfe einer solchen webbasierten Regionalagentur kann es gelingen, die Region nach außen zu profilieren, indem regionale Kompetenzen eindeutig kommuniziert werden. Zugleich kann das Portal als Koordinationsinstrument genutzt und damit zur innovativen Weiterentwicklung der regionalen Kompetenzen durch die beteiligten Akteure instrumentalisiert werden. Wesentliche Voraussetzung für die erfolgreiche Realisierung solcher Portale ist die aktive Beteiligung der regionalen Akteure. Grundsätzlich gilt, dass sich solche Portale erst dann als Instrument der Regionalentwicklung etablieren können, wenn der einzelne Anwender mit der Nutzung des Portals einen Mehrwert verbindet.

Die folgenden Beispiele, bei denen es sich um aktuelle Projekte des Forschungsschwerpunkts „Innovative Räume“ am Institut Arbeit und Technik handelt, zeigen eben diese Anknüpfungspunkte auf.

3.1 Initiative »Impuls 50plus«

Das vom Bundesministerium für Bildung und Forschung geförderte Projekt „Wirtschaftsförderung als wissensbasierte Dienstleistung“ hat zum Ziel, neue Gestaltungslösungen für den Austausch innovationsrelevanten Wissens in der regionalen Standortentwicklung zu etablieren. Systematischer Bestandteil dieser strategischen Konzeption ist die Integration von IKT als Instrument der Wissensvernetzung. Die Erprobung des Konzepts erfolgt in Kooperation mit den beiden Anwendungspartnern Wirtschafts- und Beschäftigungsförderung Gelsenkirchen und Rheinisch Bergische Wirtschaftsförderungsgesellschaft mbH (kurz: RBW). Das Projektverlauf wird im Folgenden anhand des strategischen Vorgehens im Rheinisch Bergisch Kreis konkretisiert:

Die Wirtschaftsstruktur des Rheinisch Bergischen Kreises ist durch kleine und mittelständische Unternehmen sowie einige wenige Großunternehmen geprägt. Zugleich weist die Bevölkerungsstruktur im Kreis einen überproportional hohen Anteil von über 50-Jährigen mit einem überdurchschnittlich hohem Haushaltseinkommen und hohem Lebensstandard auf. Die RBW verfolgt aufgrund dieser Wirtschafts- und Beschäftigungsstruktur sowie der begrenzten Verfügbarkeit von Gewerbeflächen die strategische Zielsetzung der Profilierung der Region als Standort mit herausragender Seniorenwirtschaftskompetenz. Vor diesem Hintergrund wurde die Initiative »Impuls 50plus« ins Leben gerufen, die den Aufbau regionaler Branchennetzwerke, die auf die Erbringung spezifischer Waren- und Dienstleistungsangebote für die Zielgruppe der über 50-Jährigen gerichtet sind, zum Ziel hat. Die Initiative versteht sich als Versuch, neue Wege zur Zukunftssicherung als Wirtschaftsstandort zu beschreiten. Mit der Etablierung einer Dachmarke »Impuls 50plus« wird angestrebt, mittelfristig strategische Standortvorteile gegenüber anderen Regionen und Städten zu realisieren, die Attraktivität des Standortes zu steigern sowie die regionale Wirtschaft zu fördern.

Im Rahmen des Projekts „Wirtschaftsförderung als wissensbasierte Dienstleistung“ wurde gemeinsam mit dem Institut Arbeit und Technik (IAT) ein Konzept zum Aufbau von regionalen Branchennetzwerken in den Bereichen „Planen, Bauen, Wohnen“, „Dienstleistung, Handel, Einkauf“, „Gesundheit & Wellness“, „Arbeit & Qualifizierung“ und „Freizeit & Tourismus“ entwickelt. Infolge der regionalen Ausrichtung der Initiative fanden sich in kürzester Zeit interessierte Unternehmen aus der Region zusammen, die sich im Rahmen der sektoralen Arbeitskreisen mit der Entwicklung neuer bzw. erweiterter Dienstleistungen und Produkte für die Zielgruppe der über 50-Jährigen befassen. Für die Leitung der fünf Arbeitskreise konnten Unternehmer aus Region gewonnen werden, die die Aktivitäten des Arbeitskreises koordinieren und in Zusammenarbeit mit den Mitgliedern konkrete Aktionspläne entwickeln und umsetzen.

Zur Unterstützung der Vernetzungsaktivitäten wurde das Portal www.impuls50plus.de realisiert, in einem öffentlich zugänglichen Bereich allgemein über die Initiative und deren Hintergründe informiert und innerhalb eines passwortgeschützten Bereichs den einzelnen Arbeitskreisen Werkzeuge für die elektronische Zusammenarbeit zur Verfügung stellt. Zu diesen Instrumenten zählen u.a. gruppenbezogene Adressbücher, Linklisten, Diskussionsforen und Terminkalender sowie News und Instrumente zum Dokumentenaustausch. Als Koordinationsgremium der regionalen Aktivitäten wurde ein Steuerungskreis, bestehend aus den Arbeitskreisleitern, der RBW und Vertretern der Projektgruppe am IAT gebildet, um so die Rückkoppelung des Wissenstransfers in die Wirtschaftsförderung und damit in die tägliche Beratungsarbeit der Mitarbeiter/-innen der RBW zu gewährleisten. Wie eine aktuelle Nutzerbefragung zeigt, wurde das Portal aufgrund seines regionalen Fokus und des damit verbundenen Nutzens für die Anwender bisher sehr positiv aufgenommen. Mittelfristig wird angestrebt, die in den Arbeitskreisen entwickelten Dienstleistungen und Produkte sowie die Seniorenwirtschaftskompetenz ebenfalls über diese Plattform zu vermarkten.

3.2 Profilbildung durch integrierte Standortentwicklung »VITA«

Im Rahmen des als Verein organisierten Branchennetzwerks mybird.de haben sich 60 kleine und mittlere Unternehmen der Software- und Internetwirtschaft aus der Region Dortmund zusammengeschlossen. Mit der Vernetzung wird angestrebt, die regionale IT-Kompetenz zu bündeln und Dortmund als herausragenden IT-Standort zu profilieren. Eine solche Profilierung soll dazu beitragen, die am Standort vorhandenen Kompetenzen transparent zu machen und aktiv zu vermarkten, um so potenzielle neue Kundensegmente sowohl in der Region als auch national zu erschließen. Dabei wird auf eine Doppelstrategie gesetzt: Zum einen finden regelmäßige Treffen zum Informationsaustausch zwischen den Mitgliedern statt, zum anderen wurde ein Portal in Betrieb genommen, dass als Vermarktungs- und Kooperationsplattform dienen soll. Aufgrund der regionalen Verankerung der Mitgliedsunternehmen besteht ein breiter Konsens in Bezug auf die anvisierten Ziele des Netzwerks. Allerdings ist es, infolge des

Fehlens eines eindeutigen Kompetenzprofils der IT-Wirtschaft bislang nicht hinreichend gelungen Dortmund in diesem Sinne zu profilieren. An diesem Punkt setzt das Projekt „Profilierung durch Integrierte Standortentwicklung der Dortmunder Wirtschaft am Beispiel der IT-Wirtschaft und ausgewählter Anwenderbranchen“ (**V**ernetzung von **IT**-Diensteleistern und **A**nwenderbranchen, kurz: VITA), das gemeinsam mit der Wirtschafts- und Beschäftigungsförderung Dortmund, dem IAT und mybird.de e.V. durchgeführt wird, an.

Ziel des Projekts ist die Intensivierung der regionalen Branchen- und Kundenverflechtungen und damit einhergehend einer stärkeren Profilierung der Region als Wirtschaftsstandort. Die Herausforderung liegt in erster Linie darin, mit einer prozessorientierten Perspektive zielgerichtete Rahmenbedingungen zu schaffen, die ein Selbstorganisation und Eindynamik der Netzwerke unterstützen. Leitlinie ist es, bislang unverbundene Akteure aus unterschiedlichen Kompetenzfeldern zusammenzuführen, den persönlichen Kontakt herzustellen und die Vertrauensbildung zu unterstützen. Die Umsetzung der gemeinsam mit der Wirtschafts- und Beschäftigungsförderung, mybird.de und den Akteuren aus den Anwenderbranchen erarbeiteten Vernetzungsstrategie soll dabei durch die aktive Positionierung einer optimierten webbasierten Kooperations- und Vermarktungsplattform unterstützt werden. Der Aufbau einer interaktiven Auftrags- und Kooperationsbörse als weiterer Baustein bietet in diesem Kontext die Möglichkeit, regionale Angebote und Nachfrage zusammenzuführen. Es wird angestrebt, die Erfahrungen aus dem Bereich der Dortmunder IT-Wirtschaft später auf andere Kompetenzfelder zu übertragen und so die Vernetzung der regionalen Wirtschaft insgesamt voranzutreiben und das Profil zu schärfen.

Die angeführten Beispiele zielen langfristig auf die Bildung integraler Netzwerke, befinden sich aber derzeit noch in der Aufbauphase. Jedoch zeigt sich bereits in diesem frühen Stadium, dass die Kombination von sektoralem und regionalem Fokus einen wesentlichen Erfolgsfaktor bei der Aktivierung der entsprechenden Akteure darstellt und der Einsatz webbasierter Instrumente zur Unterstützung dieser Prozesse von den kommunalen/ regionalen Akteuren positiv bewertet wird.

3.3 Webbasierte Vernetzung als neue Form der Daseinsvorsorge

Wie in den vorangehenden Kapiteln ausgeführt, bedingt die webbasierte Vernetzung auf regionaler Ebene eine Vielzahl positiver Effekten für eine nachhaltige Regionalentwicklung: Aus einzelbetrieblicher Sicht ergeben sich Vorteile durch branchenspezifische Informationen, produktive Kooperationen, die Erschließung neuer Geschäftsfelder. Die verbesserte Wettbewerbsfähigkeit schafft für die Region ein erhöhtes Steueraufkommen und ein gesteigertes Angebot an Arbeitsplätzen. Darüber hinaus trägt die Regionalisierung von Wertschöpfungsketten zu einer effizienteren Produktionsweise und Reduzierung von Transportaufwänden, wodurch ein Beitrag zur ökologischen Nachhaltigkeit geleistet wird, bei. Ferner unterstützen solche Portale die Identitätsbildung nach Innen sowie die Profilbildung nach Außen und sind damit bereits für sich genommen mit positiven Effekten für die Regionalentwicklung verbunden. Allerdings ließen sich diese Effekte noch vergrößern, würden die verschiedenen sektoralen Netzwerke auf regionaler Ebene in einer Gesamtstrategie koordiniert und durch zusätzliche Serviceangebote, wie regionale Logistikkonzepte, ergänzt. Viele der heute vorzufindenden regionalen Netzwerke im Internet existieren jedoch parallel nebeneinander, wie der hohe Anteil unterschiedlichster regionaler Online-Marktplätze veranschaulicht. Einige Regionen haben das Potenzial der webbasierten Vernetzung auf regionaler Ebene aber durchaus erkannt, so die Initiative kompetenzhoch³ der Städte Remscheid, Wuppertal und Solingen, die sich der Aufgabe der Integration der sektoralen Netzwerke auf regionaler Ebene stellt: Ziel ist es, die einzelnen im Rahmen der Kompetenzfeldpolitik entwickelten Portale miteinander zu verbinden. Allerdings befindet sich das Projekt noch in der Umsetzungsphase, so dass keine Aussagen zu den Ergebnissen gemacht werden können.

Insgesamt zeigt sich, dass zwar in einigen Regionen erste Pilotprojekte zum Aufbau integraler Netzwerke angelaufen sind, sich jedoch viele Kommunen/ Regionen sich diesem Thema bislang gar nicht widmen. Insofern stellt sich die Frage, ob die Entwicklung und Unterstützung dieser Vernetzungsstrategien nicht eine neue Aufgabe des öffentlichen Sektors darstellt.

Will man zukünftig die Potenziale webbasierter Vernetzungsstrategien konsequenter ausschöpfen, ist es unseres Erachtens unumgänglich, dass die Gebietskörperschaften die Strategiefindung im Sinne einer zeitgemäßen Infrastrukturplanung als ihre Aufgabe ansehen. Genauso, wie durch den Bau von Straßen und das Vorhalten eines öffentlichen Personennahverkehrs dafür gesorgt wird, dass Unternehmen zueinander kommen und Konsumenten in die Einkaufsstraßen gelangen, kann es als neue Aufgabe der Daseinsvorsorge angesehen werden, die notwendige Infrastruktur und Vernetzungsstrategien zur Nutzung des Internets zu entwickeln und diese Prozesse ggf. auch zu koordinieren. Den Kommunen, Kreisen, Regionen würde demnach die Aufgabe obliegen, eine Art Basisinfrastruktur in Form eines *Regional Wide Web* zu schaffen.

Dabei geht es weder um eGovernment noch um schnell Datenleitungen, sondern vielmehr um die grundsätzliche Koordinierung und Strategiefindung für eine solche Basisinfrastruktur. Selbstverständlich lassen sich dabei technische Lösungen nicht ausklammern, so kann das Hosting einzelner Seiten ebenso ein Instrument zur Gesamtintegration darstellen wie die Bereitstellung eines Regionalportals mit den entsprechenden webbasierten Anwendungen, Datenbanken und Schnittstellen.

Dies wird aktuell von den meisten Gebietskörperschaften allerdings noch nicht als ihre Aufgabe angesehen. Das nächste Kapitel wird daher auf die von uns analysierten Barrieren eingehen und schlaglichtartig einen Überblick über die notwendigen ersten Umsetzungsschritte geben.

4 INTEGRATION AUF REGIONALER EBENE: BARRIEREN UND VORAUSSETZUNGEN

Dass trotz der vielfältigen Potenziale, die integrale Netzwerke für eine nachhaltige Regionalentwicklung bieten, diese nur selten zur Anwendungen kommen, hat vielfältige Ursachen. Zu den wesentlichen Barrieren zählen aus unserer Sicht folgende Faktoren:

1. *Fehlen einer gemeinsamen Interessenslage:* Oftmals fehlt es an einer gemeinsamen Interessenslage der zu beteiligenden öffentlichen und private Akteure. Die erfolgreiche Realisierung einer ganzheitlichen Strategie erfordert jedoch einen

breiten Konsens in der Region und setzt die aktive Beteiligung einer Vielzahl von Akteuren mit unterschiedlichen Interessenslagen voraus.

2. *Mangelndes Problemlösungspotenzial:* Als weitere zentrale Ursache kann die heute weit verbreitete Skepsis gegenüber dem Internet als unterstützendes Instrument zur Problemlösung angesehen werden. Die anfänglich Euphorie in Bezug auf die neuen Technologien und die damit einhergehenden übersteigerten Erwartungen sind einem grundlegenden Misstrauen insbesondere hinsichtlich des Problemlösungspotenzials gewichen.
3. *Komplexität der Aufgabe:* Eine weitere Barriere liegt in der Komplexität der Aufgabe begründet, denn eine integrierte Entwicklung der Region ist auch ohne ambitionierte webbasierte Vernetzungsstrategien schon ein komplexer Prozess. Die Möglichkeiten, diesen Prozess durch den Einsatz von IKT zu unterstützen bzw. zu vereinfachen, werden dabei allerdings unterschätzt. Ein internetgestütztes regionales Wissensmanagement bietet aber enorme Potenziale.
4. *Politischer Konsens:* Bei der Formulierung und Realisierung eines RWW als neue Form der Daseinsvorsorge handelt es sich um einen mittel- bis langfristigen Prozess, bei dem nicht zwangsläufig auf kurzfristige Erfolge gesetzt werden kann. Ähnlich wie beim eGovernment zeigt sich auch in diesem Kontext, dass Politik vielfach auf kurzfristige Projekte setzt, die öffentlichkeitswirksam kommuniziert werden können. Die erfolgreiche Realisierung eines RWW hängt somit nicht nur von den öffentlichen und privaten Akteuren, sondern gleichfalls in starkem Maße von der Unterstützung einer solchen Strategie durch die politischen Entscheidungsträger ab.
5. *Mangelnde Akzeptanz:* Viele sehen die nicht unbegründete Gefahr, dass eine ganzheitliche webbasierte Strategie nichts anderes bedeutet, als den bereits bestehenden, organisch gewachsenen Netzwerken eine Top-Down-Struktur überzustülpen. Vor diesem Hintergrund empfiehlt sich ein Vorgehen, dass die relevanten Akteure rechtzeitig einbezieht, d.h. bereits im Rahmen des Strategiefindungsprozesses.

Das Konzept vom RWW als neue Form der Daseinsvorsorge setzt an den vor Ort vorhandenen Besonderheiten an, wobei diese in der Regel sehr heterogen sind und in starkem Maße durch die lokalen/regionalen Akteursstrukturen, Kompetenzen und bestehenden Netzwerke determiniert werden. Vor diesem Hintergrund lässt sich keine Strategie ableiten, die für alle Regionen Gültigkeit hat, wohl aber können einige grundlegende Aussagen darüber getroffen werden, welche grundlegenden Aspekte es im Rahmen dieses Prozesses zu berücksichtigen gilt:

1. *Basisinfrastruktur RWW:* Wie bereits erläutert, kann die Formulierung und Realisierung einer regionalen Internetstrategie durchaus als neue Form der Daseinsvorsorge verstanden werden. Die Aufgabe der Sensibilisierung und Kommunikation eines solchen Vorgehens ist auf Seiten der Stadt/Region als fest verankerte Zuständigkeit anzusiedeln.
2. *Arbeitskreise:* Es erscheint sinnvoll, einen Arbeitskreis zu konstituieren, der die Strategiefindung und -umsetzung koordiniert und die relevanten Akteure frühzeitig einbezieht.
3. *Bestandsaufnahme:* Web-Mapping. In den meisten Regionen existiert bereits eine Vielzahl webbasierter Netzwerke privater, öffentlicher und halböffentlicher Akteure. Insofern gilt es, diese Strukturen im Sinne eines „Web-Mapping" transparent zu machen, um so möglich Ansatzpunkte zu identifizieren.
4. *Mittel- bis langfristige Vernetzungsstrategie:* Unter Beteiligung der relevanten Akteure ist eine Vernetzungsstrategie zu entwickeln, die bestehende Portale integriert.
5. *Perspektivischer Inkrementalismus:* Integrale Vernetzungsstrategien lassen sich auf Grund der hohen Komplexität und anderer Barrieren vielfach nicht nach einem Entwicklungsplan „eins-zu-eins" umsetzen. Es gilt daher einzelne Projekte zu fördern, die zur Realisierung der Gesamtstrategie beitragen.
6. *Reale Netzwerke:* Wie eingangs beschrieben ist der virtuelle Raum ein Möglichkeitsraum, der erst durch die Interaktionen der Akteure zum sozialen Raum wird. Webbasierte Portale können – selbst wenn sie einen regionalen Fokus aufweisen – vorhandene Netzwerke lediglich abbilden und die Kommunikationsbeziehungen unterstützen, sie können selbst aber keine Netzwerke konstituieren. Daher sollten insbesondere solche Projekte unterstützt werden, die auf bereits vorhandene Akteursnetzwerke zurückgreifen.

Unsere bisherigen Erfahrungen zeigen, dass auf Seiten der Unternehmen eine grundsätzlich Bereitschaft zur Intensivierung der regionalen/lokalen Einbettung besteht sowie zur aktiven Mitarbeit, sofern sich für sie ein konkreter Mehrwert abzeichnet. Des Weiteren eignet sich das RWW in besonderem Maße, um den Akteuren neue Möglichkeiten der regionalen Kooperation aufzuzeigen und eine Bündelung der regionalökonomischen Aktivitäten Wirtschaftsförderung, endogene Netzwerkbildung und Standort-profilierung zu vollziehen.

Abschließend bleibt festzuhalten, dass der Raum auch im Zeitalter der Informationstechnologie keineswegs „ortslos" geworden ist und die regionale Verankerung identitätsstiftend und vertrauensfördernd wirken kann. Daher sollten Kommunen und Regionen dieses Potenzial zügig und professionell nutzen.

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Regionalplanung im Internet – Bundesweite Status-quo-Analyse und Empfehlungen für die Öffentlichkeitsarbeit und Beteiligung

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1 EINLEITUNG

Öffentlichkeitsarbeit und Öffentlichkeitsbeteiligung haben für die Raumplanung einen immer größeren Stellenwert. Einerseits müssen die planenden Institutionen in der öffentlichen Diskussion um den Umbau und die Leistungsfähigkeit des Staates deutlich machen, welchen grundsätzlichen Beitrag die räumliche Planung mit ihren Institutionen und Instrumenten für die Entwicklung eines Raumes leistet (vgl. FÜRST 2000). Andererseits haben sie die Aufgabe, durch eine gezielte Öffent-lichkeitsarbeit die Akzeptanz und damit auch die Umsetzung ihrer konkreten Planungen zu verbessern (ARL 1995, 285f.).

Dafür scheint das Internet prädestiniert: Es hat sich als Informations- und Kommunikationsmedium etabliert und bietet vielfältige Möglichkeiten, Informationen multimedial aufzubereiten und mit den Nutzern in einen interaktiven Dialog zu treten. Gleichzeitig können einfache Internetauftritte mit einem relativ geringem Ressourcenaufwand umgesetzt werden, sodass diese Art der Öffentlichkeitsarbeit auch mit dem klammen Budget eines Planungsträger möglich erscheint.

Die Chancen sind also offensichtlich – aber werden sie auch genutzt? In welchem Umfang sind Planungsträger bereits im World Wide Web (WWW) vertreten? Inwieweit werden die Möglichkeiten zu Information, Kommunikation und Beteiligung, die das Internet bietet, auch wirklich eingesetzt? Und wie sollte die "ideale" Website eines Planungsträgers aussehen?

Diese Fragen standen im Mittelpunkt einer Diplomarbeit an der Universität Hannover (FRAHM 2002), die das Thema am Beispiel der Regionalplanung untersucht hat und deren Ergebnisse die Grundlage dieses Beitrags bilden. Dabei wurde zunächst eine bundesweite Untersuchung aller Webpräsenzen der Regionalplanung durchgeführt. Darauf aufbauend wurden vier Webpräsenzen näher analysiert. Als Ergebnis der Arbeit wurden Empfehlungen für die Entwicklung und Optimierung von Internet-Auftritten der Regionalplanung ausgesprochen.

2 ÖFFENTLICHKEITSARBEIT UND BETEILIGUNG IN DER REGIONALPLANUNG

2.1 Öffentlichkeitsarbeit in der Regionalplanung

Eine Verpflichtung zur Information der Öffentlichkeit besteht seit 1994, als in Deutschland die europäische Richtlinie über den freien Zugang zu Informationen über die Umwelt durch das Umweltinformationsgesetz (UIG) umgesetzt wurde. Das Gesetz räumt den Bürgern das Recht ein, auch außerhalb eines laufenden Verwaltungsverfahrens ohne Nachweis eines berechtigten Interesses Zugang zu den bei Behörden vorhandenen Umweltinformationen zu erhalten (BURG 1999, 77). Zu diesen Informationen gehören auch verwaltungstechnische Pläne und Programme der Raumordnung und Landesplanung (KUMMER & SCHUMACHER 1997, 8ff.).

Eine gezielt eingesetzte Öffentlichkeitsarbeit kann zur Erfüllung, wenn nicht sogar zur Qualitätssteigerung der Regionalplanung beitragen (ARL 1995, 285f.). In der Öffentlichkeitsarbeit für die Regionalplanung liegt allerdings ein erst wenig genutztes Potenzial für eine größere Akzeptanz und Umsetzung regionaler Planungsziele (PRIEBS 1999, 304f.). Derzeit ist Öffentlichkeitsarbeit für die Regionalplanung eher angebots- als nachfrageorientiert. Die Grenzen liegen häufig im personellen und zeitlichen Aufwand: Die institutionellen und personellen Voraussetzungen sind für eine gezielte Ansprache von Medien, anderen Multiplikatoren und der Öffentlichkeit häufig suboptimal (ARL 1995, 286); für eine Professionalisierung der Öffentlichkeitsarbeit fehlt Geld in den Budgets der Regionalplanungsträger (KUNZMANN 2002, 71).

Wenn die Regionalplanung mit ihren Analysen und Zielsetzungen verstanden werden soll, ist eine allgemein verständliche Information der Entscheidungsträger und der Bevölkerung in ansprechender, d. h. fachlich kommentierter und journalistisch aufbereiteter Form jedoch unerlässlich (PRIEBS 1999, 304). Allerdings ist es "nicht einfach, die abstrakte Materie der Regionalplanung in publikumswirksame Rhetorik umzusetzen" (KNIELING et al. 2003, 192). Speziell die komplexen Sachverhalte der Regionalplanung verlangen eine gute Informationspolitik, wobei über

- Regionalplanung als Institution selbst mit ihren Planungsinhalten, Instrumenten und der Bedeutung der räumlichen Planung für die Entwicklung und Gestaltung der jeweiligen Region,
- Regionalpläne, Konzepte zu regionsspezifischen Themen und Grundlagenuntersuchungen,
- Daten- und Informationssysteme, z. B. zur Regionalen Standortvermarktung, sowie
- Publikationen

informiert und kommuniziert werden kann (MAIER & WEBER 1995, 721).

In der Raumplanung dient eine intensive Öffentlichkeitsarbeit auch der Vorbereitung der Beteiligung (BURG 1999, 50f.). Diese Vorbereitung ist besonders für den Bürger von entscheidender Bedeutung (GUSTEDT & LUTTER 2002, 35), da er durch sie die Möglichkeit hat, zu einem annähernd gleichgewichtigen Informationsgrad wie das politisch-administrative System zu kommen (STRUBELT 1995, 702).

2.2 Öffentlichkeitsbeteiligung bei der Aufstellung von Regionalplänen

In der Regionalplanung erfolgt bundesweit bei der Aufstellung, Änderung, Ergänzung bzw. Fortschreibung der Regionalpläne eine umfassende Beteiligung von Trägern öffentlicher Belange (TöB), halbstaatlichen Einrichtungen bis hin zu den Wirtschafts- und Sozialpartnern sowie gesellschaftlichen Gruppierungen (DALLHAMMER 1999, 252). Die unmittelbare Beteiligung von Privatpersonen wurde jedoch lange Zeit mit der Begründung abgelehnt, dass Regionalpläne keine konkreten Festlegungen enthalten, die für sie gesetzlich bindend sind. Im Laufe der Zeit haben sich in einigen Planungsregionen informelle Formen der Öffentlichkeitsbeteiligung bei der Aufstellung von Regionalplänen entwickelt. Insgesamt ist die Öffentlichkeitsbeteiligung bei der Aufstellung von Regionalplänen aber bisher kaum von praktischer Relevanz gewesen (DANIELZYK et al. 2002, 1).

Wesentliche Änderungen im Bezug auf die Öffentlichkeitsbeteiligung erfolgten durch das ROG von 1998 und dessen länderrechtlichen Umsetzungen. In § 7 Abs. 6 ROG wird den Ländern freigestellt, die Öffentlichkeit bei der Aufstellung der Raumordnungspläne einzubeziehen oder zu beteiligen. Die Länder Hessen, Sachsen, Sachsen-Anhalt und Thüringen haben die verpflichtende Beteiligung der Öffentlichkeit bereits in ihren Landesgesetzen eingeführt. In Baden-Württemberg, Bayern, Niedersachsen und Nordrhein-Westfalen existieren Bestrebungen im Rahmen einer künftigen Novellierung des jeweiligen Landesplanungsgesetzes eine Öffentlichkeitsbeteiligung für Regionalpläne vorzusehen. Weitere Veränderungen bezüglich der Öffentlichkeitsbeteiligung in der Raumordnung wird die im Juni 2001 erlassene und bis zum 20.07.2004 in nationales Recht umzusetzende europäische Richtlinie 2001/42/EG über die Prüfung der Umweltauswirkungen bestimmter Pläne und Programme (Plan-UP-RL) hervorrufen: Gemäß Art. 6 Plan-UP-RL ist im Rahmen der Umweltprüfung vor der Entscheidungsfindung eine Beteiligung der betroffenen Öffentlichkeit durchzuführen (DANIELZYK et al. 2002, 2 und 42ff.).

Öffentlichkeitsbeteiligung ist aber nicht nur als eine Möglichkeit der Stellungnahme und Anhörung zu verstehen, sondern soll auch eine Einsichtnahme in Planungen und Entscheidungen im Sinne einer "gläsernen Verwaltung" gewähren (STRUBELT 1995, 701). Zukünftig sind bei der Aufstellung von Regionalplänen neue Formen der Beteiligung und der Aufbereitung von Planungsalternativen und -entscheidungen gefordert (RUNKEL 1999, 257), beispielsweise über das Medium Internet.

3 STATUS-QUO-ANALYSE "REGIONALPLANUNG IM INTERNET"

Um der Fragestellung nachgehen zu können, in welcher Form die Träger der Regionalplanung sich das Internet derzeit zur Ergänzung der konventionellen Öffentlichkeitsarbeit und Beteiligung zu Nutzen machen, wurden deren Webpräsenzen hinsichtlich

- der Art und des Umfangs von Informationen, die sie enthalten,
- der Kommunikationsdienste, die sie anbieten, und
- der Möglichkeiten zur Beteiligung, die sie bereitstellen,

mittels einer Checkliste, die insgesamt 37 Kriterien enthält, analysiert. Die Erhebung erfolgte im August 2002.

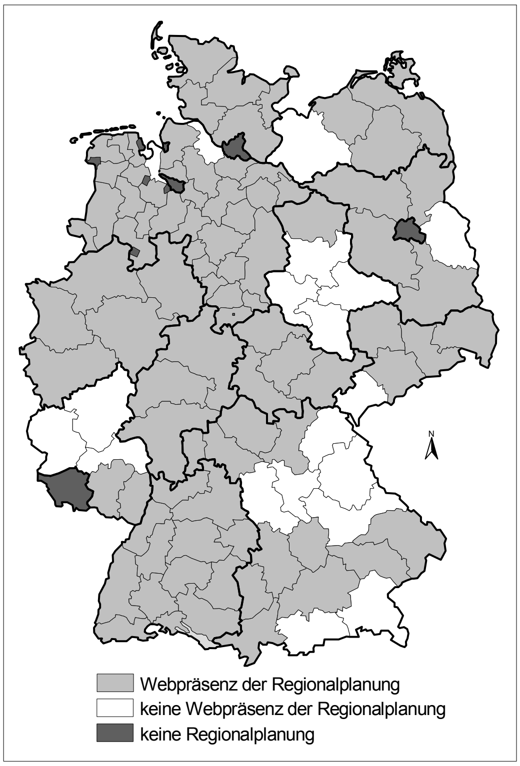

Abb. 1: Status quo der Webpräsenzen der Regionalplanung

3.1 Träger der Regionalplanung im Internet

Die Regionalplanung ist online! Über vier Fünftel der Träger der Regionalplanung waren zum Zeitpunkt der Untersuchung im Internet vertreten. Weitere Regionalplanungsträger haben inzwischen ebenfalls ihre eigene Website.

Fehlende Webpräsenzen sind vor allem bei den bayrischen, rheinland-pfälzischen und sachsen-anhaltinischen Regionalplanungsträgern zu finden, wobei die jeweilige Organisation der Regionalplanung ursächlich sein kann. In Sachsen-Anhalt wurde 1999 die Organisation der Regionalplanung neu geordnet und auf fünf Regionale Planungsgemeinschaften (RPG) übertragen, wobei die Regionalplanungsträger die Arbeit zu unterschiedlichen Zeitpunkten aufgenommen haben – teilweise erst 2002. Eine ähnliche Situation findet sich in Rheinland-Pfalz: Durch die Auflösung der Bezirksregierungen Ende der 1990er Jahre ist die Trägerschaft der Regionalplanung umorganisiert worden und im August 2002 waren nur zwei von insgesamt fünf Regionen im Internet präsent. Auch ein Drittel der bayrischen Planungsverbänden hat keine eigene Website. In Bayern sind Regionale Planungsverbände (RPV) Träger der Regionalplanung, die Zuständigkeit liegt jedoch auch bei so genannten Regionsbeauftragten, die ihren Sitz bei der Mittelinstanz haben. So finden sich bei den Webpräsenzen der sechs bayrischen Regierungsbezirke teilweise auch Informationen zur Regionalplanung, z. B. veröffentlicht die Regierung von Oberbayern Teile des Regionalplans der Region Oberland im Internet.

Bei der Präsenz im WWW kooperieren einige Regionalplanungsträger miteinander. Beispielsweise haben der Regionalverband (RV) Unterer Neckar und die Planungsgemeinschaft Rheinpfalz, die beide Mitglieder des Raumordnungsverbands Rhein-Neckar sind, eine gemeinsame Webpräsenz. Eine Besonderheit stellt das Portal "RPG in Thüringen" dar, unter dem alle vier RPG des Landes Thüringen vier eigenständige Websites präsentieren, die sich in punkto Struktur und Design gleichen.

3.2 Information in der Regionalplanung via Internet

Die Webpräsenzen der Regionalplanung werden derzeit vorrangig zur Information verwendet. Sie nutzen das Internet zur Darstellung ihrer (Pflicht-)Aufgaben und zur Erläuterung ihrer Organisationsform. Aber auch detailliertere Informationen zum Planungsgegenstand, über Planungsabläufe und -vorhaben sowie zur Information über die Planungsregion sind bereits, wenn auch im unterschiedlichen Maße, vorhanden. Die Informationen, die auf den Webpräsenzen der Regionalplanung gegeben werden, unterscheiden sich hinsichtlich der Breite der Informationen deutlich voneinander: Keine Webpräsenz erfüllt alle 27 Kriterien der Kategorie Information (s. Abb. 2). Die meisten Kriterien erfüllt die Webpräsenz der Bezirksregierung Düsseldorf. Auch die Webangebote des RPV München und des Verbands Region Stuttgart gehören zu denjenigen mit dem breitesten Themenspektrum. Dies lässt jedoch nicht auf die Qualität des Webangebots schließen.

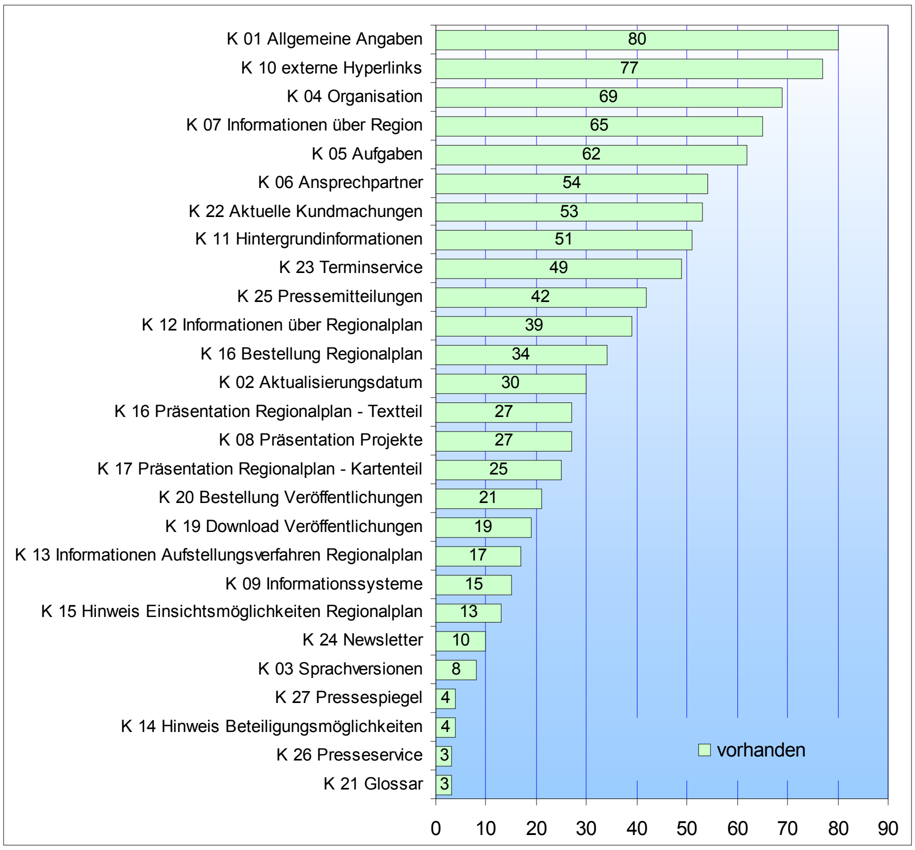

Abb. 2: Informationsfunktionen von Webpräsenzen der Regionalplanung

Das einzige Kriterium, das bis auf eine alle Webpräsenzen erfüllen, besteht in den allgemeinen Angaben zur herkömmlichen Kontaktaufnahme. Weiterführende Informationen zu Ansprechpartnern der Regionalplanung sind jedoch nur auf etwa zwei Drittel der Websites zu finden. Am zweithäufigsten sind Hyperlinks zu externen Websites, die sogar bei fast 68 % der Webpräsenzen in Link-Sammlungen zusammengestellt angeboten werden. Eine sehr vorbildliche Sammlung von Hyperlinks zur Landes- und Regionalplanung sowie wieteren Themen bietet die Website des RPV Oberlausitz-Niederschlesien.

Häufig wird auch über die Region informiert. Hingegen sind Regionale Informationssysteme nur auf etwa 19 % der Websites zu finden. Es handelt sich mit zwei Ausnahmen um Standortinformationssysteme für Gewerbeflächen u. Ä., deren Präsentation von statischen, tabellarischen Darstellungen bis hin zu dynamischen, interaktiven Informationssystemen reicht. Auffällig dabei ist die Region Schwarzwald-Baar-Heuberg. Sie bietet ein Regionales Wirtschaftsinformationssystem über Unternehmen der Region an, erfüllt jedoch keine Kriterien, die mit den Aufgaben der Regionalplanung verbunden sind. Auf einigen Websites befinden sich Links auf externe Informationssysteme, beispielsweise haben sechs niedersächsische Landkreise ihr Webangebot mit dem Regionalen Informationssystem "RegIS-Online" verknüpft (vgl. GNEST 2002).

Fast zwei Drittel der Websites informieren gesondert über Aktuelles aus der Region. Nur knapp 37 % der Anbieter geben hingegen ein Aktualisierungsdatum an, sodass es bei den anderen Websites für den Nutzer nicht ersichtlich ist, ob die Informationen noch aktuell sind. Besonders gut lassen sich die einzelnen Informationen bezüglich ihrer Aktualität einschätzen, wenn jede einzelne Webseite ein Aktualisierungsdatum enthält; dies ist jedoch nur bei 9 % der Fall.

Ein Drittel der Websites informiert über Projekte der Regionalplanung, die damit hinter der Information über die Aufgaben und den Regionalplan rangieren. Das Themenspektrum der präsentierten Projekte ist dabei sehr breit: Es reicht von Themen wie GIS in der Regionalplanung und Windenergie bis hin zu Projekten der Regionalentwicklung und des Regionalmarketings in der Region.

Serviceangebote wie Bestellung und Download von Veröffentlichungen sind bei einem Viertel der untersuchten Websites zu finden. Die Bestellung kann fast immer per Online-Formular oder E-Mail erfolgen.

In einem regionalplanerischen Glossar kann der Nutzer nur auf den Websites des RV Nordschwarzwald, des RPV München und dem RPV Oberlausitz-Niederschlesien nachschlagen. Der RPV Donau-Wald, der RPV Landshut und die Region Hannover haben das eigene Webangebot mit dem Glossar des RPV München per Link verknüpft.

4 PRÄSENTATION DES REGIONALPLANS

Auf weniger als einem Drittel der untersuchten Websites werden sowohl der Text- als auch der Kartenteil der verbindlichen Fassung des Regionalplans der Region präsentiert. Die präsentierten Regionalpläne sind unterschiedlich aufbereitet: Der größte Teil der kartografischen Darstellungen sind "view-only"[1]: Auf sieben Websites wurden die Karten in keinerlei Form aufbereitet, sodass die gesamten – in der Regel sehr umfangreichen – Karten in Form von Rasterdaten zum Download oder zur Betrachtung im Browser vorliegen. Weitere 14 Websites enthalten zumindest teilweise in Einzelblätter zerlegte, aufbereitete Karten, sodass gewünschte Kartenblätter gezielt betrachtet werden können[2]. Die view-only Regionalpläne im Internet bieten unterschiedliche Darstellungsmöglichkeiten, z. B. ist die kartografische Internet-Darstellung des Gebietsentwicklungsplans (GEP) des Regierungsbezirks Köln mit einer blattschnittfreien Navigation ausgerüstet. Interaktiv[3] präsentieren nur 5 % der Regionalplanungsträger ihre zeichnerische Darstellung im WWW: RPV München und die hessischen Landesplanung, die die Regionalpläne der drei Planungsregionen und den Landesentwicklungsplan gemeinsam im Internet veröffentlicht.

Die Textteile der Regionalplanung werden zu fast 75 % als PDF-Datei zum Download angeboten; rund 25 % liegen als Hypertext vor – hauptsächlich bei den Websites der bayrischen RPV; der RPV München bietet seinen Regionalplan sogar auf beide Weisen an.

Zusätzlich ermöglichen fast 40 % der Webpräsenzen der Regionalplanung, die verbindliche Fassung des Regionalplans via Internet zu bestellen. Zwei weitere Regionalplanungsträger bieten ein Bestellformular im WWW an, um den Regionalplan auf dem herkömmlichen Weg per Post zu beziehen.

4.1 Kommunikation in der Regionalplanung via Internet

Alle untersuchten Webpräsenzen bieten eine Kontaktmöglichkeit per E-Mail an. Auf fast allen Websites werden zentrale E-Mail-Adressen angegeben (s. Abb. 3); überdies kann bei etwa 55 % der Behörden, bei denen die Regionalplanung nur einen Teil der Webpräsenz darstellt, bzw. 24 % der Planungsverbände bzw. -gemeinschaften ein Ansprechpartner der Regionalplanung direkt per E-Mail angeschrieben werden. Gerade bei den Verbänden werden jedoch weitaus häufiger Ansprechpartner genannt, die jedoch nicht direkt per E-Mail kontaktiert werden können.

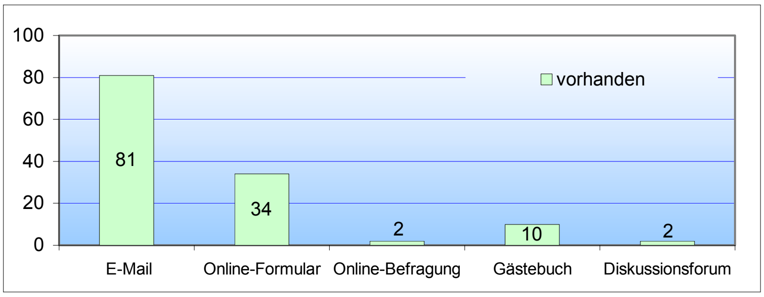

Abb. 3: Vorhandene Kommunikationsmöglichkeiten in der Regionalplanung via Internet

Zusätzlich haben mehr als 40 % ihre Website mit einem Online-Formular ausgerüstet. Einige Websites bieten die Möglichkeit, einen Ansprechpartner auszuwählen (z. B. Bezirksregierung Düsseldorf) oder das eigene Anliegen durch die Auswahl verschiedener angebotener Betreffs (z. B. RV Nordschwarzwald) zu konkretisieren. Mailing-Listen werden nur zum Versand für Newsletter verwendet.

Öffentliche Diskussionsforen zu Themen der Regionalplanung werden gegenwärtig lediglich auf den Websites des niedersächsischen Landkreises Osnabrück und der Bezirksregierung Düsseldorf betrieben. Jedoch hat einzig die Website der Bezirksregierung ein spezielles Forum zum Thema Regionalplanung. Diese beiden Websites bieten auch die Möglichkeit eines Chats an. In der Vergangenheit wurde aber noch keiner zum Thema Regionalplanung durchgeführt.

Die Möglichkeiten einer elektronischen Befragung nutzen zwei der untersuchten Websites: Die Region Oberlausitz-Niederschlesien stellt ein Online-Formular zur Kritik an der Website bereit. Der Landkreis Osnabrück fordert die Nutzer auf, in einem Forum Anregungen zu seinem Webauftritt zu geben. Auf dieser Website wird auch ein E-Voting durchgeführt. Die Fragen wechseln dabei wöchentlich und haben einen aktuellen oder regionalen Bezug. Die zehn existierenden Gästebücher werden ausschließlich auf Webpräsenzen von Behörden, insbesondere auf denen der niedersächsischen Landkreise, angeboten.

4.2 Beteiligung in der Regionalplanung via Internet

Zur Beteiligung bei Aufstellung von Regionalplänen wird das Internet von den Trägern der Regionalplanung erst vereinzelt verwendet. Dabei dient es mehr zum Auslegen der Planentwürfe, also als Informationsmedium, denn als Kommunikationsmedium zwischen den Beteiligten.

Knapp ein Fünftel der Träger der Regionalplanung nutzen das Internet, um die beschreibenden und zeichnerischen Darstellungen ihrer Regionalplanentwürfe öffentlich auszulegen. Dabei liegen die angebotenen Textteile grundsätzlich als PDF-Datei zum Download vor. Nur die RPG Havelland-Fläming bietet zusätzlich die textliche Darstellung online als Hypertext an. Die Karten sind ebenso wie die der verbindlichen Regionalpläne unterschiedlich aufbereitet:

- Elf Mal wurde ein Regionalplanentwurf view-only veröffentlicht, wobei fast zwei Drittel der Karten für das WWW aufbereitet wurden.
- Neben der interaktiven Aufbereitung des RPV München legt auch der RV Nordschwarzwald seinen Regionalplanentwurf interaktiv öffentlich aus.

1 View-only Karten sind kartografisch und inhaltlich gegenüber dem analogen Original meist unveränderte Karten. Diese Form der Darstellung kann mit Basisfunktionen wie Scrollen, Zoomen und Abrufen von Informationen ausgestattet sein (SCHREIBER 2000, 67).

2 Zur Auswahl der Einzelblätter steht eine Blattübersicht (i.d.R. clickable map), ein Dropdown-Menü und/oder eine anklickbare Tabelle bereit.

3 Eine kartografische Darstellung wird als interaktiv bezeichnet, wenn sie über die genannten Basisfunktionen hinaus das Auswählen und kombinieren von Variablen mittels Menüs und Layern erlaubt (SCHREIBER 2000, 67).

- Als einziger kann der Landkreis Soltau-Fallingbostel einen analytischen[4] Regionalplanentwurf anbieten, der als Datei zum Download bereitgestellt und dessen Karten offline mit dem GIS ArcView von ESRI betrachtet werden können. Dann stehen alle Funktionalitäten, die das GIS bietet, zur Verfügung. Alternativ kann ein kostenlos verfügbares Programm heruntergeladen werden, mit dem die Karten aber nur betrachtet werden können.

Für die Abgabe von Stellungnahmen zum Regionalplanentwurf nutzen nur der RV Nordschwarzwald, die RPV München und Ingolstadt sowie die Bezirksplanungsbehörde Düsseldorf das Internet. Zum Zeitpunkt der Untersuchung wiesen drei weitere Regionalplanungsträger auf ihrer Webpräsenzen auf konventionelle Beteiligungsmöglichkeiten hin. Anregungen und Bedenken können während des Aufstellungsverfahrens des Regionalplans an den RPV München und den RPV Ingolstadt per Online-Formular gesendet werden: Der Nutzer kann per Dropdown-Menü den gewünschten Betreff "Regionalplan-Fortschreibung" angeben sowie in einem mehrzeiligen Textfeld seine Anregungen und Bedenken hinterlassen und per Button abschicken.

Auf der Website RV Nordschwarzwald und der Bezirksregierung Düsseldorf können sich Interessierte in Diskussionsforen zu regionalplanerischen Verfahren austauschen: Auf der nordrhein-westfälischen Website wird dabei ein Forum angeboten, das zur Diskussion sowohl zu Aufgaben und Themen des Regionalrats als auch über das GEP-Änderungsverfahren für den Metrorapid bereit gestellt wurde. Der RV Nordschwarzwald stellt hingegen seinen Regionalplanentwurf mit Foren zu den Themen "Raumordnung", "Siedlung", "Freiraum" und "Verkehr und Energie" im Internet bereit.

Bei allen Angeboten zur Abgabe von Stellungnahmen über das Internet ist es lediglich dem Diskussionsforum zum Regionalrat/GEP-Änderungsverfahren zu entnehmen, dass es sich um eine informelle Ergänzung zum Verfahren handelt. Bei allen anderen Beteiligungsangeboten, ist aus den gebotenen Informationen nicht zu erkennen, welchen Stellenwert die abgegebenen Anregungen und Bedenken im Aufstellungsverfahren haben und an wen die Beteiligungsmöglichkeit adressiert ist.

Außerdem bieten die Webpräsenzen des RV Nordschwarzwald und des RPV Ingolstadt keine weiteren Informationen zum Planungsprozess des Regionalplans, sodass bisher nicht am Aufstellungsprozess Beteiligte der Website nicht entnehmen können, in welcher Phase sich das Verfahren derzeit befindet. Anders gestaltet sich dies auf der Website der Bezirksregierung Düsseldorf: Dort erhalten Interessierte ausführliche Informationen über alle abgeschlossenen und laufenden Verfahren.

Darüber hinaus wird auf den Websites der RPG Thüringens angekündigt, dass zukünftig über den jeweils aktuellen Stand der Regionalplanfortschreibung informiert sowie Möglichkeiten zur Diskussion und Meinungsäußerung geschaffen werden sollen.

5 FALLSTUDIEN "REGIONALPLANUNG IM INTERNET"

Es wurden die Websites des RV Nordschwarzwald, des RPV München, der RPG Havelland-Fläming und der Bezirksregierung Düsseldorf als Fallstudien untersucht, da sie unter den vorhandenen Webpräsenzen eine Vorreiterrolle einnehmen. Im Folgenden geben Steckbriefe einen Überblick über die analysierten Fallstudien:

RV NORDSCHARZWALD	www.regionalplan-interaktiv.de
Online seit 2002 Auslegung des Regionalplanentwurfs im Internet (WebGIS, MapServer, Maßstab 1:600.000 bis 1:25.000) Verbesserte kartografische Darstellung des Regionalplanentwurfs	Kleinere Auflagenzahl des Regionalplanentwurfs notwendig, dadurch verringerte Druckkosten Diskussionsforen, grafischer Kommentar (Zeichenmodus) und Extranet (für TöB und Mitglieder der Verbandsversammlung) zur Beteiligung am Aufstellungsverfahren des Regionalplans Arbeitserleichterung bei der schriftlichen Stellungnahme
RPV MÜNCHEN	www.region-muenchen.com
Online seit 1999 Umfangreiches Informationsangebot Interaktiver Regionalplan (grafische Lösung, maßstabslos)	Auslegung des Regionalplanentwurfs im Internet (interaktiv) Möglichkeit zur Beteiligung via Online-Formular
RPG HAVELLAND-FLÄMING	www.havelland-flaeming.de
Online seit 2001 View-only Regionalplan (etwa Maßstab 1:50.000)	Auslegung des Regionalplanentwurfs im Internet Website mit vielen Funktionen und Inhalten, die mit verhältnismäßig geringen Aufwand realisiert wurde

4 Analytische Karten stellen dem Benutzer ähnliche Funktionen wie ein GIS zur Verfügung. Der Inhalt und die Gestaltung der Kartenelemente kann vollkommen frei erfolgen (SCHREIBER 2000, 67).

BEZIRKSREGIERUNG DÜSSELDORF	www.bezreg-duesseldorf.nrw.de
Online seit 1996	View-only Regionalplan
Dezentrales Content-Management-System (CMS) zur Pflege der Website	Auslegung des Regionalplanentwurfs im Internet
Umfangreiches Informationsangebot	Vielfältige Kommunikationsmöglichkeiten wie Diskussionsforen mit regionalplanerischen Bezug und Gästebuch als Feedbackmöglichkeit

6 EMPFEHLUNGEN FÜR WEBPRÄSENZEN DER REGIONALPLANUNG

Die Untersuchung hat gezeigt, dass derzeit vorwiegend Information ins Netz gestellt werden. Kommunikation via Internet steckt noch in den Kinderschuhen und für die Beteiligung bei der Aufstellung von Regionalplänen wird das Internet erst vereinzelt eingesetzt. Webpräsenzen der Regionalplanung dienen derzeit vorrangig der Selbstdarstellung der Regionalplanungsträger, sodass die existierenden Webpräsenzen zur Öffentlichkeitsarbeit sowie Transparenz und Nachvollziehbarkeit der regionalplanerischen Arbeit beitragen. Die vier untersuchten Fallbeispiele haben gezeigt, dass für die Regionalplanung der Auftritt im Internet vorteilhaft sein und auch mit geringen Mitteln erfolgen kann. Mit Hilfe einer Webpräsenz kann Öffentlichkeitsarbeit betrieben, können Planungsprozesse unterstützt und z. T. sogar Arbeit, Kosten und Zeit eingespart werden. Aus diesen Gründen ist zu empfehlen, dass jeder Träger der Regionalplanung zumindest mit einem grundlegenden Angebot im Internet vertreten ist.

6.1 Entwicklung einer Webpräsenz

Die Zielgruppe für Webpräsenzen der Regionalplanung ist heterogen und verfügt über unterschiedliches Wissen über das Thema Regionalplanung. Da zunehmend auch die Öffentlichkeit Adressat der Regionalplanung ist, muss sich das Webangebot auch für Regionalplanungslaien geeignet sein.

Darüber hinaus können sich die Webpräsenzen der Regionalplanung zum Portal für die Region entwickeln, zumal die Regionalplanung viele Mitglieder, Beteiligte und Akteure hat, welche die Webpräsenz in dieser Funktion nutzen könnten. Neben planungsbezogenen Information kann die Regionalplanung auf ihrer Website mittels externer Hyperlinks andere regionale Webangebote, die der Wirtschafts- und Tourismusinformation sowie -förderung dienen, bündeln.

Statt Webdesign auf dem neusten Stand der Technik ist Nutzerfreundlichkeit gefordert. Die Analyse der Fallbeispiele hat gezeigt, das in der Praxis die Möglichkeiten nicht voll ausgeschöpft werden. Daraus ergibt sich die Forderung, bei der Umsetzung der Webseiten auf die mediengerechte Aufbereitung zu achten.

Die Struktur des Webangebots richtet sich nach der Organisationsform des Trägers der Regionalplanung: Im Falle der Ansiedlung der Regionalplanung bei der Mittelinstanz, der Landesebene oder bei den Landkreisen darf eine Strukturierung des Webangebots nicht ausschließlich nach der Struktur der Behörde erfolgen. Die Auffindbarkeit des Webangebots der Regionalplanung unter den anderen Angeboten der Website wird dadurch – insbesondere für diejenigen, die nicht mit dem Verwaltungsaufbau vertraut sind – erschwert.

Zukünftig ist ein vermehrter Einsatz und die Verbesserung der Präsentation von Karten mittels Internet-GIS-Technologien notwendig, damit die Nutzer interaktive in Pläne einsehen können. Mit Hilfe von 3-D-Darstellungen könnten Planungsvorhaben der Regionalplanung anschaulicher und nachvollziehbarer – insbesondere für Regionalplanungslaien – visualisiert werden. Eine deratig ausgerüstete Webpräsenz und vor allem eine Beteiligung beim Aufstellungsprozess von Regionalplänen via Internet erfordert allerdings finanzielle, zeitliche und personelle Ressourcen, die nicht allen Regionalplanungsträgern in ausreichendem Maße zur Verfügung stehen. Daher sollte angestrebt werden mit anderen Trägern der Regionalplanung zu kooperieren, um Synergieeffekte nutzen zu können. Auch ist eine gemeinsame Website der Planungsregionen eines Landes mit der Landesplanung denkbar. Auf dieser könnten grundlegende Informationen bereitgestellt werden, auf die von der Webpräsenz der Regionalplanung nur per Hyperlink verwiesen werden muss.

Generell ist eine Pflege in Eigenregie vom Regionalplanungsträger zu bevorzugen, da auf diese Weise auch aktuelle Informationen im Netz veröffentlicht werden können. Je mehr Mitarbeiter in der Planungsverwaltung ansässig sind, um so dezentraler sollte die Einstellung und Pflege der Webinhalte gestaltet werden. Für eine Behörde mit einer großen Anzahl an Mitarbeitern und einem umfangreichen Webangebot ist kaum ein anderes System als ein CMS denkbar, während für die Regionalplanungsträger mit einer kleinen Verwaltung und einer Website mit verhältnismäßig geringem Umfang auch eine statische Website in Frage kommt.

Um das Interesse für das Webangebot und die Akzeptanz der Nutzer zu gewinnen, ist es erforderlich, für das Webangebot zu werben. Damit ist die Webpräsenz nicht nur ein Beitrag zur Öffentlichkeitsarbeit der Planungsregion, sondern erfordert auch selbst Öffentlichkeitsarbeit. Dieser Arbeitsaufwand darf nicht eingespart werden, ansonsten ist der Erfolg der Website gefährdet.

Das Webangebot soll auf seinen Erfolg hin überprüft werden, um den Ansprüchen und Wünschen der Nutzer entsprechen zu können. Dazu können die Server-Logfiles ausgewertet werden sowie qualitative Erfolgskontrollen durch auf der Website implementierte Feedbackmöglichkeiten erfolgen.

6.2 Funktionen und Inhalt einer Webpräsenz

Die Untersuchung der vier Fallstudien hat gezeigt, dass Webpräsentationen der Regionalplanung stark von personengebundenen Initiativen und Synergieeffekten sowie personellen, zeitlichen und finanziellen Ressourcen abhängig sind. Außerdem wurde in keinem Fall direkt ein komplettes Webangebot erstellt – die Websites wurden nach einer Ersterstellung schrittweise ergänzt und verbessert. Daher werden die Empfehlungen für die Funktionen und inhaltlichen Bestandteile von Webpräsenzen der Regionalplanung basierend auf dem Prinzip eines "Baukastensystems" ausgesprochen. Der Baukasten setzt sich zusammen aus:

- **Grundbausteine:** Sie sind grundlegende Bestandteile von Webpräsenzen der Regionalplanung, die mit weniger Aufwand als die ergänzenden und zusätzlichen Bausteine zu realisieren sind und vorhanden sein sollen.
- **Ergänzenden Bausteine:** Sie machen das Angebot für die Benutzer attraktiver und runden es ab oder sind nicht für alle Webpräsenzen erforderlich, benötigen aber auch mehr zeitliche, personelle und/oder finanzielle Ressourcen als Grundbausteine.
- **Zusätzlichen Bausteine:** Sie benötigen im besonderen Maße zeitliche, personelle und/oder finanzielle Ressourcen.

Die Bausteine basieren auf den Kriterien der Status-quo-Analyse und werden durch Funktionen und Inhalte der Websites der Fallstudien ergänzt. Ihre Einordnung in das System erfolgte aufgrund der Erkenntnisse aus den Fallstudien in Kombination mit den Ergebnissen der Analyse des Status quo. Dieses System (s. Tab. 1) kann zur Erstellung einer Webpräsenz der Regionalplanung verwendet werden. Auch kann es der Überprüfung und gegebenenfalls zur Ergänzung eines bereits bestehenden regionalplanerischen Webangebots genutzt werden.

	Grundbausteine	Ergänzende Bausteine	Zusätzliche Bausteine
Information	Allgemeine Angaben und Webimpressum Ansprechpartner, Organisation und Aufgaben	Terminservice Berichte von Sitzungen der Gremien	Übertragungen und Archivierung von Veranstaltungen via Internet
	Informationen über den Regionalplan der Region Informationen zum Aufstellungsverfahren des Regionalplans Hintergrundinformationen über Regionalplanung Hinweis auf Einsichtsmöglichkeit des Regionalplans Hinweis auf konventionelle Beteiligungsmöglichkeit	Präsentation von Projekten der Regionalplanung Informationen über weitere Aufgaben und Aktivitäten der Regionalplanung Kurzinfo	
		Kurzinfo in weiteren Sprachen	Webpräsenz in weiteren Sprachen
	Informationen über die Region	Regionalstatistische Daten	Regionale Informationssysteme
	Textteil des Regionalplans als Download View-only Regionalplan	Textteil des Regionalplans online als Hypertext Interaktiver Regionalplan (grafische Lösung)	Interaktiver oder analytischer Regionalplan (WebGIS)
	Link auf bestehende Glossare	Regionalplanerisches Glossar	
	Externe Links	Link-Sammlungen	
	Bestellungsmöglichkeit Regionalplan	Bestellungsmöglichkeit weiterer Veröffentlichungen	
		Download von ausführlichen Informationen, Printmedien und öffentlichen Dokumenten	
	Externe Hyperlinks zu lokalen und regionalen Zeitungsherausgebern	Aktuelle Kundmachungen Pressemitteilungen, -service und -spiegel Newsletter	
Kommunikation	Online-Formular Zentrale E-Mail-Adresse	E-Mail-Adressen von Ansprechpartnern Moderierte, thematische Diskussionsforen Online-Befragung	Chat Extranet für Kooperationen, Koordination von Projekten etc.
Beteiligung	Textteil des Regionalplanentwurfs als Download View-only Regionalplanentwurf	Textteil des Regionalplanentwurfs als Hypertext Interaktiver Regionalplanentwurf (grafische Lösung)	Interaktiver und analytischer Regionalplanentwurf (WebGIS)
	Stellungnahmemöglichkeit per E-Mail für gesetzlich vorgeschriebenen Beteiligten	Stellungnahmemöglichkeit per Online-Formular oder E-Mail für alle Nutzern	Äußerung von Anregungen und Bedenken in Diskussionsforen und Chats

Tab. 1: Bausteine für Webpräsenzen der Regionalplanung

7 QUELLENVERZEICHNIS

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Regionale und kommunale Internetportale – Ein Instrument der regionalen Entwicklung und Zusammenarbeit?

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1 EINFÜHRUNG UND BEGRIFFLICHE GRUNDLAGEN

Das globale Internet wird als Informations- und Kommunikationskanal im lokalen und regionalen Kontext auf vielseitige Weise genutzt. Auf der einen Seite kann eine unzählige Vielfalt einzelner Internetauftritte von Unternehmen, Institutionen, Vereinen und Privatpersonen beobachtet werden. Auf der anderen Seite sind aber aus unterschiedlichen Richtungen heraus Bemühungen zu erkennen, verschiedene Inhalte zu integrierten Angeboten im Internet zusammenzufassen. Mit solchen umfassenden Angeboten, die begrifflich meist mit Plattform oder Portal umschrieben werden, beschäftigt sich dieser Beitrag. Angesicht der weiten Verbreitung und des oft umgangssprachlichen Gebrauchs der Begriffe erscheint zunächst eine grundlegende Definition und Einordnung als dringend notwendig.

- Der Begriff „**Plattform**" steht im allgemeinen Sinne für „Basis" oder „Grundlage". In der Informationstechnik gelten oft Hard- und Softwarearchitekturen als Plattformen, die als technologische Infrastruktur die Grundlage für verschiedene Anwendungen bildet (z.B. für einen Webauftritt oder ein Online-Bestellsystem). Darüber hinaus werden aber auch Anwendungen selbst als Plattformen bezeichnet, wenn der spezifische Zweck einen grundlegenden Charakter besitzt (z.B. Informations-, Beschaffungs-, Vertriebsplattform oder Bau-, Handwerker-, Bürgerplattform).
- Der „**Portal**"-Begriff versinnbildlicht in seiner ursprünglichen Bedeutung dagegen mehr den Zugang zu den Informationen und Inhalten. Im übertragenen Sinne stellt ein Portal im WWW ein eigenes Webangebot dar, dessen Zweck meist in der thematischen Sammlung und Systematisierung von Quellen (Hyperlinks) besteht, die einzeln in der Weite des WWW schwer zu finden sind.

Bezogen auf lokale und regionale Inhalte wäre demnach zum Beispiel der Begriff regionale Plattform dann angebracht, wenn ein Webauftritt vor allem eigene Inhalte darstellt. Wenn dagegen die Zugangsfunktion zu fremden Inhalten überwiegt, wäre die Bezeichnung Regionalportal zutreffender. In der Praxis hat sich inzwischen der Portalbegriff durchgesetzt, was leicht durch entsprechende Abfragen in Suchmaschinen nachzuvollziehen ist. Entsprechend dieser Konvention soll im Rahmen dieses Beitrags ebenfalls der Portalbegriff verwendet werden, obwohl aufgrund der inhaltlichen Angebote die Bezeichnung Plattform in den meisten Fällen passender wäre.

Die in diesem Sinne als **Internetportale** bezeichneten Webangebote mit verschiedenen lokalen und regionalen Inhalten sollen durch zwei Merkmale **charakterisiert und voneinander abgegrenzt** werden, durch:

- den räumlichen Bezug, der auch als Zielmarkt interpretiert werden kann, sowie
- den Betreiber des Portals, der als Anbieter der Informationen und Dienstleistungen auftritt.

Auf der ersten Ebene kann dementsprechend eine Differenzierung in kommunale und nicht-kommunale Internetportale vorgenommen werden (Abb. 1). **Kommunale Portale** (z.B. Gemeinde-, Stadt-, Landkreis-Portale) besitzen a priori einen Zielmarkt, der bezüglich der Verwaltungsdienstleistungen mit dem administrativen Gebiet übereinstimmt und daher sehr genau definiert ist. Bei anderen regionalbezogenen Angeboten lassen sich die räumlichen Grenzen dagegen nicht ohne weiteres bestimmen. Im besonderen Maße trifft dies auf Portale zu, die nicht von Kommunen betrieben werden, sie sollen hier allgemein als **Regional-Portale** (im weiteren Sinne) bezeichnet werden. Regional-Portale werden vor allem von Werbe-/Webagenturen, IT-Unternehmen, Internet Service Providern (ISP) und selbständigen Betreibern unterhalten. Ihr Zielmarkt lässt sich nicht eindeutig bestimmen, für eine realitätsnahe Abgrenzung wären mehrdimensionale Ansätze notwendig, die zur Entstehung von komplexen Konstrukten führen, die unter den Begriffen wie „regionale Identitäten" oder „räumliche Identitäten" diskutiert werden. Um eine solche komplexe und schwer nachvollziehbare Abgrenzung zu vermeiden, soll nachfolgend das **Betreiberkriterium** bevorzugt werden. Eine Sonderstellung nehmen die **Tourismusportale** ein: zum einen ist die Betreiberzuordnung nicht eindeutig (kommunal und nicht-kommunal), und zum anderen ist der Zweck der Portale primär ein anderer (die Region als „Produkt" nach außen für Touristen, aber auch nach innen als Freizeitort).

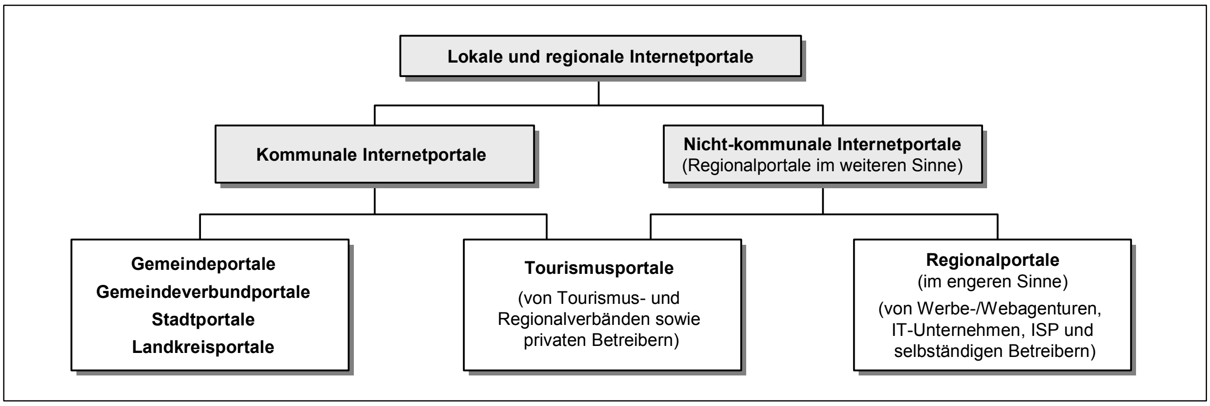


Abb. 1: Klassifizierung von lokalen und regionalen Internetportalen

2 STAND DER FORSCHUNG ZU KOMMUNALEN UND REGIONALEN INTERNETPORTALEN

Kommunale Internetportale waren in Deutschland bereits mehrfach Gegenstand von Untersuchungen. Die Erhebungen sind jedoch vor allem im Bereich E-Government einzuordnen, da meist der Implementierungsstand von Verwaltungsdienstleistungen im Internet untersucht wurde. Beispiele für solche Bestandsaufnahmen sind die Studie „E-Town 2002 – Deutschlands digitale Hauptstädte“ (Eder 2002), der „Internet-City-Test – Der Internet-Auftritt der deutschen Großstädte“ (Einemann 2002), „www.landkreis.de – Der Internet-Auftritt der deutschen Landkreise“ (Einemann 2001) sowie aus europäischer Perspektive die „Webbasierte Untersuchung des elektronischen Service-Angebots der Öffentlichen Hand“ im Rahmen des eEurope-Programms der Europäischen Kommission (Cap Gemini Ernst & Young 2002).

Neben der inhaltlichen Einschränkung auf typische E-Government-Fragestellungen ist allen genannten Erhebungen gemeinsam, dass sie sich methodisch auf eine **Beobachtung der Webangebote** beschränken. Die Untersuchung von Webseiten ist zwar relativ einfach und kostengünstig durchzuführen, weshalb sie oft angewandt wird, sie ist in der Aussage aber auch sehr begrenzt. Die aufwendigere (Online-)**Befragung als Erhebungsmethode** kam bisher bei Internetportalen nur selten zum Einsatz, dies gilt sowohl für die Portalbetreiber wie auch für die Portalnutzer. Beispiele für Umfragen zur Nutzung von Online-Verwaltungsdienstleistungen sind die Studie „Government Online“ von TNS, zu der jährlich in über 30 Ländern Interviews in der Bevölkerung durchgeführt werden (TNS EMNID 2003), sowie die umfangreiche webbasierte Befragung im Auftrag der Bayerischen Staatskanzlei „Was-will-der-Buerger.de“ (Accenture 2002). Größere Befragungen von Portalbetreibern sind nur von kommunalen Verbänden bekannt (Städtetag, Landkreistag), die Ergebnisse sind jedoch nicht der Öffentlichkeit zugänglich. Ausführlich dokumentiert sind hingegen die Aktivitäten im Rahmen des „Städtewettbewerbs Multimedia MEDIA@Komm“ (z.B. Grabow 2001), die sich aber nur auf die Teilnehmer erstrecken.

3 KONZEPTION EINER EIGENEN EMPIRISCHEN UNTERSUCHUNG

Alle genannten Beispiele beziehen sich auf Portale, die von den Kommunen zur Umsetzung ihrer Verwaltungsdienstleistungen im Internet betrieben werden. Diese Ansätze greifen in zweierlei Hinsicht zu kurz. Erstens bietet die Mehrzahl der kommunalen Portale wesentlich mehr Leistungen an, als aus ihren administrativen Aufgaben heraus unbedingt notwendig wäre, und zweitens wurden die vielen nicht-kommunalen Portale, die teilweise in Konkurrenz oder auch in Public-Privat-Partnership (PPP) zu den kommunalen Portalen stehen, überhaupt noch nicht berücksichtigt.

An diesen beiden Punkten setzt eine eigene empirische Erhebung an, die im Frühjahr 2003 durchgeführt wurde. Ausgangspunkt war zunächst eine Untersuchung der Webangebote von 600 Kommunal- und Regionalportalen in Deutschland (Koch 2002). Unter diesen Portalen wurde anschließend eine webbasierte Umfrage gestartet, die mit einer Rücklaufquote von 37,5% sehr erfolgreich verlief (Koch 2003). Daraufhin folgte der Entschluss, die Befragung auszuweiten, die dann fast in einer Vollerhebung mündete. Entsprechend den verfügbaren Datenquellen gab es drei Teilerhebungen: per E-Mail wurden **Gemeinden und Städte**, **Landkreise** sowie **Regionalportal-Betreiber** (alle in Deutschland) angeschrieben und zur Teilnahme an der Online-Befragung eingeladen (Tab. 1).

Teilerhebung	Befragungs umfang	Rücklauf	Rücklauf-quote (netto)	Auswertung	Anzahl	Anteil
1. Gemeinde-/Städte-Befragung	5.171	1.188	24,4%	1. Gemeinde-Portale	433	29%
				2. Stadt-Portale	497	34%
				3. „Gemeindeverbund“-Portale	258	17%
2. Landkreis-Befragung	323	115	36,1%	4. Landkreis-Portale	115	8%
3. Regionalportal-Befragung	435	175	40,6%	5. Regional-Portale	175	12%
Gesamt	**5.929**	**1.478**			**1.478**	**100%**

Tab. 1: Erhebungsumfang und Rücklauf der Befragungen

Die Resonanz auf die Befragung war insgesamt sehr gut. Die etwas geringere Rücklaufquote der Gemeinde- und Stadtportale erklärt sich aus dem relativ hohen Anteil von kleinen Gemeinden, die entweder keine eigene Homepage oder zumindest kein Portal im hier betrachteten Sinne betreiben. Wie in Tab. 1 ersichtlich ist, wurde zur Auswertung eine zusätzliche Gruppe mit dem Namen „**Gemeindeverbund**“ gebildet. In ihr sind acht verschiedene Arten von Gemeindezusammenschlüssen enthalten, die in den einzelnen Bundesländern unterschiedlich strukturiert und bezeichnet sind (z.B. Amt, Flecken, Markt, Verbandsgemeinde, Verwaltungsverband). Es handelt sich dabei also um Portale, auf denen mehrere Ortschaften (Gemeinden) vertreten sind, die zwar administrativ zusammengelegt wurden, aber immer noch eine eigene namentliche Identität besitzen.

Alle diese Portale leisten über ihre Verwaltungstätigkeit hinaus einen Beitrag zur regionalen Entwicklung und Zusammenarbeit. In welchem Maße und in welcher Form diese ausgeprägt sind, wird im Folgenden an ausgewählten Beispielen erläutert, wobei ansatzweise auf die Unterschiede zwischen den einzelnen Portalarten eingegangen wird (eine vollständige Auswertung ist unter www.local-ecommerce.de abrufbar).

4 AUSGEWÄHLTE ERGEBNISSE DER UNTERSUCHUNG

4.1 Zielgebiete der Portale

Das Zielgebiet stellt neben dem Betreiberkriterium ein weiteres Differenzierungsmerkmal zwischen den Portalarten dar. In Abb. 2 ist klar erkennbar, dass ein deutlicher Zusammenhang zwischen den Portalarten, die nach dem Betreiber unterschieden werden, und dem Zielgebiet besteht:

- Bei den **Gemeinde-, Stadt- und Landkreis-Portalen** gaben jeweils über 90% der Antwortenden ihr kommunales Gebiet als Zielmarkt an. Daneben spielt die umliegende Region mit 30% und mehr Nennungen eine bedeutende Rolle.

- Anders stellt sich die Auffassung der **Gemeindeverbund-Portale** dar. Die verschiedenen Strukturen von Gemeindezusammenschlüssen bieten offenbar kein klares Zielgebiet für ein Portal, denn nur die Hälfte wählte diese Option aus, dagegen sahen mehr als 60% in den einzelnen Gemeinden den vorrangigen Zielmarkt. Der Anteil der Portale, die zugleich die Gemeinde und den Gemeindeverbund als Zielgebiet angaben, liegt lediglich bei 20% von 254 Nennungen dieser Portalart.
- Die Region als Zielgebiet jenseits kommunaler Grenzen ist mit 85% nicht nur das Hauptabgrenzungskriterium bei den **Regional-Portalen**, sondern nimmt auch bei allen kommunalen Portalarten eine wichtige Stellung ein.

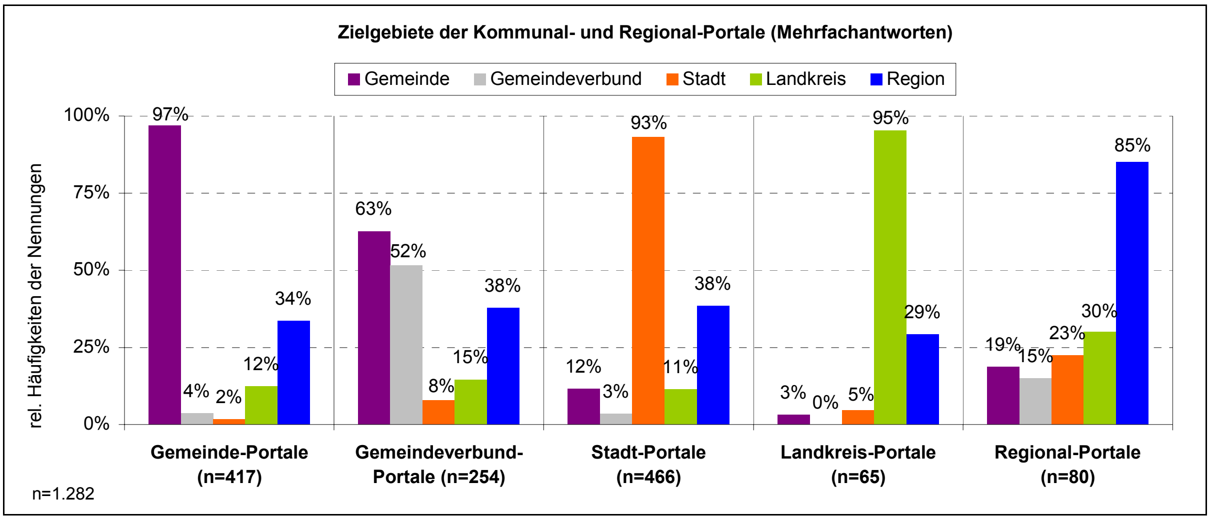


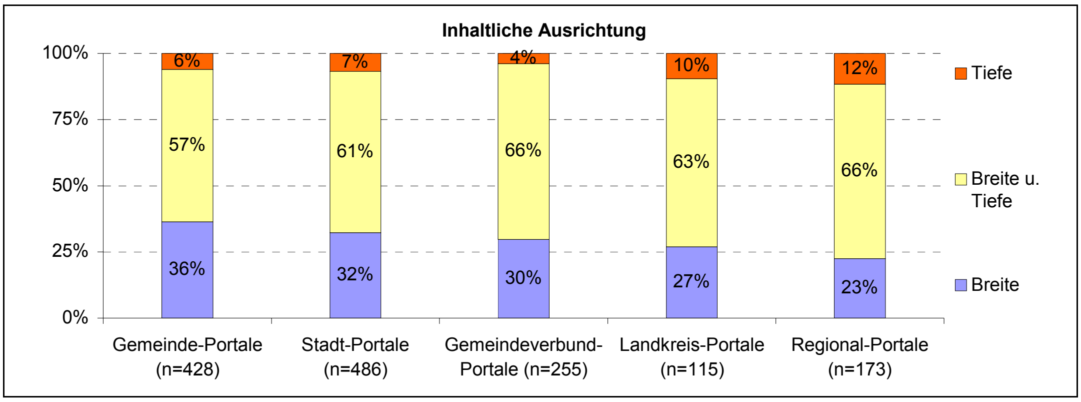
Abb. 2: Zielgebiete der Portale in Abhängigkeit von der Portalart

4.2 Inhaltliche Ausrichtung und Angebote der Portale

Ungeachtet der verschiedenen Zielmärkte sind zwei Drittel aller antwortenden Portale bestrebt, sowohl ein möglichst vielfältiges als auch umfassendes Angebot zu realisieren (Abb. 3).

- Mit **inhaltlicher Breite** (horizontale Portale) ist gemeint, dass ein Portal mehrere Primärangebote, wie z.B. Verwaltungsdienstleistungen, Touristikangebote (Reisen, Unterkünfte, Präsentationen), regionale Markplätze, Kunst-/ Kultur-/ Sportangebote (Veranstaltungen, Vereinspräsentationen) etc. vereint (vgl. Abb. 4).
- **Inhaltliche Tiefe** (vertikale Portale) bedeutet dagegen die Konzentration auf ein oder wenige Primärangebote, z.B. Verwaltungsdienstleistungen, Tourismus(-portal), regionaler Marktplatz, Immobilien(-portal). Innerhalb dieses Kernangebotes wird dann aber ein maximaler Ausbau in der Wertschöpfungskette angestrebt, beim Tourismusportal z.B. Präsentation der Region, Angebot/Vermittlung/Buchung von Veranstaltungen/Reisen/Unterkünften, Verkauf von regionalen Artikeln, Newslettersystem als Kundenbindungsinstrument etc.

Beim Vergleich der Portalarten kann eine Tendenz festgestellt werden, dass mit zunehmender Markt- bzw. Portalgröße (von Gemeinde- in Richtung Regional-Portale) der Anteil der Portale kontinuierlich abnimmt, die mehr auf eine breite Ausrichtung setzen, während der Anteil mit einem vertiefenden Ausrichtung zunimmt.



(Unterschiede zwischen Portalarten sind signifikant p< 0,5% Irrtumswahrscheinlichkeit, Chi²-Test nach Pearson)

Abb. 3: Inhaltliche Ausrichtung der Portalangebote in Abhängigkeit von der Portalart

Die Notwendigkeit einer breiten regionalen Ausrichtung der Portale spiegelt sich auch in der Bewertung von einzelnen **inhaltlichen Angeboten**, im Portal als **Rubriken** bezeichnet, wider (Abb. 4):

- Regionale Informationen (Veranstaltungen, Neuigkeiten) sowie die Präsentation des Ortes bzw. der Region werden von allen Portalen als elementar wichtig eingestuft – bei den kommunalen Portalen sogar genauso wichtig wie Verwaltungsdienstleistungen.

- Nachvollziehbar ist, dass ein Teil der spezialisierten Regional-Portale (Tourismusportale) das Angebot von Verwaltungsdienstleistungen als weniger notwendig erachtet, weshalb dann diese Rubrik an dritter Stelle erscheint.
- Angebote im Bereich Freizeit und Touristik werden von allen Portalarten ebenfalls als erforderlich angesehen, insbesondere von den Stadt- und Regional-Portalen.
- Die Nennungen von E-Commerce-Aktivitäten (z.B. beim Electronic Shopping, Immobilien) gehen zum großen Teil auf die Regional-Portale zurück, bei den Kommunalportalen weisen die Nennungen der Stadt-Portale eine höhere Ausprägung auf.

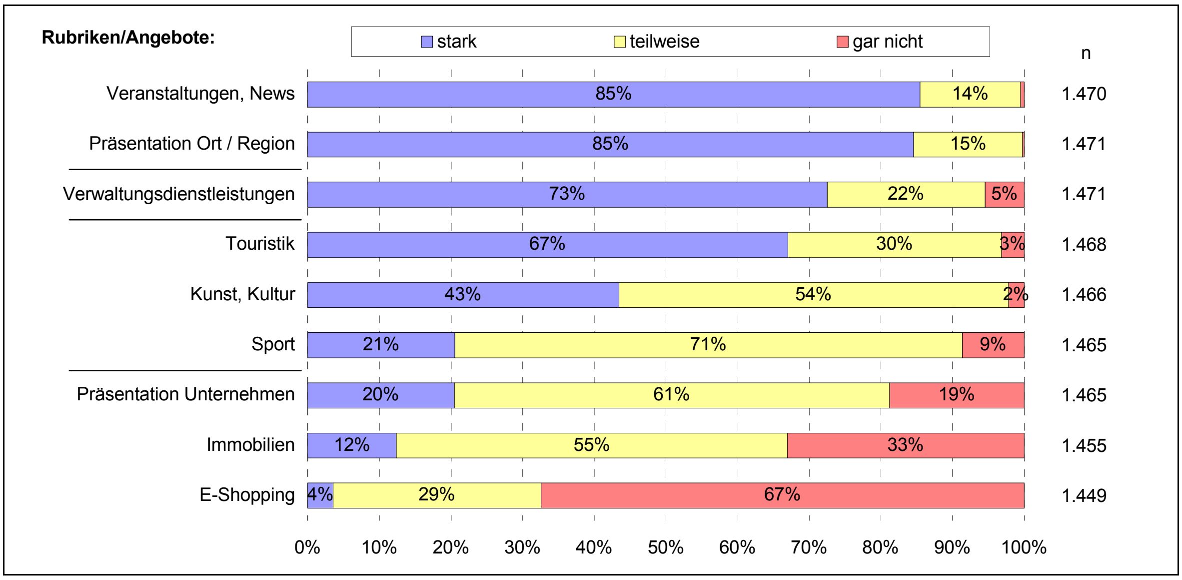


Abb. 4: Einschätzung der Notwendigkeit verschiedener Rubriken für ein Regionalportal

4.3 Mitwirkung von Beteiligten beim Portalaufbau und Portalbetrieb

Ein Indikator für die regionale Einbindung eines Portals ist die direkte **Mitwirkung verschiedener Akteure bei der Portalgründung und später beim laufenden Betrieb des Portals** (Abb. 5). Durch die Unterscheidung in der Befragung zwischen tatsächlicher und angestrebter Mitwirkung kann festgestellt werden, dass generell eine wesentlich umfangreichere Mitwirkung verschiedener Gruppen angestrebt wird, wenn auch die Stärke der Mitarbeit bei Unternehmen und Privatpersonen schwankt (mehr teilweise als starke Mitwirkung). Zwischen den Gruppen Unternehmen, Interessengruppen/Vereine und Regionalmarketing-Betreibern bestehen bei der Bewertung zur gewünschten Mitwirkung hochsignifikante positive Korrelationen. Dies deutet auf eine bestimmte Gruppe von Portalbetreibern hin, die eine möglichst umfassende Beteiligung von verschiedenen Partnern wünscht.

- In erster Linie gehören dazu die **Regional-Portale**, die von allen Portalarten die deutlich höchste Bereitschaft zur Mitwirkung der verschiedenen Gruppen aufweisen (auch bezüglich der Verwaltung).
- Im Gegensatz dazu deutet das Antwortverhalten der **Landkreis-Portale** im Durchschnitt auf das geringste Interesse an der Beteiligung externer Gruppen hin, insbesondere aus dem privaten und Freizeit-Bereich.
- **Gemeinde- und Gemeindeverbund-Portale** zeigen im Vergleich zu den anderen Portalarten eine relativ hohe Beteiligung von Privatpersonen, den geringsten Wert legen sie auf eine strukturierte Zusammenarbeit mit dem Regionalmarketing.

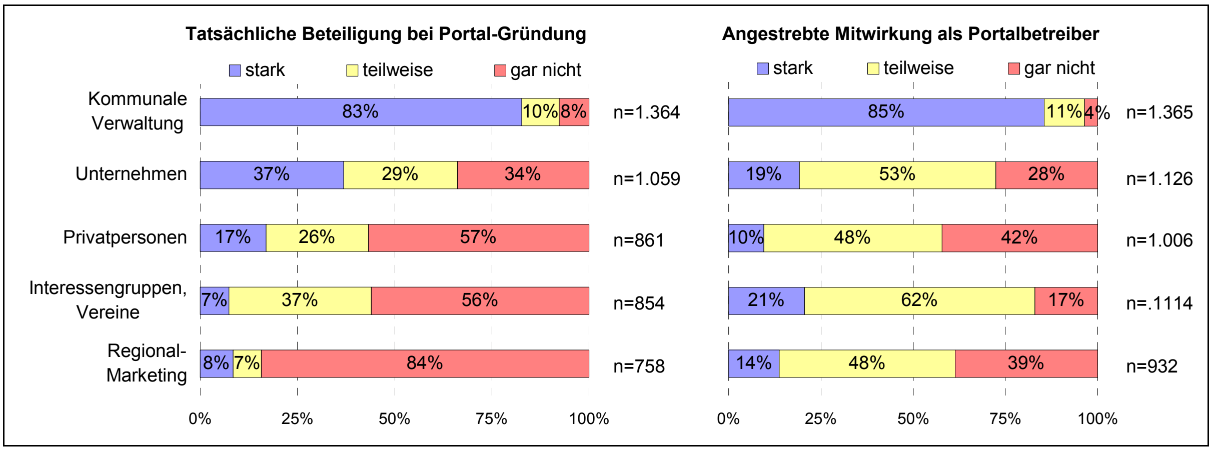


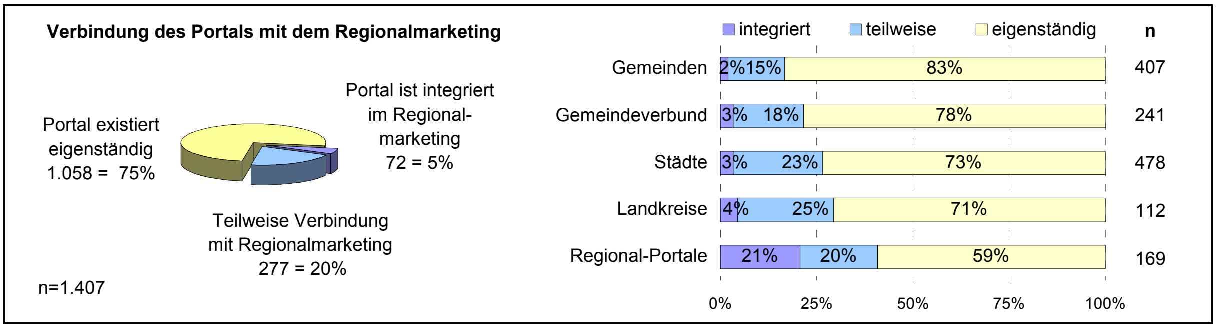
Abb. 5: Beteiligte bei der Portal-Gründung und gewünschte Mitwirkung als Portalbetreiber

4.4 Integration des Portals mit Regionalmarketing-Aktivitäten

Ein Kommunal- oder Regionalportal ist, wie die auszugsweisen Ergebnisse der Untersuchung zeigen, als Informations- und Kommunikationsmedium in verschiedener Weise mit der Region verbunden. Darüber hinaus kann ein solches Portal aber auch **bewusst als ein Instrument eingesetzt** werden, um gezielt Einfluss auf die Region zu nehmen. Nachdem bereits die Stellung des Regionalmarketing in der Frage zur Beteiligung bei der Portalgründung und angestrebten Mitwirkung bewertet werden sollte (vgl. Abb. 5), wurde in einer separaten Frage noch einmal konkret die Verbindung des Portals mit dem Regionalmarketing aufgegriffen (Abb. 6):

- Im Vergleich zur Antwort in Abb. 5 kann zunächst folgende steigende Tendenz geschlussfolgert werden: bei insgesamt 15% war das Regionalmarketing mindestens teilweise beteiligt, gegenwärtig besteht bei 25% mindestens eine teilweise Verbindung mit dem Regionalmarketing und über 60% streben eine Mitwirkung im Portalbetrieb an.
- Diese anscheinend klare tendenzielle Aussage muss jedoch eingeschränkt werden. Bei der Kreuztabellierung der Antworten musste beispielsweise festgestellt werden, dass von den 72 Antwortenden, bei denen das Portal mit im Regionalmarketing integriert ist, 12% keine Mitwirkung des Regionalmarketing wünschen. Bei den 277 Portalen, die eine teilweise Verbindung mit dem Regionalmarketing angaben, lag der Anteil gar bei 33%.
- Die Dissonanzen zwischen den Aussagen zeigen sich ebenfalls im Vergleich der Antwortzahlen: von den 72 Portale, die eine Integration angaben, äußerten sich nur 50 Portale (72%) zur gewünschten Mitwirkung des Regionalmarketing. Von den 277 Portalen, die eine teilweise Verbindung angaben, liegen nur 181 Nennungen (62%) zur Mitwirkung vor.

Die Analyse der Antworten deuten zum einen auf ein vorhandene Problembereiche in der Zusammenarbeit mit Verantwortlichen des Regionalmarketing hin, zum anderen scheint die Art und Weise der Verbindung nicht klar definiert zu sein, worauf die unstimmigen Antworten hindeuten. In jedem Falle bestehen aber auch noch reichlich Gestaltungspotenziale, denn von der großen Anzahl derer, die ihr Portal eigenständig betreibt (1.058) und die eine Bewertung zur Mitwirkung des Regionalmarketing abgab (681), befürwortet eine Mehrheit (10% stark, 48% teilweise) die Mitwirkung des Regionalmarketing im Portalbetrieb. Die Differenz in der Antwortzahl von 1.058 und 681 in den beiden Fragen zeigt den Anteil noch unschlüssiger Portale.



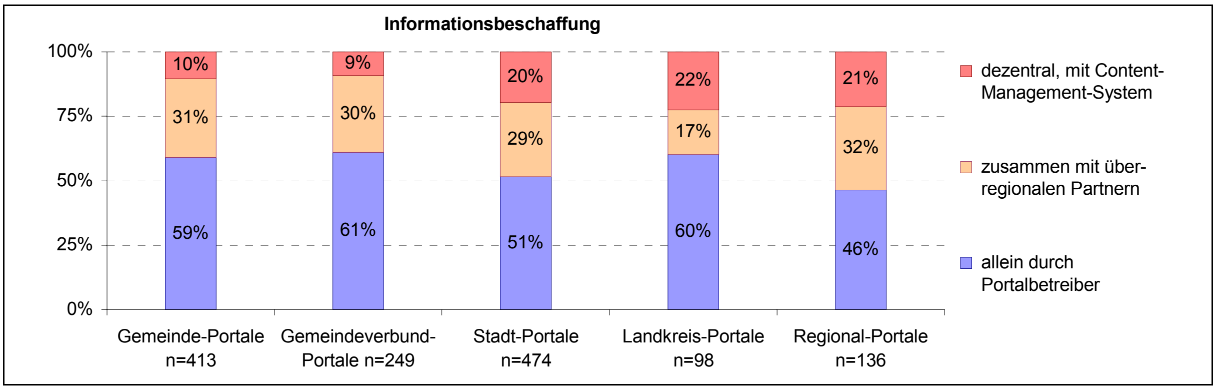
(Unterschiede zwischen Portalarten sind signifikant mit p<0,1% Irrtumswahrscheinlichkeit, Chi²-Test nach Pearson)

Abb. 6: Verbindung des Regionalportals mit dem Regionalmarketing insgesamt und differenziert nach der Portalart

4.5 Organisation der Informationsbeschaffung

Das Angebot von regionalbezogenen Informationen ist für Kommunal- wie auch für Regional-Portale von höchster Bedeutung (vgl. Abb. 4). Bei der Vielfalt von regionalen Informationen und Angeboten erscheint schon allein aus wirtschaftlichen Gründen die Einbeziehung von regionalen Partnern als notwendig. Über einen reinen Informationsaustausch hinaus kann im Idealfall ein **Content-Management-System** eingesetzt werden, mit dem verschiedene Beteiligte dezentral und selbständig Inhalte auf dem Portal veröffentlichen können. Die Beantwortung einer entsprechenden Frage unterstreicht im Wesentlichen die Tendenz, die bei den Antworten zur allgemeinen Mitwirkung von regionalen Akteuren festgestellt wurde (Abb. 7).

- Von den **Stadt- und Regional-Portalen** arbeitet etwa die Hälfte mit regionalen Partnern zusammen, ein Fünftel nutzt dazu bereits ein Content-Management-System.
- Auch **Landkreis-Portale** nutzen relativ oft ein Content-Management-System, doch wie bei den **Gemeinde- und Gemeindeverbund-Portalen** beschaffen noch etwa 60% der Portale selbst ihre Inhalte und stellen diese online.



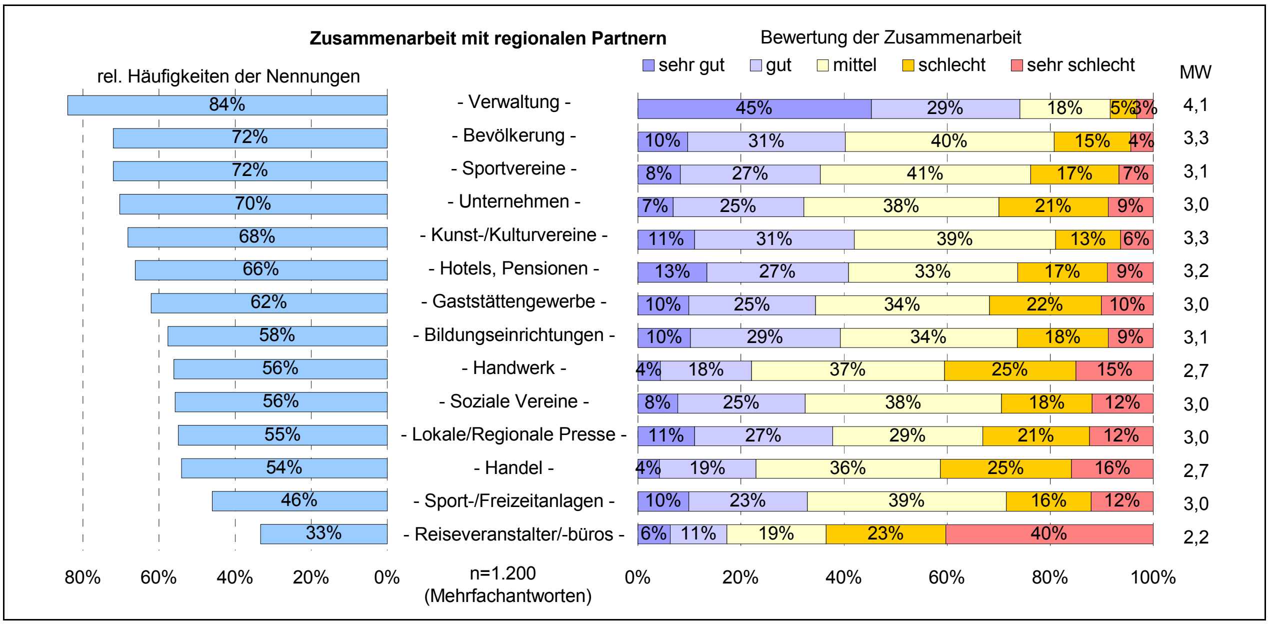
(Unterschiede zwischen den Portalarten sind signifikant mit p<0,1% Irrtumswahrscheinlichkeit, Chi²-Test nach Pearson)

Abb. 7: Vergleich der Organisation der Informationsbeschaffung für das Portal in Abhängigkeit von der Portalart

4.6 Zusammenarbeit mit regionalen Partnern

Nach verschiedenen inhaltlichen Kriterien der Zusammenarbeit sollte in differenzierter Weise erfasst werden, mit welchen regionalen Akteuren die Portale konkret zusammenarbeiten und wie sie diese bewerten (Abb. 8).

- Bedingt durch den hohen Anteil an kommunalen Portalen in der Befragung wurde die **Verwaltung** mit Abstand am häufigsten genannt. Gleichzeitig erhielt die Verwaltung auch die beste Bewertung. Die **Bevölkerung** als eine spezielle Zielgruppe wurde am zweithäufigsten genannt und mit am zweitbesten bewertet. Bildungseinrichtungen sowie die Presse wurden immer noch von mehr als der Hälfte der antwortenden Portale aufgeführt.
- Die **Wirtschaft** als Zielgruppe ist mit den Unternehmen ebenfalls an der Spitze der Nennungen vertreten. Kleinere gewerbliche Vertreter aus dem Bereich Handel und Handwerk wurden auch von mehr als der Hälfte genannt, erhielten dabei aber schon deutlich schlechtere Bewertungen.
- Typische **Tourismusbereiche** sind Unterkünfte (Hotels, Pensionen) und das Gaststättenwesen. Beide wurden von etwa zwei Dritteln der Antwortenden angegeben. Selten scheint die Zusammenarbeit mit Reiseveranstaltern/Reisebüros zu funktionieren. Mit nur einem Drittel Nennungen befinden sie sich sowohl von der Anzahl als auch von der Bewertung her auf dem letzten Platz.
- Die verbleibenden vier Vertreter können dem **Freizeitbereich** zugeordnet werden. Sport- sowie Kunst-/Kulturvereine spielen als regionale Partner offensichtlich eine große Rolle. In ihrer Bewertung werden sie überwiegend positiv eingeschätzt. Soziale Vereine sind generell nicht von unerheblicher, aber doch von geringerer Bedeutung für die Zusammenarbeit. Immerhin werden sie noch von über der Hälfte aufgeführt − im Gegensatz zu den Betreibern von Sport- und Freizeitanlagen, die auf dem vorletzten Platz zu finden sind und eine mittlere Bewertung bekamen.



(MW= Mittelwert, Skala: 1=sehr schlechte … 5=sehr gute Zusammenarbeit)

Abb. 8: Häufigkeiten und Bewertung der Zusammenarbeit der Portale mit regionalen Partnern

Die Gegenüberstellung der Portalarten hinsichtlich der Häufigkeit der Nennungen zeigt vor allem eine klare Abweichung des Antwortverhaltens der Landkreis-Portale:

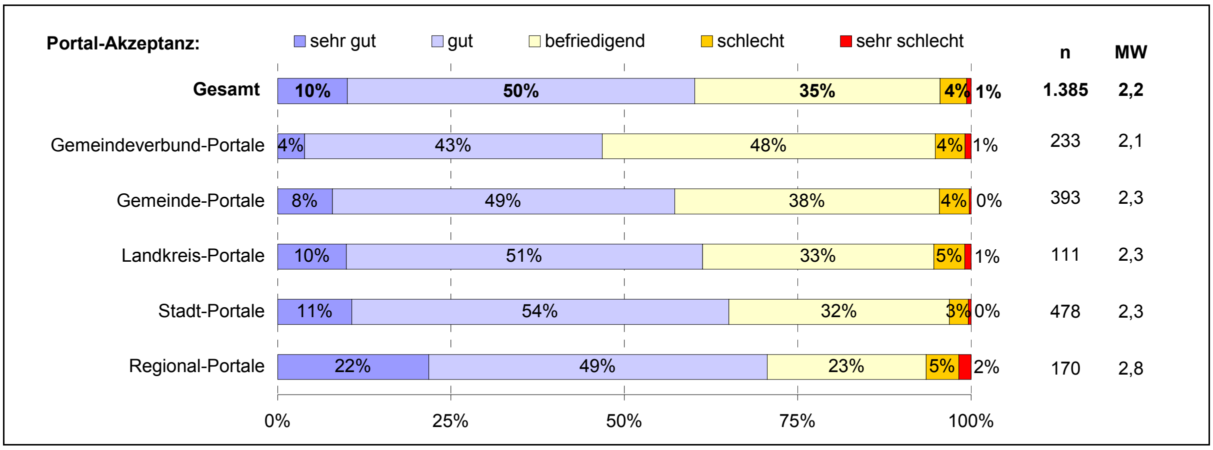
- In den Bereichen Wirtschaft, Tourismus und Freizeit gaben die **Landkreis-Portale** durchgängig mit Abstand die geringsten Nennungen ab. Lediglich die Verwaltung wurde mit 94% am häufigsten aufgeführt. In der Bewertung gaben Landkreis-Portale, soweit sie denn kooperieren, dann aber generell überdurchschnittlich gute Noten ab.
- Die **Regional-Portale** besitzen offenbar die besten Kontakte zur Presse (73%), im Bereich Tourismus heben sie sich besonders stark von den anderen Portalarten ab (da 50% Tourismusportale sind) und bewerten diesen Bereich auch gut. Vergleichsweise mehr Probleme als andere Portalarten gaben sie im Freizeit- und Bildungsbereich an.
- **Gemeinde-, Gemeindeverbund- und Stadt-Portale** haben schwerpunktmäßig bei Partnern im Freizeitbereich die häufigsten Nennungen bei überwiegend durchschnittlichen Bewertungen.

4.7 Akzeptanz der Portalangebote aus Anbietersicht

Damit Kommunal- und Regionalportale überhaupt einen Einfluss in der Region entfalten können, müssen ihre Angebote von den Zielgruppen angenommen werden. Zur Ermittlung der Akzeptanz sind normalerweise repräsentative Nutzerbefragungen notwendig, die idealerweise auch über traditionelle Befragungsmethoden (telefonisch, schriftlich) durchgeführt werden, um den Kreis der potenziellen Nutzer (gegenwärtige Nicht-Nutzer) mit einzubeziehen und eventuelle Hinderungsgründe zu erfassen. Einfacher und kostengünstiger sind webbasierte Umfragen auf dem Portal, doch wie eine Recherche unter den Portalen ergab, werden diese kaum durchgeführt. Das Bewusstsein dafür scheint insgesamt sehr gering zu sein, denn selbst das Angebot einer kostenlosen Nutzerbefragung, die die Portalbetreiber-Befragung ergänzen sollte, wurde nicht angenommen.

Aus diesen Gründen kann die Portalakzeptanz an dieser Stelle nur anhand von Aussagen der Portalbetreiber analysiert werden. Doch auch die Ergebnisse einer globalen **Selbsteinschätzung** der Portalbetreiber zeigen bereits interessante Ansätze (Abb. 9):

- Im Vergleich der Portalarten schneiden die **Regional-Portale** am besten ab. Bemerkenswert ist, dass sich sogar 22% sehr zufrieden mit der Portalakzeptanz gaben. Über 70% schätzen die Akzeptanz mit gut oder sehr gut ein.
- In relativ gleichmäßigen Abständen von 4-5% folgenden bei einer guten und sehr guten Bewertung die **Stadt-, Landkreis- und Gemeinde-Portale**.
- Etwas zurückhaltender sind die **Gemeindeverbund-Portale** in ihrer Einschätzung, weniger als die Hälfte (47%) beurteilen die Akzeptanz ihrer Portale mit gut oder sehr gut, etwa genauso viel rechnet mit einer befriedigenden Akzeptanz.



(n= Anzahl der Nennungen, MW= Mittelwert, Skala: 1=sehr schlechte … 5=sehr gute Akzeptanz;
Unterschiede zwischen Portalarten sind signifikant mit p<0,1% Irrtumswahrscheinlichkeit, ANOVA, Student-Newman-Keuls-Test)

Abb. 9: Allgemeine Akzeptanz des Portals aus Sicht der verschiedenen Portalbetreiber

Eine Möglichkeit die Akzeptanz von Portalangeboten zu ermitteln, ist die **Erfassung von Zugriffszahlen** auf die angebotenen Leistungen. Von den Befragten gaben 61% an, auf diese Weise regelmäßig die Portalnutzung zu evaluieren, 34% verneinten die Antwort und 5% konnten keine Angabe machen.

Anschließend sollten die Portalbetreiber in einer offenen Fragestellung die **drei am meisten nachgefragten Portalangebote bzw. Rubriken** nennen. Die Anzahl der Angaben von 694 (47% aller Antwortenden) in der ersten Rubrik gibt bereits Aufschluss darüber, dass mehr als die Hälfte der Portalbetreiber nicht detailliert über die Portalnutzung informiert ist. Am geringsten informiert zeigten sich dabei **Landkreis-Portale**, lediglich ein Drittel (34%) konnte bei dieser Frage überhaupt eine Angabe machen. Etwas besser sieht die Situation bei den **Stadt-Portalen** aus, bei diesen lag die Antwortquote immerhin bei 59%.

Inhaltlich lassen sich die Ergebnisse in drei Gruppen einteilen (Abb. 10):

- An erster Stelle standen wieder (wie in Abb. 4) Veranstaltungen, Termine und aktuelle Mitteilungen, die insgesamt 30% aller Angaben umfassen.
- Die zweite Gruppe wird von Verwaltungsdienstleistungen dominiert, die mehr kundenorientierten Formulierungen wie Bürgerservice, Bürgerdienste, Bürgerinformationen gehören ebenfalls dazu (beide zusammen 28% aller Nennungen).
- Ebenfalls häufig angegeben wurden verschiedene Angebote im Bereich Tourismus und Freizeit (zusammen 33%).

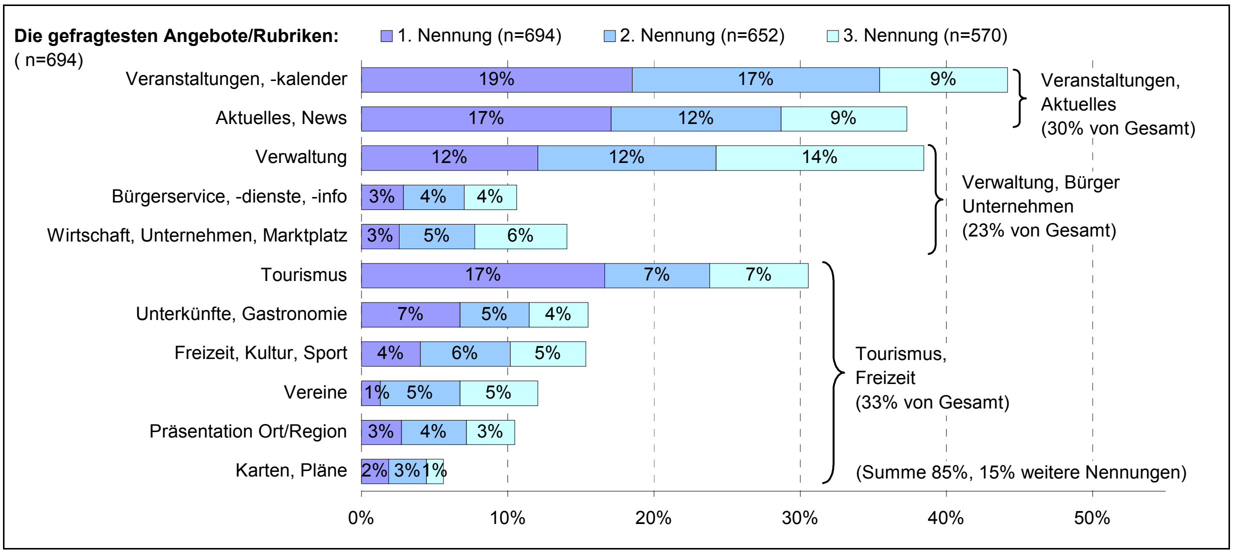


Abb. 10: Am meisten nachgefragte Rubriken aus der Sicht der Portalbetreiber

5 ERFOLGSFAKTOREN FÜR KOMMUNALE UND REGIONALE PORTALE

Am Ende des Fragebogens sollten in drei nummerierten Feldern die wichtigsten Erfolgsfaktoren aus der Sicht der Antwortenden angegeben werden. Bei der Durcharbeitung des Fragebogens wurden bereits vielfältige Kriterien für die Gestaltung und das Management von Regionalportalen angesprochen, so dass eine intensive Beschäftigung mit der Thematik sichergestellt werden konnte. Die sinngemäße inhaltliche Zusammenfassung der wichtigsten Angaben zeigt in den ersten zwei Punkten die zentralen Erfolgsfaktoren eines Portals sowie im Weiteren oft genannte Anforderungen (Tab. 2):

- Die **Aktualität** sowie eine **übersichtliche Strukturierung** und **einfache Navigation** können als zentrale Basisanforderungen an ein Kommunal- oder Regional-Portal gewertet werden, in denen fast alle Antwortenden übereinstimmen.
- Eine sehr große Anzahl hält ein **breites, vielfältiges Angebot** für sehr wichtig, welches unbedingt an den **Nutzerbedürfnissen/Zielgruppen** auszurichten ist. Ein Teil wies dabei auf den notwendigen **Lokal- und Regionalbezug** der Inhalte hin.
- Als sehr wichtig für die Akzeptanz gilt ein ansprechendes Design/Layout, allerdings mit vertretbarem technischen Aufwand und unter Berücksichtigung der Ladezeiten der Portalseiten. Weiterhin wurde von einem bedeutenden Anteil auf die Bereitstellung von Verwaltungs- bzw. Bürgerdienstleistungen, auf das „Für“ und „Wider“ der Werbung sowie auf die bereits ausführlich betrachtete Kooperation- und Zusammenarbeit mit verschiedenen Partnern hingewiesen.

Erfolgsfaktor	Summe	1. Nennung	2. Nennung	3. Nennung
1. Aktualität	**664**	401	172	80
2. Übersichtliche, benutzerfreundliche Strukturierung, einfache Navigation	**661**	187	263	211
3. Breites, vielfältiges, regionalbezogenes Angebot	**229**	48	115	66
4. Nutzer-/Zielgruppenorientierung, Akzeptanz	**189**	62	60	67
5. Ansprechendes Design/Layout	**158**	32	56	70
6. eGovernment	**154**	39	51	64
7. Lokale/regionale Inhalte	**132**	43	41	48
8. Bekanntheit des Portals, Werbung	**109**	50	18	41
9. Schnelligkeit, kurze Ladezeiten	**107**	19	34	54
10. Kooperation, Zusammenarbeit	**96**	16	41	39
Nennungen gesamt	**2.445**	**857**	**832**	**756**

Tab. 2: Zusammenfassung wichtiger Erfolgsfaktoren für Regionalportale

6 FAZIT

Die auszugsweise vorgestellten Ergebnisse der webbasierten Befragung von Portalbetreibern lassen insgesamt den Schluss zu, dass alle Portalarten einen ausgeprägten regionalen Bezug aufweisen, was an der Breite der angebotenen regionalen Informationen und an der Vielfalt von Verknüpfungen mit regionalen Partnern zum Ausdruck kommt. Aufgrund des fehlenden Angebots an Verwaltungsdienstleistungen engagieren sich **Regional-Portale** in diese Hinsicht am stärksten. Von den kommunalen Portalen weisen die **Stadt-Portale** die signifikant höchsten Werte bei der Vielfalt an regionalen Angeboten und Kooperationsbeziehungen auf. **Landkreis-Portale** sind mehrheitlich von einer starken Verwaltungsorientierung geprägt, wobei sich abweichend davon eine Gruppe herauskristallisiert, die in besonders hohem Maße auch regionale Leistungen anbietet. Die These, dass mit dem Internet oder allgemein mit IuK-Technologien ein signifikanter Beitrag zur Entwicklung und Förderung ländlicher Gebiete geleistet wird, kann mit den vorhandenen Ergebnissen nicht unterstützt werden. Speziell die Ergebnisse der **Gemeindeverbund-Portale** zeigen ein sehr restriktives Verhalten, welches teilweise auch die geringe Akzeptanz bei den Nutzern erklärt. Bei kleineren **Gemeinden** muss hingegen generell die Frage nach dem Sinn und der Effizienz eines eigenen Portals gestellt werden. Insgesamt kam die Bedeutung von kommunalen und regionalen Portalen klar zum Ausdruck, von einem bewussten und zielgerichteten Einsatz als Instrument der regionalen Entwicklung und Zusammenarbeit kann zum gegenwärtigen Zeitpunkt jedoch noch nicht ausgegangen werden.

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Die NÖ Breitbandinitiative – Niederösterreichs Weg in die Informationsgesellschaft

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Die moderne Informationsgesellschaft beruht auf dem umfassenden Gebrauch von Informations- und Kommunikationsnetzen, sowie einem breiten Angebot neuer Produkte, Dienstleistungen und Informationsangebote. Die Bedingungen für Zugang und Nutzung dieser "Informationsinfrastruktur" basieren auf demokratischen Grundwerten, dienen der Chancengleichheit und gewährleisten für alle Bürger Information und Kommunikation.

1 DAS NÖ TELEKOMMUNIKATIONS – LEITBILD 1997

Das Land NÖ hat bereits 1997 den Weg zur Informationsgesellschaft mit dem NÖ Telekommunikations - Leitbild beschritten. Es baute zunächst auf den Säulen Verwaltung, Bildung und Wirtschaft auf und wurde seither mit Blick auf den rasanten Fortschritt der Kommunikationstechnologien laufend weiterentwickelt.

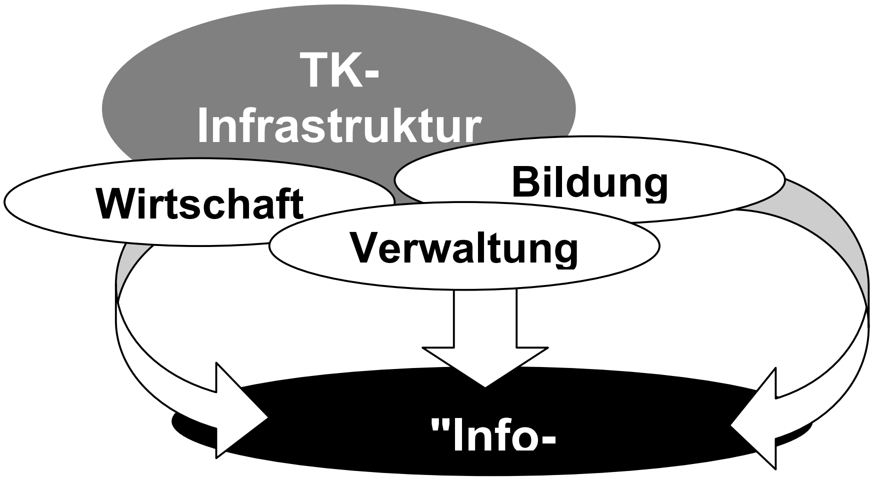


Abbildung: Schwerpunkte des TK-Leitbildes NÖ 1997

1.1 Schwerpunkt Wirtschaft

Seit jeher ist die Standortqualität eine, wenn nicht *die* zentrale Voraussetzung für den betrieblichen Erfolg eines Unternehmens. Während der 150 Jahre seit Beginn der industriellen Revolution bildete die räumliche Erreichbarkeit (Erreichbarkeit von Absatzmärkten, Vorleistern, Arbeitskräften etc.) das entscheidende Moment für die Qualität eines Betriebsstandorts. Mit heutigen Möglichkeiten der Telekommunikation tritt nun ein neues Standortkriterium an die Seite der räumlichen Erreichbarkeit, die Möglichkeit virtueller Erreichbarkeit über den Zugang zu Kommunikations- und Informationsnetzwerken, bestimmt durch die Anschlussqualität an die Hochleistungsnetze der Telekommunikation.

Wie einst die Lage an einem schiffbaren Gewässer oder der Eisenbahnanschluss Voraussetzung für die Entwicklung industri-eller Unternehmen war, so ist heute der Zugang zu Telekommunikationsinfrastruktur mit großer Bandbreite für viele Betriebe unverzichtbar, hingegen das Fehlen ausreichender Anschlussqualität ein mitunter entscheidender Konkurrenznachteil.

Umgekehrt lässt sich heute vielfach schlechte räumliche Erreichbarkeit durch Zugang zu den Hochleistungsnetzen der Telekommunikation kompensieren. Mit der Möglichkeit des Datenaustauschs und der „virtuellen“ Zusammenarbeit sind räumliche Nähe und die tatsächliche Begegnung mit Auftraggebern heute in wesentlich geringerem Ausmaß erforderlich, womit ein Hauptnachteil peripherer Gebiete für eine ganze Reihe von Branchen stark gemildert wird.

Entscheidend ist der Ausbau der Hochleistungsnetze der Telekommunikation insbesondere in den Bereichen, wo Raumordnung und Förderprogramme Betriebsansiedelungen vorsehen. Anschlüsse mit entsprechender Bandbreite müssen im Sinne zukunftsorientierter Planung ebenso zur „Grundausstattung“ eines Betriebsstandorts gezählt werden wie Wasser- oder Stromanschluss.

1.2 Schwerpunkt Bildung und Verwaltung

Die globale Vernetzung der elektronischen Medien schafft neue Voraussetzungen, die über die traditionellen Kanäle der Ausbildung hinausgehen. Durch elektronische Netze können Zusammenhänge geschaffen werden, für die es in traditionellen Systemen keine Möglichkeiten gab. Die größte Herausforderung im Bereich öffentlicher Einrichtungen stellen daher zweifellos die Schulen dar. Der Zugriff auf moderne multimediale Unterrichtsmaterialien ist über das Internet möglich und Schüler müssen für den Umgang mit diesen Medien gerüstet werden. Zumindest die Schulen für die über Zehnjährigen müssen daher kurzfristig mit Zugängen zu den Hochleistungsnetzen ausgestattet werden, will man nicht den Anschluss an internationale Entwicklungen verpassen.

1.3 Schwerpunkt: Bürger

Mit der rasanten Entwicklung von Technologie und Markt sind mittlerweile vor allem Mobilfunk und PC-Technologie in praktisch allen Lebensbereichen präsent. Jeder einzelne Bürger ist heute in der Lage, seinen Weg in die Informationsgesellschaft zu beschreiten. Das Land NÖ sieht es als seine Aufgabe, den Bürger auf seinem Weg in die Informationsgesellschaft zu begleiten. Die seinerzeitigen Schwerpunkte Verwaltung, Bildung und Wirtschaft wurden um den vierten Schwerpunkt "Bürger" ergänzt.

2 UMSETZUNG DES TK-LEITBILDES IM EINKLANG MIT *EEUROPE 2005*

Von Anbeginn wurde das NÖ Telekommunikations – Leitbild entsprechend der verfügbaren technischen Möglichkeiten konsequent umgesetzt.

In der Verwaltung wurde bereits mit der Vernetzung aller Landesdienststellen (von den Bezirkshauptmannschaften bis zu den Straßenmeistereien) und dem Web-Angebot des Landes www.noe.gv.at ein sehr erfolgreicher Schritt gesetzt.

In der Bildung konnten entsprechende Lehrgänge an der Donau Universität und an den Fachhochschulen eingerichtet werden, eine NÖ Bildungsplattform www.bildung4you.at wurde als Webangebot geschaffen und zur Zeit wird eine Vernetzung aller Schulen getestet.

Im Bereich Wirtschaft wurde mit www.loweraustria.biz ein umfassendes Portal geschaffen - mit Informationen über den Wirtschaftsstandort, Förderungen, F&E- und Ausbildungseinrichtungen, Kooperationsmöglichkeiten und Cluster sowie die Gründerinitiative des Landes GENIUS; und für den Tourismusbereich wurde mit TISCOVER eine erfolgreiche Portallösung zur Darstellung der NÖ Tourismuswirtschaft initiiert: www.niederoesterreich.at.

Der Europäische Rat hat in Lissabon im Juni 2000 den entsprechenden Aktionsplan ***eEurope*** festgelegt, in dem die wesentlichen Leitlinien des Landes NÖ aus dem Jahre 1997 bestätigt wurden.

Konkret sollen

- alle Bürger, Schulen, Unternehmen und Verwaltungen in das digitale Zeitalter gebracht werden, sowie
- dieser Prozess gesellschaftlich integrativ sein, auf Konsumentenvertrauen aufbauen und den sozialen Zusammenhalt stärken.

Die Prioritäten im ***eEurope* Aktionsplan** wurden folgendermassen festgelegt:

- Billigeres, schnelleres und sicheres Internet
- Investitionen in Menschen und Fertigkeiten zur Teilnahme aller an der wissensgestützten Wirtschaft
- Förderung der Nutzung des Internet

2.1 Wo besteht ein Defizit?

Was die Telekommunikations-Infrastruktur betrifft, wurde im Leitbild davon ausgegangen, dass der Markt die Vernetzung der Unternehmen von selber regeln wird, da damals die Informations- und Kommunikationstechnologie in den kleinen und mittleren Unternehmen Wachstumsraten an die 20% aufgewiesen hat. Der Markt hat die Vernetzung jedoch nicht ausreichend vorangetrieben. Es gibt zur Zeit eine Vielzahl von Insellösungen, wie den ADSL-Ausbau der Telekom, Funk Anbieter (WLAN) oder die verschiedenen Kabel-TV-Anbieter. Derzeit versorgt der Markt in NÖ jedoch nur die Ballungsräume gut. Nur dort ist nahezu jede Technologie verfügbar.

Der ländliche Raum ist unterversorgt. Abseits der Entwicklungsachsen gibt es in ca. 400 Gemeinden in NÖ nicht die Möglichkeit, sich an eine qualitativ hochwertige Telekommunikationseinrichtung anzuschließen. Dadurch kann 2003 etwa ein Drittel der Betriebe und 45% der Bürger noch nicht erreicht werden. Diese zukünftigen Kunden stellen aber für viele Breitband-Anwendungen jenes Potenzial dar, das die "kritische Masse" (Zahl der Teilnehmer) zu überschreiten erlaubt, ab der erst ein Angebot kommerziell erfolgreich ist.

Bezugnehmend auf diese Problematik hält der ***eEurope* Aktionsplan** fest:

„Die uneingeschränkte Teilnahme der strukturschwächeren Regionen an der Informationsgesellschaft ist für die Union ein vorrangiges Anliegen. Projekte zur Förderung der Übernahme neuer Technologien müssen daher zu einem grundlegenden Bestandteil der regionalen Entwicklungspläne werden. Wenn der Markt versagt, weil private Investoren allein nicht rentabel sind, können öffentliche Investitionen in strukturschwächeren Regionen gerechtfertigt sein. Sie dürfen allerdings den Wettbewerb nicht verzerren und müssen technologisch neutral sein. Über die Investitionen muss jede Region aufgrund ihrer besonderen wirtschaftlichen und sozialen Struktur selbst entscheiden“.

Die Mitgliedsstaaten sollten zusammen mit der Kommission erforderlichenfalls die Einführung von Breitbanddiensten in benachteiligten Regionen unterstützen. Daher wurde die **NÖ Breitbandinitiative** gestartet.

3 AUSBAU DER BREITBAND-INFRASTRUKTUR

3.1 Der Bedarf der NÖ Wirtschaft

Um den Wirtschaftsstandort NÖ zu stärken, ist eine Anbindung an die Breitbandinfrastruktur unbedingt erforderlich. Im Hinblick auf die EU Erweiterung ist darauf hinzuweisen, dass gerade die Klein- und mittleren Unternehmen in den Beitrittsländern auf dem neuesten Stand in der EDV-Ausstattung sind.

Konkrete Anforderungen an das Land NÖ und eine Erhebung haben ergeben, dass ein sehr konkreter Bedarf an einer "Breitband-Versorgung" besteht. Dieser Bedarf wurde im Telekommunikations-Infrastrukturkonzept 2003 für NÖ quantifiziert und dem Angebot gegenübergestellt. Das Ergebnis ist, dass es "weiße Flecken" der Breitband-Versorgung in NÖ gibt, die zu füllen die bloßen Kräfte des Marktes bisher nicht in der Lage waren. Ca. 15.000 Betriebe sind davon betroffen.

Die beiliegende Karte zeigt die Gebiete, in denen heute schon eine Breitband-Infrastruktur zur Verfügung steht, in grüner Schattierung, solche Gebiete, in denen eine Versorgung unmittelbar bevorsteht, in gelb. Der für Verwaltung, Bildung und Wirtschaft erhobene Bedarf in den unversorgten Gebieten („weißen Flecken“) wurde nach kleinräumigen Siedlungskreisen aufgeschlüsselt und nach Prioritäten gereiht. Dieser ist an den roten Punkten in der Karte abzulesen.

Ziel ist es, zu angemessenen Preisen eine moderne Telekom-Infrastruktur auch in den derzeitigen "weißen Flecken" der Versorgung aufzubauen. Sie werden gefüllt, indem das Land NÖ in den Markt eingreift und durch seine normative Kraft dafür sorgt, dass ein möglichst homogener Markt für Breitband-Dienste in NÖ entsteht**.**

3.2 Masterplan für die TK-Infrastruktur in NÖ

Die Zeit seit dem Erstellen des TK-Leitbilds 1997 wurde genützt, die über NÖ verteilten Standorte der Landesverwaltung breitbandig zu vernetzen und so die TK-Infrastruktur der Verwaltung zu schaffen. Hier erfüllt das Land die selbstauferlegte Aufgabe, eine Vorreiterrolle auf dem Weg in die Informationsgesellschaft einzunehmen.

Schon seit über einem Jahr werden alle Anstrengungen unternommen, diese Vernetzung auf weitere Standorte, nämlich die der Bildung, auszudehnen. Erste Schritte in Richtung auf das NÖ-Bildungsnetz wurden gesetzt.

"In die Fläche" geht die TK-Infrastruktur aber erst durch Erschließen der Wirtschaft. Konkreter Handlungsbedarf wurde identifiziert.

Flächendeckend ist sie erst, wenn sie jeden Bürger erreicht hat. Die Migration der für die Wirtschaft zu treffenden Maßnahmen in Richtung auf den Bürger erscheint angesichts des bei TK-Diensten immer besser werdenden Preis/Leistungsverhältnisses realistisch.

Mit dem Wachstum der TK-Infrastruktur im Zusammenhang stehen Verfügbarkeit und andere Erfolgsfaktoren, die in einem Masterplan zur Schaffung einer TK-Infrastruktur für NÖ ihren Niederschlag finden.

Masterplan für die TK-Infrastruktur in NÖ				
	Verwaltung	**Bildung**	**Wirtschaft**	**Bürger**
Verfügbarkeit	**ab 1997**	**ab 2002**	**ab 2003**	**ab 2004**
Teilnehmer	**einige 100**	**einige 1.000**	**einige 10.000**	**einige 100.000**
Bandbreite	**min. 2 Mb/s**	**etwa 2 Mb/s**	**min. 384 kb/s**	**etwa 384 kb/s**

Die hier angegebenen Zahlen für **Teilnehmer** und **Bandbreite** sind nur Größenordnungen, die aufzeigen, dass sich die TK-Infrastruktur von einem "elitären" Markt hin zu einem Breitenmarkt entwickelt. Diese Klassifikation soll nicht verhindern, den einzelnen Teilnehmer mit mehr oder weniger Bandbreite zu mehr oder weniger Kosten anzuschließen.

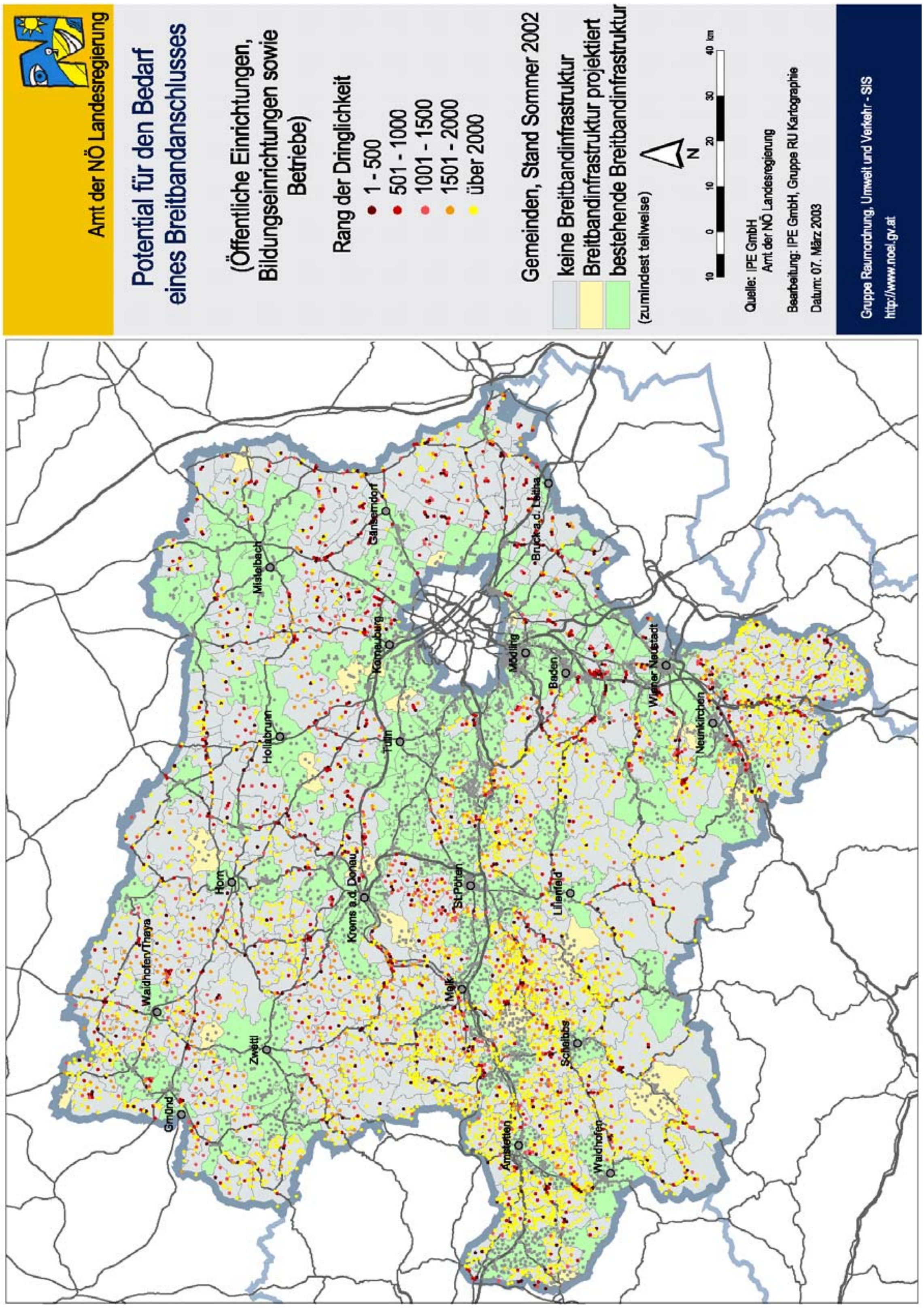
3.3 Dienstleistungskonzession zur Versorgung der „weißen Flecken“

In konsequenter Fortführung der im obigen Masterplan zusammengefassten Zielsetzungen des Telekommunikations-Infrastrukturkonzeptes und im Einklang mit den Zielen des *eEurope* Aktionsplans hat das Amt der NÖ Landesregierung europaweit eine Dienstleistungskonzession ausgeschrieben, um die Wirtschaftsbetriebe des Landes entsprechend dem ermittelten Bedarf mit Breitband-Netzdiensten zu versorgen.

Entscheidend dabei war, dass das Land NÖ mit der Dienstleistungskonzession nur insofern und dort in den Markt eingreift, als der dringende Bedarf nach einer Breitbandversorgung auf andere Weise in einem für NÖ’s Wirtschaftsbetriebe akzeptablem Zeitraum nicht zustande käme.

Dies wird dadurch erreicht, dass der Konzessionär verpflichtet wird, in 1000 gemäß Bedarfserhebung zur Zeit nicht mit Breitband-Netzdiensten versorgten Siedlungskreisen Unternehmen, die einen Bedarf anmelden, innerhalb von 6 Monaten entsprechende Dienste zur Verfügung zu stellen. Dafür gewährt das Land NÖ pro Siedlungskreis eine einmalige Aufbauhilfe. Eine Diskriminierung des Wettbewerbes wird dadurch vermieden, dass der Nachweis zu erbringen ist, dass im betreffenden Gebiet bis dahin noch keine Breitbandnetzdienste mit entsprechenden Mindestqualitätskriterien angeboten werden. Sollte in einem Gebiet ein Wirtschaftsbetrieb bereits mit einem Breitband-Netzdienst des Konzessionärs versorgt sein, haben alle weiteren Betriebe innerhalb von 6 Wochen ab Anmeldung versorgt zu werden.

Keineswegs werden andere Anbieter daran gehindert, danach auch in diesen Gebieten tätig zu werden. Lediglich die vom Land gewährte Aufbauhilfe ist an die Dienstleistungskonzession gebunden.



Das Land NÖ hat dem in Europa bisher einmaligen Modell der Dienstleistungskonzession den Vorzug gegenüber einer Public-Private-Partnership (PPP) Lösung gegeben, um die zu errichtende Infrastruktur nicht in öffentliches Eigentum zu übernehmen und damit auch nicht die Letztverantwortung für deren Betrieb zu haben.

Darüber hinaus wurden mit der Vergabe einer Dienstleistungskonzession an einen einzigen Bestbieter eine Reihe von wichtigen Zielsetzungen, teils in Form von Auflagen an die Anbieter, verfolgt:

Aufbau einer homogenen, landesweiten Telekommunikations-Infrastruktur so rasch wie möglich, mit einheitlichen technischen Leistungsmerkmalen, einheitlichen Qualitätskriterien und einheitlichen Preisen für Anschaltung und Nutzung für alle Betriebe NÖ's unter Einbeziehung lokaler Kooperationspartner.

- Es sind bereits lokale Initiativen zur Selbstversorgung in NÖ im Entstehen, die zwar aus regionaler Sicht zu begrüßen sind (Aufbau und Halten von technisch hochwertigen Qualifikationen auch in benachteiligten Regionen mit positiven Auswirkungen auf den Arbeitsmarkt und die lokale Kaufkraft), von denen jedoch als Folge ihrer Unterschiedlichkeit zu befürchten wäre, dass sie einerseits auch öffentliche Gelder benötigen würden, andererseits aber nicht den zielgerichteten strukturpolitischen Effekt erreichen ließen, der aus Sicht des Landes wünschenswert wäre. Die Einbindung lokaler Initiativen in einen homogenen Aufbau der Infrastruktur war daher ein ganz wesentliches Bewertungskriterium der Angebote.
- Transparente und für den einzelnen Kunden kalkulierbare und nachvollziehbare Kostenstruktur.
- Dies wird durch monatliche Entgelte erreicht, die unabhängig von der Online-Zeit und vom übertragenen Datenvolumen sind, wobei ein Richtwert von 5 GB / Monat nach dem Fair Use Prinzip angenommen wurde.
- Zukunftsweisende Qualitätskriterien, die möglichst alle gängigen Nutzungsformen des Internet auf absehbare Zeit hin ermöglichen.
- Es wurde daher gefordert, eine Qualitätsklasse anzubieten, die eine symmetrische Übertragungsrate von mind. 384 kbit/Sek. für Senden und Empfangen von Daten erlaubt. Damit wird den Nutzern nicht nur das Download großer Datenmengen von entfernt liegenden Servern ermöglicht, sondern auch die Unternehmensvernetzung für leistungsfähige Peer-to-Peer Applikationen sowie die Einrichtung von Informationsservern, die von ihrem niederösterreichischen Standort aus Daten anbieten, unterstützt.
- Neben den stationären Anschlüssen für die jeweiligen Firmennetze sollten auch Mobilanschlüsse innerhalb des geplanten Netzes möglich sein, da sich dies in immer stärkerem Maße als wesentliche Nutzungsform der Zukunft etabliert. Mit der Verpflichtung, Roaming-Abkommen mit anderen Anbietern abzuschließen, will das Land den Wildwuchs an Hotspot-Anbietern einigermaßen in den Griff bekommen, ohne jedoch Einzelinitiativen zu behindern.
- Als weiteres Qualitätsmerkmal muss den Kunden auch eine Verfügbarkeitsgarantie mit eindeutig definierten Kriterien (Service Level Agreement) angeboten werden.

Größter Wert wurde darauf gelegt, die Ausschreibung technologie-neutral zu gestalten, um keinen potentiellen Anbieter zu diskriminieren. Die Datenrate von 384 kbit/Sek. wurde u.a. deswegen gewählt, um auch UMTS-Anbieter von dieser Ausschreibung nicht auszuschließen. Ein ähnliches Projekt in Kanada hat im Nachhinein diese Entscheidung ebenfalls bestätigt.

Die Firma **nökom** war mit dem Produkt "wavenet" schließlich der Bestbieter und bietet seit Juli 2003 diesen Dienst mit unterschiedlichen Qualitätsklassen zu einem moderaten monatlichen Entgelt ab € 48,-- (exkl. Mwst.) in Niederösterreich an. Sämtliche Preise werden bis Mitte 2006 garantiert.

Die Aufbauhilfe, die die Firma **nökom** dafür innerhalb von maximal 3 Jahren für die 1000 auszubauenden Gebiete vom Amt der NÖ Landesregierung erhalten wird, ist mit insgesamt € 14,5 Mio. limitiert. Dadurch wird sukzessive je nach Bedarf der NÖ Wirtschaftsbetriebe eine flächendeckende Versorgung mit Breitbanddiensten aufgebaut. Werden alle Gebiete ausgebaut, wird die Firma nökom über € 40 Mio. in NÖ investieren müssen.

4 RICHTUNGSWEISENDE MAßSTÄBE FÜR DIE ZUKUNFT

Dieser Schritt der NÖ Breitbandinitiative wurde auf Grund der erwähnten Bedarfserhebung vorerst mit dem Schwerpunkt auf der Versorgung der Betriebe (bzw. der kommerziellen Nutzer) gesetzt. In dem Moment, wo jedoch die Infrastruktur aufgebaut ist, hat auch jeder Bürger die Möglichkeit, Breitbanddienste zu gleichen Bedingungen in Anspruch zu nehmen. Ein weiterer Ausbau in Gebieten, in denen der Bedarf an Breitbanddiensten primär von Privatnutzern kommt, wird vom Land NÖ in Zukunft ebenfalls ins Auge gefasst, dies jedoch im Einvernehmen mit entsprechenden Initiativen der Bundesregierung, die ja heute schon neue Breitband-Internetanschlüsse für Privatnutzer durch Steuererleichterungen fördert.

Entscheidender Erfolgsfaktor der Breitbandinitiative ist neben einer leistungsfähigen TK-Infrastruktur die Verfügbarkeit digitalisierter Inhalte. Auch hier ist das Land NÖ tonangebend, etwa durch die bereits erwähnten Schritte im eGovernment Bereich oder im Rahmen der NÖ Bildungsplattform. Eine weitere Initiative konnte in Zusammenarbeit mit dem ORF Niederösterreich und der Firma Kabelsignal gesetzt werden: Quasi als Dienstleistung für die „Auslandsniederösterreicher“, die die NÖ Regional-programme des ORF nicht empfangen können, wird die Sendung „**NÖ heute**“ sowohl live als auch jeweils eine Woche lang zum „Nachschauen“ auf den Internetseiten des Landes angeboten. Darüber hinausgehende Inhalte, vor allem kommerzieller Natur müssen in erster Linie von den Wirtschaftsbetrieben NÖ’s kommen, für die durch die NÖ Breitbandinitiative die Voraussetzungen geschaffen wurden, entsprechende Inhalte anzubieten.

Mit der Breitbandinitiative hat das Land NÖ eine Vorreiterrolle in Österreich übernommen und möglicherweise die Rahmenbedingungen für den Ausbau der weiteren Telekommunikations-Infrastruktur gesetzt.

Die vom Land NÖ gesetzten Maßnahmen dürfen sich nicht in dieser höchst notwendigen, aber letztlich doch beschränkten Initiative eines Bundeslandes erschöpfen. Der ***eEurope*** Aktionsplan der EU, zu dem sich auch Österreich verpflichtet hat, geht über die Aktivitäten einzelner Regionen weit hinaus. Damit ist auch der Bund gefordert, der in Anerkennung der Vorreiterrolle Niederösterreichs selbst aktiv werden muss, um etwa diese Infrastruktur-Initiative auf das gesamte Bundesgebiet auszudehnen und finanziell zu unterstützen.

Integration von Geo- und Content-orientierten Web-Diensten: Eine OGC-konforme Lösung auf Basis der OpenSource Software des GIS-Projekts degree und der CoreMedia© Smart Content Technology

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ABSTRACT

Aufgrund des räumlichen Bezugs vieler Portalinhalte stellt die Erweiterung von Internetportalen durch Geodatendienste einen entscheidenden Mehrwert dar. Durch eine geeignete Middleware kann der notwendige Integrationsaufwand zwischen heterogenen GIS-Applikationen und einem Content Management System (CMS) entscheidend reduziert werden. Ziel des hier vorgestellten Projektes ist die generische Verknüpfung zwischen verschiedenen OGC konformen Web GIS Diensten und der Smart Content Technology der CoreMedia© AG, Hamburg, mittels des OpenSource-Produktes deegree als kaskadierendem Web Map Server am Beispiel des Portalauftritts der Metropolregion Hamburg bzw. der Gemeinde Seevetal als Pilotprojektpartner.

1 EINLEITUNG

Die Projekte Internetportal für die Metropolregion Hamburg bzw. Webauftritt des Stadtplanungsamtes (u.a. Bürgerbeteiligung) der Kommune Seevetal sind eine Projektkooperation zwischen dem Arbeitsbereich Softwaresysteme und dem Arbeitsbereich Stadt-, Regional- und Umweltplanung der Technischen Universität Hamburg-Harburg. Die Metropolregion Hamburg (MRH) setzt sich aus der Freien und Hansestadt Hamburg (FHH), fünf schleswig-holsteinischen Landkreisen, dem Wirtschaftsraum Brunsbüttel sowie acht niedersächsischen Landkreisen zusammen. Hauptaufgaben der MRH sind die Erarbeitung und Fortschreibung des „Regionalen Entwicklungskonzeptes“, die Definition von gemeinsamen Handlungsfeldern, Festlegung von Leitprojekten, sowie die Entscheidung über Fördermaßnahmen im Rahmen bilateraler Förderfonds (Hamburg – Niedersachsen und Hamburg – Schleswig–Holstein). Die Portalkonzeption könnte nach Abstimmung mit der Senats- bzw. den Staatskanzleien der beteiligten Bundesländer unter der Internetadresse „http://www.metropolregion.hamburg.de“ veröffentlicht werden. Ziel ist es, mit der Internetpräsenz ein Portal für die Metropolregion zu etablieren, in dem unterschiedliche Nutzungsszenarien Berücksichtigung finden (Konzept der „Lebenslagen“) und weiterführende Dienste verschiedener Dienstanbieter aus der Metropolregion nutzbar gemacht werden. Im Idealfall soll so ein Netzwerk entstehen, welches die verschiedenen administrativen Ebenen, Verbände und Institutionen sowie private Initiativen in der Region in einem Dachportal zusammenfasst. Über die reine Informationsebene hinausgehend, soll die zu schaffende Infrastruktur die interkommunale Kooperation über die politischen und administrativen Grenzen hinaus fördern, das Regionalbewusstsein in der Metropolregion stärken, Zugang zu E-Government Anwendungen bereitstellen und als globales Aushängeschild im Sinne einer repräsentativen Außendarstellung dienen.

Der Schwerpunkt des hier vorgestellten Projektes liegt auf einer Integration, Kommunikation bzw. Visualisierung verteilter Geodatenbestände der Region auf Basis offener Standards (OGC konform) mit der Smart Content Technology der Firma CoreMedia AG, Hamburg. Weiterhin arbeiten wir in Kooperation mit der Kommune Seevetal an einem CMS Modul „Bauleitplanung / Beteiligung“ auf Basis von CoreMedia, welches nach erfolgreicher Bewährung auch anderen Kommunen zur Verfügung gestellt werden kann und schrittweise zu einem Planungsserver (u.a. Beteiligung Träger öffentlicher Belange) ausgebaut werden könnte. Ein dritter Schwerpunkt ist die Erarbeitung von Content Syndication Konzepten unterschiedlicher räumlich abgegrenzter Portale: Kommune (Seevetal), Kreis (Harburg), Land (Hamburg, Schleswig-Holstein), Metropolregion Hamburg, Bund, Handelskammern der Region. Die Metropolregion Hamburg bietet dafür eine gute technische Infrastruktur, da eine Vielzahl von Portalen (z.B. hamburg.de (Auftritt der FHH), schleswig-holstein.de sowie kommunale Webauftritte in der Region) über ein einheitliches Content Management System (CMS) auf der Basis der Software Smart Content Techology gepflegt werden.

Die von der KBSt (Koordinierungs- und Beratungsstelle der Bundesregierung für Informationstechnik in der Bundesverwaltung im Bundesministerium des Innern) veröffentlichte SAGA Richlinie (Standards und Architekturen für E-Government-Anwendungen Version 2.0)1 definiert als „Basiskomponente Content Management System“ für die E-Government Initiative BundOnline 2005 ebenfalls die Smart Content Technology der CoreMedia AG. Mit der Basiskomponente CMS verfolgt der Bund das Ziel, die Verwaltung und Pflege von Informationen in Intranet- und Internetumgebungen auf Bundesebene zu vereinheitlichen und zu erleichtern. Das formulierte Ziel einer einheitlichen Plattform zur Pflege von Content unterschiedlicher Akteure in einem geografisch abgegrenzten Raum lässt sich auf die Metropolregion übertragen. Der Zugriff auf das CMS erfolgt dabei über einen auf Java Technologie basierenden Editor oder einen browser-basierten Web-Editor. Das CMS erlaubt eine Trennung von Gestaltung, Inhalt und Logik. Inhalte werden separat vom Layout auf Grundlage von Dokumenttypen strukturiert erfasst und verwaltet. Innerhalb des CMS erfolgt die Strukturierung der Inhalte eines Portalauftritts durch diese Dokumenttypen und deren Relationen zueinander. Ein Dokumenttyp enthält Attribute, welche die eigentlichen Informationen aufnehmen. Relationen beschreiben die Beziehungen zwischen den Dokumenttypen und legen fest, welche Dokumente untergeordenete Dokumente enthalten können sowie welche Attribute sie von ihnen übernehmen (Vererbung). Die Darstellung des erfassten Inhalts wird durch Darstellungsvorlagen (Templates)

[1] SAGA Standards und Architekturen für E-Government-Anwendungen Version 2.0, Schriftenreihe der KBSt, Band 59, Dezember 2003, Berlin

gewährleistet. Dokumententypen sowie Templates, die im Rahmen unseres Portalprojektes entwickelt werden, lassen sich auch für Portallösungen auf Bundes-, Landes oder kommunaler Ebene weiter nutzen.

2 E-GOVERNMENT IN DER METROPOLREGION HAMBURG

Den Anforderungen aus einer verstärkten Standortkonkurrenz im Rahmen eines wachsenden globalen Wettbewerbs begegnen Städten und zunehmend auch Stadtregionen mit Maßnahamen wie

- der Verstärkung interkommunaler Kooperationsformen etwa im Bereich der interkommunale Bauleitplanung,
- Ausbau der Serviceangebote an Bürger, Gewerbetreibende und Verwaltung, beispielsweise in Richtung Flächenbörsen, „One Stop Agency" im E-Government oder „best practicies"- Börsen).

Es ist inzwischen weitgehend anerkannt, dass umfassende, marktgerechte Informations-, Beratungs- und Serviceangebote zu den wesentlichen Standortfaktor einer Kommune zählen. Öffentliche Verwaltungen definieren sich zunehmend als Dienstleister im Sinne der Belange ihrer Klienten bzw. Kunden. Gleichzeitig ändern sich die Anforderungen von Bürgern und Wirtschaft an den Staat. Kommunen sollen in einem partnerschaftlichen Dialog Bürger sowie Unternehmen bei ihren Belangen unterstützen. Verwaltungsdienstleistungen sollen über verschiedene Informations- und Serviceknoten (z.B. Internet, Servicebüro oder Callcenter) 24 Stunden ortsunabhängig angeboten werden. Die technische Vorraussetzung für diese Serviceleistungen ist jedoch ein Zugang bzw. die Möglichkeit einer Recherche in kommunalen Geschäftsprozessen. In diesem Zusammenhang entstehen gänzlich neue Anforderungen an das verwaltungsweite Informationsmanagement (Zugriff auf verschiedene Datenbestände, Benutzerrechte). [2]

Die Bereitstellung von Serviceangeboten darf sich dabei nicht mehr ausschließlich an den administratorisch definierten Gemeindegrenzen orientieren. Bei den Serviceangeboten kann man zwischen verschiedenen Integrationstiefen von eGovernment-Anwendungen unterscheiden. Anwendungen können von reinen Informationsangeboten über Interaktions-, Transaktions- bis zu Partizipationsverfahren (E-Democracy) reichen. Diese unterscheiden sich hinsichtlich der Tiefe ihrer Integration in kommunale Geschäftsprozesse. Die Serviceangebote unterscheiden sich ebenfalls in den Anforderungen an raumbezogene Dienste, welche von einfachen Auskunfts- und Mappingdiensten über „adhoc"-Anfragen auf unterschiedlichen Datenquellen bis hin zu rückkanalfähigen Internet-GIS-Anwendungen z.B. für „digitize on screen" Anwendungen im Rahmen von Beteiligungsanwendungen (Bürgerbeteiligung bzw. Beteiligung der Träger öffentlicher Belange im Rahmen von Bauleitplanverfahren) reichen können.[3]

Gemäß der SAGA-Richlinien erfordert E-Government interoperable Informations- und Kommunikationssysteme auf Basis einfacher und klarer Standards und Spezifikationen, die (idealerwesie) reibungslos zusammenwirken. Im Rahmen des SAGA Prozesses werden erforderliche Standards, Formate und Spezifikationen kontinuierlich festgelegt und fortgeschrieben. Transaktionen als vollständige Geschäftsprozessabwicklung über das Internet sollen auf Basis des OSCi-Transportprotokolls v1.2 (Online Service Computer Interface) in Form von Web Services ausgeführt werden. Browserbasierte E-Government Anwendungen verzichten auf aktive Inhalte, um einen Nutzer nicht dazu zu zwingen, Sicherheitseinstellungen des Browsers herabzusetzen. Von einem Einsatz properitärer Plugin-Lösungen zur Visualisierung von- und Interaktion mit Geodatenbeständen ist entsprechend der Richtlinie abzusehen. SAGA empfiehlt z.B. als Austauschformat für Geoinformationen die Auszeichnungssprache GML zum Transport und zur Speicherung geografischer Informationen, welche räumliche und nicht räumliche Eigenschaften berücksichtigt. Im Rahmen der Bundesinitiative „Deutschland Online, I. Säule: Dienstleistungsportfolio, Vorhaben 6. Geodaten, Standardisierung Bauleitplanung (ePlanzV) erarbeitet eine Arbeitsgruppe unter der Federführung von Hamburg und dem Kreis Bad Segeberg an einer objektstrukturierten Repräsentation der Planzeichenverordnung. Somit wäre es in Zukunft möglich, Bauleitpläne in einem einheitlichen Format als Basis für ein Web-Mapping zur Verfügung zu stellen.

3 GEO- UND PLANUNGSDIENSTE IN DER METROPOLREGION HAMBURG

Der Zugang zu Wissen innerhalb einer Region, über eine Region und zu administrativen Verwaltungsprozessen muss über verschiedene Kanäle (Endgeräte: Browser, PDA, Papier…) und unterschiedliche Portale im Netz (Contentsyndication) ermöglicht werden. Eine Lösung besteht nicht darin, eine einzige neue Adresse im WWW zu platzieren (z.B. www.wirtschaftsfoerderung-in-der-Metropolregion.de). Diese Internetadresse wäre sicherlich nicht besonders häufig besucht, da sie nicht in ein Gesamtkonzept für den Internetauftritt der Metropolregion eingebunden ist. Analog zu dem Konzept eines one-Stop-government gilt ebenso für kommunale / regionale Web-Angebote die Definition einer Einstiegsadresse im Internet über die man sämtliche Angebote zu einem geografischen Namensraum (z.B. der Name der Stadt oder Region) abrufen kann. Sollen Informationen im Netz zur Verfügung gestellt werden, die für mehrere Kommunen bzw. eine Region gelten, wäre es technologisch möglich, z.B. identische Informationen zu Gewerbeflächenstandorten in einem Portal der Metropolregion als auch unter einer kommunalen Internetadresse zu veröffentlichen. Inhalte können von einem Redakteur für unterschiedliche Webauftritte zentral gepflegt und verteilt werden. Eine Kommune könnte sich zum Beispiel bereit erklären, ebenfalls Informationen über Gewerbeflächen benachbarten Gemeinden für eine Recherche zur Verfügung zu stellen.

Bislang werden bürgerrelevante Inhalte einer Region meist von den verschiedenen Akteuren dezentral gepflegt. Um die Aktivitäten in einer Region möglichst breit zu dokumentieren, ist es notwendig, neben administrativen Informationen den Aktivitäten von Interessensvertretungen bzw. NGOs Raum für eine Selbstdarstellung zu geben. Diese Arbeitsgruppen verfügen über Wissen, jedoch teilweise über keine geeignete eigene technische Infrastruktur dieses Wissen intern zu kommunizieren bzw. extern zu

[2] vgl.: Marco Brunzel, Kommunale Internetportale als Datendrehscheibe und Kommunikationsplattform, in: Detlef Kröger (Hrsg.), Internetstrategien für Kommunen, Köln 2001, S. 227.

[3] vgl.: Kai-Uwe Krause, Aufbau eines Planungsservers für die Metropolregion Hamburg, in: 8. Symposium zur Rolle der Informationstechnologie in der Raumplanung – Computergestützte Raumplanung, Tagungsband CORP 2003, Wien

veröffentlichen. Um diese Aufgabe erfolgreich bewältigen zu können, bedarf es der Etablierung einer Kommunikationsplattform für eine Vielzahl von regionalen Akteuren, die außer einem Netzanschluss keine weitere technische Basis benötigt[4]. Das Ergebnis interner Kooperations- bzw. Abstimmungsprozesse ist gleichsam der „Content", der die Wettbewerbsfähigkeit nach außen hin demonstriert. Als Beispiel dafür mögen Planungsprozesse dienen. Nicht erst seit der Erkenntnis, dass ein Großteil der Daten in kommunalen Zusammenhängen einen Raumbezug (Adresse, Koordinaten, Kleinräumige Gliederung, etc.) aufweist, liegt es auf der Hand, dass georeferenzierten Informationen beim Aufbau von Portalen eine besondere Rolle zukommt. Auf der regionalen Ebene werden diese, gestützt auf Verwaltungsprozesse mit unterschiedlichen administrativen Ebenen, verteilt aktuell gehalten. Es gilt, gemäß dem Lebenslagenmodell, die jeweils wichtigen raumbezogenen Daten zur Verfügung zu stellen. Die Anforderungen können dabei vom einheitlichen Zugang zu administrativen, rechtsverbindlichen Daten und Karten bis hin zu Freizeitkarten variieren.

In der Metropolregion Hamburg wird eine Vielzahl von Informationssystemen und digitalen Kartenwerken im Stadt-, Regionalplanungs- und Wirtschaftsförderungskontext sowohl mit unterschiedlicher fachlicher als auch räumlicher Fokussierung sowie mit unterschiedlichem rechtlichem Auftrag bzw. rechtlicher Verbindlichkeit geführt. Dabei kann man Anwendungen unterscheiden, die zum einen Geobasisdaten bzw. Informationen zu Liegenschaften (z.B. GDI-MRH, GeoInfo.online, REGIS) zum Zweck der Auskunft bzw. als Grundlage für weitere Fachinformationssysteme zur Verfügung stellen, zum anderen Katasterwerke als Grundlage der Raumbeobachtung auf Landesebene, bzw. statische Kartenwerke zur Dokumentation raumplanerischer Konzepte (Planwerke der regionalen Entwicklungskonzeption – REK).

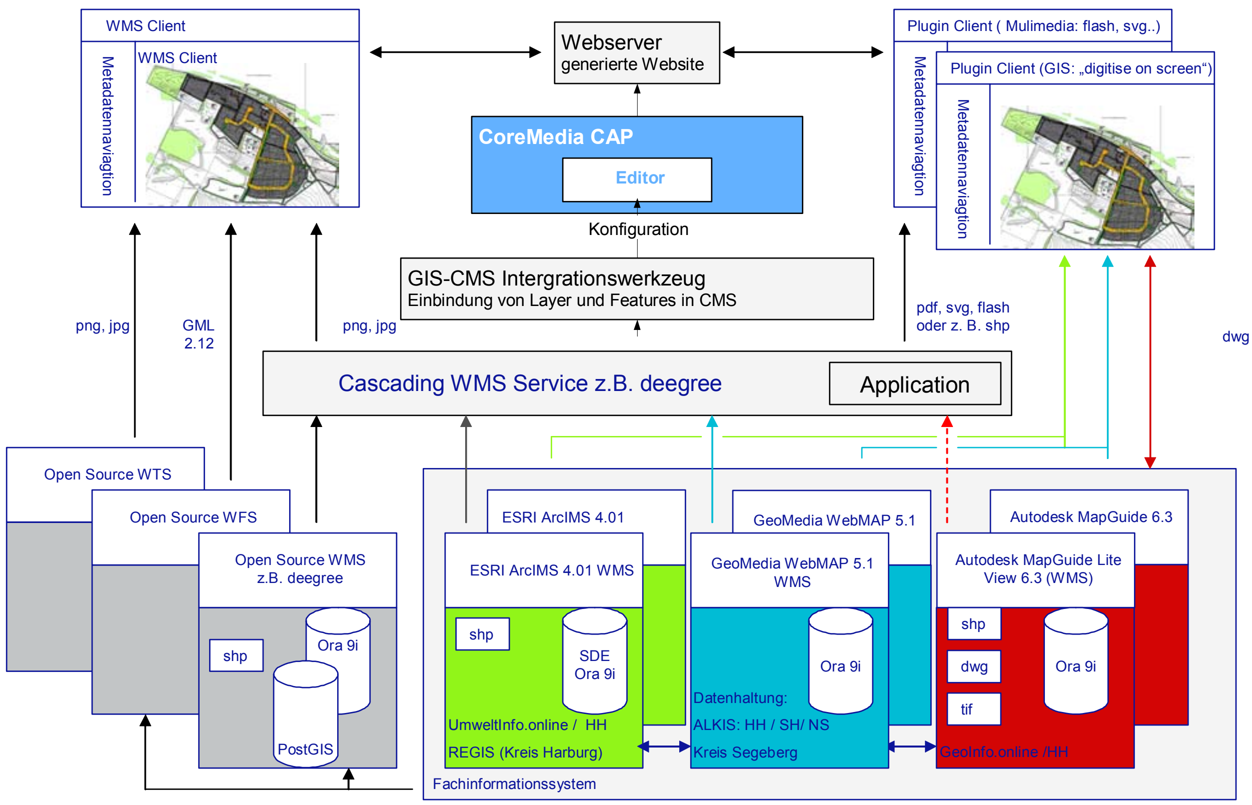

Abb.1: Geodatendienstestruktur Metropolregion Hamburg

Neben diesen öffentlichen Stellen führen auch Interessensvertretungen wie z.B. die Handelskammer oder die Handwerkskammer Hamburg wirtschaftliche oder räumliche Informationssysteme. Im Rahmen des Wettbewerbs „Neue Leit- und Modellprojekte für die Metropolregion Hamburg" (2003) wurde das von den für Vermessungs- und das Katasterwesen zuständigen Ämtern bzw. Landesbetrieben vorgeschlagene Projekt „Geodateninfrastruktur für die Metropolregion – (GDI-MRH)" als Leitprojekt prämiert. Es ermöglicht in Zukunft den Zugriff auf Geobasisdaten der drei beteiligten Bundesländern sowie eine Integration und Präsentation dieser in eigenen Fachinformationenssystemen auf Basis einheitlicher Standards (OpenGIS konform).[5]

4 INTEGRATION VON GEODATENDIENSTEN IN COREMEDIA© CAP

In der Konzeption von Geodatendiensten für die MRH muss von Beginn an auf Interoperabiltät geachtet werden, um die für die verteile Struktur notwendige Kommunikation über die Systemgrenzen hinaus zu gewährleisten. Diese Interoperabilität wird durch die Verwendung von offenen Standards gesichert, welche im Bereich der Geoinformationstechnologie für das Internet von dem OpenGIS Consortium[6] (OGC) entwickelt werden. Zu den wichtigsten Spezifikationen zählen der Web Map Service (WMS), welcher

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[4] vgl.: Marco Brunzel, Dienste statt Software, Kommune 21, Heft 12/2003

[5] metropolnews 3/2003, Lenkungsausschuss der Gemeinsamen Landesplanung Hamburg / Niedersachsen / Schleswig-Holstein

[6] http://www.opengis.org/

Geodaten als Karte im Web visualisiert und der Web Feature Service (WFS), der dazu dient, Geodaten direkt im GML-Format über das Internet auszuliefern.

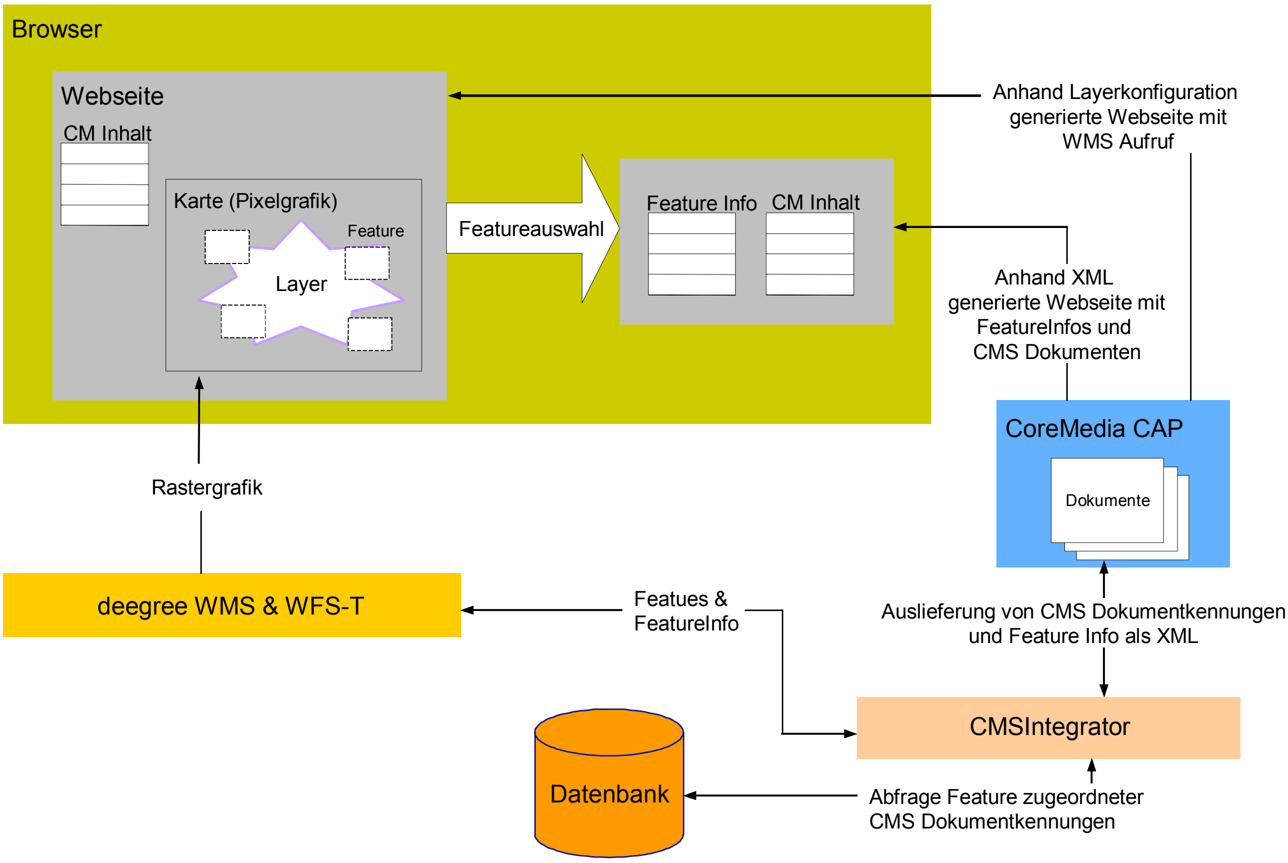

Abb.2 Schematischer Aufbau der CMS - GIS Integration

Um den Aufwand zur Integration von verteilten Geodatendiensten in CoreMedia zu reduzieren, bietet es sich an, eine geeignete Middleware zu benutzen, welche diese Geodatendienste als einen einzelnen Dienst erscheinen lässt und so ermöglicht, Geodatensammlungen (Layer) verschiedener Dienste als eine Karte auszuliefern. Diese Anforderungen erfüllt das Produkt deegree[6] an, welches initial von dem Geographischen Institut der Universität Bonn, Bereich GIS & Fernerkundung[7] und der Firma lat/lon[8] entwickelt wurde und jetzt als OpenSource-Projekt[9] der Allgemeinheit zur Verfügung steht. Deegree ist ein Java-Framework, welches ermöglicht, Anwendungen mit georeferenzierten Inhalten zu entwickeln und enthält zu Demonstrationszwecken auch Beispielimplementationen und ist zudem die Referenzimplementation der OGC für den WMS. Es ermöglicht die Entwicklung von Desktop-Lösungen ebenso wie von Infrastrukturen mit verteilten, dienstebasierten Komponenten, welche über wohldefinierte Schnittstellen im Sinne des OGC interagieren. Diese Eigenschaften von deegree, zu denen auch Offenheit des Quellcodes, die Implementation in einer modernen, objektorientierten Sprache und die breite Unterstützung der OGC-Standarts zählen, letztlich den Ausschlag gegenüber konkurierenden Systemen wie dem WMS der Universität von Minnesota[10] und dem WFS-Projekt „Geoserver“[11] gegeben.Um Geodaten über Internet zur Verfügung zu stellen werden bisher spezielle Internetseiten implementiert, welche die Besonderheiten des zur Integration der Geodatendienste notwendigen Webmappings berücksichtigen. Diese Vorgehensweise führt zu einem hohen Aufwand durch die manuelle Erstellung und Pflege der Webseiten. Bei großen Webauftritten werden zur einfachen Verwaltung der Webseiten Content Management Systeme eingesetzt, die es Web-Redakteuren erlauben, Inhalte auf die Website zu publizieren, ohne sich über Layout, Navigation, Design oder deren technische Umsetzung Gedanken machen zu müssen

Um in eine große Website, wie sie das MRH-Portal darstellt, Geodatendienste zu integrieren, ist es also notwendig eine Benutzungsschnittstelle zu schaffen, die es einem Redakteur auf einfache Weise ermöglicht, die Verbindung zwischen den von dem CMS erzeugten Webseiten und den von den GIS zu liefernden Geodaten herzustellen. Dem Redakteur soll ermöglicht werden, sowohl Geodatensammlungen (Karten, wie z.B. Bauleitpläne) als auch einzelnen geographischen Elementen (Features) innerhalb der Karten, Inhalte aus dem CMS zuzuordnen und diese pflegen zu können. Diese Inhalte stellen also Annotationen zu dem geographischen Inhalt der Karten dar und sollen über eine integrierte Webseite im Internet/Intranet abrufbar sein. Diese Funktionalität ist prototypisch als Webanwendung („CMSIntegrator“) realisiert und dient sowohl der Referenzierung auf die

7 http://katla.giub.uni-bonn.de
8 http://www.lat-lon.de/
9 http://deegree.sourceforge.net/
10 http://mapserver.gis.umn.edu/
11 http://geoserver.sourceforge.net/html/index.php

Geodatensammlungen (Layer), als auch der Verküpfung von den in CoreMedia gepflegten Annotationen und Geodatenelementen (Features).

Mit Hilfe des CMSIntegrators ist es möglich, Karten (genauer: OGC-konforme WMS-Aufrufe) in die von CoreMedia generierten Webseiten zu integrieren. Einerseits ist es möglich, Karten komplett auszuwählen und einem CoreMedia-Dokument zuzuordnen, sodass die Karte in der von CoreMedia generierten Webseite integriert dargestellt wird. Weiterhin ist es möglich, einzelne Bereiche der Karte zu annotieren, also CoreMedia-Dokumenten zuzuordnen. Dazu stehen je nach Fähigkeiten des Geodatenservers prinzipiell mehrere Möglichkeiten zur Verfügung. Einerseits können bereits existierenden Features CoreMedia Dokumente zugeordet werden, dazu darf z.Zt. die Karte allerdings nicht von einem kaskadiernenden WMS stammen, da der Aufruf von kaskadierten FeatureInfos noch nicht spezifiziert ist. Andererseits sollte es möglich sein, neue Bereiche in den Karten festzulegen, die annotiert werden können, also gegebenenfalls neue Features zu erstellen und als benutzerspezifische Layer in den Kartenaufruf einzubinden. Dazu ist ein Web Feature Service notwendig, der es erlaubt, Features abzuspeichern (transaktionaler WFS), wozu der eingesetzte Geodatenserver deegree fähig ist. Dazu ist es notwendig, vektororientierte Zeichenelemente – z.B. von einer Javascript-Bibliothek[12] erzeugt – in GML zu konvertieren, um von dem WFS verarbeitet werden zu können.

Um die Annotation der Karten zu verdeutlichen, ist es wünschenswert, dass der Benutzer annotierte Bereiche der Karte graphisch hervorheben kann. Diese Auszeichnung von annotierten Bereichen kann zum Einen durch die Änderung von grafischen Attributen (Farbe, Umrandung, etc.) von bereits existierenden Kartenelementen oder zum Anderen durch das Einfügen eigener Zeichenelemente in die Grafik (z.B. Einkreisungen, Pfeile, etc.) realisiert werden.

Die erste Alternative ließe sich mit Hilfe eines WMS, welcher die optionalen Styled Layer Descriptor,- und Filter Encoding-Erweiterungen der WMS-Spezifikation, realisieren. Mit dessen Hilfe wäre es möglich, bestehende Features mit benutzerspezifischen Darstellungsattributen (User Styles) zu visualisieren. Dazu ist allerdings der Zugriff des WMS auf einen datenliefernden WFS notwendig, damit die Zeichenvorschrift auf die noch nicht gerenderten Daten angewandt werden kann. Ist die Datenquelle jedoch ein anderer, kaskadierter WMS und ist dieser zudem nicht SLD-fähig, ist diese Technik nicht einsetzbar und kommt für das hier vorgestellte Szenario nicht in Frage.

Um der Systemarchitektur aus kaskadierten WebMapServern gerecht zu werden bleibt also die zweite Alternative, für die mehrere Realisierungsvarianten denkbar sind. Es wäre zum Beispiel möglich, dass die Karte als Pixelgrafik von dem Benutzer bearbeitet – etwa mittels eines Java-Applets - und im CMS abgespeichert wird. Allerdings soll im Zuge der Barrierefreiheit auf die Installation von Plugins – also auch der Java Runtime-Umgebung – möglichst verzichtet werden. Weiterhin hat diese Lösung den Nachteil, dass die gespeicherte Karte nicht mehr Teil der OpenGIS Web Services Systemarchitektur wäre und somit die Vorteile der Interoperabilität wegfallen würden. Um dies zu vermeiden, wäre der Einsatz des oben erwähnten transaktionalen WFS möglich, in dem die Zeichenelemente als neuer benutzerspezifischer Layer gespeichert werden.

Die Architketur des CMSIntegrators ist so konzipiert, dass er nicht nur in Verbindung mit CoreMedia eingesetzt werden kann, sondern als generaliserte Lösung mit geringem Aufwand an andere CMS angepasst werden kann. Dazu werden die Parameter der darzustellenden Layer in einer initialen Konfiguration abgespeichert, welche über eine Schnittstelle abgerufen werden kann. Diese Konfiguration dient dann dem CMS als Ausgangspunkt für die dynamische Generierung der WMS-URLs. Über die Schnittstelle können auch die zu einem einzelnen Feature zugeordneten CMS-Dokumentkennungen abgefragt werden. Die Anfrage des CMS muss dabei nur die Kartenkonfigurationskennung, die aktuelle Bounding Box, Rasterbildgröße und die Klickkoordinaten auf dem Bild beinhalten. Mit Hilfe einer 'GetFeatureInfo' Anfrage an den WMS werden so innerhalb der Applikation die zugeordneten CMS-Dokumentkennungen ermittelt, zurückgeliefert und im anfragenden CMS ausgewertet.

Durch die implementierte API ist es einfach möglich, innerhalb des CMS die Schnittstellen des CMSIntegrators abstrahiert zu verwenden und die zurückgelieferten Referenzierungen auszuwerten. Sowohl die Applikation, als auch die API setzt dabei auf Standards des OGC, sowie HTTP, XML und Java.

5 ZUSAMMENFASSUNG UND AUSBLICK

An dieser Stelle möchten wir uns bei der Firma Coremedia© AG, Hamburg für die sehr konstruktive und offene Zusammenarbeit und für die Aufnahme unseres Projektes in das CoreMedia Hochschul-Kooperationsprogramm bedanken. Insgesamt bieten sich in der Metropolregion Hamburg gute technische und organisatorische Voraussetzungen und Möglichkeiten, verteilte Geodatendienste OGC konform mit Portalinhalten zu verknüpfen. Die im Rahmen der Arbeitsgruppe entwickelte Integration von Geo- und Content-orientierten Web-Diensten wird im Rahmen eines Feldversuches am Beispiel von aktuellen Stadtplanungsprojekten der Gemeinde Seevetal evaluiert. Mitarbeiter des Stadtplanungsamtes können die Darstellung aktueller Planungsprojekte selbst pflegen und eigenständig Kartengrundlagen mit Content verknüpfen. Bürger können im Rahmen von Beteiligungsprozessen Plangrundlagen annotieren. Auf Basis dieser Lösungen entwickelt die Arbeitsgruppe als nächsten Schritt eine Plattform für die Beteiligung der Träger öffentlicher Belange.

[12] http://www.walterzorn.de/jsgraphics/jsgraphics.htm

6 LITERATUR UND LINKS

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http://geoserver.sourceforge.net/html/index.php

http://www.walterzorn.de/jsgraphics/jsgraphics.htm

Interaktive Bildschirmkarten: Instrument des Wissensmanagements als Grundlage für Planungsprozesse (am Beispiel des Nationalparks Berchtesgaden)

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1 ZUSAMMENFASSUNG

Wissen und Informationen sind Bestandteile und Grundlagen jedes Planungsprozesses. Ihre Bedeutung kann prinzipiell aus verschiedenen Perspektiven betrachtet werden: Zum einen lassen sich Akquisition und Weitergabe von Fach- oder thematischen Wissen und zum anderen „Know how", d.h. technisches Wissen zur Erzeugung bzw. dem Umgang mit Fachwisssen, unterscheiden. Während Datenaufbereitung, Informationsverarbeitung zur Wissensgewinnung, einschließlich ihrer technologischen Unterstützung, selbstverständliche Vorgänge sind, wird es immer wichtiger, bestehendes Wissen allgemein zugänglich – unter Verwendung digitaler Technologie - bereitzustellen und existierende Informationsbestände nahtlos in bestehende Arbeitsprozesse einzubinden. Notwendig ist ein ganzheitlicher Ansatz im Wissensmanagementsowohl hinsichtlich Wissenserwerbs als auch bezüglich der Weitergabe von Fachwissen und „Know how". Vor allem in der Wirtschaft ist Wissensmanagement, mit dem Ziel Wissen Einzelner und breiter Anwendergruppen zu erweitern und zu vernetzen, heute bereits ein zentraler Erfolgsfaktor. Dabei verlangt im Umwelt- oder Planungsbereich insbesondere der hohe Stellenwert von Geo-Daten und kartographischer Visualisierung spezielle Werkzeuge für ein erfolgreiches Wissensmanagement.

Als eine solche Anwendung wurde „MaaT" (**Ma**p **a**nd **T**echnology) als System *Interaktiver Bildschirmkarten* in Form eines Zwei-Komponentensystems - mit den Bestandteilen *Kartographische Nutzeroberfläche* und *Digitaler Kartenplan* - für den Nationalpark Berchtesgaden entwickelt. Im Rahmen der *Kartographischen Nutzeroberfläche*, verwirklicht in der Programmierumgebung „Visual Basic 6.0", unterstützt durch die Mapping- und GIS-Komponente „MapObjects 2.2", kommt der Bereitstellung und Vermittlung fachlichen Wissens mittels kartographischer Visualisierung große Bedeutung zu. Sie erfolgt durch an das Medium Bildschirm bzgl. Darstellung und interaktiver Nutzung adäquat modifizierte digitale Karten. Grundlage der kartographischen Visualisierung anhand der *Kartographischen Nutzeroberfläche* ist der *Digitale Kartenplan*. Umgesetzt in XML dient er der Speicherung aller für die Kartendarstellung in der *Kartographischen Nutzeroberfläche* benötigten Angaben und Regeln (Datenverweise, maßstabsabhängige Ableitungs- und Darstellungsvorschriften, Nutzungsregeln). Zudem werden im *Digitalen Kartenplan* Kontextinformationen in Form von Metadaten unterschiedlichen Bezugsniveaus (Karten, Layer und Geo-Daten) verwaltet. Somit erfolgt in der *Interaktiven Bildschirmkarte* Wissensmanagement in vielfacher Weise (Fachwissen, Wissen zur Kartenerzeugung, Kontextinformationen). Die Effektivität der Arbeitsprozesse kann gesteigert, die innerbetrieblichen Wissensverluste verringert werden.

2 WISSEN UND KARTOGRAPHISCHE VISUALISIERUNG IN PLANUNGSPROZESSEN

Obwohl derzeit allgemein anerkannte und verbindliche Schemata zu Planungsabläufen fehlen, sind prinzipiell die in Abb. 1 genannten Hauptschritte von Bedeutung (BERNOTAT et AL. 2002). Für die einzelnen Schritte spielen der gezielte Einsatz von Wissen und Informationen sowie deren adäquate Bereitstellung durch vor allem (karto-)graphische Darstellungen eine wichtige Rolle (vgl. Abb. 1). Erst aufbauend auf und in Anlehnung an die Erkenntnisse zu Wissensmanagement und Visualisierung als Form der Wissensvermittlung, wie sie im Weiteren vorgestellt werden, wurde für die Verwaltung des Nationalparks Berchtesgaden ein konkretes Werkzeug zur Unterstützung von Planungsvorgängen durch Wissensbereitstellung entwickelt.

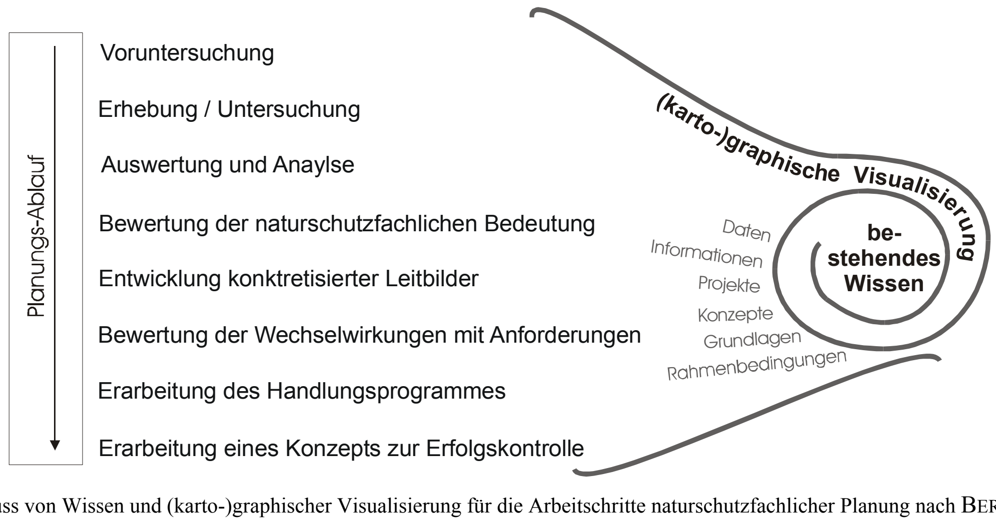

Abb. 1: Einfluss von Wissen und (karto-)graphischer Visualisierung für die Arbeitschritte naturschutzfachlicher Planung nach BERNOTAT et AL. 2002

2.1 Grundsätzliches zum Wissensmanagement

Immer häufiger wird Information als vierte Ressource zu den drei konventionellen Produktionsfaktoren Boden, Arbeit und Kapital genannt. Mehr denn je beeinflussen Information und Wissen nicht nur den wirtschaftlichen Erfolg und die Wettbewerbsfähigkeit von Unternehmen (BAUER und GÜNZEL 2001). Überall steigt nicht nur der Bedarf neues Wissen zu gewinnen und das umfangreiche, bestehende Wissen zu speichern und zu pflegen, sondern auch bereitzustellen und weiterzugeben. Existierende Informationsbestände sind nahtlos in bestehende Arbeitsprozesse einzubinden. Um ein den Problemen angepasstes Wissensmanagement zu ermöglichen, ist eine differenzierte Betrachtung der Bausteine des Wissensmanagements und der verschiedenen Arten von Wissen hilfreich.

2.1.1 Die Bausteine des Wissensmanagements

Die Werkzeuge des Wissensmanagements müssen an den Bausteinen des Wissensmanagements orientiert sein. Sie haben zum Ziel, das in Organisationen vorhandene Wissen optimal für die Erreichung der z.B. betrieblich angestrebten Ziele einzusetzen (TOCHTERMANN und MAURER 2000). Es muss Wissensaustausch bzw. –verteilung, Wissensdokumentation bzw. –bewahrung, Wissenserwerb und Wissensentwicklung sowie Wissenstransparenz und –nutzung gefördert werden (vgl. Abb. 2). Vordergründig steht in vielen Betrieben der Wissenserwerb mit Wissensentwicklung. Für Unternehmen und Mitarbeiter ist jedoch die Weitergabe und Nutzung bereits bestehenden Wissens ebenso wichtig. Nicht nur das gezielte Auffinden von Wissen muss ermöglicht werden, auch die entsprechende Darstellung ist relevant. Dabei kommen generell verschiedene Arten von Wissen zum Tragen.

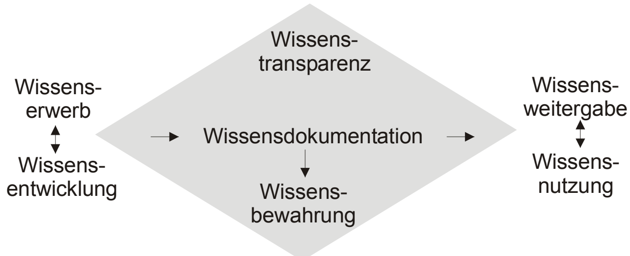

Abb. 2: Bausteine des Wissensmanagements

2.1.2 Arten von Wissen

Wissen kann zunächst in explizites und implizites Wissen unterschieden werden (vgl. Abb. 3). Während explizites Wissen klar definiert, formalisierbar oder zum Beispiel digitalisierbar ist, handelt es sich bei impliziten Wissen um persönliches Wissen. Dieses ist nicht sofort als Wissen erkennbar und kann durch direkten Kontakt mitgeteilt oder ausgetauscht werden (SCHOLZ 2001).

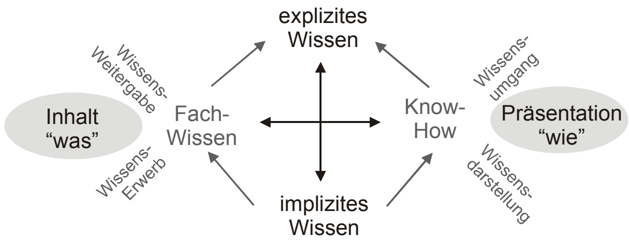

Abb. 3: Arten von Wissen

Des Weiteren werden Fachwissen, das nicht nur neu erworben werden kann, sondern auch weiterzugeben ist, und Wissen bzgl. des Umgangs mit und der Darstellung von Wissen bzw. Fachwissen als „Know how" unterschieden. Fachwissen und „Know how" liegen als explizites oder implizites Wissen vor.

Beispielsweise ist im Planungs- oder Umweltbereich vieles an projektbezogenen Fachwissen nur dem jeweiligen Bearbeiter bekannt. Gleiches gilt auch für Wissen zur Erzeugung von z.B. Karten als optimales Medium zur Wissensdarstellung und –weitergabe. Dieses ist ebenfalls oft nur dem Bearbeiter in seiner Funktion als Kartenproduzenten bekannt. Gerade vieles an „Know hows" liegt als implizites Wissen in Form individueller, menschlicher Speicherung vor.

Generell muss Wissen und insbesondere auch das technische Wissen allgemein zugänglich verwaltet werden. Das „Know how" ist zu computerisieren, d.h. informationstechnisch verarbeitbar, auffindbar und transferierbar zu machen (TOCHTERMANN und MAURER 2000; MAURER und TOCHTERMANN 2001; TOCHTERMANN und MAURER 2001). Je reichhaltiger und impliziter „Wissen" ist, desto mehr müssen technologische Möglichkeiten bzw. Wissensmanagement-Werkzeuge genutzt werden (SCHOLZ 2001).

Dabei besteht, wie Abb. 4 zeigt, bei der „Digitalisierung" existierenden Wissens noch Handlungsbedarf. Das digitale Vorliegen von Wissen, wie z.B. in elektronischen Datenbanken und Dokumenten, bedeutet jedoch nicht gleichzeitig, dass dem Nutzer auch ein effektiver digitaler Zugang gewährleistet ist.

2.2 Wissensvermittlung in der Planung: Kartographische Visualisierung

Neben der Notwendigkeit der Bereitstellung muss die Darstellung von Wissen für den Nutzer in einer auf Daten, Informationen und Wissen sowie die menschliche Wahrnehmung und Kognition angepassten Art und Weise geschehen. Insbesondere in der Raumplanung ist das Wort nach wie vor mächtig und Ideen oft nicht anschaulich vermittelt (BENEDIKT und KRATOCHWIL 2002). Der Visualisierung kommt im planerischen Bereich - zum einen für die Kommunikation und zum anderen für die Gewinnung von Wissen - jedoch eine überragende Rolle zu. Zudem ist die Visualisierung eine der am frühsten benutzten und am häufigsten eingesetzten Darstellungs- und Wahrnehmungstechniken der Umwelt des Menschen. Sie beruht auf der menschlichen Fähigkeit Regelmäßigkeiten und Muster zu erkennen. Für den wissenschaftlichen Erkenntnisprozess und als Verfahren zur raschen Übermittlung komplexer Informationen ist die Visualisierung eine wichtige Methode (STREIT 1997). Besonders Karten sind für Umwelt- und

Planungssachbelange, als visuelles Kommunikationsmittel, ein sehr anschauliches Medium (FITZKE und GREVE 2002). Wie bei der Visualisierung zeigt sich der Zusammenhang zwischen Raumplanung und Kartographie im Wesentlichen bei den Kartenfunktionen Informationsquelle, Analyse- und Planungsgrundlage und Präsentationsmittel (GARTNER 1998).

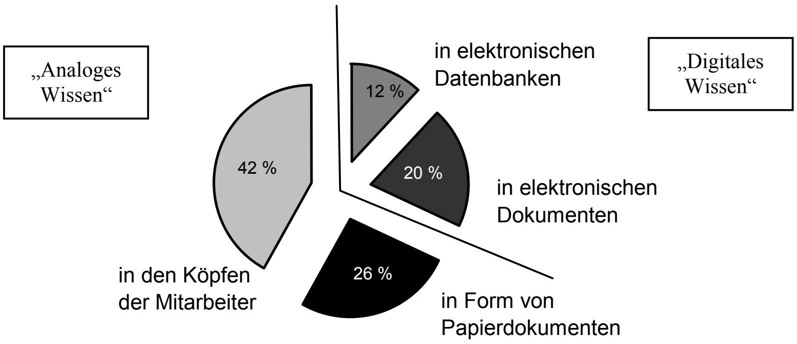

Abb. 4: In Unternehmen gespeichertes Wissen (Grundlage: SCHOLZ 2001)

In Folge des Raumbezugs der meisten Planungsaufgaben und der damit im Zusammenhang stehenden (kartographischen) Visualisierung, kommt der Verwendung von Geo-Daten und GIS eine große Bedeutung zu: Erfassung, Verwaltung, Bearbeitung und Präsentation der anfallenden Geo-Daten erfolgt mittels GIS. Im Weiteren erleichtert die Unterstützung durch moderne Informationstechnologie nicht nur von GIS, sondern auch durch Multimedia und durch die Möglichkeiten der interaktiven Informations-Nutzung am Bildschirm, generell den Zugang und Umgang mit dem visuell zu vermittelnden Wissen.

Entsprechend dem Zweck der Visualisierung im Kontext Wissen – entweder hinsichtlich Exploration oder Kommunikation - werden unterschiedliche Ansprüche an die Visualisierung von Geo-Daten mittels Computerbildschirm gestellt: Während die Geo-Visualisierung ohne gestalterische Regeln erfolgen kann und der reinen Exlporation dient, müssen bei der kartographischen Visualisierung, mit dem Ziel eine optimale Kommunikation des bestehenden Wissens zu erreichen, die traditionellen kartographischen Regeln (vgl. z.B. HAKE et AL. 2002) eingesetzt werden. Im Gegensatz zur Wissensgewinnung durch Geo-Visualisierung wird der kartographischen Visualisierung von Geo-Daten und der dafür nötigen Umsetzung mittels Darstellungsmedium Bildschirm bisher nur wenig Aufmerksamkeit geschenkt. Wie durch Tab. 2 verdeutlicht, benötigt die kartographische Darstellung in Funktion der Wissensvermittlung Anpassungen an das neue Medium Computerbildschirm im Vergleich zum traditionellen Darstellungsmedium Papier. Bevor ein geeignetes Werkzeug für den Zugang zu bestehenden Wissen realisiert wird, muss sich mit den für die kartographische Visualisierung - als Form der Wissensvermittlung - benötigten Elementen, Grundlagen und Anforderungen auseinandergesetzt werden.

Tab. 2: Vergleich ausgewählter Eigenschaften von analogen und digitalen Karten (Grundlage: DENZER, MAYER und HAAS 1995; MÜLLER 1997; STREIT 1997; SCHMIDT und RINNER 2001)

	Analoge (Papier-) Karte	**Digitale (Bildschirm-) Karte**
Auflösung	Hoch (600 – 1200 dpi)	Niedrig (72 dpi)
Darstellung	Statisch	Interaktionen, Dynamik, Animation
Karteninhalte	Festgelegt	Flexibel gestaltbar
Kartenprojektion	Festgelegt	Frei wählbar
Maßstab (abh. Erfassungsmaßstab)	Festgelegt	Frei wählbar
Platzangebot (Darstellung)	Unbegrenzt	Gering, begrenzt
Nutzer-Betrachtungsdauer	Lang	Kurz
Datenbankverbindung	Keine	Möglich
Kontextinformation	Nicht verfügbar	Möglich
Informations-Speicherung	Früher Papierkarte	GIS-Dateien, Geo-Datenbanken
Dokumentenanzahl	Einzeldokument	Mehrfach-Dokument, Multimedia
Kommunikation	Rein statische Kommunikation	Interaktive Kommunikation
Detaillierungsgrad	Anderes Kartenblatt	Möglichkeiten über Zoom, Generalisierung

3 GRUNDLAGE DER WISSENSVERMITTLUNG DURCH KARTOGRAPHISCHE VISUALISIERUNG

Der Umgang mit der Ressource Wissen verlangt, dass beim Management nicht direkt beim Endprodukt angesetzt wird. Das gesamte Daten- und Informationsumfeld, Zugangs- und Umgangswissen sowie Kontextwissen bzw. –informationen sind zu berücksichtigen. In vielen Unternehmen herrscht nicht nur Unklarheit, wo welche Experten sitzen und an welchen Projekten innerhalb der Organisation gearbeitet wird. Vielmehr liegt auch Intransparenz bei Daten und ihrem Umgang (Zugang, Verknüpfungen, Bearbeitung, Darstellung usw.) vor. Im Folgenden wird den allgemeinen Elementen des Wissensmanagements und anschließend dem Wissensmanagment im Zusammenhang mit kartographischer Visualisierung und Geo-Daten Aufmerksamkeit geschenkt.

3.1 Die Elemente des Wissensmanagements

Beim Wissensmanagement kommt vor allem der Verwaltung von Daten und Informationen Bedeutung zu (vgl. Abb. 5). Die drei Elemente Daten, Informationen und Wissen, die in engem Zusammenhang stehen, werden begrifflich oft vermischt. Sie sind aber deutlich voneinander abgegrenzt: Prinzipiell basieren Informationen auf Daten. Die Bearbeiter von Problemen sind jedoch primär nicht an Daten interessiert; benötigt werden Informationen und Wissen. Relevant ist ein schneller Zugang zu bestehenden Informationen abgeleitet aus Daten in entsprechender Darstellung, sowie in Folge die Gewinnung benötigten Wissens beim Menschen als Entscheidungs- und Handlungsgrundlage. Dabei werden Informationen bei den einzelnen Menschen erst auf Grund des kommunizierten Informationsgehalts und dem jeweiligen persönlichen Kontext und Erfahrungsschatzes zu Wissen. Während Daten und Informationen unter Anwendung des zugehörigen „Know hows" maschinell gespeichert und wieder gewonnen (abgeleitet und dargestellt) werden, muss Wissen kodifiziert, d.h. als Information dargestellt und als Daten abgebildet werden. Dabei kann zum einen nicht jedes Wissen kodifiziert werden, zum anderen geht bei dem Versuch, Wissen als Information darzustellen, oftmals ein Teil des Wissens verloren. Diesem kann teilweise durch die Bereitstellung von Kontextinformationen in Form von Metadaten begegnet werden (BAUER und GÜNZEL 2001; GÖTZER et AL. 2001; RENNINGER 2001). Obwohl von Wissensmanagement gesprochen wird, findet damit lediglich Informations- bzw. Datenverwaltung und -vermittlung statt.

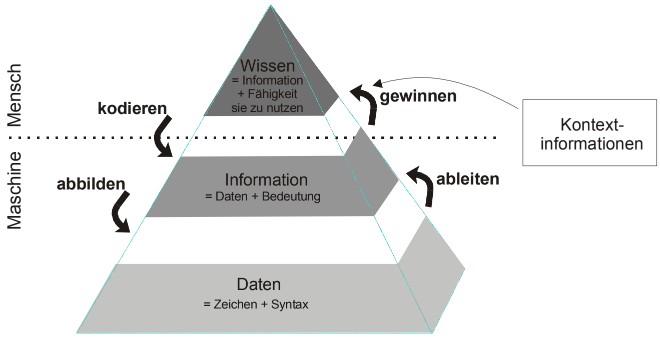

Abb. 5: Wissenspyramide (Grundlage: GUMM und SOMMER 1999; GÖTZER et AL. 2001; POPP 2001, PROBST und ROMHARDT 1998)

3.2 Elemente der kartographischen Visualisierung

Für die kartographische Visualisierung anhand des Mediums Computerbildschirm im Kontext der Wissensvermittlung, sind außer den Elementen des Wissensmanagements, Geo-Daten, Informationen und Wissen und Kontextinformationen im Besonderem auch das „Know how" um Ableitung und Darstellung von Geo-Daten zu kartographischen Informationen von Bedeutung. Der Zusammenhang zwischen Geo-Daten, Informationen, Fachwissen, „Know how", Kontextinformationen - als wichtige Unterstützung der Wissensbildung beim Nutzern - und Karten sowie dem Umfang und der Komplexität der benötigten Informationen und Wissen für die Kartenerzeugung als Grundlage der Wissenbildung beim Nutzer ist in Abb. 6 dargestellt.

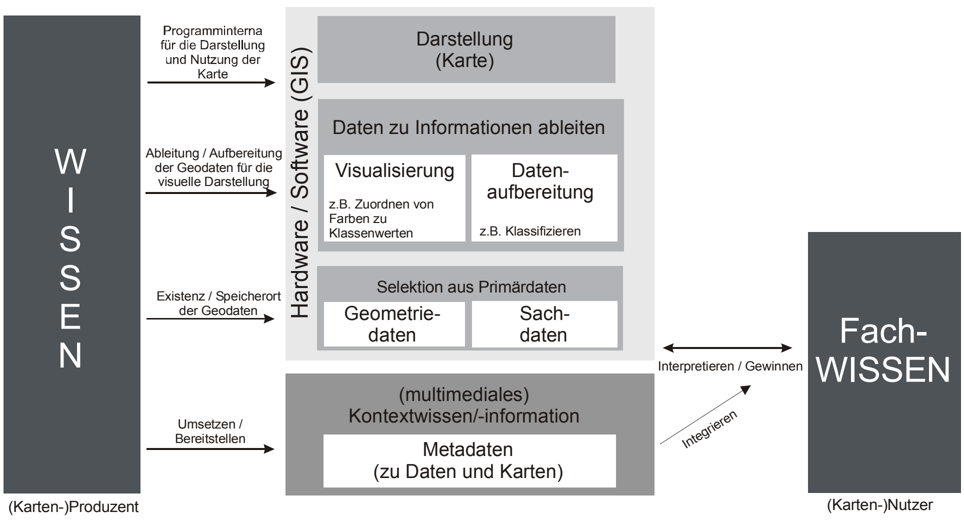

Abb. 6: Der Zusammenhang zwischen Daten, Informationen, Karten und Wissen (Quelle: verändert nach HENNIG 2003)

4 INTERAKTIVE BILDSCHIRMKARTEN – INSTRUMENT ZUM WISSENSMANAGEMENT IM NATIONALPARK BERCHTESGADEN

Auch in der Verwaltung des Nationalpark Berchtesgaden besteht Bedarf das existierende Wissen der Mitarbeiter - d.h. Fachwissen und Wissen um die optimale Darstellung von Karten als Kommunikationsmittel des bestehenden Fachwissens - anderen Mitarbeitern auf möglichst geeignete Weise zugänglich zu machen. Hierfür wurde eine spezielle Software-Applikation entwickelt.

Das Werkzeug „MaaT" (Map and Technology) stellt als System *Interaktiver Bildschirmkarten* dem Nutzer nicht nur das für Entscheidungen und Planungsprozesse benötigte Fachwissen mittels kartographischer Präsentation am Bildschirm zur Verfügung. Vielmehr wird auch das „Know how", d.h. Angaben und Regeln, zur Erzeugung der einzelnen Karten bereitgestellt.

Auf Grund des Umfangs und der Komplexität von Angaben und Regeln, die für eine dem Darstellungs- und Nutzungsmedium Bildschirm entsprechenden Ableitung kartographischer Informationen aus Geo-Daten und ihrer adäquaten Präsentation benötigt werden, bestehen die *Interaktiven Bildschirmkarten* aus den zwei Komponenten *Kartographische Nutzeroberfläche* und *Digitaler Kartenplan* (vgl. Abb. 7). Diese Zweiteilung ermöglicht eine weitgehend redundanzfreie und übersichtliche Speicherung und Verwaltung des „Know hows". Im Weiteren werden die beiden Komponenten – *Kartographische Nutzeroberfläche* und *Digitaler Kartenplan* – in aller Kürze vorgestellt.

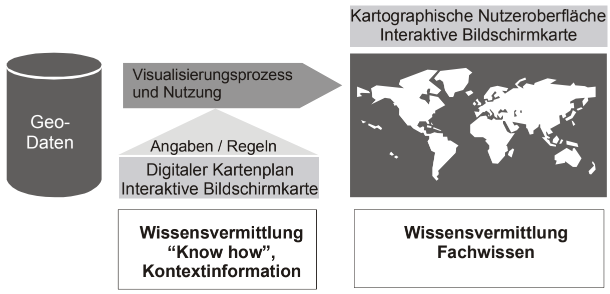

Abb. 7: Kartographischer Visualisierungsprozess im Rahmen der *Interaktiven Bildschirmkarte* (Grundlage: verändert nach KRAAK 2001: 9)

4.1 Die Kartographische Nutzeroberfläche

Die *Kartographische Nutzeroberfläche* als Darstellungs- und Nutzungsumgebung der *Interaktiven Bildschirmkarten* von „MaaT" ist als PC-Version in der Programmierumgebung „Visual Basic 6.0" realisiert. Die Verwendung der Mapping- und GIS-Komponente „MapObjects 2.2" ermöglicht die Visualisierung und Nutzung der Geo-Daten.

Einen schematischen Überblick zum Aufbau der *Kartographischen Nutzeroberfläche* bietet Abb. 8. Die einzelnen Bildschirmbereiche und Kartenbestandteile, wie z.B. Legende, Maßstab und Kartenfeld, sollen in ihrer Umsetzung und ihrem Inhalt prinzipiell der Unterstützung der räumlichen und thematisch-inhaltlichen Orientierung des Nutzers beim Umgang mit dem visualisierten Fachwissen dienen. In Zusammenhang mit ihnen stehen dem Nutzer auch verschiedene Interaktionen zur Gestaltung des Karteninhalts („control-panel" Legende) und -ausschnitts (Übersichtsfenster) zur Verfügung. Zudem sind Interaktionen zur Unterstützung des Nutzers bei der Kartenauswertung als Funktionen des Kartenlesens und –messens implementiert. Als Unterschied zu vergleichbaren Werkzeugen wird in der *Kartgraphischen Nutzteroberfläche* der Karteninhalt in Dichte und Gehalt an den durch den Nutzer gewählten Maßstab angepasst (vgl. HENNIG 2003). Dies erfolgt durch Generalisierungsmaßnahmen, wie z.B. mittels Layerausstattung und Symbolik. Entsprechend dem im Kartenfeld maßstabsabhängig angezeigten Karteninhalt ändert sich auch der Inhalt der klassischen Kartenlegende. Ihre Symbolerklärungen entsprechen stets den im Kartenbild tatsächlich visualisierten Informationen.

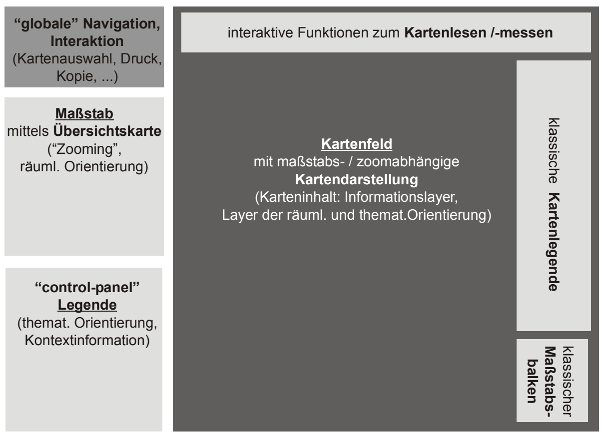

Abb. 8: Schematischer Überblick über Bildschirmbereiche bzw. Kartenrandausstattung und Interaktionen in der *Kartographischen Nutzeroberfläche* der *Interaktiven Bildschirmkarte* (Quelle: verändert nach HENNIG 2003)

4.2 Der Digitale Kartenplan

Der *Digitale Kartenplan* wird in XML (eXtensible Markup Language) anhand der zwei verschiedenen Typen von XML-Dokumenten, bezeichnet als XML-Dokument „Karte" und „Layer", in einem file-basierten System umgesetzt. Diese Struktur entspricht dem klassischen Layerkonzept wie es im Rahmen vieler GIS-Karten bzw. -Projkete verwendet wird (vgl. BILL und ZEHNER 2001). Mit XML wird ein für Verwaltung und Speicherung der „Erstellungsvorschriften" digitaler Karten bisher wenig beachteter Ansatz gewählt. Die Umsetzung der einzelnen XML-Dokumente als Grundlage der in der *Kartographischen Nutzeroberfläche* darzustellenden Karten erfolgt mittels der beiden XML-Editoren „XMLSPY5" und „XML EditML Pro v2.6". Einen Einblick in Struktur und Inhalt des *Digitalen Kartenplans* gewährleistet Abb. 9.

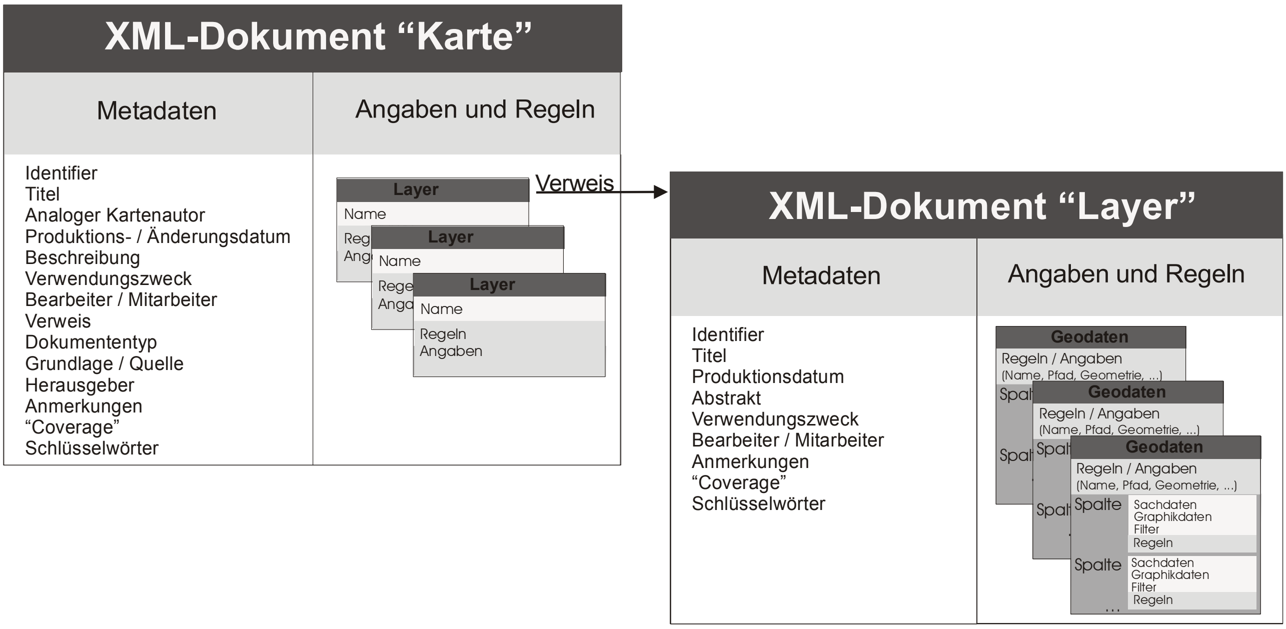

Abb. 9: Schematischer Überblick zu Inhalt und Struktur (klassisches Layerkonzepts) des *Digitalen Kartenplans* der *Interaktiven Bildschirmkarte* (Quelle: verändert nach HENNIG 2003)

Grundlage der *Interaktiven Bildschirmkarte* bzw. der *Kartographischen Nutzeroberfläche* ist der *Digitale Kartenplan*. Während die *Kartographische Nutzeroberfläche* der Vermittlung von Fachwissen dient, werden durch den *Digitalen Kartenplan* die Angaben und Regeln für die Kartendarstellung und –nutzung am Bildschirm verwaltet. Der *Digitale Kartenplan* stellt u.a. die benötigten Angaben zum Datenzugriff (Geometrie-, Sachdaten und graphikbeschreibende Daten) und Regeln bzgl. Klassifikationen, Filtervorgaben und Verknüpfungsvorschriften der Geo-Daten, Nutzungsvorschriften bzgl. Kartenlesen – und messen sowie Gestaltung des zoomabhängigen Karteninhalts in strukturierter Form bereit.

Des Weiteren nimmt der *Digitale Kartenplan* Aufgaben zur Vernetzung und zum Management bestehenden Wissens, hinsichtlich der einzelnen Wissens- bzw. Informationseinheiten „Karte", wahr. Zu den Geo-Daten, den die Karten aufbauenden Layern und den einzelnen Karten werden Zusatz- bzw. Kontextinformationen in Form von Metadaten verwaltet. Die Kontextinformationen der Geo-Daten werden durch Metadaten - wie allgemein üblich – mittels des FGDC-Metadaten-Standards (www.fgdc.gov) zur Verfügung gestellt. Zu den aus den Geo-Daten abgeleiteten kartographischen Informationen (Karten und Layer) sind die Kontextinformationen in Anlehnung an den Dublin-Core Metadaten-Standard (www.dublincore.org) erstellt. Die Metadaten zu den Karten umfassen beispielsweise Angaben bzw. Links zur Methodik, Verwendung und Literaturverweise. Verwaltet im *Digitalen Kartenplan* sind die Kontextinformationen über die *Kartographische Nutzeroberfläche* dem Nutzer zur Unterstützung der eigenen Wissensbildung gleichzeitig mit der kartographischen Information zugängig.

Damit werden in den einzelnen *Interaktiven Bildschirmkarten* inhaltlich zusammengehörende Informationen strukturiert zusammengefasst und bilden für jede einzelne, in das System „MaaT" integrierte Karte eine abgeschlossene Informationseinheit. Gleichzeitig steht das bis dahin implizite Wissen der Kartenerzeugung nicht nur der *Kartographischen Nutzeroberfläche* als Grundlage der Kartenvisualisierung und –nutzung zur Verfügung, sondern kann auf Grund seiner Umsetzung in XML auch durch die übrigen Mitarbeiter für die Produktion der einzelnen Karten in anderen (GIS-)Programmen verwendet werden.

5 UNTERNEHMENSPORTAL INTERAKTIVE BILDSCHIRMKARTE

Für die bisherige Realisierung und die zukünftige Weiterentwicklung der *Interaktiven Bildschirmkarte* spielte und spielt Wissensmanagement eine große Rolle. Verschiedene Bausteine des Wissensmanagements, wie beispielsweise die Wissensweitergabe, -nutzung, -dokumentation und –transparenz, werden durch die *Kartographische Nutzeroberfläche* und den *Digitalen Kartenplan* wahrgenommen. Basierend auf der Trennung in zwei Komponenten ist die *Interaktive Bildschirmkarte* ein umfassendes Werkzeug des Wissensmanagements und bietet die Möglichkeit die oftmals bestehenden Lücken bzgl. Wissensweitergabe und –nutzung zu schließen.

Vor allem durch die Sonderstellung des *Digitalen Kartenplans* bei Wissensvernetzung und -management – hinsichtlich Fachwissen und umfassendes „Know how" zur Kartenerzeugung, gebunden an die einzelne Karten - bietet sich der Begriff „Unternehmensportal" für das System *Interaktiver Bildschirmkarten* als treffende Bezeichnung an. Um den Zugang zu Informationen und Wissen zu gewährleisten, werden in Unternehmen in zunehmendem Maße Unternehmensportale eingesetzt. Sie stellen einen „Single Point of Access" zum Unternehmensgedächtnis dar. Über sie ist das vorhandene Wissen des Unternehmens, unabhängig von den Inhalten, der verwendeten Speichertechnologie und dem Standort, abrufbar. Idealerweise ist ein Unternehmensgedächtnis eine vollständige computerisierte Abbildung des menschlichen Wissens der Mitarbeiter eines Unternehmens (MAURER und TOCHTERMANN 2001). Insbesondere durch die weitergehende Integration von Kontextinformation in multimedialer Aufbereitung und einer noch umfassenderen systematischen Verlinkung betriebsinterner Ressourcen impliziten und expliziten Wissens kann „MaaT" derart wieterentwicklet werden, dass für dieses Informationssystem, mit derzeit noch Schwerpunkt bzgl. kartographischer Informationsvermittlung, die Bezeichnung Unternehmensportal nicht nur verwendet werden kann sondern verwendet werden muss.

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working architecture

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1 ZIELSETZUNG

Schaffung eines allgemein einsetzbaren zentralen Verwaltungssystems anhand einer konkreten Anforderung. Zentralisierung von verteilten Informationen (Mails, Termine, Daten) und Minimierung von benötigten Programmen (Internet-Zugang ohne Plugins). Das allgemeine Einsatzgebiet sind Firmen und Organisationen, die Leistungs- und Verwaltungsoptimierung durch zentrale Verwaltung von verschiedenen Funktionen erzielen wollen. Die konkrete Anwendung ist die Verwaltung eines Instituts der Fakultät für Architektur, das einerseits Architektur darstellt und andererseits Studenten mit unterschiedlichsten Anforderungen betreut.

1.1 Zentrale Informationsverarbeitung mit dezentralen Zugängen

Es gibt einen zentralen Server, der alle wichtigen Funktionen wie Sicherheit, Administration, Benutzermanagement, Funktionsverwaltung und vieles mehr übernimmt. Es gibt drei Arten von dezentralen Zugängen: Es gibt die allgemeinen Internetuser, die sich über Architektur informieren wollen, dann gibt es externe Benutzer, die angemeldet (registriert und befugt) Teile des Systems verwenden, und schliesslich sind da noch die internen Benutzer, die über die gesamte Palette der Funktionen verfügen können. Die zentrale Verwaltung teilt sich in zwei Ebenen auf, die des Administrators, der auf Systemverwaltungsebene volle Kontrolle hat, und die des Admins, der auf Benutzerverwaltungsebene Kontrolle ausübt.

1.2 Optimierung von Arbeits- und Verwaltungsvorgängen

Bedienung von wichtigen Anwendungen an einem Arbeitsplatz (Web-Desktop). Mail- und Terminverwaltung sind mit Projekten interaktiv vernetzt (wird z.B. ein neues Projekt erstellt, so wird automatisch eine neue zum Projekt zugeordnete Email-Adresse erstellt, und das Projekt erscheint in der Terminauswahl). Die Verwaltung findet sowohl auf Projekt- als auch auf Benutzerebene (interne oder externe) statt. Zentrale Nutzung von mehreren Mailkonten, Adressbüchern und Terminen (privaten und allgemeinen) machen die Verwendung von mehreren unterschiedlichen Programmen auf verschiedenen Computern und das Herumschleppen von diversen Synchronisationsgeräten überflüssig.

1.3 Förderung des Workflows zwischen internen und externen Benutzern

Durch das zentrale Arbeiten an Projekten ist es nicht notwendig, dass sich die beteiligten Personen an dem gleichen Ort befinden. Um die Kommunikation möglichst flexibel und produktiv zu gestalten, ist es möglich, für jedes Projekt Chat-, News- und Forummodule freizuschalten. Außerdem ist es möglich, online Bilder und Texte zu bearbeiten und diese als Arbeitsmappe abzuspeichern. Zugang zu internen Datenbereichen ist möglich.

1.4 Flexibilität des Systems zum multifunktionalen Einsatz

Das System kann wie ein mobiles Büro betrachtet werden, wobei das System an einer Stelle bleibt und die Benutzer mobil sind. Das Testsystem hat das Erarbeiten und die Präsentation von Architektur als Schwerpunkt. Die Flexibilität besteht darin, dass nicht nur jederzeit ohne zusätzlichen Programmieraufwand neue Datenbänke und deren Abfragen erstellt werden können, sondern auch das gesamte System auf ein anderes Arbeitsgebiet transportiert werden kann.

1.5 Informationsaustausch mit Industrie und Dienstleistern

Es ist jederzeit möglich, auf einfache Art und Weise externen Personen Zugang zum System zu gewähren. Inhalte (Termine, Bilder , Projekte, …) können zur Darstellung im Internet freigeschaltet werden. Down- und Uploads können allgemein oder mit loggin zur Verfügung gestellt werden.

1.6 Informationsaustausch mit anderen Institutionen

Um den Informationsaustausch mit anderen Institutionen zu fördern, ohne dabei Daten mehrfach abzuspeichern, ist es sinnvoll, gemeinsame Schnittstellen zu finden, über die kommuniziert werden kann. Dies kann entweder geschehen, indem man externen Benutzern Zugriff auf das System gewährt oder indem man anderen Systemen Zugriff (z.B. über XML) auf Daten gestattet, die dann von dem anderen System genutzt werden.

2 INHALT

Hierbei handelt es sich um einen Verwaltungs- und Managementserver für das Institut für Hochbau für Architekten (Abt. Konstruktion, Installation und Entwerfen), mit dem die interne Verwaltung und die externe Betreuung der Studenten optimiert werden sollen.

2.1 Instituts- (firmen-) spezifische Aufgabenstellungen (Personen, Aufgaben,Daten, …)

Benutzer- und Gruppenmanagement für interne Benutzer mit einer flexiblen Steuerung (jeder Benutzer kann das Recht der Benutzersteuerung bekommen). Projektspezifisches Anmeldesystem für externe Benutzer (Anmeldedaten können zwecks Evaluierung der Richtigkeit der Daten mit externen Datenbänken verglichen werden). Interne Benutzer können unterschiedliche oder gleiche Aufgaben bekommen. Flexible Gestaltung des allgemeinen Webbereichs (Ankündigungen, Termine, Personal, Shop, Projekte, …). Zentral nutzbares Kalender- und Webmailsystem mit privaten und allgemein nutzbaren Konten, Adressbüchern und Terminen.

2.2 Projektspezifische Aufgabenstellungen (Termine, Workflow, Daten, …)

Es besteht die Möglichkeit, Projekten unterschiedliche Aufgaben zuzuordnen. Da es sich hier um ein Architekturinstitut handelt, das Studenten (externe Mitarbeiter) auf der Basis von Lehrveranstaltungen (Projekten) lehrt, gibt es hier lehrveranstaltungsspezifische Termine (Analysenver- und -abgabe, Exkursionsdokumentation, Vorlesungen mit Anwesenheitspflicht, Prüfungen mit Benotungen, Zwischenkorrekturen mit oder ohne Benotung, komplette Online-Korrektur, …). Die Studenten können sich unter verschiedenen Kriterien zu Lehrveranstaltungen anmelden (Teilnehmeranzahl kann beschränkt werden, Gruppenbildung mit der Möglichkeit, die Gruppe zu wechseln, …). Exklusive Down- und Uploadbereiche für angemeldete Personen.

2.3 Allgemeine Arbeitsoptimierung (Mail, Kalender, Down-Upload, …)

Das Web-Mailsystem bietet herkömmlichen Webmailsystemen (hotmail, yahoo, ..) zahlreiche Vorteile. Es gibt die Möglichkeit mehrere Mailserver abzufragen und mit mehreren Identitäten zu arbeiten. Außer der Möglichkeit, private (an den Benutzer gebundene) Konten zu verwenden, gibt es Mailkonten, die automatisch generiert werden (diese sind an Projekte gebunden). Wird ein neues Projekt angelegt, generiert sich automatisch ein Mailkonto, für das man einen beliebigen Alias vergeben kann. Dieses Konto kann dann als öffentliches Konto von jedem Benutzer verwendet werden. Das heißt, bei vielen Projekten wird nicht die eigene Mailbox mit Mails überflutet und damit unübersichtlich, sondern das Projekt wird in einem eigenen Konto verwaltet und kann von mehreren Benutzern betreut werden. Mailverteilerlisten werden automatisch aus allen Konten generiert und können öffentlich und privat genutzt werden. Ähnlich verhält es sich bei den Terminen, wo es die Möglichkeit gibt, zuvor erzeugten Projekten, verschiedene Arten von Terminen zuzuordnen. Ebenfalls gibt es hier die Unterteilung in privat und öffentlich. Natürlich kann man auch benutzerspezifisch Down- und Uploads für verschiedene Bereiche freischalten, wobei man hier die File-Typen beschränken kann (zip-nicht entpackend; zip-entpackend; jpg; pdf; …).

2.4 Kommunikation zwischen Personal und Studenten (Forum, Chat, News, …)

Um Arbeitsabläufe zu optimieren und wenn das System dahingehend ausgelegt ist, dass sich die Benutzer nicht am gleichen Ort aufhalten, ist die Optimierung der Kommunikation ein wesentlicher Bestandteil. Man kann für jedes Projekt Forum-, Chat- und Newsmodule freischalten. Es gibt ein spezielles Korrekturmodul, in dem es möglich ist mehrere Bilder hochzuladen, diese in einer Sitzung (= eine Art Konferenzschaltung) zu bearbeiten, in einen Chatmodul Kommentare dazu abzugeben und das Ganze abzuspeichern. Hier können mehrere Benutzer (z.B. Assistent und Student) gleichzeitig ein Projekt bearbeiten. Ist die Sitzung beendet, kann man die Projektentwicklung hierarchisch jederzeit abrufen, speichern oder ausdrucken. So kann man jederzeit auf Informationen zurückgreifen, die sich sonst in Zettelwerk verlieren würden. Hier bieten sich Entwicklungsmöglichkiten für Firmen an, die mit externen Mitarbeitern arbeiten, die sich so Zeit, Telefon- und Fahrtkosten ersparen würden.

3 UMSETZUNG

Allgemeine und spezielle Umsetzung des Projektes.

3.1 Allgemein

Allgemeine Beschreibung der Schnittstellen und Anbindungsmöglichkeiten.

3.1.1 Ein zentraler Server (modular erweiterbar)

Alle Funktionen und Module können sich auf einem Server befinden (sicherheitstechnisch nicht optimal aber vertretbar). Das System kann sich aber auch auf mehrere Server verteilen (je nach zu erwartender Belastung und Budgetlage).

3.1.2 Opensource, Freeware

Es werden ausschließlich Freeware-Produkte verwendet, so dass keine Zusatzkosten aus lizenzpflichtigen Softwareprodukten erwachsen.

3.1.3 Einbindung in heterogene Netzwerke (Windows, Apple, Linux)

Prinzipiell ist auch ein systemübergreifendes Benutzermanagement möglich. Das bedeutet, dass der Server entweder als Schnittstelle *für* unterschiedliche Netzwerke, oder als zusätzlicher Server *in* unterschiedlichen Netzwerken aggieren kann.

3.1.4 Flexibler Zugang zu den Daten (https, vpn, smb, appletalk)

Externer Zugriff auf extern oder intern abgelegte Daten. Intern ist der Netzwerkzugriff von Windows, Apple und Linuxsystemen möglich.

3.1.5 Trennung von Design und Funktionalität

Da der Hauptzugriff über ein Webinterface stattfindet ist das Design oft entscheidend. Daher gibt es eine weitgehende Trennung der internen Funktionalität vom externen Design des Systems. Dadurch entsteht eine flexible Einsatzmöglichkeit, da man auf die individuellen Bedürfnisse des Benutzers (z.B. Kunden) flexibler reagieren kann.

3.1.6 Aufteilung der Administration (Benutzermanagement, Funktionserstellung, Programmierung)

Auf der administrativen Ebene gibt es eine Gewaltentrennung. Einerseits gibt es den Admin, der allgemeine administrative Aufgaben übernimmt (hier sind keine programmiertechnischen Kenntnisse nötig), und andererseits den vollen Administrator, bei dem minimale technische Kenntnisse notwendig sind (Datenbankstrukturen, sql). Hier ist es möglich, über verschiedene Editierebenen Änderungen an der Gesamtstruktur vorzunehmen.

3.2 Speziell

Beschreibung der serverspezifischen Funktionalität.

3.2.1 Server (Abb:1)

- Systemsoftware: Linux-Redhat
- Datenbank: MySql
- Webserver: Apache
- Fileserver: Samba
- Skriptsprache: PHP
- Mailserver: Cyrus
- Firewall: IPtables
- VPN-Server: IPsec

3.2.2 Funktionalität

- Contentmanagementsystem
- Anmeldesystem für externe Benutzer (allgemein und projektbezogen)
- Webmail (automatische Adressbücher, Verteilerlisten)
- Kalender
- Diverse Module (Shop, Abo, News, Chat, Forum, Bibliothek, …)

3.2.3 Interaktivität

- Die gesamte Homepage wird aus der Datenbank generiert
- Automatische Menüführung (horizontal und vertikal)
- Benutzer- und Funktionsmanagement (Userlevel 1)
- Generierung von Datenbankstrukturen durch Editoren (Userlevel 2)

3.2.4 Allgemeine Verwaltung (Userlevel 1)

- Benutzermanagement:
  - Erstellung von internen Benutzern
  - Zuweisung der Benutzer zu Gruppen
- Funktionsmanagement
  - Zuweisung von Funktionen für Benutzer (Mail, Kalender, Chat, Datenzugriff, …)
- Allgemeine Mailkonten
  - Einrichtung von allgemeinen Mailkonten (info@ , sekretariat@ , events@ , …)

3.2.5 Datenbankverwaltung (Userlevel 2)

- Erstellung und Verwaltung von Datenbanktabellen (RDBMS)
  - Menügesteuertes Anlegen von neuen Datenbankstrukturen
- Automatische Erstellung von Eingabeseiten zu Datenbanktabellen
  - Eingabeseiten zu neuen Datenbanktabellen werden automatisch generiert
- Bearbeitung der Eingabeformate für Datenbankfelder (SQL Eingabe)
  - Flexibles Gestalten von Eingabearten für Felder (Checkbox, Pulldownmenü, …)

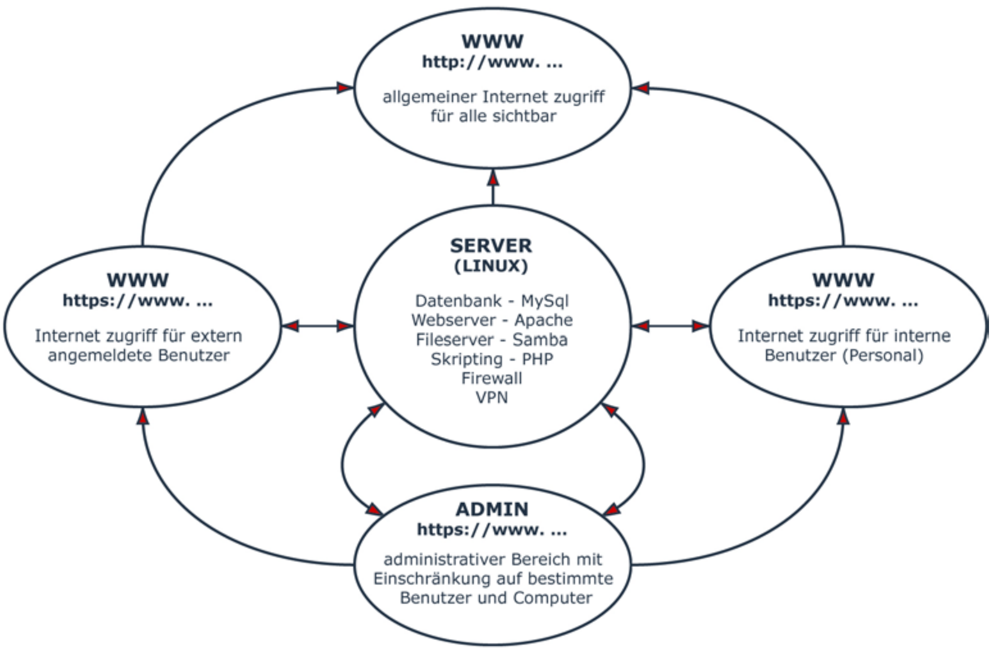

Abb.1: Server

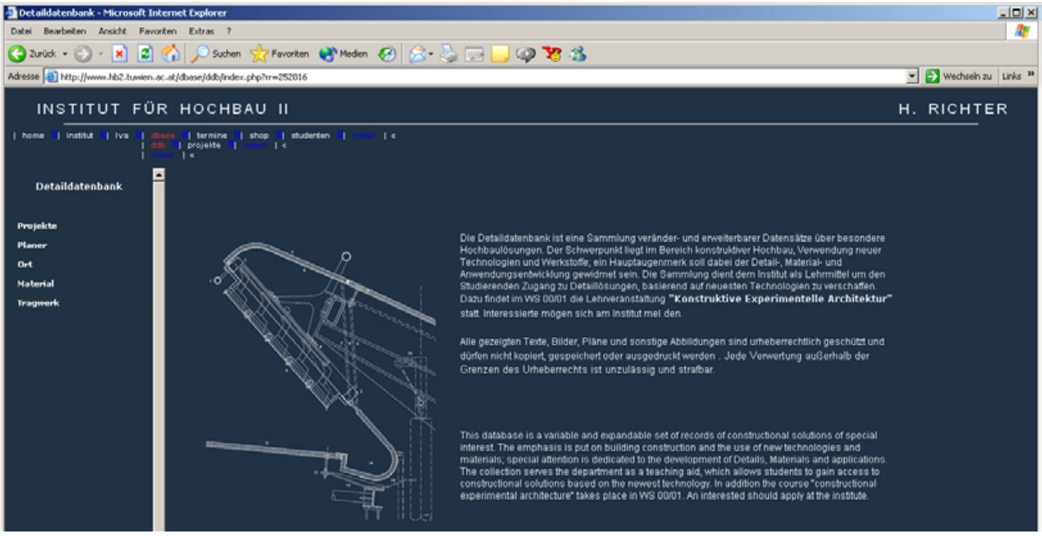

Abb.2: Allgemeine www Benutzer

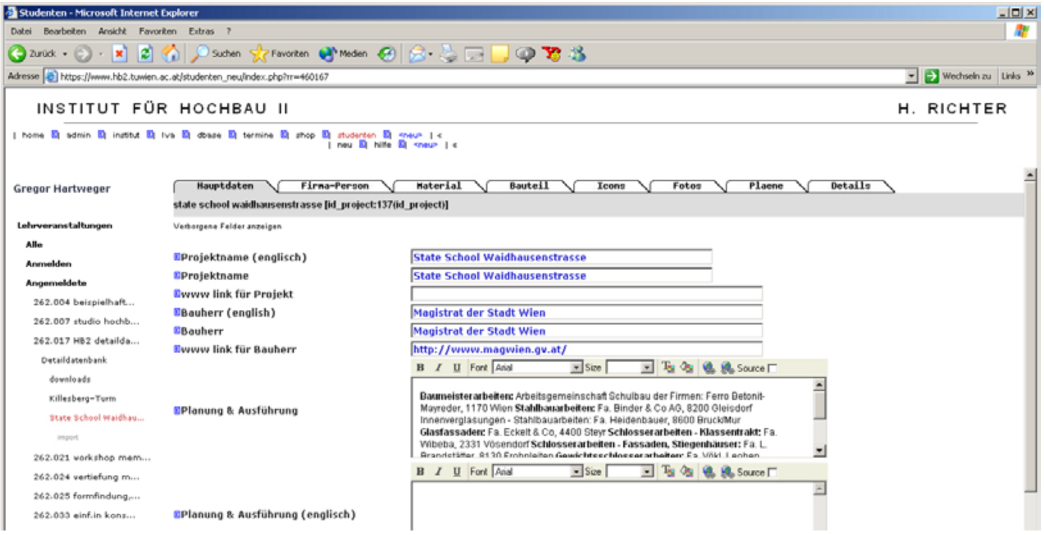

Abb.3: Externe Benutzer

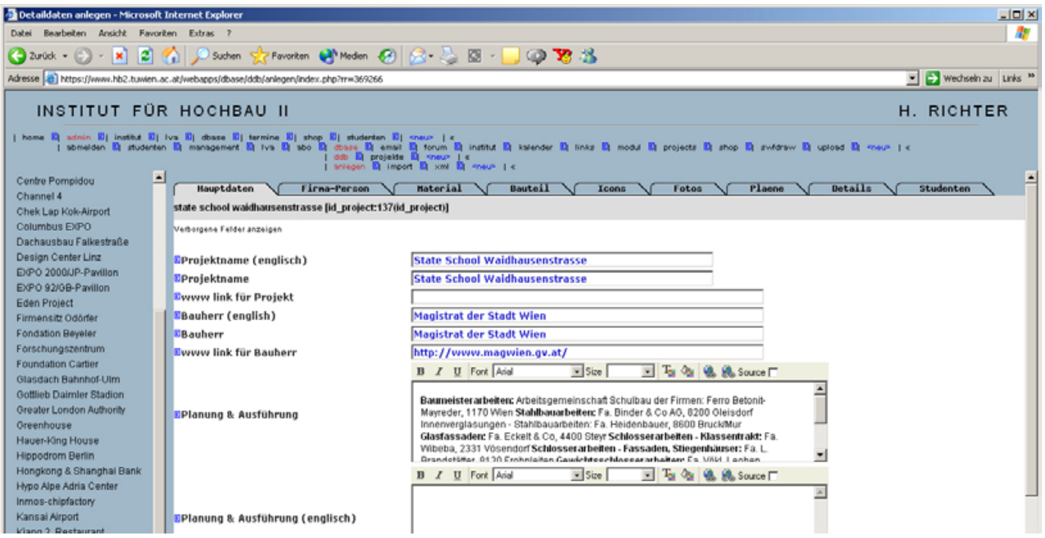

Abb.4: Interne Benutzer

e-Government in der Straßenverwaltung.
Behördenintegration schafft hochwertige Daten und Planungsgrundlagen im Verkehrsbereich.

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1 ZUSAMMENFASSUNG:

Das Land Kärnten hat in einem Pilotprojekt geprüft welche Vorteile die GIS-unterstützte Abarbeitung folgender Arbeitsabläufe mit sich führen kann:

- Verwaltung von Verkehrszeichen und Bodenmarkierungen
- Automatisierte Erstellung und StVO-Überprüfung von Verordnungen
- Erfassung und Auswertung von Straßenzustandsinformationen und Videobefahrungen
- Sanierung der Verkehrsregelung mit Unterstützung durch "Verkehrslogik"

Die Erfahrungen des Pilotprojekts zeigen detailliert, welche Informationen für welche Straßenkategorien sinnvoll anzuwenden sind und welche Vorteile sich durch die Work-flow Unterstützung für die Straßenverwaltung ergeben. Dies sind insbesondere eine Verbesserung der Rechtssicherheit und Verkehrssicherheit sowie die übersichtliche integrierte Dokumentation. In der Präsentation werden auch die technischen Grundlagen der Umsetzung, insbesondere in der automatisierten kartographie-gestützten Verordnungsgebung sowie der Ableitung der Verkehrslogik, detailliert vorgestellt.

Als Nebenprodukt dieser Verfahrensabläufe werden jedoch auch Daten produziert, die für Anwendungen außerhalb der Straßenverwaltung im engeren Sinn Verwendung finden können. Dazu zählen insbesondere Grundlagendaten für die Verkehrstelematik sowie Basisdaten für die Verkehrsplanung, die ansonsten nicht oder nur mit hohem Erhebungsaufwand und dabei ungenau vorliegen.

2 PROBLEMSTELLUNG

Derzeit gibt es keine Gesamtübersicht über den Naturstand der Verkehrszeichen, sowie der dazugehörenden Dokumentation. Diese Situation ist in Kärnten in der Kompetenzverteilung zwischen Land Kärnten, Bezirkshauptmannschaft und Gemeinde begründet, existiert aber analog in anderen österreichischen Bundesländern (und wohl auch über Österreich hinaus). Eine gemeinsame Darstellung, sowie ein gemeinsamer Datenzugriff sind wünschenswert, zumal auch Dienststellen des Landes Kärnten, die mit der Erhaltung von Straßen und Infrastruktureinrichtungen zu tun haben, eine Möglichkeit zur Abfrage von Informationen und graphischen Auswertungen haben sollen.

Ein weiterer Aspekt ist die Problematik der Rechtssicherheit: Verordnungen sind anfechtbar! Inkonsistenzen im Naturstand führen zu Widersprüchen zur geltenden StVO. Ein aktueller und korrigierter Naturstand soll Rechtssicherheit gewährleisten.

Ein weiteres Problem stellt der sogenannte ‚Schilderwald' dar. Ein im Laufe der Zeit gewachsener Verkehrszeichenbestand beeinträchtigt die Übersicht und vermindert das Auffassungsvermögen der Verkehrsteilnehmer. Eine Reduktion der Verkehrszeichen soll zu einer Steigerung der Verkehrssicherheit führen.

Abschließend sein noch erwähnt, dass in manchen Situationen Informationen über zurückliegende Naturstände wünschenswert wären, so im Falle der Unfallursachenforschung oder aber auch von Verhandlungen in Unfallfällen.

3 ZIELSETZUNGEN UND LÖSUNGSANSATZ

Die Realisierung des CNC – Corporate Network Carinthia, Behördennetz für Kärntner Gemeinden, und dessen Einbindung in das Kärntner Verwaltungsnetz stellt die technische Voraussetzung für die Umsetzung eines behördenübergreifenden workflows dar. In der Interaktion zwischen Land, Bezirkshauptmannschaft , Gemeinden und Straßenmeisterei liegt die zentrale Datenhaltung in der Abt.7, Wirtschaftsrecht und Infrastruktur.

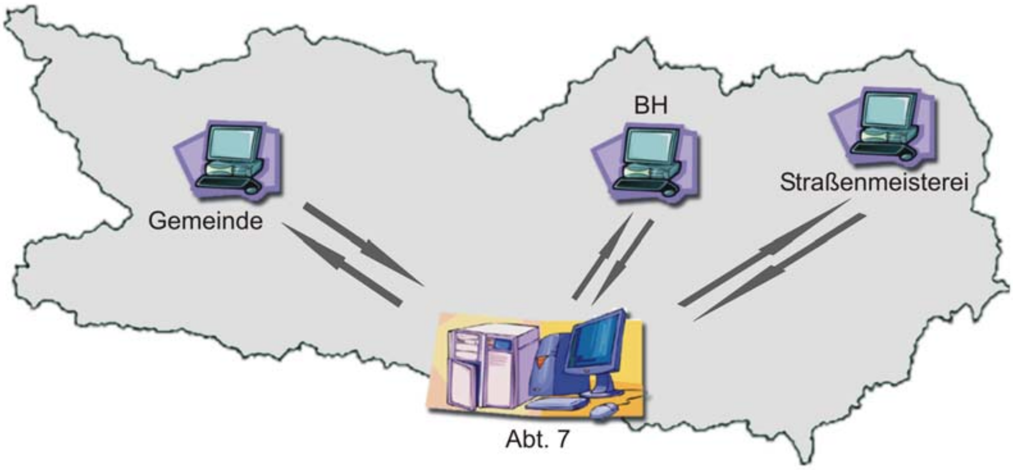


Abb. 1: Behördennetz

Im Pilotprojekt wird aufbauend auf eine Behördenkooperation zwischen Land Kärnten, Bezirkshauptmannschaft, Gemeinde und Straßenmeisterei versucht die Arbeitsabläufe bezüglich Verordnungen zu beschreiben und in einem Workflow umzusetzen.

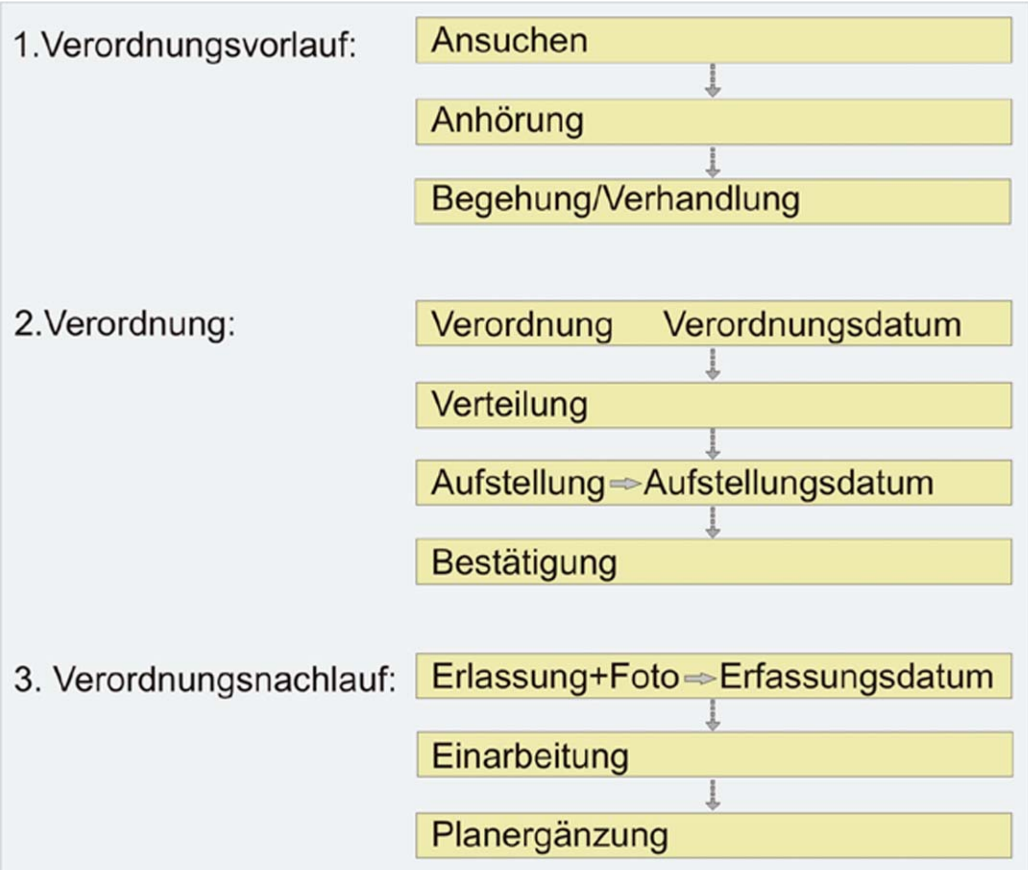


Abb. 2: Workflow - Verordnung

In diesem Zusammenhang wird an der Vereinheitlichung der Verordnungsgebung gearbeitet.

Aus den Textbausteinen für die Maßnahme, Verortung und Kundmachungshinweise wird ein einheitliches Verordnungsdokument automatisiert erstellt. Dies führt in weiterer Folge zu einem landesweiten gültigen Formulierungsstandard, was sowohl die Verständlichkeit und Nachvollziehbarkeit, als auch die Rechtssicherheit verbessern soll.

Die automatisierte Unterstützung der Verordnungsgebung steht an zentraler Stelle in der Umsetzung, da damit einerseits die genannten Aspekte der Rechtssicherheit verbunden sind, andererseits nur so langfristig eine konsistente Aktualisierung des Naturbestandes (Verkehrszeichen) gewährleistet werden kann. Mit dem gewählten Lösungsansatz werden im Zuge eines bestehenden Arbeitsvorgangs - der Erstellung und Umsetzung der Verordnung – automatisiert die notwendigen Datenbestände erzeugt und stehen so in der Datenbank und (karto-)graphisch bereits zur Verfügung.

4 IMPLEMENTIERUNG

4.1 Erfassung

Die Erfassung hat gezeigt, dass folgende Aspekte von zentraler Bedeutung für eine effiziente Durchführung und qualitativ gute Datenbank sind:

- Trennung von Erfassung vor Ort (Zuordnung Koordinaten, Richtung der Verkehrszeichen) und inhaltlicher Dateneingabe
- Erfassung aller Verkehrszeichen mit eigenen Fotos (dies erlaubt einerseits die oben angegebene
- Sicherung der Datenaktualisierung bereits zum Zeitpunkt der Erfassung. Dies wurde durch die direkte Integration des Verordnungsprozesses ermöglicht.

Der resultierende Arbeitsablauf – für die Naturstandsvermessung ist hier der Teil Verordnungsgebung abzuziehen – bietet damit folgendes Bild:

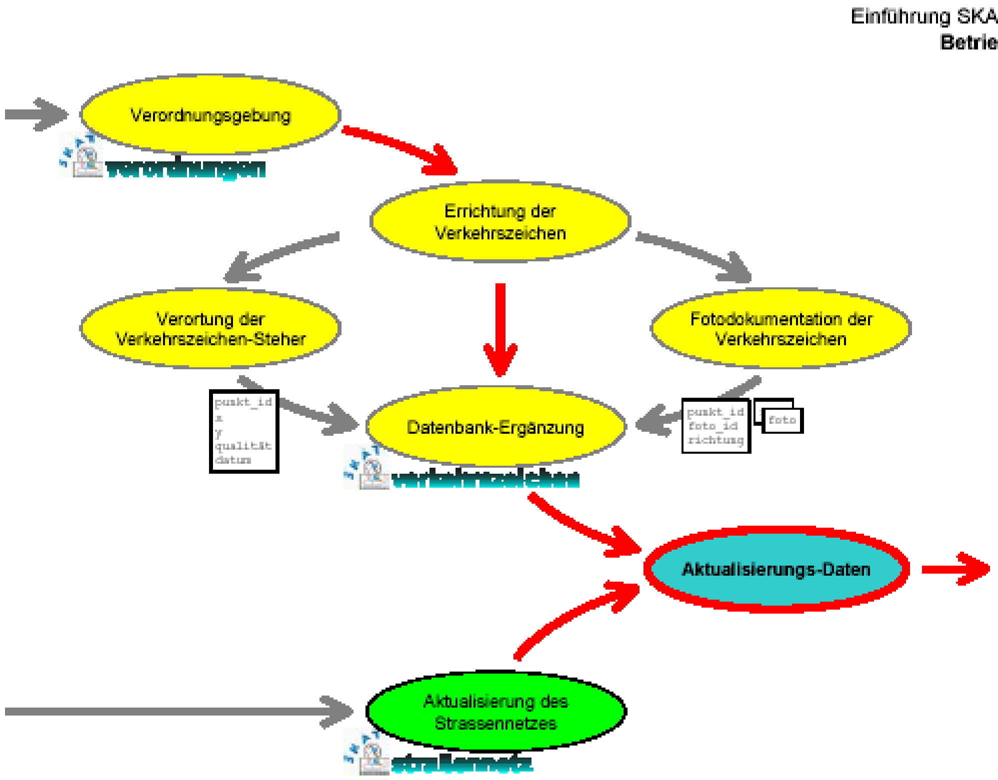


Abb. 3: Datenwartung am Beispiel der Verkehrszeichen

4.2 Technische Komponenten

Die softwaretechnische Umsetzung erfolgte mithilfe der Module von SKAT (StraßenKartographie- und AdministrationsTools) von PRISMA solutions. Die Produktfamilie SKAT wurde in den letzten Jahren entwickelt, um eine umfassende Verwaltung des Rechts- und Naturstandes im Straßenraum zu gewährleisten. Dazu bietet es mehrere, aufeinander abgestimmte, Softwaremodule. Diese werden laufend weiterentwickelt, um auch zukünftig alle wesentlichen Aufgaben im Straßenbereich bestmöglich unterstützen zu können (Bodenmarkierungen, Straßeneinrichtungen, etc.).

Der technische Lösungsansatz beruht dabei auf zwei wesentlichen Komponenten:

- Abbildung aller Informationen in einer Datenbank (auch die Geometrie wird – konform zur OGIS-Spezifikationen SQL 1.1 (normalised SQL bzw. binär) abgelegt).
- Graphische Unterstützung aller Eingaben und Abfragen, durch eine – auf Komponentensoftware – basierende eigenständige Anwendung. Besonderes Augenmerk wurde dabei auf die laufende kartographische Unterstützung des Arbeitsablaufs gelegt, der mit MapObjects (2.1) umgesetzt wurde.

Im Detail kann das technische Lösungskonzept mit folgenden Schlagworten kurz charakterisiert werden:

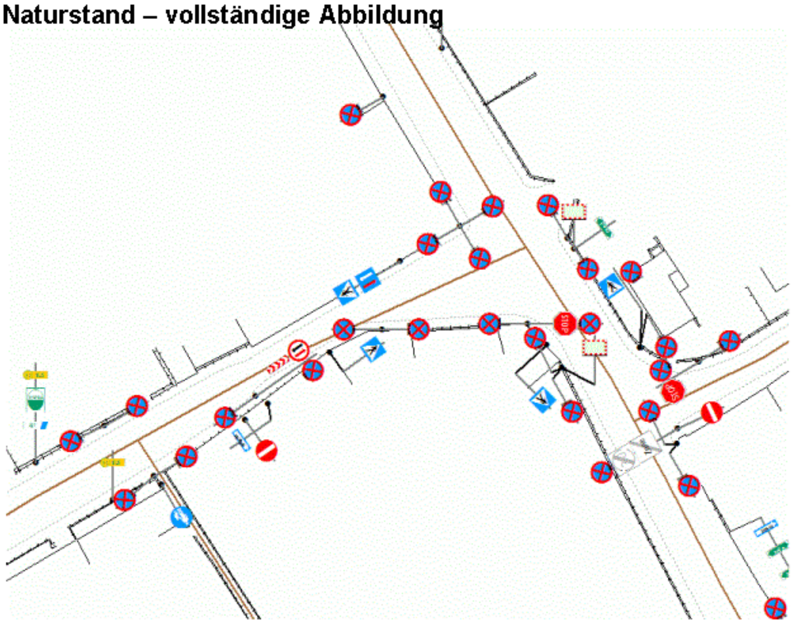
Metadatenbank:	Grundsätzlich werden sämtliche Informationen, die für die Systemfunktionalität und für den Benutzerzugriff von Bedeutung sind, in einer zentralen Metadatenbank dokumentiert. Diese basiert auf den gängigen Standards für raumbezogene Daten (FGDC, ISO 19115), erweitert diese aber um wesentliche Aspekte der Datenverwaltung (Modellierung der Datenbankstruktur)

	des Benutzerzugriffs (Festlegung von Benutzern und Rollen) des Workflows sowie der kartographischen Gestaltung (als Vorschlagswerte für den Benutzer). Dabei erfolgt von den einzelnen Clients kein direkter Zugriff auf die Daten mehr, sondern jeder Zugriff wird über die Metadatenbank und die dort hinterlegten Regeln durchgeführt.
Kartographie:	Die einzige Möglichkeit zur Gestaltung einer hochqualitative Graphik stellte sich in der Verwendung von eigenen TrueTypeFonts dar. Diese bilden die Basis für alle Verkehrszeichendarstellungen, wobei – je nach Maßstab und gewünschten Inhalten – die Darstellung über die Datenbank adaptiert werden kann (beispielsweise: unterschiedliche Freistellungen je Maßstabsbereich).
Datenbanken:	Unabhängigkeit von speziellen Datenbanksystemen durch offenen Zugriff über normierte SQL-Schnittstellen. Wo notwendig, wurden die Trigger wurden aus dem Grund der Systemunabhängigkeit ebenfalls nicht direkt in der Datenbank hinterlegt, sondern – definiert in der XML-Sprache XQuery – in der Metadatenbank hinterlegt. Damit ist einerseits die Systemunabhängigkeit gewährleistet, andererseits können aber auch eigene Triggers und auch Funktionen vom Administrator der Metadatenbank erzeugt werden. Dieses Konzept wurde so umfassend durchgeführt, dass die entsprechenden Funktionen als eigener Workflow-Layer (als benutzerorientierter Bestandteil des Business Layer) in der Systemarchitektur angesehen werden können.

Die technische Umsetzung selbst kann anhand von zwei Beispielen dargestellt werden, der Verwaltung von Verkehrszeichen / Verordnungen und der Überprüfung der StVO-Konformität mittels Verkehrslogik.

4.3 Beispiel Verkehrszeichen und Verordnungen

Naturstand – vollständige Abbildung



Verkehrszeichendarstellung des Naturstandes im System (oben) und Darstellung einer verordneten Maßnahme als Ergebnis des Verordnungsablaufs.

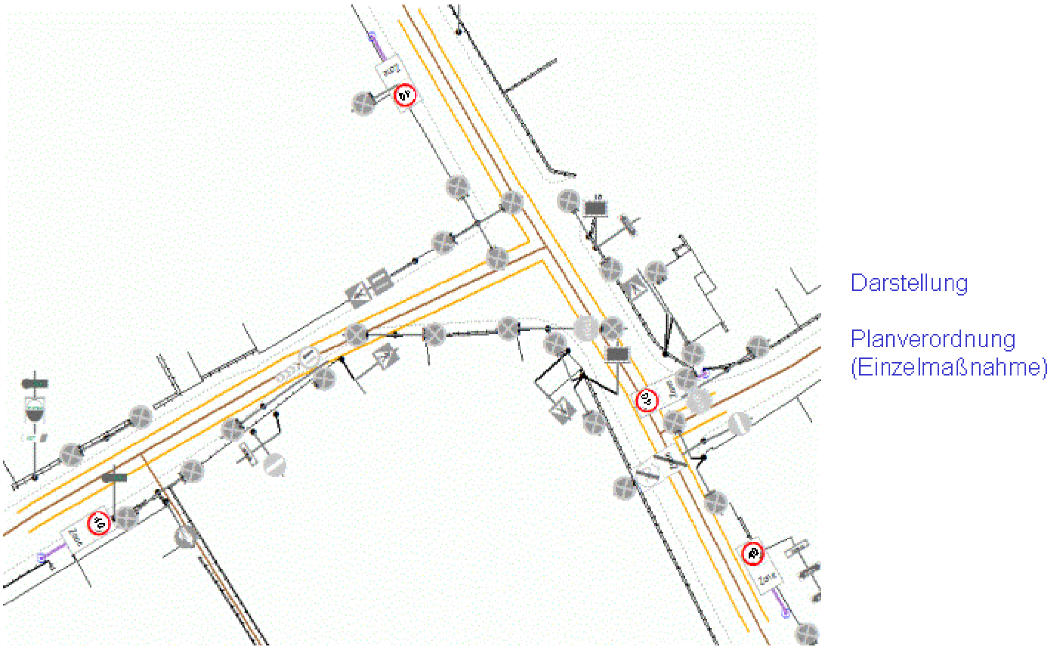


Abb. 4: Plandarstellungen

4.4 Beispiel Verkehrslogik

Die Verkehrslogik basiert auf einem umfassenden technischen Regelwerk, das die gesamte StVO formalisiert abbildet. Mit Hilfe der Verkehrslogik können zwei wesentliche Ergebnisse berechnet werden:

Überprüfung von Maßnahmen und Verkehrszeichen auf ihre StVO-Konformität (beispielsweise Anfang/Ende – Schilder; Vollständigkeit einer Zonenbeschilderung)

Ableitung von Gültigkeitsbereichen von Maßnahmen im Netz. Damit können Attribute, wie Geschwindigkeiten, Abbiegerelationen oder Parkgelegenheiten automatisiert aus dem Verkehrszeichenbestand abgeleitet und auf das digitale Straßennetzwerk übertragen werden.

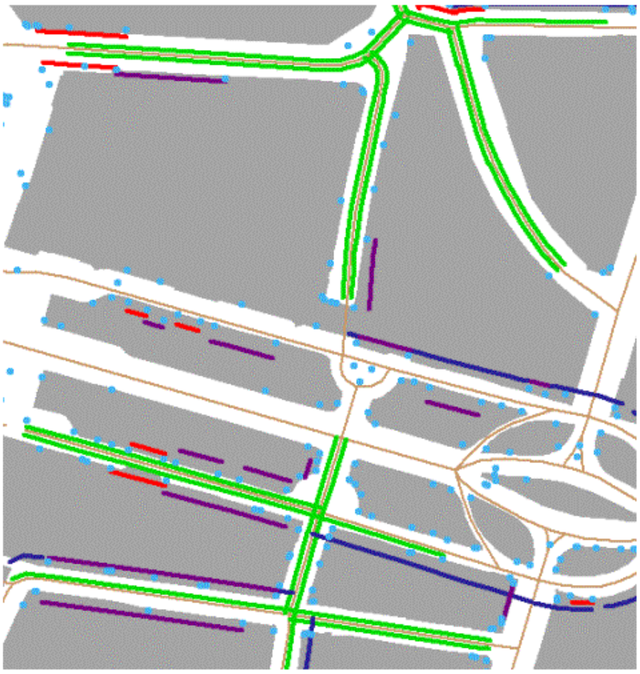
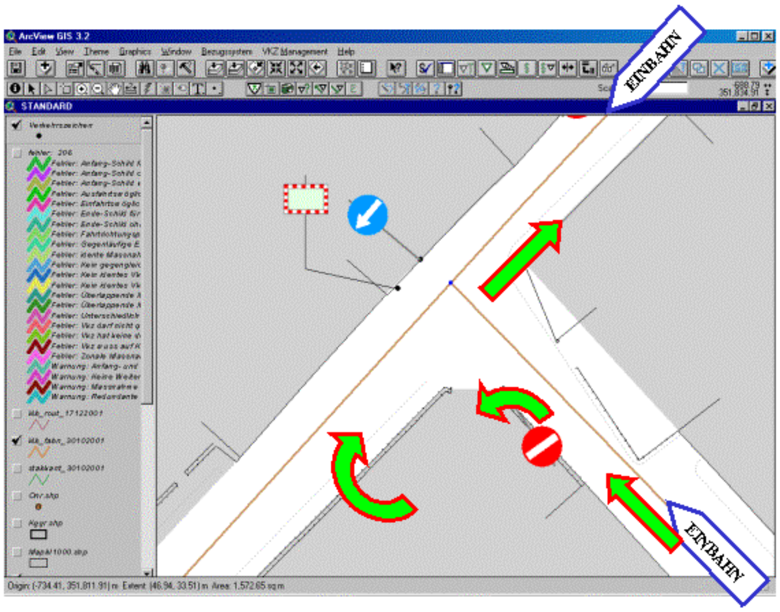
 Parkplätze	Die Abbildung zeigt die – mit Hilfe des StVO-Regelwerks und des Bestandes an Verkehrszeichen – abgeleiteten Parkmöglichkeiten.
 Fahrtmöglichkeit gegen Einbahnstraße !	Die Abbildung zeigt eine Problemstelle an. Hier ist eine zusätzliche Kennzeichnung mit einem „Einfahrt verboten“ – Schild notwendig. Sanierungs-bedarf !!“

Abb. 5: Ergebnisse der Verkehrslogik

5 ZUSATZNUTZEN IN DER PLANUNG:

Aufgrund der speziellen Verarbeitung der anfallenden Daten mithilfe der Verkehrslogik ist es möglich, eine Reihe von Zusatzdaten quasi als Nebenprodukt automatisiert aus den Verwaltungsdaten zu erzeugen. Diese Nebenprodukte sind vor allem für die Verkehrstelematik sowie die Verkehrsplanung interessant:

- aktuelles Straßennetz mit allen Benennungen und topologischen Beziehungen
- Abbiegerelationen an Kreuzungen
- Verlauf von Vorrangstraßen
- Geschwindigkeitsbeschränkungen am Netz (auch als Zonen, wie beispielsweise
- Gekennzeichnete Gefahrenstellen

Damit kann ein wesentliches Problem der Verkehrsplanung, nämlich die Erstellung, Wartung und Kalibrierung der für die Verkehrsmodellierung verwendeten digitalen Straßennetzwerke deutlich reduziert werden. Die Aktualität der Daten kann durch den Verwaltungsablauf garantiert werden (da dieser direkt mit der Rechtssicherheit verknüpft ist !) und die Datenerstellung beschränkt sich im wesentlichen auf die Definition und Unterstützung von Schnittstellen. Dabei müssen diese Schnittstellen natürlich eine gewisse Intelligenz aufweisen, um nicht nur eine Basisdatendefinition, sondern auch eine (schrittweise, unvollständige) Aktualisierung des Modellgraphen zu erlauben. Damit bietet sich für die Verwaltung auch die Möglichkeit einen einheitlichen Standard im Datensektor für die Verkehrsplanung zu schaffen – und damit auch die Nachvollziehbarkeit der Ergebnisse zu verbessern.

Für die Verkehrstelematik bieten sich die Vorteile und Nutzungsmöglichkeiten in einer ähnlichen Form, wobei als zusätzlicher Aspekt die Unterstützung und Berücksichtigung der Verkehrssicherheit zu beachten ist. So kann die Öffentliche Hand mit der Weitergabe der entsprechenden Daten – beispielsweise über Gefahrenstellen und deren Charakterisierung - auch die möglichen Warnbereiche mit steuern. Ähnliche Möglichkeiten bestehen auch in der Ansprache und Definition von Umleitungen und anderen direkt verkehrssteuernden Maßnahmen.

6 AUSBLICK

Die Kärntner Landesregierung erwartet sich durch die Einführung von SKAT Verbesserungen in den Bereichen Dokumentation und Arbeitserleichterung, Rechtssicherheit und – langfristig auch – Verkehrssicherheit. Die Kosteneinsparungen können nur langfristig geschätzt werden, aber Erfahrungen anderer Städte und Länder zeigen alleine durch eine mögliche Verringerung des Verkehrszeichenbestandes ein Einsparungspotential von 10-15%.

6.1 Arbeitsunterstützung

- Übersichtliche Verwaltung des Straßennetzes sowie der Verkehrszeichen und Verordnungen
- Verwaltung von Zusatzinformationen zu Verkehrszeichen (Anbringung, Material, Zustand, etc.)
- Unterstützung in der Verordnungsunterstellung
- Automatisierte Datenarchivierung (z.B. Verknüpfung Verordnung – Verkehrszeichen)
- Unterstützung bei der digitalen Weiterleitung von Verordnungsdokumenten oder Verkehrszeicheninformationen

6.2 Dokumentation

- Digitales Archiv über Straßennetz, Verkehrszeichen und Verordnungen sowie deren Verknüpfungen
- Direkter Zugriff auf zeitlich zurückliegende Datenbestände (Historienverwaltung)
- Kartografische Übersicht zur Vorbereitung von Verhandlungen, Begehungen, etc.
- Grundlage für laufende Überprüfungen von Verkehrszeichen

6.3 Rechtssicherheit

- Dokumentation der tatsächlichen Aufstellungsorte von Verkehrszeichen
- permanente Verknüpfung von Verkehrszeichen und Verordnungen
- Vermeidung von Inkonsistenzen im Sinne der StVO durch automatisierte Prüfungen
- Zugriff auf zeitlich zurückliegende Datenbestände zur Beweisführung in diversen Verfahren

6.4 Verkehrssicherheit

- Übersichtlichkeit durch Reduktion des Schilderwaldes um "unnotwendige" Verkehrszeichen
- Klare Verkehrssituationen (Vorrang, etc.) durch Prüfung der Verkehrslogik
- Erleichterung der Prüfung der Sichtbarkeit beziehungsweise Erkennbarkeit von Verkehrsschildern

6.5 Planungsunterstützung

- Einheitliche Basis für Verkehrsmodellierung
- Erleichterung in der Erstellung und Aktualisierung von Verkehrsgraphen, inkl. der wichtigsten Attributierungen (Geschwindigkeit, Gefahrenstellen, Abbiegerelationen)

6.6 Verkehrstelematik

- Einheitliche Datenbasis
- Aktualität und Verlässlichkeit der Daten
- Eingriffsmöglichkeiten der Öffentlichen Hand im Sinne der Verkehrssicherheit

Netzwerk Geoinformation Tirol
Regionale Verfügbarkeit öffentlicher Geodaten in einem Data Warehouse

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1 ORGANISATORISCHE ASPEKTE (BEITRAG RIEDL)

1.1 Ausgangslage

Das Tiroler Raumordnungs-Informationssystem ***tiris*** wurde als das geografische Informationssystem der Tiroler Landesverwaltung seit dem Jahre 1991 aufgebaut und fortlaufend weiter entwickelt. Eine erste Ausbaustufe bestand in der Dezentralisierung des ursprünglich im Bereich der Raumordnung entwickelten Ansatzes auf alle raumbezogen wirkende Verwaltungsbereiche des Landes. In weiterer Folge wurden mit anderen Gebietskörperschaften insbesondere den 279 Tiroler Gemeinden, und mit gemeinnützigen Institutionen wie dem Österr. Roten Kreuz dauerhafte Datenaustauschbeziehungen eingerichtet. Als dritte wesentliche Entwicklungsstufe des ***tiris*** ist die strategische Ausrichtung der Datennutzung auf benutzergesteuerte Web Map Services zu nennen, welche für spezielle Nutzerkreise im Intranet und Internet, aber auch für die Öffentlichkeit angeboten werden.

Einige Eckzahlen vermögen das Ausmaß diese regionalen Geodatenverbundes im öffentlichen Bereich zu veranschaulichen:

- tiris verwaltet 200 Gigabyte an Vektordaten und 1 Terrabyte an Rasterdaten;
- zwischen Gemeinden und Land finden jährlich 2000 Transfers von Geodatensätzen statt;
- im geschützten Bereich der WMS werden jährlich 70.000 Anmeldungen (Identifikationen) registriert;
- am WMS-Server des ***tiris*** werden pro Jahr 400.000 Visits und 3,8 Millionen Hits registriert.

Die Annahme und Wertschätzung der von ***tiris*** angebotenen Dienstleistungen innerhalb der Landesverwaltung ist sehr hoch. Die Produktpalette (Inhalte, WMS) wird fortlaufend ergänzt, derzeit läuft im Innenverhältnis eine Software bedingte Migration der Geodatenspeicherung und Arbeitsabläufe.

Die Beziehung zu den vertraglich eingebundenen Partnern des ***tiris*** ist in kommunikativer Hinsicht hoch entwickelt. Die recht hohe Durchdringung des öffentlichen Bereiches mit geografischen Informationstechnik in Tirol lässt die Begehrlichkeit nach **Ausweitung der Inhalte und Anwendungsgebiete** steigen. Ein Schwerpunkt inhaltlicher Anforderungen zeichnet sich im Infrastrukturbereich (Energie, Straßen, Telekommunikation, Wasser) ab. Dort sind entweder sehr große, zum Teil landesweite Versorger mit eigener GI-Infrastruktur tätig oder aber kommunale, oftmals sehr klein strukturierte Unternehmen.

Infolge des intensiven Datenaustausches - insbesondere bei der Datenaktualisierung - tritt **der hohe Arbeitsaufwand bei der Konvertierung** oftmals geringfügiger Datenänderungen immer stärker in den Vordergrund. Viele Gebietskörperschaften vergeben die Planung und Durchführung ihrer Aufgaben an freiberuflich tätige Ingenieure und technische Büros. Die verschiedenen Digitalisiersysteme produzieren Daten mit unterschiedlichen geometrischen und topologischen Modellen, welche nicht ohne weitere Bearbeitungsschritte in andere Systemen integriert werden können.

Neben die organisatorischen und technischen Hindernissen treten **oftmals nutzungsrechtliche Probleme** infolge fehlender Nutzungsrechte auf. Datensätze externer Herkunft dürfen zumeist nicht an Dritte weitergegeben werden, weil die Nutzungsbeziehungen nur bilateral abgestimmt sind. Nachdem sich geografische Informationen zumeist aus Schichtungen verschiedenster Datenlayer zusammensetzen, stellen fehlende Nutzungsrechte ein oftmals nicht überwindbares bürokratisches Bollwerk dar.

1.2 Auftrag

Das Land Tirol beabsichtigt eine regionale Kooperation all jener Institutionen herbeizuführen, welche öffentliche Geodaten erstellen, vorhalten und nutzen. Dazu setzt die Tiroler Landesregierung die „Strategiegruppe Netzwerk Geoinformation Tirol“ ein, um die Grundsätze einer solchen Zusammenarbeit in einer Rahmenvereinbarung näher auszuarbeiten und der Landesregierung zur Beschlussfassung vorzulegen (Beschluss der Tiroler Landesregierung vom 15. April 2003).

Wichtige öffentliche Geodaten sollen in Tirol künftig im Rahmen einer Kooperation nach einheitlichen Kriterien erfasst und in vernetzten Strukturen vorgehalten werden. Alle beteiligten öffentlichen Einrichtungen und deren Auftragnehmer können dann online auf aktuell gehaltene Originaldaten zugreifen und diese nutzen. Moderne Informationsdienste ermöglichen den dezentralen Zugang für spezielle Nutzer und für die Öffentlichkeit.

In der Strategiegruppe finden sich Vertreter der Gebietskörperschaften, Interessensvertreter, Versorgungsunternehmen und EDV-Firmen. Die gestaltende Kerngruppe wird vom Land Tirol, dem Tiroler Gemeindeverband, der TIWAG-Tiroler Wasserkraft AG, der Kufgem-EDV GmbH sowie der Daten-Verarbeitung-Tirol-GmbH gebildet.

1.3 Teilnehmer und Tätigkeitsfelder

Ein Data Warehouse einzurichten ist eine **strategische Entscheidung**. Im gegenständlichen Falle geht es nicht darum dieses Vorhaben in einer Institution zu verwirklichen, sondern es sollen alle Erzeuger, Vorhalter und Datenverarbeiter von öffentlichen Geodaten, insbesondere auch die Ersteller von Informationsdiensten, integriert werden. In diesem Sinne kann die Einrichtung des

Netzwerkes Geoinformation Tirol als öffentliche Aufgabe angesehen werden, wiewohl die einzelnen Tätigkeitsfelder sowohl im amtlichen als auch in privatwirtschaftlichem Umfeld stattfinden können. Der Kreis potenzieller Teilnehmer lässt sich daher durch die qualifizierte Bearbeitung von öffentlichen Geodaten festlegen und nicht etwa duch die Stellung der datenverantwortlichen Institutionen als Behörden oder private Unternehmen an sich. Jedenfalls, und diesbezüglich geht der Ansatz im Netzwerk Geoinformation Tirol weit über das derzeit auf „hoheitliche" Institutionen beschränkte Diskussionsfeld der Österr. Geodatenpolitik hinaus, werden die Vorhalter von öffentlichen Infrastrukturen zur Teilnahme eingeladen und sind daran auch höchst interessiert.

Nach einer Definition im „**Konzept für eine Österreichische Geodatenpolitik**" (2002) sind öffentliche Geodaten für den Vollzug der Gesetze und öffentlichen Aufgaben notwendig, sie werden von Stellen, welche mit öffentlichen Aufgaben betraut sind, geführt. In einer Konkretisierung dieses Ansatzes wird für das Netzwerk GI Tirol festgelegt, dass die Objekte als auch die beschreibende Informationstiefe öffentlicher Geodaten sich durch die Praxis amtlicher Verwaltungsakte (unter Wahrung des personenbezogenen Datenschutzes) definieren. Ein Beispiel dazu: Elektrische Leitungsanlagen mit einer Leistung von mehr als 1000 Volt (ausgenommen Eigenanlagen) sind nach dem Tiroler Starkstromwegegesetz bewilligungspflichtig. Das Ansuchen zur Bewilligung hat die Lage im Katasterplan, sowie Angaben über Zweck, Umfang, Betriebsweise und Ausführung der geplanten elektrischen Leitungsanlage zu enthalten. Damit ist auch der Rahmen über Genauigkeit und Beschreibung im öffentlichen Sinne vorgegeben.

Im Sinne dieser Ausführung wird es in Tirol mehrere hundert von datenverantwortlichen Stellen beauftragte **Erzeuger von öffentlichen Geodaten,** wie Ziviltechniker und technische Büros, fallweise auch Eigenerhebungen durch Versorgungsunternehmen und Ämter geben. In den allermeisten Fällen werden diese Datenerzeuger vor ihren Bearbeitungen Plangrundlagen und Bestandsdaten aus den eingerichteten Datenspeichern beziehen können. Die daraufhin erstellten Quelldaten sind in bereinigter und standardisierter Form in Datenspeicher für öffentliche Geodaten einzubringen, welche in geringer Anzahl von den datenvorhaltenden Stellen bzw. in ihrem Auftrag fortdauernd bereit gestellt werden. Bei der Einbringung fallen Qualitätskontrollen der Quelldaten und Bearbeitungsschritte zur Datenintegration an, ehe ein dokumentierter, inhaltlich konsistenter und flächendeckender Datenbestand entsteht. Möglichst viele Schritte der Datenharmonisierung und Datenintegration sollen von den Erzeugern der Quelldaten selbst selber ausgeführt werden, indem diese Bearbeitungsschritte fester Bestandteil der Auftragsvergabe wird.

Wesentliche Voraussetzung für die **effiziente Verwendung und den Vertrieb** der öffentlichen Geodatenbestände ist die Sicherung der Nutzungsrechte. Die derzeitige Absicht im Netzwerk GI Tirol zielt darauf ab, dass alle Teilnehmer ihre öffentlichen Geodaten untereinander frei, das heißt ohne Nutzungsbeschränkungen zur Verfügung stellen. Die Nutzungsrechte von allfällig zu integrierenden Daten externer Herkunft, also von voraussichtlich nicht am Netzwerk teilnehmenden Institutionen wie den Bundesvermessungsdienst, werden zentral von **der einzurichtenden Geschäftsführung** verwaltet, wodurch die einzelnen Netztwerkteilnehmer zwar die anteiligen Kosten aber keinen bürokratischen Aufwand zu tragen haben. Die Weitergaben von Datensätzen oder Datennutzungsrechte für Applikationen an externe Datenverarbeiter kann auch von der Gechäftsführung des Netzwerk vorgenommen werden, dabei sind die von den datenverantwortlichen Stellen vorgeschriebenen Abgabebedingungen einzuhalten. Damit steht den interessierten Kunden ein Ansprechpartner für alle Nutzungsabsichten zur Verfügung.

1.4 Geschäftsmodell

Die Entwicklung eines Geschäftsmodelles für die spezifischen Leistungen des Netzwerkes einerseits und den Leistungsaustausch der Teilnehmer durch die wechselseitige Datennutzung andererseits hat sich als Kernpunkt der Strategiediskussion herausgestellt. Aus derzeitiger Sicht kann die angestrebte Kooperation im Netzwerk Geoinformation Tirol am ehesten durch ein **genossenschaftliches Modell** eine formale Bindung erhalten. Dabei geht es im Grunde darum, durch spezifische Dienstleistungen die Aktivitäten der einzelnen Teilnehmer zu fördern und zu unterstützen. Die Teilnehmer am Netzwerk haben eine Doppelfunktion: Sie sind zugleich mitgestaltender Teilhaber, als auch Kunde und Klient der angebotenen Dienstleistungen.

Welche **Dienstleistungen** wird das Netzwerk Geoinformation Tirol anbieten? Betrachtet man die „statischen" Stationen der Geodaten auf ihrem Weg zur Geoinformation von der Erzeugung (Aktualisierung) über die Vorhaltung zur Datenanwendung, so kommt der Form und dem Inhalt der Datentransfers zwischen diesen Stationen besondere Bedeutunng zu. Mit anderen Worten: Erzeugung, Vorhaltung und Anwendung war und bleiben eigenständige Aufgaben der Teilnehmer am Netzwerk, die Dateneinbringung und die Einbindung zur Datennutzung wird von Diensten des Netzwerkes (mit)gestaltet. Solche sind die Festlegung von Datenstandards, die Dokumentation von Erzeugungs- bzw. Aktualisierungsprozessen, die umfassende Dokumentation des Datenstandes (Metadaten), die Kontrolle der Datenqualität, die Festlegung von qualifizierten Datenzugangsbedingungen, die Vergabe von Nutzungsberechtigungen, die Dokumenatation von Datennutzungen u.a. mehr. Diese Leistungen sind in inhaltliche Hinsicht gemeinschaftlich festzulegen. Dafür soll eine Strategiegruppe und eine anwendungsorientierte Technikgruppe sorgen, welche von ausgewählten Teilnehmern am Netzwerk ohne Kostenersatz beschickt wird. Die Entwicklung und Durchführung der Dienstleistungen an sich wird von der Geschäftsführung beauftragt bzw. in Teilbereichen selbst ausgeführt und den Teilnehmern nach Maßgabe der jeweiligen Inanspruchnahme kostendeckend verrechnet.

Einen zweiten wesentlichen Aspekt in der derzeitigen Diskussionen stellt die Frage nach Abgeltung des **Leistungsaustausches zwischen den Netzwerkteilnehmern** dar. Dabei geht es um die Frage der entgeltlichen Datennutzung einerseits, aber auch um „bilaterale" Dienstleistungen wie beauftragete Datenvorhaltungen oder die gemeinsame Produktion von Informationsdiensten. Kooperationen zwischen einzelnen Netzwerkteilnehmern sollen auf Grundlage der Basisvereinbarung erlaubt sein, ja sind zur weiteren Vertiefung der Zusammenarbeit sogar erwünscht. Die Geschäftsführung kann dafür auf Kosten der jeweiligen Partner Unterstützung anbieten, etwa wenn vertiefende Dokumentationen oder ergänzende Zugangsberechtigungen erforderlich sind. Eine Grundsatzfrage für das gemeinschaftliche Projekt bleibt allerdings die Frage nach der gegenseitigen Datennutzung. Hier wird seitens maßgeblicher Kräfte im Diskussionsprozess die Meinung vertreten, dass die öffentlichen Geodaten der Netzwerkteilnehmer untereinander unentgeltlich und zur Verfügung gestellt werden. Eine Ausnahme können extern zugekaufte oder teure Plangrundlagen wie z.B. hochauflösende Bilddaten sein. Die Kosten dafür sind nach Interessensgebiet und pauschaliert auf die Netzwerkteilnehmer aufzuteilen.

2 TECHNISCHE ASPEKTE (Beitrag Nedertscheider)

Um die erforderlichen technischen Rahmenbedingungen von Netzwerk Geoinformation Tirol beschreiben zu können, wollen wir uns jene drei Prozesse ansehen, die die Funktionsweise des Kooperationsprojektes grundlegend umschreiben:

- Dateneinbringung
- Datenhaltung / Datenverarbeitung
- Datenbereitstellung und Datennutzung

Es geht darum, Daten unterschiedlicher Produzenten in einheitlichen und dokumentierten Strukturen in ein System einzulagern, diese Daten dort aktuell vorzuhalten um sie schließlich möglichst effizient in den informationstechnologischen Produktionsprozess einzubringen. Durch die Kooperation im Rahmen des Netzwerk Geoinformation Tirol lassen sich Synergieeffekte in allen drei Schwerpunkten nutzen, die anderwertig wohl kaum lukrierbar wären.

2.1 Dateneinbringung

Es gilt, eine Vielzahl von digitalen, geografischen Datenformaten hinsichtlich ihrer Strukturen zu vereinheitlichen und diese vor allem in definierten Standards abzulegen. Zukünftig kooperierende Partner im Netzwerk GeoinformationTirol arbeiten derzeit mit unterschiedlichen inhaltlichen und auch technischen Standards. Datenstrukturen sind in keiner Weise homogenisiert, ebensowenig wie dies die technischen Systeme sind.

2.1.1 Datenimport in das Netzwerk Geoinformation Tirol

Neben den oben angesprochenen inhaltlichen und technischen Standards, die Basis für das Funktionieren der Partnerschaft sind, ist es notwendig, auf aktuelle Daten zu achten. Nur gültige aktuelle geografische Datenbestände erfüllen die von ihnen erwarteten Anforderungen hinsichtlich des Informationsgehaltes.

Für den aktualisierenden Datenupload ist die für das jeweilige Thema zuständige Organisationseinheit eigenverantwortlich. Der Datenupload selber wird je nach Datenhaltungsvariante (siehe Datenhaltung / Datenverarbeitung) entweder auf einen zentralen Server, oder auf den eigenen Server durchgeführt.

2.1.2 Datenclearing

Zur Wahrung hoher Datenstandards nach Importvorgängen ist jedenfalls über Qualitätssicherungsmechanismen nachzudenken. Die Qualitätssicherung sollte überwiegend automatisiert über Prüfprogramme bewerkstelligt werden. Abzulehnen sind in diesem Zusammenhang aufwändige, händisch durchgeführte Datenprüfungsvorgänge, die wegen des hohen Personal- und Zeitbedarfes nicht leistbar sind.

2.1.3 Zugriffsrechte

Ein Berechtigungssystem wird zu regeln haben, wer in welcher Form auf die Server zugreifen darf. Wem ist es erlaubt, Daten einzulagern, in welcher Form sind die Daten einzuspielen, arbeiten mehrere Partner an einer Datenebene, wie kann der gemeinsame Zugriff auf eine Datenschicht koordiniert werden? Ein derartiges Berechtigungssystem wird selbstverständlich auch den lesenden, datennutzenden Zugriff regeln.

2.1.4 Metadaten

In einem Datenverbund ist es von enormer Bedeutung, eingelagerte Datenbestände in Metadatenbanken zu dokumentieren, um sie derart leichter zugänglich und auch verständlich zu machen. Dabei sind internationale Standards der Metadatendokumentation heranzuziehen. In Übereinstimmung mit den Metadaten geben Geodatenkataloge schließlich Auskunft über Datenangebot, Verfügbarkeiten und Datenstand von Geodaten für den jeweils nachgefragten Bereich. Ein Geodatenkatalog wäre im einfachsten Fall ein Internetdienst, über den Geoinformationen nach verschiedensten Kriterien gesucht werden können.

2.2 Datenhaltung / Datenverarbeitung

Bezüglich der Datenhaltung sind mehrere Szenarien angedacht:

<u>Variante 1 - mehrere GIS-Server mit verteilter Datenhaltung:</u> Jede am GIS Tirol teilnehmende Organisationseinheit hat ihre Daten verantwortlich auf dem jeweils eigenen Server in normierten Datenstrukturen einzubringen und zu warten. Betrieb und Datensicherung des Servers hat der jeweilige Partner für den Gesamtverbund zu bewerkstelligen. Der Zugriff auf die verteilten Server der Kooperationspartner erfolgt über schnelle Online-Verbindungen. Das Konzept der verteilten Datenhaltung ermöglicht es, aufwändige Datenaustausch- und Downloadvorgänge weitestgehend hintan zu halten, auf die gültigen, aktuellen Daten des Partners wird ‚on demand' zugegriffen.

<u>Variante 2 - ein GIS-Server mit zentraler Datenhaltung:</u> Geodaten sind von den teilnehmenden Organisationseinheiten inhaltlich und technisch standardisiert in den Zentralserver einzubringen, sodass Kunden oder auch ein GIS-Server, der dann wiederum div. Web-Dienste servicieren kann, ohne lokale Nachbearbeitung auf die eingebrachten Daten zugreifen können.

<u>Variante 3</u> - zentraler Fileserver, der über FTP-Anbindung Datenimport und Datenexport ermöglicht (gemeinsamer ‚Rohdatenpool').

2.3 Datenbereitstellung und Datennutzung

Potenzielle Nutznießer des Netzwerk Geoinformation Tirol sind Gemeinden und Gemeindeverbände, EVUs, Ver- und Entsorger, Telekoms und Mobilkoms, Ziviltechniker, Datenverarbeiter, Landes- und Bundesdienststellen inkl. ihrer Tochterunternehmen, Bahn- und Liftunternehmen etc., insgesamt etwa 1.000 Tiroler Einrichtungen. Letztlich kann jeder Bürger über diverse Online-Dienste auf GIS-Tirol Daten zugreifen und somit die Früchte der organisationsübergreifenden Kooperation nutzen.

Einen immensen Nutzen ziehen selbstverständlich auch die kooperierenden Gruppen selber. Sie schöpfen Synergien in der Dateneinarbeitung, Datenhaltung und auch in der Informationsbereitstellung aus.

2.3.1 GIS-Client

Für die Anbindung eines GIS-Kunden an den Datenpool sind leistungsfähige Netzwerke notwendig. Der GIS-Kunde arbeitet an seinem Arbeitsplatz mit leistungsfähiger GIS-Software und benötigt dafür fallweise den vollen Umfang an geografischen Datenbeständen, sodass großvolumige Datentransfers notwendig sind. Über lokal gerechnete Analysen der eigenen, sowie der Daten von GIS-Tirol Partnern sind neue Erkenntnisse möglich. Voraussetzung zur Anbindung eines GIS-Kunden ist das Vorhandensein eines Hochleistungsnetzes, die Rechnerleistung hingegen wird lokal vom Kundengerät bereitgestellt.

2.3.2 HTML-Client

Bei diesem ThinClient liegt die Applikationslogik ganz auf Serverseite. Es genügt ein Standard-Browser, ein PlugIn ist nicht erforderlich. Kosten und Administration werden auf diese Weise extrem niedrig gehalten.
Kommen diverser Scriptsprachen bzw. PlugIns zum Einsatz, wird ein Teil der Applikationslogik auf den Client verlagert. Dadurch steigen die Ansprüche auf Clientseite etwas, weil fallweise eine größere Datenübertragungsrate benötigt wird.
Wenn darüber hinaus über den HTML-Zugang direkte Download-Möglichkeiten für Echtdaten ermöglicht werden, sind entsprechende Netzkapazitäten notwendig, um die Nutzung der Datenbestände aus dem Datenpool zu ermöglichen.

Neben den genannten Datennutzungsarten ist noch ein direkter Zugriff per FTP zur Nutzung des direkten DatenDownloads möglich.

2.3.3 Zugriffsrechte / Urheberrecht / Datennutzungsrecht

Ähnlich der Rechte zur Einlagerung von Daten, benötigt das System auch eine Zugriffsberechtigung für die Nutzung der Datenbestände. Welche Daten darf der zugreifende Kunde sehen, welche Daten bleiben ihm (vorerst) verwehrt? Welcher Partner im netzwerk darf Daten mit der vollen Informationstiefe (Attributierung) herunterladen, bzw. für welche Usergruppen reicht der Zugriff auf eher allgemeine Geodaten im gröberen Maßstab?

Neben der Entwicklung eines Zugriffssystems auf die Daten, spielt das Thema Urheberrecht eine entscheidende Rolle. Die Anzahl der am Netzwerk Geoinformation Tirol beteiligten Partner ist umfangreich, sodass es notwendig sein wird, das geistige Eigentum der einzelnen Kooperationspartner im Sinne des Urheberrechts zu beschreiben und entspechende Regelungen zu finden.

Ebenso werden Datennutzungsrechte und Copyright an den einzelnen Datenschichten exakt zu definieren sein.

2.3.4 Accounting

Parallel zum Thema Urheberrecht, das die „Kosten für die Arbeit des Dateneigentümers" sichern soll, spielt die Verrechnung der Daten eine entscheidende Rolle. Jeder Partner im Netzwerk Geoinformation Tirol bringt Daten von einem bestimmten Volumen und einem bestimmten Wert ein. Das Problem ist vorerst, dass diese Daten nicht nach einem bereits vorhandenen Schlüssel bewertet werden können. Wie definieren sich z.B. die Adressdaten von tiris oder die Leitungsdaten der Energieversorger? Wer legt den Preis dieser Information fest? Hier müssen noch Regelungen gefunden und gegenseitige Übereinstimmung erzielt werden.

Lokale Geodateninfrastrukturen: Potentiale und Auswirkungen am Beispiel Brandenburgs

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1 ZUSAMMENFASSUNG

Geodateninfrastrukturen – ein Schlagwort, das die Gemeinschaft rund um Geoinformation und Geo-Informationstechnologien seit einem guten Jahrzehnt immer wieder beschäftigt. Nachdem die ersten Aktivitäten mit der Begründung der National Spatial Data Infrastructure (NSDI) aus den USA kamen und sich in weiteren nationalen, europäischen sowie globalen Entwicklungen fortsetzten, ist mittlerweile auch ein Anstieg lokaler Initiativen erkennbar.

Diesen gemeinsam ist das Ziel, Verfügbarkeit und Nutzbarkeit raumbezogener Daten und Informationen (Geoinformationen) in ihrer Region zu verbessern und Mehrwerte zu schaffen für Verwaltung, Wirtschaft, Wissenschaft und Gesellschaft. So haben in Deutschland im Bundesland Brandenburg im Jahr 2001 die Landesvermessung, das Geologische Landesamt, das Landesumweltamt und das GeoForschungsZentrum Potsdam (GFZ) eine Initiative zum Aufbau der Geodaten-Infrastruktur Brandenburg (GIB) ins Leben gerufen. Synergien sollen in und zwischen Einrichtungen und Behörden geschaffen sowie Geodaten und Geo-Informationstechnologien für vielfältige Anwendungen erschlossen werden. Immerhin birgt der „Rohstoff" Geoinformation laut einer durch das Bundesministerium für Wirtschaft und Arbeit in Auftrag gegebenen Studie erhebliche wirtschaftliche Potentiale: Ausgehend von einem Marktpotential von 8 Milliarden Euro in Deutschland – lediglich 1,2 Milliarden Euro sind zurzeit erschlossen – stellt Geoinformation ein Wirtschaftsgut dar, das es zu nutzen und zu fördern gilt.

Welche Auswirkungen der Aufbau einer Geodateninfrastruktur für verschiedene Anwendungsfelder bieten kann, soll am Beispiel Katastrophenmanagement demonstriert werden. Die Vorsorge und Bewältigung extremer Naturereignisse sowie anthropogener bzw. technogener Bedrohungen gilt als ein Bereich, für den besondere Mehrwerte durch die Nutzung der Potentiale von Geoinformationen und moderner Informationstechnologien zu erwarten sind.

2 GEODATENINFRASTRUKTUREN – WAS IST DAS?

Der Aufbau von Geodateninfrastrukturen (GDI) ist zurzeit in vieler Munde. Was verbirgt sich hinter dieser Bezeichnung? Die Definition nach NEBERT (2001, S. 8) beschreibt eine Geodateninfrastruktur als

> „base collection of technologies, policies and institutional arrangements that facilitate the availability of and access to spatial data" und "a basis for spatial data discovery, evaluation, and application for users and providers within all levels of government, the commercial sector, the non-profit sector, academia and by citizens in general".

Diese Definition zeigt auf, dass Geodateninfrastrukturen durch vielfältige Faktoren gesteuert werden. Sie können in folgenden Komponenten zusammengefasst werden:

Organisationsstrukturen: Die verschiedenen Akteure im Geoinformationswesen müssen zusammengeführt und Synergien geschaffen werden, eine Vernetzung von Verwaltung, Wirtschaft, Wissenschaft und Gesellschaft muss erfolgen. Zuständigkeiten und Wechselwirkungen sind zu definieren, die den Aufbau einer Geodateninfrastruktur koordinieren und tragen und schließlich die Umsetzung konkreter Ziele ermöglichen.

Gesetzliche und rechtliche Rahmenbedingungen: Sie basieren primär in der Verankerung des Aufbaus einer lokalen Geodateninfrastruktur in den Strategien und Zukunftsprogrammen des Landes. Hier ist Geoinformation (GI) beispielsweise als Bestandteil von eGovernment zu platzieren, auch geht es um die Vereinheitlichung von Zugangs- und Nutzungsbedingungen von Geodaten, die Angleichung von Preismodellen etc.

Daten: Als Geodaten und Geoinformationen werden sämtliche Daten und Informationen bezeichnet, die einen Raumbezug aufweisen. Hier muss zunächst Transparenz geschaffen werden. So bieten beispielsweise Metainformationssysteme in ihrer Funktion als „Datenkataloge" umfassende Möglichkeiten zur Datendokumentation sowie –recherche. Darüber hinaus sind existierende Datenbestände zu harmonisieren und zu integrieren und dem Nutzer bzw. Kunden zugänglich zu machen. Die Anwendung von Standards zur Gewährleistung einer flexiblen Nutzung und eines einrichtungs- und disziplinübergreifenden Austauschs von Daten spielt dabei eine große Rolle.

Technologien: Datenbanken und Geoinformationssysteme (GIS) sind die vorherrschenden Werkzeuge zur Verwaltung, Auswertung und Präsentation von Geodaten. Bei der gemeinsamen Nutzung und dem Austausch von Daten- und Informationsangeboten ist die Notwendigkeit zentraler Lösungen mit den heutigen technologischen Möglichkeiten nicht mehr unbedingt gegeben. Insbesondere die moderne Internettechnologie bietet vielfältige Möglichkeiten. Wie dem auch sei, Voraussetzung ist die Gründung auf gemeinsame Architekturen und standardisierte Schnittstellen. So kann Interoperabilität auch heterogener Anwendungen gewährleistet werden.

Ziel ist es letztendlich, Daten- und Informationsbestände für verschiedenste Anwendungsbereiche zugänglich zu machen und eine breite Nutzung zu ermöglichen. Die Anlehnung an abgestimmte Konzepte und Richtlinien auf übergeordneten Ebenen sind daher von großer Bedeutung, Beispiele sind die Entwicklungen zum Aufbau einer nationalen – hier: Geodateninfrastruktur Deutschland (GDI-DE) - bzw. europäischen Geodateninfrastruktur – Infrastructure for Spatial Information in Europe (INSPIRE) - sowie die „Richtlinie 2003/98/EG des Europäischen Parlaments und des Rates über die Weiterverwendung von Informationen des öffentlichen Sektors" (Directive „Public Sector Information"). Doch auch die Standardisierungsprozesse von Gremien wie dem World Wide Web Consortium (W3C), der International Standardisation Organisation (ISO) und des Open GIS Consortiums (OGC) sind in diesem Zusammenhang wegweisend.

3 UMSETZUNG EINER GEODATENINFRASTRUKTUR IM BUNDESLAND BRANDENBURG

Im Jahr 2001 haben sich das GeoForschungsZentrum Potsdam (GFZ), die Landesvermessung und Geobasisinformation Brandenburg, das Landesamt für Geowissenschaften und Rohstoffe Brandenburg und das Landesumweltamt Brandenburg zusammengeschlossen in dem gemeinsamen Bestreben, in ihrem Aktionsbereich und ihrer Region die Erschließung vorhandener Geoinformation und entsprechender Informationstechnologien (IT) voranzutreiben und für verbesserte Zugangs- und Nutzungsbedingungen einzutreten. Auf der Grundlage ihrer Gemeinsamen Erklärung (http://www.gib-portal.de/12gib/ziele.html) wurde schließlich die Initiative Geodaten-Infrastruktur Brandenburg (GIB) gegründet. Vorrangige Ziele sind

- die Erschließung von Geodaten und entsprechenden Informationstechnologien für beliebige Anwendungsfelder, z.B. Raumplanung, Transport und Logistik, Katastrophenmanagement etc.,
- der anwendungsübergreifende Austausch und die ungehinderte interdisziplinäre Nutzung von Geodaten,
- der Aufbau eines transparenten Marktes für Geodaten und Geodienste in Brandenburg,
- die Vorbereitung wesentlicher Voraussetzungen für erfolgreiches eGovernment und
- die Einrichtung einer Kommunikations- und Kompetenzplattform für Verwaltung, Wirtschaft, Wissenschaft und Gesellschaft.

Entsprechend dieser Zielstellungen und der im vorangegangenen Kapitel beschriebenen Komponenten einer Geodateninfrastruktur ist ein Umsetzungsmodell erarbeitet worden, das ein Rahmenwerk schafft zur effektiven Realisierung einer GDI in Brandenburg. Durch die Gründung auf anerkannte Modelle und Standards fügt sich der Aufbau der Geodaten-Infrastruktur Brandenburg letztlich ein in die aktuellen nationalen sowie internationalen Entwicklungen.

3.1 Organisation

Eine Organisationsstruktur ist konzipiert worden, durch die der Aufbau der GIB vorbereitet, koordiniert und umgesetzt wird. Folgende Einheiten bilden diese Organisationsstruktur ab (Abbildung 1):

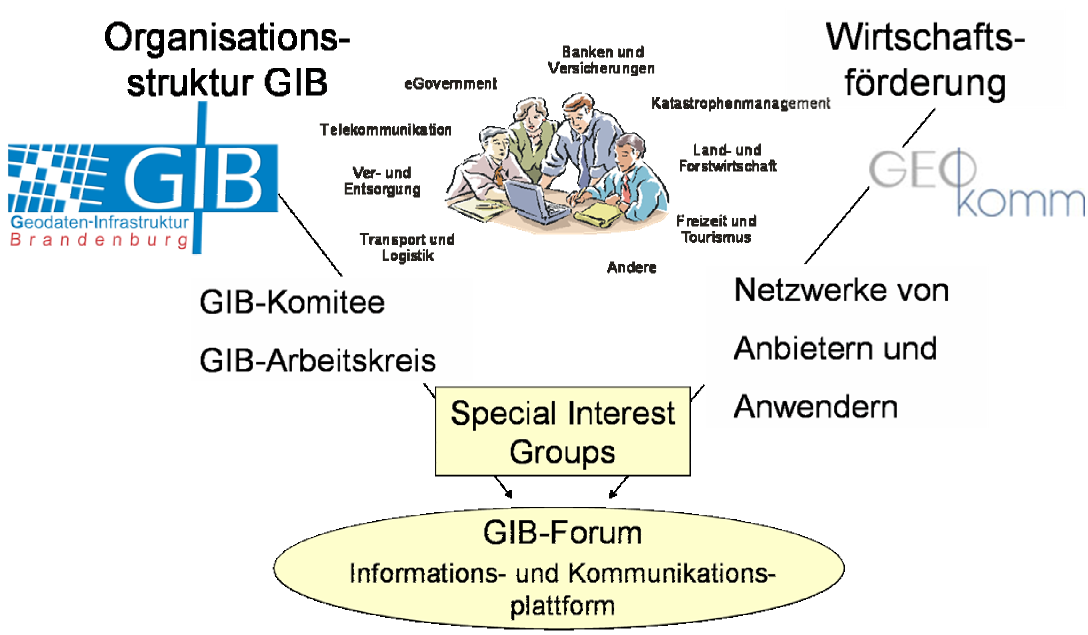

Abb.1: Organisationseinheiten der Geodaten-Infrastruktur Brandenburg (GIB) und ihr Zusammenspiel

Das *GIB-Komitee* ist ein interministerielles Gremium zur übergeordneten Vorbereitung und Koordinierung der Geodaten-Infrastruktur Brandenburg. Hier sind Vertreter der Ministerien des Inneren, der Wirtschaft und der Umwelt beteiligt sowie ein Repräsentant der Kommunen. Aufgabe des Komitees ist die Schaffung geeigneter Rahmenbedingungen im Land Brandenburg sowie die Eingliederung der lokalen Initiative in den Aufbau einer nationalen Geodateninfrastruktur in Deutschland. Das Komitee übernimmt ebenfalls die übergeordnete Abstimmung mit anderen GDI-Initiativen und dem benachbarten Bundesland Berlin.

Der *GIB-Arbeitskreis* ist verantwortlich für die Erarbeitung von Leitlinien und die inhaltliche Koordinierung der GIB. Fachlich-thematische Schwerpunkte werden definiert, Arbeitsgruppen einberufen und die Umsetzung konkreter Zielstellungen koordiniert. Auch die aktive Zusammenarbeit mit benachbarten Initiativen wird hier abgestimmt. Der Arbeitskreis besteht zunächst aus den eingangs genannten Begründern der Initiative und ebenfalls einem Vertreter der Kommunen und wird mit abgeschlossener Institutionalisierung der Geodaten-Infrastruktur Brandenburg erweitert werden.

Den *Special Interest Groups (SIGs)* obliegt die fachliche Arbeit zur Vorbereitung und praktischen Umsetzung der GIB. In ihrem jeweiligen thematischen Kontext formulieren sie in Abstimmung mit dem Arbeitskreis konkrete Aufgabenstellungen mit dem Ziel, Entscheidungsgrundlagen, z.B. Studien, zu erarbeiten, Spezifikationen zu entwickeln, Pilotprojekte zu konzipieren und durchzuführen bzw. Umsetzungsvorschläge zu erarbeiten. Zurzeit existieren folgende Special Interest Groups mit den entsprechenden Aufgaben:

- SIG Situationsanalyse: Analyse des Angebots an Geodaten und Geodiensten in Brandenburg, Vorbereitung eines Masterplans zur Umsetzung der GIB
- SIG Metadaten: Abgestimmte und einheitliche Dokumentation von Geodatenbeständen in Brandenburg über standardisierte Metadaten, Vernetzung von Metainformationssystemen auf lokaler Ebene und darüber hinaus
- SIG Webservices: Ermittlung, Nutzbarmachung und Bereitstellung raumbezogener Webservices, Unterstützung diverser Anwendungsfelder, z.B. eGovernment

Das *Forum* stellt schließlich eine offene Informations- und Kommunikationsplattform zur Förderung des Aufbaus der GIB dar. Über Workshops, Präsentationen und Konferenzen werden die an den Prozessen zur Infrastrukturentwicklung beteiligten Gruppen und relevante Nutzer zusammengebracht. Ziel ist die Darstellung und Weiterentwicklung von Aktivitäten und Vorhaben, der übergreifende Informationsaustausch und die Bildung von Konsortien zur Umsetzung konkreter Fragestellungen im Rahmen der Geodaten-Infrastruktur Brandenburg.

Privatwirtschaftliche Unternehmen sowie Nutzergruppen organisieren sich darüber hinaus in parallelen Netzwerken. Hier können sie ihre Interessen gezielt vertreten und ihrerseits den Aufbau eines anwendungsorientierten brandenburgischen Geodatenmarktes vorantreiben. Dies geschieht stets in enger Kooperation mit der politisch-administrativen Initiative GIB. So ist Ende 2002 der Verband der GeoInformationswirtschaft Berlin/Brandenburg e.V. (GEOkomm, http://www.geokomm.de) gegründet worden. Das Netzwerk verfolgt neben dem Ziel der allgemeinen Verbesserung der Verfügbarkeit, Nutzbarkeit und Qualität von Geoinformation insbesondere die Förderung des regionalen Geodaten- und -dienstemarktes. Der Verband ist dabei offen sowohl für Anbieter als auch für Nutzer von Geoinformation und entsprechenden Softwarelösungen und schließt auch Vertreter des Innenministeriums Brandenburg sowie der Senatsverwaltung Berlin mit ein. Eine konstruktive Zusammenarbeit sowie übergreifende Aktivitäten sind somit möglich.

3.2 Gesetzliche und rechtliche Rahmenbedingungen

Die politische Institutionalisierung der Initiative Geodaten-Infrastruktur Brandenburg wird derzeit durch das GIB-Komitee vorangetrieben. Ein Kabinettbeschluss befindet sich in der Abstimmung, der erste Maßnahmen zur Vorbereitung der GIB in Auftrag geben soll. Ein Masterplan soll demnach erarbeitet werden, auf dessen Grundlage politische und rechtliche Mechanismen angeschoben werden. Ausgehend von einer Ist-Analyse des brandenburgischen Geoinformationswesens sollen notwendige Schritte zur Etablierung eines Geodaten- und Geodienstemarktes und einer umfassenden Infrastruktur formuliert und als Handlungsempfehlungen übergeben werden. Die Umsetzung der Empfehlungen und die Festschreibung der Geodaten-Infrastruktur Brandenburg als Aufgabe des Landes soll schließlich über einen zweiten Kabinettbeschluss erfolgen.

Bis dahin ist es Anliegen der Initiative, die Thematik Geoinformation in die Aktivitäten zur Umsetzung von eGovernment einzubringen. Im Februar 2003 ist die „eGovernment-Strategie des Landes Brandenburg" verabschiedet worden, mit der die Landesregierung verstärkt auf Informationstechnik und Internet im Rahmen der Verwaltungsmodernisierung setzt. Gemäß der Strategie bilden Information, Kommunikation und Transaktion die Säulen der digitalen Verwaltung. Ausgehend von der Annahme, dass 80% aller Information einen Raumbezug aufweisen, sind öffentliche Geoinformationen sowie Geodienste dabei als ein wesentlicher Teil einer zukunftsfähigen eGovernment-Umsetzung zu sehen.

3.3 Daten und Technologien

Erste Arbeiten zur Implementierung der Daten- und Technologieebene – wie auch generell die operationelle Realisierung der Geodaten-Infrastruktur Brandenburg - finden im Rahmen der Special Interest Groups statt. Hier werden spezifische Fragestellungen bearbeitet und mittels konkreter Anwendungsprojekte umgesetzt.

So ist das Ziel der SIG Situationsanalyse eine umfassende Bestandsaufnahme des Angebots an Geodaten und Geodiensten im Land Brandenburg. Diese Analyse soll auch Grundlage sein für die Erstellung eines Masterplans, der letztlich die Umsetzung der Geodaten-Infrastruktur festschreiben soll. „Marktlücken" können so aufgedeckt und neue Tätigkeitsfelder erschlossen werden.

Zielstellung der SIG Metadaten ist eine abgestimmte und einheitliche Dokumentation von Geodaten für Brandenburg und darüber hinaus. Auf der Grundlage des Standards „ISO 19115: Geographic Information – Metadata" der International Organisation for Standardisation (ISO) haben die beteiligten Experten aus Verwaltung, Wissenschaft und Wirtschaft daher das „Brandenburgische Metadatenprofil" erarbeitet (KÖHLER et al. 2003). Es besteht aus der Festschreibung einer verbindlichen Auswahl an Attributen und Elementen zur einheitlichen Datenbeschreibung im Rahmen der GIB und dient als Basis zur Umsetzung von Metainformationssystemen. Metainformationssysteme sind Datennachweise vergleichbar mit Mikrofiche- und Onlinekatalogen aus dem Bibliothekswesen und ein wesentliches Instrument zur Schaffung von Transparenz des brandenburgischen Geodatenmarktes.

Die Ermittlung, Nutzbarmachung und Bereitstellung von webbasierten Geodiensten erfolgt im Rahmen der SIG Webservices. Vorhandene Dienste werden erfasst, neue Dienste konzipiert und beispielhaft umgesetzt. Vielfältige Anwendungsfelder sollen so unterstützt werden. Spezifikationen sind zu erarbeiten, prototypische Anwendungen zu entwickeln und in Testbeds zu validieren. Eine bedeutende Rolle spielt die Übertragbarkeit der Konzeptionen und Mehrwerte auf verschiedene Anwendungsfelder. „Insellösungen" sollen vermieden und stattdessen auf Standards gesetzt werden.

Pilotprojekte dienen letztlich dazu, die Potentiale und Mehrwerte einer Geodateninfrastruktur für Brandenburg an konkreten Fragestellungen zu demonstrieren. Hier steht insbesondere eGovernment im Vordergrund, weitere Felder sind beispielsweise Ver- und Entsorgung, Transport und Verkehr, Telekommunikation sowie Land- und Forstwirtschaft. Doch auch Katastrophenmanagement wird als ein Bereich gesehen, der in besonderem Maße durch eine funktionierende Geodateninfrastruktur profitieren kann. Die

Existenz einer aktuellen und qualitativen Daten- und Informationsbasis ist bei der Vorsorge und Bewältigung von Katastrophen wie kaum in einem anderen Bereich die Grundlage der Entscheidungsfindung. Im Folgenden werden die Potentiale von Geodateninfrastrukturen für dieses Anwendungsfeld beleuchtet und an aktuellen Aktivitäten in Brandenburg demonstriert.

4 MEHRWERTE DURCH LOKALE GEODATENINFRASTRUKTUREN AM BEISPIEL DES KATASTROPHENMANAGEMENTS

Natürliche und anthropogene Katastrophen sind Ereignisse hohen Gefahrenpotentials. Sie führen zu einer Beeinflussung oder Zerstörung von Eigentum, von Infrastrukturen und Basisversorgung und sogar von Leben und Gesundheit. Für die Vorsorge, Bewältigung und Nachsorge von Katastrophen ergeben sich einfache aber umfassende Anforderungen:

- Einbettung der vielfältigen Prozesse in effektive Organisations- und Koordinationsstrukturen
- Unterstützung der Prozesse durch anwendungsorientierte und fundierte Informationen als Grundlage der Entscheidungsfindung
- Angebot geeigneter Werkzeuge zur effektiven und zeitnahen Nutzung der dargebotenen Informationsprodukte

Grundlage für fundierte und entscheidungsunterstützende Informationen sind Methoden, die häufig aus der Wissenschaft kommen. Vorgehensweisen zur Einschätzung von Gefährdungen und Risiken werden entworfen und geprüft, Modellierungs- und Simulationsalgorithmen erarbeitet, deren Umsetzung Aufschluss über reale Ereignisse und deren Verlauf geben. Es gelten jedoch ähnliche Anforderungen wie die oben genannten, um die nötigen Schritte umsetzen zu können. D.h. auch für den Bereich der Katastrophenforschung geht es vor allem darum, auf eine hochwertige Datengrundlage sowie offene Systemlösungen zurückgreifen zu können. Auf dieser Basis können signifikante Forschungsergebnisse und innovative Methoden erarbeitet werden, die schließlich einen wertvollen Input liefern können für das operationelle Katastrophenmanagement.

Doch ebenfalls die Anwendungsentwicklung durch die IT- und insbesondere die GIS-Industrie profitiert von einem marktfähigen und kundenfreundlichen Angebot an Geobasis- sowie Fachdaten bei dem Bestreben, möglichst umfassende technologische Werkzeuge und Lösungen vorzulegen.

Wie sieht nun aber die Wirklichkeit aus? Erfahrungen zeigen, dass die Erfüllung dieser Anforderungen keineswegs trivial ist. Stattdessen offenbart die Realität zahlreiche Barrieren, die dieser Aufgabe entgegenstehen.

4.1 Bestehende Hemmnisse in Katastrophenvorsorge und -bewältigung

Der mangelnde Dialog zwischen den in die Prozesse des praktischen Katastrophenmanagements involvierten Gruppen ist wie eh und je ein schwerwiegendes Hemmnis bei der effektiven Katastrophenvorsorge und –bewältigung. Dies bestätigt unter anderem der Bericht der Kirchbach-Kommission, die nach den schweren Hochwasserfällen im Sommer 2002 durch die Staatsregierung Sachsens eingesetzt worden ist, um die damaligen Ereignisse und Maßnahmen sowie ihre Folgen auszuwerten. Wie in vielen Berichten zuvor wird auch hier deutlich, dass Krisenkommunikation – sowohl nach innen als auch nach außen - ein Teil der Katastrophenbewältigung ist, der durch mangelndes Bewusstsein, fehlende Strukturen und auch durch mangelnde Erfahrung gekennzeichnet ist und häufig effektives Handeln erschwert.

Schaut man über die Grenzen eines Bundeslandes hinaus, kommt außerdem nicht selten die föderalistische Ordnung Deutschlands nachteilig zum Tragen: Bei grenzüberschreitenden Ereignissen entstehen Barrieren beispielsweise durch unterschiedliche Landesregelungen sowie durch Konkurrenzempfinden und Konflikte aufgrund unterschiedlicher Zuständigkeiten von Bund und Ländern.

In der Wissenschaft, der Katastrophenforschung, wirken stattdessen andere Faktoren. Es ist zu erkennen, dass insbesondere in der Grundlagenforschung zwar wertvolle Methoden und Ergebnisse erarbeitet werden, eine Aufbereitung für den operationellen Katastrophenschutz und ein Transfer in die Praxis jedoch kaum erfolgt. Dies liegt vorwiegend im heutigen Wissenschaftssystem begründet, in dem Forscher und ihre Leistungen i.d.R. anhand der Anzahl und Qualität ihrer Fachpublikationen bewertet werden. Der Transfer von Forschungsergebnissen und Wissen zum „Endnutzer", hier: zur Planungsbehörde, zur Leitung einer Einsatzleitstelle, zum Katastrophenschützer etc., ist damit nicht primär notwendig und besitzt nur einen geringen Stellenwert.

Bezogen auf das Angebot von geeigneten Daten und Technologien im Allgemeinen werden folgende hemmende Faktoren deutlich:

- Intransparentes Angebot an relevanten Daten und Informationsprodukten
- Uneinheitliche Datenformate, Qualitäten, Zugangs- und Nutzungsbedingungen
- Technologiegetriebene Anwendungsentwicklung, mangelnde Nutzerorientierung
- Inkompatibilität von Systemen und Lösungen zur Abbildung komplexer Anforderungen und Szenarien

Neben der mangelnden Aufbereitung und Integration vielfältiger Daten (Geobasisdaten, Umweltdaten, sozio-ökonomische Daten etc.) und dem schwierigen Zugang zu diesen fehlt es demnach bereits häufig an einem umfassenden Überblick über vorhandene Daten und Informationen. Die Anwendungsentwicklung durch i.d.R. privatwirtschaftliche Unternehmen findet häufig ohne ausreichende Einbeziehung der Nutzer bzw. Kunden statt und ist darüber hinaus nicht selten zu technologiegetrieben. Dies ist jedoch teilweise wiederum begründet in dem mangelnden Angebot einer breiten und leicht zugänglichen Datenbasis, so dass vielfach nicht offene, inkompatible Eigenentwicklungen als lukrativer angesehen werden. Letztendlich existiert also kaum ein entwickelter „Markt" für katastrophenrelevante Daten, Informationsprodukte und informationstechnologische Anwendungen.

Folge dieser vielfältigen und auf verschiedenen Ebenen wirkenden Faktoren sind unkoordinierte, nicht abgestimmte und schlimmstenfalls ineffektive Maßnahmen zur Vorbeugung, Bewältigung und Nachsorge von Not- und Katastrophenfällen.

4.2 Lösungsansätze

Welche Zielstellungen müssen nun formuliert werden, um einen Abbau der dargestellten Barrieren zu ermöglichen, und welche Möglichkeiten bieten Geodateninfrastrukturen und ihre zugrundeliegenden Konzeptionen in diesem Zusammenhang?

Höchste Priorität hat zunächst die Verbesserung von Koordination und Kommunikation zwischen den beteiligten Gruppen in der praktischen Katastrophenvorsorge und –bewältigung. Ein weiterer Schritt soll die Nutzung der Potentiale modernen Daten- und Informationsmanagements und moderner Informations- und Kommunikationstechnologien sein, um eine anwendungsorientierte und geeignete Bereitstellung relevanter Daten und Informationsprodukte als Grundlage der Entscheidungsfindung zu gewährleisten (vgl. WÄCHTER & KALMES 2001).

Folgende Maßnahmen scheinen geeignet, um diese Zielstellungen mittels der in Kapitel 3 skizzierten Konzeptionen und Komponenten von Geodateninfrastrukturen umzusetzen:

4.2.1 Organisatorische Maßnahmen

Grundlage muss der Aufbau bzw. die Festigung geeigneter Organisationsstrukturen sein, um Kommunikation und Kooperation zwischen den Betreibern von Katastrophenvorsorge und –bewältigung zu fördern. Die Akteure sind zusammenzuführen und Austausch – sowohl von Information als auch Erfahrung - sowie Zusammenarbeit zu fördern. Die Realisierung über regionale und übergeordnete Netzwerkbildung liegt nahe, um neue, verbesserte Strukturen dauerhaft zu etablieren.

In Brandenburg wird dieser Ansatz zurzeit in die Praxis umgesetzt. Unter dem Dach der Initiative Geodaten-Infrastruktur Brandenburg haben das GFZ Potsdam und das Ministerium des Innern des Landes Brandenburg in einem gemeinsamen Workshop zum Thema „GIS und Geodaten im brandenburgischen Katastrophenschutz“ die relevanten Gruppen an einen Tisch gebracht. Zu den Teilnehmern gehörten v.a. Vertreter des kommunalen Katastrophenschutzes sowie des Brand- und Rettungswesens und Mitglieder der Landesschule und Technischen Einrichtung für Brand- und Katastrophenschutz. Die in der Mehrzahl der Kreise und kreisfreien Städte eingesetzten sogenannten GIS-Koordinatoren wurden ebenfalls einbezogen, um von Beginn an eine bestmögliche Vernetzung der Kompetenzen zum einen im Bereich Katastrophenschutz und zum anderen im Bereich Geoinformation und GIS zu gewährleisten. Darüber hinaus nahmen „Datenlieferanten“ wie der Landesbetrieb Landesvermessung und Geobasisinformation Brandenburg und das Landesamt für Geowissenschaften und Rohstoffe Brandenburg teil sowie Anbieter von relevanten Softwarelösungen.

Ziel der Veranstaltung war die erste Zusammenführung der brandenburgischen Katastrophenschutz-Gemeinschaft sowie eine erste Abschätzung der „Schwachstellen“ und der daraus resultierenden Anforderungen im Hinblick auf eine möglichst effektive Unterstützung des Katastrophenmanagements durch anwendungsorientierte Daten- und Informationsprodukte sowie IT-Werkzeuge. Dazu wurden in einführenden Vorträgen zunächst Organisation und Prozesse des Katastrophenschutzes auf Landes- sowie kommunaler Ebene und die Potentiale von Geodaten und Geo-Informationstechnologien einschließlich Geodateninfrastrukturen vorgestellt. Auch die Rolle der Wissenschaft als Lieferant von Methoden und wissenschaftlich fundierten Informationsprodukten wurde dargestellt, in dieser Funktion ist beispielsweise das GeoForschungsZentrum zu sehen. In Arbeitsgruppen sind schließlich die Anforderungen sowohl an Organisationsstrukturen und Wechselwirkungen zwischen den Gruppen auf den verschiedenen Ebenen und mit unterschiedlichen Zuständigkeiten als auch an eine Entscheidungsunterstützung durch eine geeignete und nutzungsorientierte Daten- und Informationsbasis evaluiert worden. Der Schwerpunkt lag dabei auf der ebenenübergreifenden Betrachtung, sprich: auf der Betrachtung der Wechselwirkungen zwischen den betreffenden Behörden, Fachämtern, Stabs- und Leitstellen und zwischen Land und Kommune.

Die Diskussionen bestätigten die im Vorangegangenen beschriebenen Erfahrungen vergangener Schadensereignisse: In der Tat ist der Dialog zwischen den Akteuren sehr eingeschränkt. Dies gilt sowohl für die Kommunikation zwischen Kommune und Land als auch für die Bereitstellung und den Austausch von Daten und Informationen zwischen Fachämtern und Stäben. Kommunikationsstrukturen sind i.d.R. nicht definiert, sondern baut – sofern sie vorhanden sind – meist auf persönlichen Verbindungen und Beziehungen auf. Offizielle Ansprechpartner zur Kontaktaufnahme zwischen Behörden und Ämtern und zwischen den administrativen Ebenen existieren häufig nicht bzw. sind nicht bekannt.

Am Ende stand schließlich die Forderung nach einem Masterplan für eine landesweite und landeseinheitliche technische und organisatorische Infrastruktur für den Aufbau und Betrieb der Leitstellen und Stabsstellen. Die Initiative Geodaten-Infrastruktur Brandenburg soll als Plattform dienen, um den Masterplan zu erarbeiten und umzusetzen. Eine Initiatorengruppe ist gebildet worden, die zunächst folgende Schritte realisieren wird:

- Aufbau einer Special Interest Group
- IST-Analyse: Bestandsaufnahme Organisation und Informationsmanagement im brandenburgischen Katastrophenmanagement, Anforderungen der Akteure
- Ableitung von Lösungsansätzen

Grundlage für konkrete Vorgehensmodelle soll demnach die Analyse zum einen der (Arbeits)Prozesse des Katastrophenmanagements sein und der Anforderungen der Beteiligten zur Erfüllung der jeweiligen Anforderungen. Eine systematische Bestandsaufnahme existierender Daten- und Informationsquellen und –angebote sowie geeigneter Dienste und Dienstleistungen wird gefolgt von der detaillierten Untersuchung ausgewählter Szenarien. Beispielsweise ein “Blaulichtszenario” aus der akuten Katastrophenbewältigung sowie ein Szenario aus dem Bereich der Planung, d.h. der Katastrophenvorsorge, sollen näher betrachtet und Zuständigkeiten, Arbeitsprozesse, eingesetzte Vorgehensweisen, Daten- und Informationsprodukte sowie Technologien analysiert werden. Thema der SIG soll neben der Entwicklung von Modellen schließlich der Transport realisierter Lösungen einzelner Landkreise in die Breite sein. Anwendungsprojekte dienen dabei dazu, die aufgedeckten Schwachstellen und Anforderungen durch geeignete Konzepte beispielhaft umzusetzen und zu validieren.

Um im Sinne der breiten Netzwerkbildung eine möglichst repräsentative Arbeit zu gewährleisten, besteht die Gruppe aus sowohl aus Fachleuten des Katastrophenschutzes als auch aus dem örtlichen Geodaten- und GIS-Umfeld, und auch die lokale Katastrophenforschung ist über das GeoForschungsZentrum beteiligt.

4.2.2 Daten und Technologien

Der Beschluss der Einrichtung einer Special Interest Group Katastrophenmanagement und der Erarbeitung eines Masterplans für eine technische und organisatorische Infrastruktur für die Katastrophenvorsorge und -bewältigung führt letztendlich zu gezielten Maßnahmen auch im Bereich der Daten und Technologien. Der Workshop „GIS und Geodaten im brandenburgischen Katastrophenschutz" hat darüber hinaus gezeigt, dass die Vorgehensweisen bei der Verwaltung und bei Verbreitung und Austausch von Daten und Informationen von Kommune zu Kommune und auch auf Landesebene sehr unterschiedlich sind. Die Methoden reichen von einer Nutzung und Weitergabe analoger Materialien und Karten über Aktenordner bis hin zu speziellen Einsatzleitsystemen, die auf zentrale Geodatenserver zugreifen. Verteilte Architekturen auf Basis der Internettechnologie hingegen nehmen nur einen sehr geringen Stellenwert nehmen. Auch hier bestätigten sich außerdem die oben geschilderten Erfahrungen der Beschränkung einer flexiblen und übergreifenden Nutzung geeigneter Daten und Informationsprodukte durch uneinheitliche Datenstrukturen und –formate, komplizierte Zugangs- und Nutzungsbedingungen und proprietäre Softwarelösungen.

Ziel ist es, eine weitgehend einheitliche Landeslösung zur effektiven Nutzung von Geoinformation als Entscheidungsgrundlage vor, während und nach einem Katastrophenfall zu erreichen. Neben der Nutzung der Potentiale moderner Informations- und Kommunikationstechnologien im Allgemeinen können folgende Maßnahmen aus Daten- und IT-Sicht zur Umsetzung der Zielstellung dienen:

- Schaffung eines transparenten Datenangebotes
- Anwendung abgestimmter Konzepte und Standards
- Entwicklung nutzungsorientierter Prototypen in Pilotprojekten
- Transfer von Forschung und Entwicklung in die Anwendung

Aufbauend auf der oben beschriebenen Szenarienanalyse werden Optimierungsmöglichkeiten abgeleitet und Modelle zur unterstützenden Informationsversorgung sowie anwendungsorientierte IT-Werkzeuge konzipiert. Die Umsetzung soll über Pilotprojekte erfolgen und schließlich in die Breite transferiert werden. Entsprechende Konsortien sollen aus Partnern aus der Region bestehen, da Brandenburg eine große Vielfalt sowohl an öffentlichen und privaten Datenanbietern sowie an Unternehmen der GI- und GIS-Branche als auch an Wissenschaftseinrichtungen und Hochschulen beheimatet. Ein wichtiger Partner wird beispielsweise das "Center for Disaster Management and Risk Reduction Technology (CEDIM)" sein. Es wird durch das GeoForschungsZentrum Potsdam und die Universität Karlsruhe getragen und verfolgt einen interdisziplinären Ansatz durch die Kombination verschiedenster Wissenschaftsdisziplinen, z.B. der Geo- und Sozialwissenschaften, des Ingenieurwesens, der Wirtschaftswissenschaften und nicht zuletzt der Geoinformatik. Das in diesem Rahmen laufende Projekt "Risikokarte Deutschland" sowie der Aufbau einer umfassenden Informationsinfrastruktur (KÖHLER 2003) bieten bereits zahlreiche Ansätze für eine Übertragung auf das Brandenburgische Katastrophenmanagement.

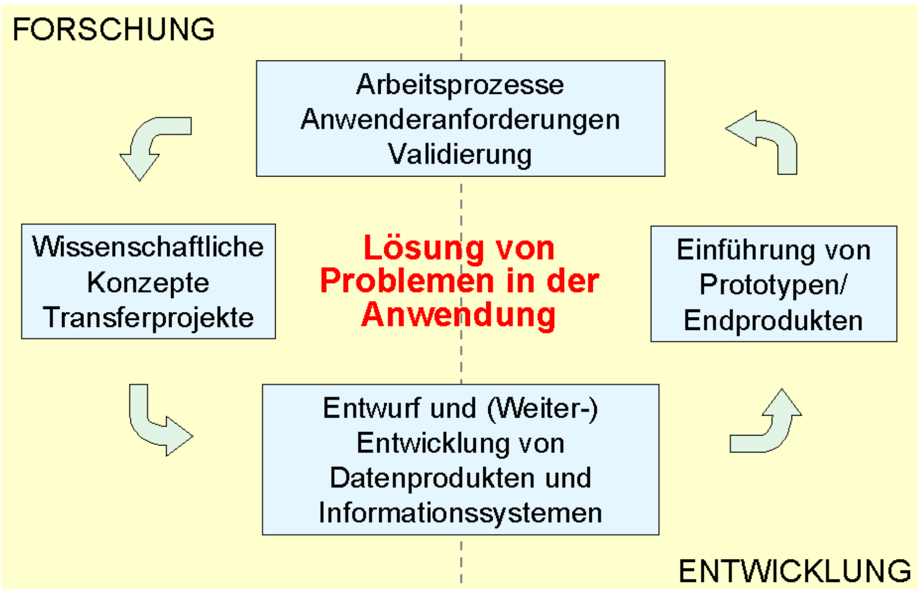

Abb.2: Transfer von Wissen und Technologie aus Forschung und Anwendungsentwicklung

Dem Wissens- und Technologietransfer nimmt in diesem Zusammenhang einen hohen Stellenwert ein (Abbildung 2). Träger von Know-how und neuen technologischen Lösungen sind vor allem Forschungsprojekte sowie die privatwirtschaftliche Anwendungsentwicklung. Doch auch beispielsweise die Arbeiten der SIGs Metadaten und Webservices der brandenburgischen

Infrastrukturinitiative bieten bereits geeignete Ansätze. Grundlage müssen jedoch stets die Aufgaben und Anforderungen der Anwender sein, sie sind maßgeblich für Forschung und Entwicklung.

5 FAZIT

Wie gezeigt bilden Geodateninfrastrukturen Rahmenwerke zur Verbesserung von Verfügbarkeit und Nutzbarkeit von Geoinformation als Gut hohen Potentials für vielfältige Anwendungsfelder. Dies umfasst sowohl organisatorische Strukturen als auch die Verwertung von Daten und Technologien. Die Vorsorge und Bewältigung von Katastrophenereignissen ist lediglich ein Bereich, für den tragfähige Mehrwerte entstehen, und durch die Bedienung anerkannter Konzeptionen und die Nutzung etablierter Standards ist Offenheit und Übertragbarkeit auf zahlreiche andere Anwendungsfelder gegeben. Durch die Orientierung an Entwicklungen auf höherer Ebene wie dem Aufbau der nationalen Geodateninfrastruktur Deutschlands und den Richtlinien, die im Rahmen beispielsweise von INSPIRE erarbeitet werden, wird eine Eingliederung in übergeordnete Ziele ermöglicht.

Zusammenfassend können folgende Mehrwerte durch die Anwendung der Prinzipien von Geodateninfrastrukturen – hier demonstriert am Katastrophenmanagement - festgehalten werden:

- Förderung von Kommunikation und Koordination
- Bündelung der spezifischen Fähigkeiten der Akteure
- Optimierte Versorgung mit qualitativen Daten, Informationsprodukten und Technologien
- Erschließung neuer Tätigkeitsfelder für den privatwirtschaftlichen Sektor sowie die Wissenschaft

Für die Vorsorge und Bewältigung von Katastrophen führt dies letztlich zu einer Effizienzsteigerung, die vor allem Zeit und somit den verbesserten Schutz von Eigentum, Basisversorgung und Infrastruktur sowie Gesundheit und Leben mit sich bringt. Durch die Vernetzung und das Zusammenwirken sämtlicher beteiligter Gruppen können hochwertige Synergien geschaffen werden. Eine Infrastruktur wird geschaffen, mittels derer Arbeitsprozesse abgebildet und unterstützt werden mit dem Ziel der zielgerichteten und effektiven Informationsvermittlung und Entscheidungsunterstützung

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Interaktive Landschaftsplanung in Königslutter am Elm

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1 EINLEITUNG

Die vielfältigen Möglichkeiten von e-Government, e-Partizipation, Content und Dokument Management Systemen, Informations- und Kommunikationstechnologie (IuK), der neuen Medien generell, werden aktuell als sogenannte Top-Themen diskutiert und bereits in vielen Planungsprozessen eingesetzt. Das europäische Parlaments fordert im Mai 2003 für die Öffentlichkeit das Recht ein, Stellung zu nehmen und Meinung zu äußern, wenn alle Optionen noch offen stehen und bevor Entscheidungen über die Pläne und Programme getroffen werden. Der digitale, interaktive Landschaftsplan beispielhaft für die Modellgemeinde Königslutter am Elm übertrifft diese Anforderungen sogar, in dem schon bei der Bestandsaufnahme den Bürgern vor Ort die Möglichkeit geboten wird, sich aktiv an der Planung zu beteiligen. Die neuen Medien werden so gewinnbringend in den Planungsprozess integriert und gestalten alle Planungsphasen transparent. In einem mit Mitteln des Bundesamts für Naturschutz (BfN), des Bundesministeriums für Umwelt, Naturschutz und Reaktorsicherheit, und des Landes Niedersachsen seit Frühjahr 2002 bis Ende 2004 geförderten Erprobungs- und Entwicklungs(E+E)-Vorhaben, begleitet ein interdisziplinäres Team der Universität Hannover die Erstellung des digitalen Landschaftsplans. Landschaftsplaner, GIS-Experten, Informatiker, Soziologen, u.a. erproben den Einsatz und die Möglichkeiten der neuen Medien im Planungsprozess und entwickeln zudem auf freier Software aufbauende Zusatzmodule.

Das dies der richtige Trend ist, bestätigt das Aktionsprogramm „Informationsgesellschaft Deutschland 2006“ der Bundesregierung, welches eine Steigerung der Internetnutzung bis 2005 auf 75 % der Bevölkerung und bis 2010 eine Verbreitung der Breitband-anschlüsse auf über 50 % aller Haushalte als konkretes Zeil anstrebt.

2 AUFBAU DER INTERNETSEITE

Die neu entstandene Internetplattform (www.koenigslutter.de/Landschaftsplan.htm) soll den aktuellen Planungsprozesses transparent gestalten, der Einsatz der unterschiedlichen neue Medien weitere Partizipations- und Kooperationsmöglichkeiten bieten.

Abb. 10: Aufbau der Internetseite (Quelle: www.koenigslutter.de/Landschaftsplan.htm)

Auf der übersichtlichen, gut strukturierten Internetseite (s. Abb. 10), die auch unerfahrenen Nutzern eine intuitive Navigation durch die unterschiedlichen Bereiche ermöglichen soll, spielt neben der Informationsvermittlung, der Kommunikation und e-Partizipation, Multimediaeinsatz und der 2D/3D-Visualisierung, das Webmapping eine entscheidende Rolle. Ein MapServer (s. Kapitel 3) verbindet in den sogenannten „interaktiven Karten“ Informationsabfrage und –gewinn mit der Kommunikation und e-Partizipation, stellt somit den Kern des interaktiven Landschaftsplans in Königslutter am Elm dar.

Das neu entwickelte Content Management System (CMS) ermöglicht eine gleichzeitige Bearbeitung der Seiten durch mehrere Redakteure und eine einheitliche Benutzer-, Gruppen- und Zugriffsregelung. Eingabemasken gewährleisten ein übersichtliches Weblayout und erfordern keine Programmierkenntnisse der Bearbeiter (s. Friese et al., 2003).

2.1 Eingesetzte Software

Der modularer Aufbau, der Einsatz und die Entwicklung von Open Source Software zielt auf eine spätere Übertragbarkeit einzelner Komponenten auf andere Kommunen oder Anwendungsbereiche ab. Als einzige proprietäre Software innerhalb des Projektes führte die Stadt Königslutter parallel zum Projektstart das Geographische Informationssystem (GIS) ArcGIS 8.x der Firma ESRI in ihre Verwaltung ein. Weiterhin wird SuSe Linux 8.x als Betriebssystem, ein Apache Webserver, der freiverfügbare UMN MapServer, eine MySQL Datenbank und die Scriptsprache php bzw. Java eingesetzt. Die neu entwickelten, plattformunabhängigen Werkzeuge: CMS mit Diskussionsforum, ein Karten- und ein Textbasiertes Beteiligungsmodul, ein Auswerte- und Auslesetool, Lernmodule, etc. werden spätestens nach Ablauf des Projektes Ende 2004 freiverfügbar sein.

2.2 Webmapping und E-Partizipation

In der Regel bieten Geographische Informations Systeme das Fundament für eine ständig zunehmende Zahl innovativer Anwendungen. Der Nutzen dieser Systeme kann durch Weiterentwicklung zu Kommunikations- und Partizipationsdiensten deutlich gesteigert werden. Neben einer Verkürzung von Kommunikationswegen wird ein fachübergreifendes, transparentes und bürgernahes Arbeiten möglich. (Bill et al., 2002, S. 301).

E-Partizipation heißt dabei, durch neue, computerunterstützte Kommunikationsprozesse die Beziehung zwischen Verwaltung, Politik und Bürgern neu zu gestalten (Märker et al., 2003).

Innerhalb des interaktiven Landschaftsplans stellt der Einsatz des MapServers den Nutzern GIS-Funktionen zur Verfügung. Dabei können unterschiedliche Themenlayer kombiniert, Informationen abgefragt, Kartenausschnitte verändert werden. Eine dynamische Legende liefert Erläuterungen, weitere werden durch Beschriftungen innerhalb des Kartenfensters maßstabsabhängig geliefert (s. Kap. 3.1).

Neu entwickelte Text- und Kartenbasierte Module bieten in Verbindung mit dem Webmappingbereich innovative E-Partizipationsmöglichkeiten, und realisieren das erhoffte, transparente und bürgernahe Arbeiten.

3 MAPSERVER: BETEILIGUNG UND AUSWERTUNG MIT OPEN SOURCE SOFTWARE

Der Begriff „Open Source Software“ steht für eine Software, deren Quellcode veröffentlicht wurde und weiterverarbeitet werden kann. (Bill et al., 2001). Der MapServer der University of Minnesota (UMN) ist ein typischer Vertreter der Open Source Software, der zur dynamischen Kartenerstellung sehr gut geeignet ist. Eine Anbindung neu entwickelter Zusatzmodule ist mit den entsprechenden Programmierkenntnissen problemlos realisierbar (Bill et al., 2003). Diese Eigenschaften werden auch im interaktiven Landschaftsplan ausgenutzt, um die im folgenden detailliert beschriebenen Zusatzmodule zu entwickeln.

Das Partizipationskonzept in Abb. 11 zeigt den Informationskreislauf auf. Der Client greift per http auf den MapServer zu und informiert sich über aktuelle Planungsstände. Ein Formular ermöglicht es, einfach und schnell objektbezogene Textinformationen und Anmerkungen an die Stadt Königslutter zu übermitteln (s. Kapitel 3.2). Ergänzende graphische Zusatzinformationen zu den Objekten können über die Kartenbasierte Beteiligung (s. Kapitel 3.3) eingebracht werden. Eine vorgeschaltete Authentifizierung am Content Management System erlaubt nur registrierten Nutzern eine Beteiligung, so können verschiedene Nutzergruppen, z.B. Träger öffentlicher Belange (TÖB) separat verwaltet und dokumentiert werden.

Einzige clientseitige, technische Voraussetzungen sind ein aktueller Webbrowser und für die kartenbasierte Beteiligung ein installiertes Java-Applet. Serverseitige Browserabfragen verhindern den Zugriff auf den MapServer bei Verwendung eines nicht aktuellen Webbrowsers und weisen, um Ansichtsprobleme zu vermeiden, auf die Installation eines aktuelleren hin.

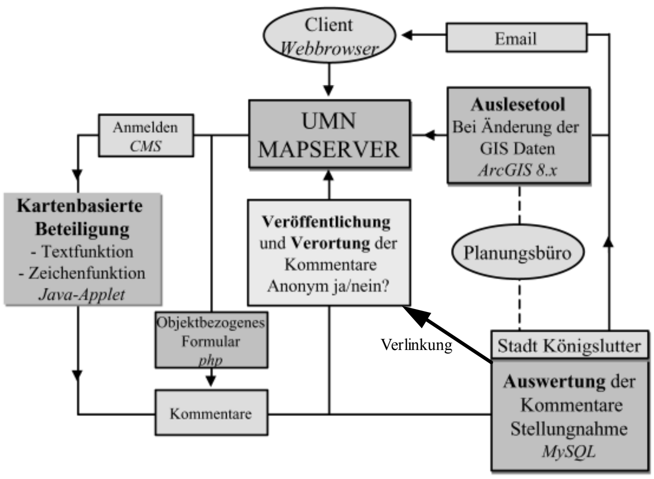

Abb. 11: Partizipationskonzept

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Alle Kommentare werden automatisch als Layer „Anmerkung aus der Bürgerbeteiligung“ im MapServer visualisiert, der Planungsprozess wird transparent gestaltet, Doppelungen vermieden und Kommunikationswege verkürzt. Aus Gründen des Datenschutzes besteht die Möglichkeit, die Kommentare auch anonym zu veröffentlichen.

Nach einer Auswertung der eingegangenen Anmerkungen (s. Kapitel 3.5) leitet die Stadt die weiteren Schritte ein. Das externe Planungsbüro kann eingeschaltet werden, kleinere Ergänzungen oder Änderungen der Datenbasis können bei Bedarf auch direkt im GIS vorgenommen und die Änderung der Konfigurationsfiles für den MapServer mit dem Auslesetool (s. Kapitel 3.6) vorgenommen werden. Die erfolgte Stellungnahme der Stadt wird per Email an den Nutzer verschickt und somit der Partizipationskreislauf geschlossen.

3.1 MapServer Oberfläche

Hauptzielgruppe des interaktiven Landschaftsplans sind neben den Trägern öffentlicher Belange die Bürger vor Ort in Königslutter am Elm. Es handelt sich also in der Regel um „GIS-Laien“, dies wurde bei der Gestaltung des Mapservers berücksichtigt.

Nutzertests zeigten nicht nur Probleme und Mißverständnisse im Handling auf, sondern führten auch zu folgenden wichtigen Zwischenergebnissen und Regeln für die Gestaltung der MapServer Oberfläche:

- eindeutige intuitiv bedienbare Schaltflächen verwenden, ggf. ausformulieren,
- digitale Orthophotos und topographische Karten dienen zur Orientierung und sind unverzichtbar,
- eine dynamische, aggregierte Legende und
- maßstabsabhängige Informationen im Kartenfenster helfen beim Informationsfluß,
- möglichst wenig Anglizismen bzw. Fachtermini integrieren.

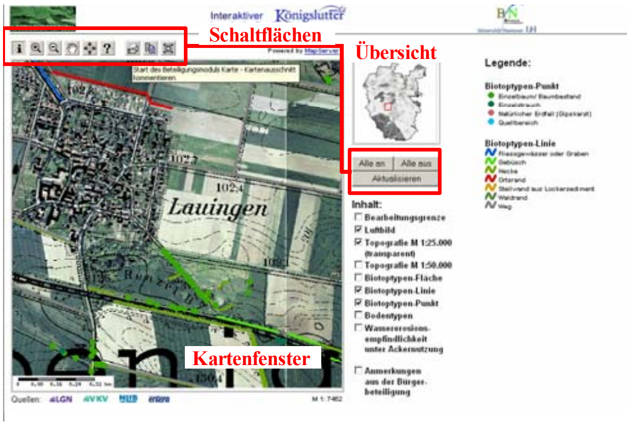

Abb. 12: MapServer Oberfläche

Die Schaltflächenanzahl wurde auf ein Minimum reduziert, eine Hilfe-Funktion unterstützt die Nutzer zusätzlich. Eine zusätzliche Verlinkung zu einem Hilfe-Diskussionsforum befindet sich in der Umsetzungsphase.

3.2 Formularbasierte Beteiligung

Mit dem Einsatz des MapServers wird den Nutzern die Möglichkeit gegeben, objektbezogene Informationen abzurufen und Anmerkungen zu diesen an die Stadt zu übermitteln. Eine erste, einfache Beteiligungsform stellt das sogenannte Beteiligungsmodul light, der Einsatz eines (php-) Formulars dar (s. Abb. 13).

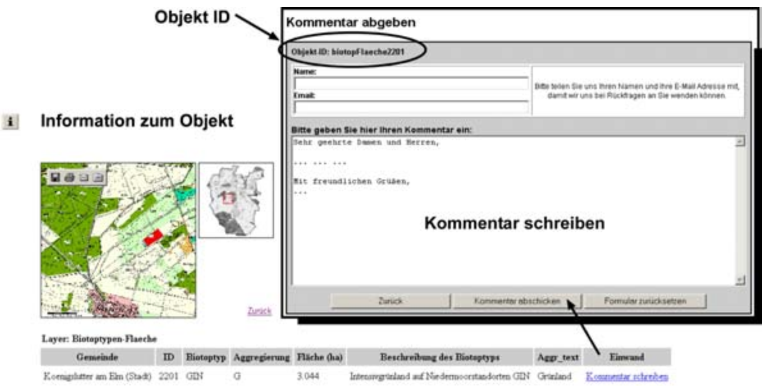

Abb. 13: Formularbasiertes Beteiligungsmodul "light"

Nach der Attributabfrage wird das Kartenfenster verkleinert, das/die ausgewählte(n) Objekt(e) rot markiert und die dazugehörigen Attribute aufgezeigt. Innerhalb diese Attribute besteht die Möglichkeit ein Link anzuklicken, der das Formular öffnet. Die automatisch übertragene Objekt-ID ermöglicht den Auswertern später eine eindeutige Zuordnung der in das Textfeld eingetragenen Anmerkungen, an die eingegebene Emailadresse wird die Stellungnahme der Stadt verschickt. Die Kommunikationswege werden verkürzt.

Diese als Übergangslösung angedachte Variante der Beteiligung erwies sich als sehr anwenderfreundlich, objektbezogene Anmerkungen können so sehr gut und schnell übermittelt werden. Sobald jedoch ergänzende Anmerkungen abgegeben werden sollen, empfielt es sich das nun alternativ eingesetzte Kartenbeteiligungsmodul zu nutzen, da hier verbale Umschreibungen (z.B. nördlich des Grabens..) durch direktes Kartieren vermieden werden können.

3.3 Kartenbeteiligungsmodul

Nach der erfolgreichen Anmeldung am CMS besteht die Möglichkeit das Modul auf zweierlei Arten zu starten. Die erste Variante übernimmt den aktuellen Kartenausschnitt, speichert diese Graphik zusammen mit Zusatzinformationen (Datum, Uhrzeit, aktive Layer, Koordinaten, etc.) in einer persönlichen Datenbanktabelle.

Dem Nutzer stehen hier folgende Optionen zur Verfügung:

- Bearbeiten,
- Löschen,
- Ausdruck,
- Übermitteln der Daten.

Stehen mehrere Anmerkungen innerhalb dieser Datenbank zur Verfügung, können diese auch in der Gesamtheit gelöscht, gedruckt oder übermittelt werden.

Zur Bearbeitung eines Datensatzes wird das Java-Applet gestartet und die Graphik in das Kartenfenster übernommen. Um auch diese Funktion intuitiv benutzbar zu machen, stehen eingeschränkte Graphikfunktionen zur Auswahl. Linien, Polygone, Punkte oder Freihand-zeichnungen können in max 4 unterschiedlichen Strichstärken und vier Farben in die Karte eingezeichnet werden.

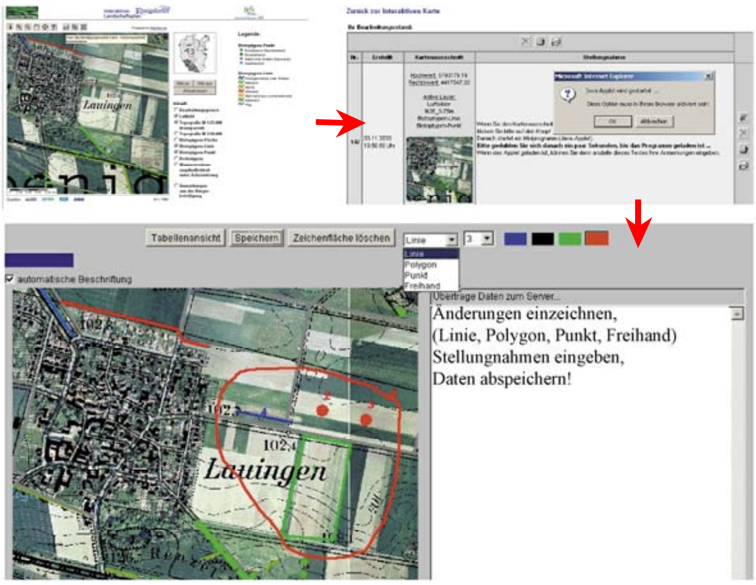

Abb. 14: Kartenbeteiligungsmodul

Mehrere Einzeichnungen können mit einer Autolabelfunktion durchnummeriert und im Textfenster mit den Anmerkungen ergänzt werden. „Speichern“ und zurück in die „Tabellenansicht“ bewirkt eine Übernahme der neuen Daten in die persönliche Datenbank.

Wird diese Bearbeitung hier unterbrochen und soll sie später fortgesetzt werden, kann durch die zweite Startvariante aus dem MapServer heraus, direkt in die bestehende persönliche Datenbank eingestiegen werden. Die Editierbarkeit der Daten endet erst durch die Übersendung der Anmerkungen an die auswertende Behörde. Nach diesem Schritt stehen die Informationen nur noch informell als Druckvorlagen zur Dokumentation bereit.

Beim Übersenden werden die Autoren gefragt, ob ihre Anmerkungen anonym oder mit dem Namen versehen im Internet veröffentlicht werden können. Die gewünschte Planungstransparenz wird erfüllt, Dritte können sich diese Anmerkungen im Internet anschauen und Doppelungen der Anmerkungen und somit der Arbeitsaufwand für die Auswerter werden minimiert.

3.4 Textbeteiligungsmodul

Das Textbeteiligungsmodul basiert auf dem gleichen Prinzip wie das zuvor beschriebene Kartenbeteiligungsmodul. Es bezieht sich allerdings nicht auf das Kartenwerk, sondern auf den Fachtext des Landschaftsplans.

Da dieser zur aktuellen Projektphase noch nicht vorliegt, wird hier nur kurz beschreibend darauf eingegangen.

Berechtigte Nutzer (z.B. TÖB) können auf den digital vorliegenden Landschaftsplanfachtext zugreifen. Ein Inhaltsverzeichnis ermöglich das Vor- und Zurückblättern wie in einem Buch. Ein Markieren des jeweiligen Textabschnittes mit der linken Maustaste und anschließendes Aktivieren eines Buttons realisiert die Textübernahme in die persönliche Datenbanktabelle. Analog zum Kartenmodul erfolgt die automatische Übernahme von Kapitel und Absatznummer, um eine spätere Zuordnung zu vereinfachen. Die Eingabe der Anmerkungen erfolgt in einem separaten Textfeld.

3.5 Auswertemodul

Alle eingegangenen Anmerkungen gilt es nun in der auswertenden Behörde zu sammeln, zu bearbeiten und - damit die Partizipation keine „Einbahnstrasse", sondern eine Art „Kreisverkehr" darstellt - zu beantworten. Die Datenarchivierung erfolgt in einer MySQL-Datenbank.

Eine automatische Durchnummerierung der Anmerkungen, Eingangsdatum und Uhrzeit, Absenderinformationen, Text-, bzw. Kartenausschnitt mit eingezeichneten Informationen, Texteingaben werden aufgezeigt (s. Abb. 15). Den Bearbeitern stehen wieder die bekannten Optionen zur Verfügung. Zusätzlich besteht die Möglichkeit direkt aus der Datenbank auf den aktuellen Kartenausschnitt des MapServers verlinkt zu werden. Die Anmerkungen können so in einem ersten Schritt verifiziert und kontrolliert werden.

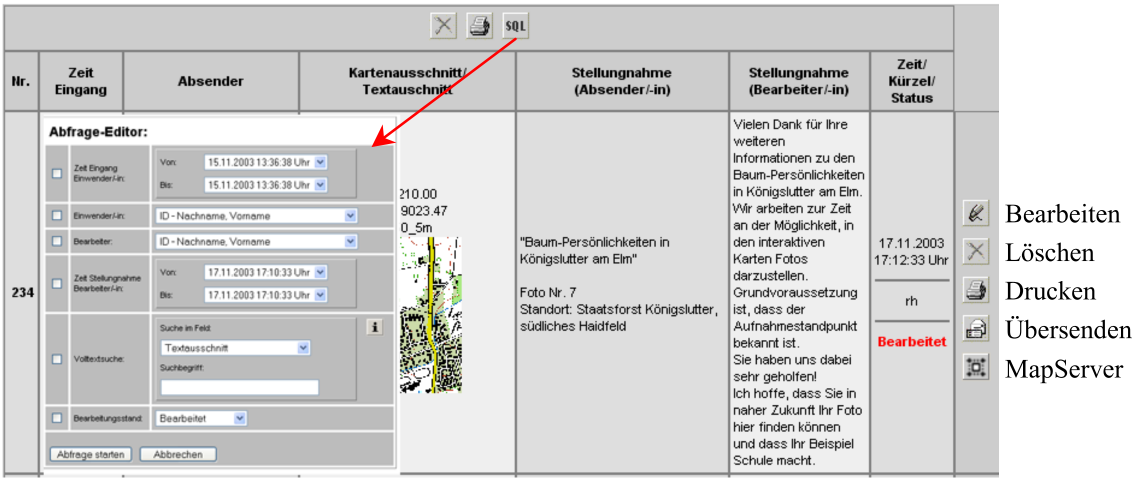

Abb. 15: Abfrage-Editor

Die Stellungnahme der Bearbeiter kann jederzeit ergänzt oder geändert werden. Ist diese per Email an den Absender der Anmerkung verschickt, wird unter das Bearbeitungsdatum und Uhrzeit der Status auf „Bearbeitet" geändert. Werden Anmerkungen hier gelöscht, erfolgt auch eine automatische Löschung des Datensatzes im MapServer.

Ein Abfrage-Editor erleichtert die spätere Auswertung nach Einwendern oder Bearbeitern, Eingangs- oder Bearbeitungszeitraum, aber auch eine Suche nach Volltext oder Bearbeitungsstand ist möglich.

3.6 Konfigurationsmodul

Bewirken die Anmerkungen eine Überarbeitung der Daten, sind neben Grundkenntnissen des Geographischen Informationssystems auch Kenntnisse im Konfigurieren des MapServers gefordert. Dieses ist jedoch in vielen Bereichen nicht zu realisieren. Ein zusätzlich programmiertes Script ermöglicht daher die automatische Konfiguration der Mapfiles aus ArcGIS heraus. Ein anschließendes Copy & Paste dieser Dateien schließt den Vorgang ab.

4 FAZIT

GIS und MapServer bieten die Möglichkeit einer nutzerfreundlichen Darstellung und Verbesserung der Verfügbarkeit der Planinformationen über das Internet. Darstellungs- und eingeschränkte Abfragefunktionen des GIS-Systems stehen dabei zur Verfügung. Um einen schnellen Bildaufbau der Karten im Internet zu gewährleisten, mussten die Originaldaten für das Internet optimiert werden. Trotz der Reduzierung der Auflösung eignen sich die Karten gut, um wichtige Zusatzinformationen – die im analogen Landschaftsplan nicht vorhanden sind – wiederzugeben und bilden eine wichtige Grundlage für die Kommunikation und Partizipation im Planungsprozess.

Die interaktiven Karten zum Landschaftsplan sind seit dem Februar 2003 online verfügbar und konnten während der Bestandserhebung eingesetzt werden, um Angaben zu korrigieren, Kommentare und Anregungen zu äußern. Bisherige Rückmeldungen belegen, dass die interaktiven Karten von Beteiligten und Betroffenen genutzt werden, um die Daten von zu Hause aus zu prüfen. Bemängelt wurde von Interessierten die Dauer von Datenübertragungen. Zudem hat sich gezeigt, dass bei einer Rückmeldefunktion zu den Karten ein Formular eingesetzt werden sollte. Insbesondere für Planungslaien haben sich die digitalen Orthophotos als beliebte Zusatzinformationen bei den interaktiven Karten erwiesen. Bei der Verwendung auf den Internetseiten gilt es jedoch aus rechtlichen Gründen bestimmte Vorgaben der niedersächsischen Landesvermessung zu beachten (u. a. verringerte Auflösung, Verknüpfung mit anderen Planungsinhalten).

Das Kartenbeteiligungsmodul ist seit September 2003 auf den Internetseiten verwendbar. Da sich dieses Angebot vor allem auch an Bürger richtet, die nicht als Planungsexperten zu verstehen sind, stellt die Entwicklung der Benutzeroberfläche der interaktiven Karten einschließlich der Rückmeldefunktionen eine gestalterische Herausforderung dar. Die Oberfläche soll intuitiv zu bedienen und überschaubar sein, weshalb die Schaltflächen auf ein Minimum beschränkt und eindeutig sein müssen. Zudem werden Hilfestellungen zur Bedienung der Navigationsbuttons integriert. Die Begrifflichkeiten sollen auch für Laien verständlich sein: So wurde beispielsweise der auf fachlicher Ebene übliche Begriff „Layer" bei den interaktiven Karten durch „Inhalt" ersetzt. Anglizismen und Fachbegriffe werden so weit möglich vermieden oder erklärt.

Als Zwischenfazit und knapp ein Jahr vor Beendigung des Projektes ist festzustellen, dass Webmapping mit Open Source Software im Planungsprozess

- zu mehr Transparenz beiträgt,
- eine komfortable und ergänzende Beteiligung über das Internet ermöglicht,
- die Auswertung und das Einarbeiten der Rückmeldungen erleichtert,
- das fachübergreifende, transparente und bürgernahe Arbeiten möglich macht.

Es verbessert die Qualität des Planungsprozesses und regt die Bürgerbeteiligung an. Der modulare Aufbau der Internetplattform und die Verwendung und Entwicklung von freier Software, bieten kostengünstige Einsatzmöglichkeiten in allen Bereichen, in denen lokales Fachwissen Dritter interessant ist.

Durch den Einsatz von Open-Source Softwareentwicklungen zielt das Projekt in Zeiten leerer kommunaler Haushaltskassen auf eine Alternative zu kommerzieller Software. Die entwickelten Softwaremodule werden anderen Kommunen, die den Einsatz neuer Medien im Planungsprozess beabsichtigen, am Ende des Projekts (Dezember 2004) zur Verfügung gestellt. Mit dem interaktiven Landschaftsplan Königslutter am Elm und allen daraus entwickelten, freiverfügbaren Zusatztools, soll anderen Kommunen aber auch anderen Bereichen ein Instrument angeboten werden, das sie nach ihren Bedürfnissen anpassen und einsetzen können.

Die Open Source Software macht es möglich!

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http://www.bwa.bund.de/Redaktion/Inhalte/Downloads/aktionsprogramm-informationsgesellschaft-2006,property=pdf.pdf, Stand 11.12.2003

Links zu Projektpartnern:

Bundesamt für Naturschutz, www.bfn.de

Ingenieurgesellschaft für Planung und Informationstechnologie *entera,* www.entera.de

Universität Hannover, Institut für Landschaftspflege und Naturschutz, www.laum.uni-hannover.de/iln

Stadtquartiere im Informationszeitalter – Erfolgsfaktoren von Projekten

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1 EINFÜHRUNG

Die Informations- und Kommunikationstechnologien und die Kommunikations- und Medienwirtschaft sind seit Beginn der 1980er-Jahre als Thema der Stadtentwicklung entdeckt worden. Im In- und Ausland sind eine Reihe städtebaulicher Projekte realisiert worden, die gezielt die Möglichkeiten neuer Informations- und Kommunikationstechniken einbeziehen oder die einen „kommunikations- und medienwirtschaftlichen Kern" haben. Entstanden sind Großprojekte wie Mediaparks oder Medienmeilen ebenso wie kleinere spezialisierte Standorte, neue Stadtquartiere ebenso wie weiterentwickelte traditionelle Medienstandorte.

Das Deutsche Institut für Urbanistik, die Forschungs- und Beratungseinrichtung der deutschen Städte, hat im Rahmen eines Forschungsprojekts[1] die konzeptionellen Ansätze, Akteursstrukturen und Umsetzungsstrategien solcher Projekte vergleichend betrachtet (Floeting 2004). Die folgenden Ausführungen konzentrieren sich auf die Erfolgsfaktoren derartiger Projekte.

2 ERFOLGSFAKTOREN

Erfolgreiche Projekte – d.h. Projekte, die den Strukturwandel in den Städten und Regionen unterstützen, zur Entwicklung der Informationsgesellschaft auf lokaler und regionaler Ebene beitragen, sich konkrete Ziele gesetzt haben und diese weitgehend erreicht haben – benötigen spezifische Konstellationen und Rahmenbedingungen für ihre Entwicklung. Unterschiedliche Projekte haben spezifische Erfolgskonstellationen, d.h. die Bedeutung einzelner Faktoren für die erfolgreiche Umsetzung der Projekte ist unterschiedlich groß.

2.1 Urbanität des Standorts

Standorte der Kommunikations- und Medienwirtschaft sind traditionell eher urbane Räume, die vor allem von den kreativen Bereichen der Branchen bevorzugt werden. Die neuen IuK-Unternehmen der New-Media-Szene siedeln sich auch vorzugsweise in urbanen Räumen an. Urbanität wird dabei häufig sehr kleinräumig verstanden, sodass schon Standorte des Innenstadtrands – erst recht Stadtrand- und Umlandlagen – von diesen Unternehmen weniger nachgefragt werden. Für Bürostandorte – um die es sich im Kern bei den meisten der Standorte kreativer Unternehmen der Kommunikations- und Medienwirtschaft handelt – sind dabei auch eher „ungewöhnliche" städtische Räume wie alte Industriegebiete, Lagerhausstandorte, „Amüsierviertel" interessant. Selbst Hauptsitze großer Kommunikations- und Medienwirtschaftsunternehmen „schrecken" vor solchen Standorten nicht zurück, sondern suchen im Gegenteil die dort vermutete kreative Atmosphäre. Die ungewöhnliche Adresse gehört mit zur jungen kreativen Corporate Identity. So hat ein Unternehmen wie AOL Deutschland – die deutsche Gesellschaft des weltweit größten Internet-Providers – seinen Hauptsitz am Ende der Hamburger Reeperbahn. Boston Consulting – eines der weltweit führenden Beratungsunternehmen – hat seinen Berliner Sitz in einem Altbauquartier am Hackeschen Markt.

Mit den kleinräumigen urbanen Standorten werden Vorteile für face-to-face-Kontakte zu Kunden oder anderen Unternehmen verbunden. Die kleinräumige Mischung von Büroflächen, Restaurants, Einzelhandel, Dienstleistern, Unterhaltungsangeboten und Wohnungen unterstützt den Lebensstil junger urbaner Kreativer, die diese Dienstleistungsangebote in großem Umfang in Anspruch nehmen. Die Vermischung von Arbeitszeit und Freizeit in diesem Arbeits- und Lebensmilieu wird durch die schnelle – möglichst 24stündige – Verfügbarkeit der Angebote unterstützt. Die urbanen Standorte entwickeln deutlich andere Zeitstrukturen als übliche Büro-, Produktionsstandorte oder Wohngebiete (vgl. Eberling/Henckel 2002, 167). Diese Entwicklung stellt eine Renaissance typisch europäischer Stadtstrukturen mit spezifischen urbanen Qualitäten dar.

Prägnante Beispiele der Untersuchung für städtische Strukturen, deren Erfolg wesentlich von der urbanen Qualität des Standorts bestimmt wird, sind Stadtquartiere wie der Bereich rund um den Hackeschen Markt im Berliner Stadtbezirk Mitte (Spandauer Vorstadt), die Hanauer Landstraße in Frankfurt am Main und der Hamburger Stadtteil Ottensen. Diese Standorte haben sich weitgehend unabhängig von planerischen Eingriffen entwickelt. Eine Reihe von Stadtentwicklungsprojekten versucht diese urbanen Qualitäten mit mehr oder minder großem Erfolg durch die Herstellung bestimmter Nutzungsmischungen „künstlich" zu erzeugen. Beispiele für solche Entwicklungen sind der MediaPark in Köln oder der Medienhafen in Düsseldorf. Auch die im Rahmen des dortmund-projects geplanten stadträumlichen Entwicklungen sehen solche Mischnutzungsprojekte vor.

2.2 Projektgröße

Die Größe eines Stadtentwicklungsprojekts stellt einerseits eine beschreibende Größe dar, andererseits beeinflusst die Projektgröße auch den Erfolg des Projekts. Dies gilt für einen großen Teil der untersuchten Stadtentwicklungsprojekte. Die Projektgröße reicht bei den betrachteten einzelnen Stadtentwicklungsprojekten von Einzelhäusern bis zu Entwicklungsflächen von 350 ha Größe. Das Maß der Aufmerksamkeit, das den unterschiedlichen Projekten von der Öffentlichkeit entgegengebracht wird, hängt natürlich auch von der Größe des Projekts in Relation zu anderen Stadtentwicklungsprojekten in der betreffenden Stadt ab. Großprojekte sind in stärkerem Maße in der Lage eine eigene Entwicklungsdynamik zu erzeugen als einzelne kleine Standorte. Beispiele für solche Großprojekte sind etwa der MediaPark in Köln, der Medienhafen in Düsseldorf, die mediacity in Leipzig, traditionelle Medienstandorte wie die MediaCity in Berlin Adlershof, die Medienstadt in Potsdam-Babelsberg oder das Mediengelände „Unter

[1] Das Forschungsprojekt wurde durch die Städte Hamburg, Leipzig, München und Wiesbaden unterstützt.

den Eichen“ in Wiesbaden. Die Chancen Synergieeffekte zwischen Unternehmen und Einrichtung in Großprojekten herzustellen, ist häufig größer als in kleineren Projekten, wenn dies tatsächlich angestrebt wird. Wird die Vernetzung in Großprojekten nicht gezielt gefördert und wird bei der Mischung der angesiedelten Unternehmen und Einrichtungen nicht auf die Ergänzungsfähigkeit und Redundanz zwischen ihnen geachtet, d.h. wird nicht gezielt versucht eine spezifische Mischung herzustellen, sind Großprojekte aber auch stärker gefährdet überhaupt Synergien zu entwickeln. Große Einzelunternehmen oder Einrichtungen an solchen Standorten dominieren die Struktur häufig so stark und sind in eigene Unternehmensnetzwerke eingebunden, die mit den benachbarten Unternehmen und Einrichtungen nichts zu tun haben, so dass Synergien am Standort kaum entstehen. Ein Beispiel dafür ist bisher die Entwicklung in der Messestadt München-Riem. Kleinere Standorte haben demgegenüber den Vorteil, dass sich gerade zwischen kleinen Unternehmen - besonders zwischen Gründerunternehmen – im alltäglichen Handeln Synergien ergeben, weil man gleiche Probleme hat und die räumliche Nähe in einem kleinen Projekt unkomplizierte alltägliche Kontakte erleichtern. Diese Kontakte gehören zur Unternehmenskultur von kleinen Unternehmen und von Gründerunternehmen. Beispiele für derartige kleinere Projekte sind die Gründerflächen in der „Sprungschanze“ und im Gründerzentrum „Etage 21“ in der ehemaligen Rinderschlachthalle in Hamburg.

2.3 Stadtentwicklungsplanung und Projektentwicklung

Viele Stadtquartiere des Informationszeitalters haben sich eher zufällig entwickelt. Urbane Standorte in Innenstädten großer Zentren ebenso wie Televillages in ländlich peripheren Regionen. Bei einigen Projekten ist der thematische Schwerpunkt „Kommunikations- und Medienwirtschaft“ beiläufig entstanden – der konjunkturellen Entwicklung und der damit verbundenen Flächennachfrage geschuldet. In vielen Städten sind aber auch Stadtentwicklungsprojekte, die Standorte für die Kommunikations- und Medienwirtschaft qualifizieren sollen und IuK-Technologien gezielt für die Stadtentwicklung nutzen, gezielt von der Stadt(entwicklungs)planung oder der kommunalen Wirtschaftsförderung initiiert worden. Die Planung solcher Projekte ist ein wesentlicher Bestimmungsfaktor für die Entwicklung. Bei einigen Beispielen ist sie ein wichtiger Erfolgsfaktor. Das erste Beispiel für ein derartiges aus der Stadtentwicklungsplanung entstandenes Projekt ist der MediaPark in Köln. Das Projekt wäre nicht entstanden, wenn nicht die kommunale Stadtentwicklungsplanung die Initiative für die Konversion eines innenstadtnahen Bahngeländes übernommen, strukturelle und organisatorische Voraussetzungen für die Entwicklung und Umsetzung des Projekts geschaffen und Know How – z. T. in Form von Personen – bereitgestellt hätte. Auch der Medienhafen in Düsseldorf ist ein Beispiel für diese umfassende Stadtentwicklungsplanung. Andere Beispiele dafür sind die Messestadt München-Riem, die Hafencity Hamburg oder die Wissenschaftsstadt Berlin-Adlershof.

Mit der Entwicklung der Projekte veränderten sich langsam auch planerische Auffassungen vom Umgang mit der Stadtentwicklungsplanung. Am Kölner Beispiel kann man sehr gut den Paradigmenwechsel verfolgen:

- von der allein liegenschaftsorientierten kommunalen Wirtschaftsförderung und allein planerischen Regelungen verhafteten Stadtplanung (bis in die erste Hälfte der 1980er Jahre), die vor allem auf Großunternehmen ausgerichtet war,
- hin zu einer Projektplanung (seit Mitte der 1980er Jahre bis in die zweite Hälfte der 1990er Jahre, die Wirtschaftsförderungs- und Stadtentwicklungsaspekte verknüpfte, aber immer noch eng an die Entwicklung einzelner Standorte gebunden war (Beispiele MediaPark oder Coloneum),
- bis zu einer eher moderativen technologieorientierten Stadtentwicklungspolitik (TechnologieSpange), die die Bildung von Clustern anregt, Vernetzung fördert und sich darüber hinaus auf die Rahmensetzung bei der wirtschaftsräumlichen Entwicklung konzentriert.

Diese Veränderungen im Planungsverständnis sind einerseits Ausdruck eines allgemeinen Beschleunigungs- und Individualisierungsprozesses, andererseits Kennzeichen des Bedeutungsverlustes der kommunalen Stadtentwicklungsplanung in vielen Städten und der schwierigen finanziellen Situation der Kommunen. Die Stadtentwicklungsplanung wäre kaum noch in der Lage, in der umfassenden Weise wie dies bis in die 1980er Jahre der Fall war, Prozesse zu planen und zu steuern. Die Anforderungen von Unternehmen, Investoren, aber auch von Bürgern an individuelle Lösungen sind seit dieser Zeit erheblich gestiegen. Die Internationalisierungs- und Globalisierungsprozesse entziehen viele Entscheidungen dem unmittelbaren Einfluss der kommunalen Ebene. Dies beeinflusst auch das Handeln der kommunalen Wirtschaftsförderung und der Stadtentwicklungsplanung, die eher mit internationalen Akteuren Entscheidungen auszuhandeln hat, häufig nicht mehr in einem Konsens der lokalen Akteure entscheiden kann und Anordnungsbefugnisse verloren hat. Insgesamt hat die Stadtentwicklungsplanung gegenüber der euphorischen Planungsphase der 1970er Jahre erheblich an Bedeutung und Einfluss verloren. Dies drückt sich z.B. auch in der Strukturierung von Verantwortlichkeiten aus. In manchen Städten gibt es die Stadtentwicklungsplanung als Amt oder Dezernat überhaupt nicht mehr, in einigen Städten ist sie z.B. mit dem Amt für Statistik zusammengelegt worden. Schließlich führen die immer größer werdenden Einschränkungen der kommunalen Handlungsmöglichkeiten aufgrund der verschlechterten finanziellen Rahmenbedingungen in den Kommunen zu einer Veränderung des Verwaltungshandelns auch in der kommunalen Wirtschaftsförderung und Stadtentwicklungsplanung. Weiche Instrument – die vermeintlich weniger kosten – gewinnen an Bedeutung gegenüber großen Bauinvestitionen und Infrastrukturprojekten. Die Kommunen reagieren damit auch auf eine veränderte Nachfrage seitens der Unternehmen, Investoren und Bürger. In dem Maß, in dem bestimmte Einrichtungen in vielen Städten vorhanden sind, werden gerade die „weichen Instrumente“, die das Geschäftsklima und die Lebensqualität prägen, immer stärker standortentscheidend. Beispiele für den neuen moderativen, vernetzenden und Rahmen setzenden Ansatz technologieorientierter Stadtentwicklungsplanung sind beispielsweise das dortmund-project oder die TechnologieSpange Köln.

2.4 Modularität

Die Modularität der Konzepte entscheidet ganz wesentlich über den Erfolg der Umsetzung. Technologieorientierte Projekte müssen sich in noch stärkerem Maß als andere Stadtentwicklungsprojekte auf schnelle, manchmal sprunghafte Veränderungen einstellen. Die Technologieentwicklung ist nur in einem geringen Maß vorhersagbar. Prognosen der Technologienentwicklung schätzen die nachfolgende Entwicklung in den vergangen Jahren in der Regel deutlich anders ein als sie sich später tatsächlich abzeichnete. Beispiele für solche technologischen „Fehlprognosen“ gab es z.B. bei der prognostizierten Diffusion des Bildschirmtextes (deutlich zu hohe Prognosen), der Verbreitung des PC (erheblich zu niedrige Prognosen), dem Aufbau eines UMTS-Netzes (langsamerer Aufbau). Die Veränderungen, die zwei Querschnittstechnologien (Mobilfunk, Internet) in den letzten zehn Jahren in Deutschland mit sich gebracht haben, wurden kaum vorhergesehen. Vor dem Hintergrund dieser Prognoseprobleme wird klar, dass modular strukturierte Stadtentwicklungsprojekte viel einfacher auf nicht vorhersehbare technologische Veränderungen und veränderte Märkte reagieren können. Besonders wichtig ist eine modulare Struktur für Großprojekte der Stadtentwicklung, deren Realisierung mitunter mehrere Jahrzehnte dauern kann. Die Gegenüberstellung zweier Großprojekte der Stadtentwicklung für die Kommunikations- und Medienwirtschaft – dem MediaPark Köln und dem Medienhafen Düsseldorf – macht die Bedeutung einer modularen Struktur für den Erfolg von Stadtentwicklungsprojekten für die Kommunikations- und Medienwirtschaft besonders deutlich. Der Vergleich lässt sich deshalb besonders gut herstellen, weil beide Städte in einem Bundesland liegen und damit grundsätzlich gleichen Förderbedingungen unterliegen. Obwohl das Land seinen Förderschwerpunkt für die Medienwirtschaft aber eher in Köln als in Düsseldorf gesetzt hat, hat sich in Düsseldorf nahezu kontinuierlich in den letzten beiden Dekaden ein Medienstandort entwickelt. Während der Leitstandort der ersten Phase der Förderung der Kommunikations- und Medienstadt Köln – der MediaPark – lange Zeit unvollendet blieb und z. T. das Bild einer „Investitionsruine“ nach außen abgab, vermittelte der Medienhafen in Düsseldorf das Bild einer kontinuierlichen Entwicklung, obwohl auch dort erhebliche Umbrüche zu verzeichnen waren. Der MediaPark Köln wurde von Anfang an als Standort der traditionellen Medien kommuniziert. Das Projekt entstand nach einem städtebaulichen Entwurf und einem Architekturentwurf „aus einem Guss“. Veränderungen waren kaum möglich. Als sich die privaten Fernsehsender, die man im MediaPark ansiedeln wollte, für andere preiswertere Standorte entschieden, war man dennoch gezwungen das fertige Konzept umzusetzen. In der Öffentlichkeit entstand zwischenzeitlich – auch durch die lange Bauzeit – der Eindruck, das Projekt sei gescheitert. In Düsseldorf dagegen konnte man flexibel auf die veränderten wirtschaftlichen Bedingungen reagieren, weil man auch die einzelnen Module des Medienhafens flexibel entwickeln konnte. Gescheiterte Ansiedlungen von Spartenkanälen (Wetterkanal, Kinderkanal) konnten durch neue Projekte ausgeglichen werden. Das von Beginn an als modular kommunizierte Stadtentwicklungskonzept vermittelte nach außen den Eindruck, es gehe „Stück um Stück“ voran, auch wenn es Rückschläge gab.

Beispiele für modulare Konzepte bei der Entwicklung ganzer Stadtquartiere sind neben den genannten die Messestadt München-Riem, der channel Harburg, die Wissenschaftsstadt Berlin-Adlershof, die Stadtquartiere Kosterforst in Itzehoe, Nordwolle in Delmenhorst und Wiley in Neu-Ulm. Bei den kleineren Projekten spielt die modulare Entwicklung eine weniger große Rolle für den Erfolg der Projekte. Dennoch sind einige der Projekte explizit modular strukturiert um flexibel auf veränderte Märkte reagieren zu können. Ein Beispiel dafür sind die MediaWorksMunich. Die modulare Struktur ahmt die natürliche Wachstumsstruktur von Stadtquartieren mehr oder minder gut nach. Gewachsene Stadtquartiere der Kommunikations- und Medienwirtschaft wie die Spandauer Vorstadt in Berlin sind alle modular strukturiert.

2.5 Ergänzungsfähigkeit der vorhandenen Wirtschaftsstruktur

Viele neue Standorte der Kommunikations- und Medienwirtschaft oder der IuK-Nutzung werden innerhalb n vorhandener Strukturen entwickelt und nutzen endogene Potenziale. Es gibt aber auch Beispiele für IuK-orientierte Stadtentwicklungskonzepte, die eher den Charakter eine Enklave haben (vgl. Läpple 1989, 213-226). Diese Standorte sind bisher eher weniger erfolgreich als die in das lokale innovative Milieu eingebetteten Standorte. Ihnen fehlen die Vernetzungsmöglichkeiten mit Unternehmen in der Umgebung und damit der direkte Austausch von Wissen. Sie sind wenig oder gar nicht in Zulieferstrukturen einbezogen oder auf wenige Abnehmer angewiesen. Beispiel für solche Entwicklungsoasen waren die ersten Teleports (vgl. Floeting 1994, 13-16). Von den untersuchten Projekten stellen die Netzgemeinde Oberhambach (wegen der zeitlich begrenzten Laufzeit des Projekts), Televillages Crickhowell und Colletta di Castelbianco solche im Sinne einer Regionalentwicklung eher weniger erfolgreichen Beispiele dar. In gewissem Umfang kann auch die mediacity Leipzig als Beispiel für ein bisher wenig eingebettetes Projekt angesehen werden. Die in der mediacity angesiedelten Fernsehproduktionsunternehmen und technischen Dienstleister sind in außerordentlich großem Umfang auf den am Standort angesiedelten Mitteldeutschen Rundfunk als Abnehmer ihrer Produkte und Dienstleistungen angewiesen. Zulieferbeziehungen zu anderen Unternehmen sind die Ausnahme. Mit der mediacity wurde ein lokales Milieu mit bisher geringer Einbettung in die Wirtschaftsstrukturen der Stadt für die Unternemen der Wertschöpfungskette Fernsehproduktion in Leipzig geschaffen. Dennoch ist das Maß an fehlender „embeddedness“ deutlich geringer als bei den vorgenannten Beispielen.

Die gewachsenen Stadtquartiere wie z.B. die Spandauer Vorstadt in Berlin oder Ottensen in Hamburg bieten in besonderer Weise diese „embeddedness“. In etwas abgeschwächter Form gilt dies etwa auch für die Hanauer Landstraße in Frankfurt am Main und die TechnologieSpange in den rechtsrheinischen Stadtteilen Kölns, wobei in Köln der Prozess der Einbettung gerade erst beginnt. Beispiele für eine besonders gute Einbettung in eine ergänzungsfähige regionale Wirtschaftsstruktur sind unter den Projekten, die neue Stadtquartiere entwickeln der MediaPark Köln oder der channel Harburg. Bei den kleineren Einzelprojekten sind es beispielsweise der Spreespeicher in Berlin-Friedrichhain, Media Works Munich oder die Zeise-Hallen in Hamburg. Mit Ausnahme des Kenniswijk-Projekts in Eindhoven zeigt keines der vor allem technologisch orientierten Projekte eine nennenswerte Einbettung in die Regionalentwicklung. Beim Kenniswijk-Projekt hat man sinnvollerweise die „embeddedness“ zu einem Auswahlkriterium für die Modellregion gemacht und mit der Region Eindhoven einen Standort gewählt, in dem bereits gut funktionierende Kooperationsstrukturen und eine hohe Technologieakzeptanz bestehen. So kann man darauf verzichten eine nachholende Entwicklung zu fördern und sich auf innovative Konzepte konzentrieren.

2.6 Initialkerne

Die Entwicklung neuer Stadtquartiere, die sich als Standort der Kommunikations- und Medienwirtschaft etablieren wollen, kann wesentlich erleichtert werden durch die Ansiedlung eines Ankerunternehmens oder einer Ankereinrichtung. Gemeint sind Unternehmen und Einrichtungen mit starker Ausstrahlwirkung als Abnehmer von Leistungen und Kooperationspartner anderer Institutionen. Darüber hinaus sind solche Unternehmen in der Lage, zur Bildung eines positiven Images des Standorts in der betreffenden Branche und darüber hinaus beizutragen. In einigen Projekten haben diese Ankerunternehmen und -einrichtungen auch eine wichtige Funktion als gesicherter Mieter zur Refinanzierung der Entwicklungs- und Betriebskosten von Immobilien.

Beispiele für Projekte mit starken Ankerunternehmen oder -einrichtungen sind bei den Großprojekten z.B. der MediaPark Köln mit den Forschungs- und Weiterbildungseinrichtungen, einem Spartenkanal (Musik-TV) und einem öffentlich-rechtlichen Hörfunkanbieter. Längere Zeit waren die Forschungs- und Weiterbildungseinrichtungen Hauptbestandteil des MediaParks und hatten eine wichtige Funktion für das „Überleben" des Projekts. Die später angesiedelten Unternehmen aus dem Fernseh- und Hörfunkbereich haben dazu beigetragen, dass sich das in der Zwischenzeit deutlich verschlechterte Image des Standorts wieder erheblich verbessert hat.

Weitere Beispiele für Stadtquartiere mit starken Ankerunternehmen und –einrichtungen sind der Medienhafen Düsseldorf (Werbeagenturen, Spartenkanäle), die Messestadt München-Riem (Softwarentwickler), die Wissenschaftsstadt Berlin-Adlershof (Universität, Studiobetrieb) und der channel Harburg (Universität). Kleinere Einzelprojekte, die von Immobilienunternehmen entwickelt werden, nutzen das Prinzip des Ankerunternehmens schon aus ökonomischen Gründen (Mietgarantien, Überkreuzsubventionierung, verbesserte Vermietbarkeit). Beispiele dafür sind die mediacity Leipzig (öffentlich-rechtliche Rundfunkanstalt), der Spreespeicher in Berlin-Fiedrichshain (Musikverlag), die Hanauer Landstraße in Frankfurt am Main (Multimediaagentur, Internet-Provider, Werbeagenturen) oder die MediaDocks in Lübeck (Forschungs- und Weiterbildungsinstitute).

2.7 Funktionsmischung

Gewachsene innerstädtische Stadtquartiere zeichneten sich früher durch ein hohes Maß an Nutzungsmischung aus. Die Citybildung hat die Wohnfunktion in vielen Fällen aus der Innenstadt verdrängt. In einigen Bereichen ist die typische europäische Innenstadtstruktur aber erhalten geblieben. Besonders stark ausgeprägt ist diese Mischung beispielsweise noch in der Spandauer Vorstadt im Berliner Bezirk Mitte. Die fehlende Dynamik der Wirtschaftsentwicklung und die Außerkraftsetzung von Mechanismen der Bodenrente in der DDR haben in diesem Stadtteil bis 1990 traditionelle europäische Innenstadtstrukturen mit hohem Wohnanteil konserviert, die z. T. auch noch heute zu finden sind. Urbanität besteht in diesen Stadtteilen in der Nutzungsmischung. Andere Beispiele für diese Nutzungsmischung sind der Hamburger Stadtteil Ottensen, die Hanauer Landstraße in Frankfurt am Main oder die Leipziger Südvorstadt.

Die Unterstützung der kleinräumigen Funktionsmischung steht auch im Vordergrund einer Reihe von Neubauprojekten, deren Ziel die engere Verbindung von Wohnen und Arbeiten ist. Nutzungsmischung ist aber auch in den großen Stadtquartiersprojekten ein wichtiges planerisches Prinzip. Aussagen darüber, ob die gemischten Strukturen – die ein Angebot an die Bewohner und Beschäftigten im Quartier darstellen – von diesen auch in der intendierten Form kleinräumig genutzt werden, sind zumeist nicht möglich. Ein Beispiel, bei dem auch in der tatsächlichen Nutzung eine Mischung festzustellen ist, stellt das Stadtquartier Klosterforst in Itzehoe dar. Mitarbeiter des angesiedelten Call Centers wohnen im Quartier, Wohnungen und Arbeitsplätze sind zum Teil in derselben baulichen Einheit vorhanden. Weitere Beispiele sind das Nordwolle-Gelände in Delmenhorst, das Wiley-Gelände in Neu-Ulm, die Messestadt München-Riem, der MediaPark Köln, der Düsseldorfer Medienhafen oder die Televillages.

2.8 Integration von Freizeitangeboten

Die zurückgehende Zahl von Normalarbeitsverhältnissen, die zunehmende Vermischung von Arbeits- und Freizeit und die Flexibilisierung von Zeitstrukturen begünstigt auch die räumliche Integration von Freizeiteinrichtungen in Stadtquartiere des Informationszeitalters. Zur Unternehmenskultur vieler New-Media-Unternehmen und anderer Gründerunternehmen gehört diese Vermischung von Arbeits- und Freizeit. Sie suchen Unternehmensstandorte, an denen auch ein interessantes Freizeitangebot besteht. Projektentwickler haben diese Nachfrage aufgegriffen und entsprechende Angebote entwickelt. Einige Standorte haben sich gerade dadurch erfolgreich etabliert, dass sie in der Nähe von Freizeiteinrichtungen zu finden waren. Ein besonders gutes Beispiel dafür ist das MediaWorksMunich, das in München direkt an den Kunstpark Ost – eine der größten Veranstaltungsstätten der Stadt – grenzte. Der Betreiber des MediaWorksMunich warb explizit mit dieser Nähe für seine Büroflächen und verband damit ein besonders kreatives Milieu am Standort.

Viele gewachsene Standorte wie die Spandauer Vorstadt oder die Hanauer Landstraße verfügen in besondere Weise über ein umfassendes Freizeitangebot. In einzelnen Projekten werden bewusst solche Angebote integriert wie z.B. beim Spreespeicher in Berlin-Friedrichshain. Auch neue Stadtquartiersentwicklungen setzen auf die Integration solcher Angebote. So sollte beispielsweise im Phönix-Gelände in Dortmund unter anderem ein „Games Dome" für Computerspiele entstehen.

2.9 Spezialisierung

Mit der Zunahme der Zahl an Stadtquartieren und Einzelprojekten, die sich als Standort der Kommunikations- und Medienwirtschaft verstehen, nimmt die Bedeutung des Alleinstellungsmerkmals „Kommunikations- und Medienstandort" ab. Festzustellen sind einerseits Diversifizierungstendenzen, andererseits aber auch eine zunehmende Spezialisierung der Standorte auf bestimmte Funktionen, Nutzergruppen und Branchen. Obwohl die konvergente Entwicklung zwischen der analogen Fernsehwelt, der analogen Telefonwelt und der digitalen Computerwelt viel langsamer verläuft als von vielen prognostiziert und vor allem die Technologie – also die Digitalisierung – weniger aber die Unternehmensstrukturen betrifft, haben sich in den letzten Jahren traditionelle Medienstandorte in zunehmendem Maß auch den „neuen Medien" zugewandt. Ein gutes Beispiel sind die strukturellen Veränderungen des Mediengeländes „Unter den Eichen" in Wiesbaden. Das Gelände, das in den 1950er und 1960er Jahren der Filmproduktion diente, wandelte sich in den 1970 Jahren zum Fernsehstandort. Bis in die 1990er Jahre waren Fernsehproduktionen das wichtigste „Standbein". Seit Mitte der 1990er Jahre hat sich das Gelände zum Medienstandort mit Hochschule, Fernsehproduktion und Multimediaunternehmen entwickelt.

Zunehmende Spezialisierungstendenzen sind vor allem bei neuen Standorten – auf der Suche nach einem eigenen Standortimage – zu finden. Beispiele dafür sind etwa das Coloneum in Köln, das sich im wesentlichen an Studionutzer wendet, die Wissenschaftsstadt in Berlin-Adlershof, die vor allem forschungsorientierte Nutzer anspricht und das Stadtquartier Klosterforst in Itzehoe, das sich auf CallCenter-Dienstleistungen spezialisiert hat.

Daneben gibt es Spezialimmobilien, die sich an Telearbeiter wenden. So beispielsweise die Televillages Crickhowell und Colletta di Castelbianco, aber auch die Stadtquartiere Klosterforst in Itzehoe oder das Nordwolle-Gelände in Delmenhorst. Das Nordwolle-Gelände ist aber auch ein Beispiel dafür, dass diese Spezialisierung nicht zwangsläufig ein Erfolgfaktor ist. Dort nutzen nämlich nur wenige Bewohner tatsächlich die infrastrukturellen Möglichkeiten für Telearbeit.

2.10 Integration der traditionellen Kommunikations- und Medienwirtschaft

Die stärkste Einbindung traditioneller Medienwirtschaft in Stadtentwicklungsprojekte ist in den etablierten Medienstandorten wie der MediaCity in Berlin-Adlershof, der Medienstadt in Potsdam-Babelsberg oder dem Mediengelände „Unter den Eichen“ in Wiesbaden und an den neuen Standorten der Medienwirtschaft wie dem Coloneum in Köln und der mediacity in Leipzig zu finden. Aber auch neu entwickelte Standorte beziehen die traditionelle Kommunikations- und Medienwirtschaft ein. Im Zuge einer weiter voranschreitenden Konvergenzentwicklung werden neue Synergiepotenziale in der Kooperation von traditioneller Kommunikations- und Medienwirstchaft mit den „neuen Medienunternehmen“ vermutet. In bestimmten Bereichen sind diese Synergien heute bereits sichtbar, z.B. im Bereich der digitalen Bildbearbeitung, die besonders für Spezialeffekte und digital generierte Welten in der Filmwirtschaft oder bei der Herstellung von Videoclips genutzt wird. Im Lodenfrey-Park in München wurdenn Kooperationen dieser Art (zwischen einem Musiksender und einem auf digitale Bildbearbeitung spezialisierten Unternehmen) modellhaft entwickelt. Andere Standorte, die „neue Medienunternehmen“ und traditionelle Kommunikations- und Medienwirtschaft versuchen zu integrieren, sind beispielsweise der MediaPark Köln, der Spreespeicher in Berlin-Friedrichhain und der Hamburger Stadtteil Ottensen.

2.11 Clusterförderung und integrierte Strategie

Obwohl in vielen Städten über neue Formen der kommunalen Wirtschaftsförderung diskutiert wird und die Vernetzung von Unternehmen und Einrichtungen an bestimmten Standorten von vielen Städten postuliert wird, sind nur wenige Stadtentwicklungsprojekte, die sich als Standort der Kommunikations- und Medienwirtschaft etabliert haben oder entwickeln wollen, tatsächlich in eine umfassende technologieorientierte Stadtentwicklungsstrategie integriert. Hierin besteht ein wesentliches Manko der bisherigen Entwicklung. Standorte werden parallel entwickelt und konkurrieren z. T. miteinander. Die Potenziale der Technologieentwicklung werden für den regionalen Strukturwandel nur unzureichend genutzt. Die Außenwirkung zahlreicher Einzelprojekte ist geringer als die eines integrierten Standortkonzepts. Kommunale Wirtschaftsförderungsaufgaben und Stadtentwicklungsaufgaben im Bezug auf die Entwicklung von Stadtquartieren des Informationszeitalters und der Technologieentwicklung werden weitgehend unabhängig voneinander wahrgenommen, in einigen Fällen auch unkoordiniert. Kleinere Standorte profitieren von der Einbindung in eine umfassende technologieorientierte Stadtentwicklungsstrategie in vielfältiger Weise, da sie in der Regel anders als Großprojekte nur in beschränktem Umfang als Standortbildner fungieren können.

In Köln wurde Ende der 1980er Jahre mit dem Konzept der „Medienstadt Köln“ erstmals der Ansatz für eine integrierte technologieorientierte Stadtentwicklungsstrategie entwickelt, die sich zu diesem Zeitpunkt noch auf die klassischen liegenschaftsorientierten kommunalen Wirtschaftsförderungsstrategien stützte und ein städtebauliches Großprojekt initiierte (MediaPark Köln). Ein ähnliches Beispiel wurde durch die Projektentwicklungsgesellschaft des MediaParks Köln Anfang der 1990er Jahre für Leipzig entwickelt, aber nicht umgesetzt. Neuere Konzepte betonen eher die moderativen Komponenten, wenngleich weiterhin städtebauliche Projekte in die Konzepte integriert sind. Beispiele für diese integrierten technologieorientierten Stadtentwicklungskonzepte sind das Konzept der Medienstadt Düsseldorf oder das dortmund-project. Auf kleinräumiger Ebene wurde ein neues Cluster der Medienwirtschaft in der Leipziger mediacity entwickelt. Dennoch gibt es bisher in der Stadt kein integriertes Konzept für die Entwicklung des Standorts. Die Entwicklung konzentrierte sich in den letzten Jahren stark auf diesen Einzelstandort. Weitgehend unabhängig von gezielter Förderung haben sich in einigen gewachsenen Quartieren wie der Spandauer Vorstadt in Berlin-Mitte, dem Hamburger Stadtteil Ottensen oder der Hanauer Landstraße in Frankfurt am Main Cluster der Kommunikations- und Medienwirtschaft entwickelt.

2.12 Öffentlich-private Kooperation

Das erste deutschlandweit bekannte Projekt für ein neues Stadtquartier der Kommunikations- und Medienwirtschaft und der Medientechnologie-Nutzung – der MediaPark Köln – war zugleich ein viel zitiertes Beispiel für das neue Projektentwicklungsmodell der öffentlich-privaten Kooperation, das in der angewendeten Form Ende der 1980er Jahre aus der Stadtentwicklungspolitik von Kommunen in den USA „importiert“ wurde und als „public private partnership“ bekannt wurde. Der MediaPark Köln wurde später aber auch zu einem Beispiel für die Fallstricke öffentlich-privater Kooperation und der Auffangfunktion kommunalnaher Unternehmen für „gestrauchelte“ Projekte.

Im Zuge der schwierigen Entwicklung der kommunalen Haushalte sind die Städte in immer stärkerem Maß – nicht nur bei Stadtentwicklungsprojekten – auf die Kooperation mit privaten Unternehmen und private Investitionen angewiesen, denn sie können immer weniger Projekte vorfinanzieren. Die öffentlich-private Kooperation soll aber nicht nur die finanziellen Engpässe in den Kommunen überbrücken, sie soll den Projekten auch in den Kommunen nicht vorhandenes Know How (Branchenkenntnisse, Kenntnisse innovativer Projektentwicklung usw.) einbringen. Gerade bei technologieorientierten Projekten sind öffentlich-private Partnerschaften aus diesem Grund von besonderer Bedeutung für eine gute Platzierung der Projekte am Markt und damit letztendlich für ihren Erfolg.

Art und Umfang der Kooperation können sich deutlich unterscheiden und sie kann unterschiedliche Phasen des Projektes (Entwicklung, Realisierung, Betrieb) mit einbeziehen. Von den untersuchten Projekten gehört die mediacity Leipzig zu den engsten öffentlich-privaten Kooperationen: Der Standort wurde nach den Vorstellungen des privaten Partners auf öffentlichem Grund von einer öffentlichen Gesellschaft entwickelt und Tochterunternehmen des privaten Partners betreibt im Auftrag des öffentlichen Entwicklers die Immobilie. Beispiele für öffentlich-private Kooperationen sind etwa die Wissenschaftsstadt Berlin-Adlershof, der Medienhafen in Düsseldorf, die mediaciy Leipzig, der Lasipalatsi in Helsinki, die MediaDocks in Lübeck und das Zentrum für Kunst und Medientechnologie in Karlsruhe.

2.13 Öffentliche Förderung

Eng verbunden mit der öffentlich-privaten Kooperation sind in vielen Fällen die umfassende Förderung der Projekte sowie flankierende Maßnahmen, die häufig weit über eine Anschubfinanzierung hinaus gehen. Öffentliche Förderung bedeutet dabei nicht nur ausgewiesene Fördermittel, sondern beinhaltet auch zahlreiche indirekte Fördermöglichkeiten wie die ermäßigte Grundstücksabgabe, die Anmietung von Flächen durch die Kommune oder kommunalnahe Einrichtungen zu erhöhten Flächenkosten oder mit Mietgarantien, den Bezug von Leistungen von angesiedelten Unternehmen usw. Kommunen alleine könnten die Förderung derartiger Projekte kaum finanzieren. Häufig ist daher das Land Fördermittelgeber. Beispiele für eine besonders umfangreiche Förderung sind die Wissenschaftsstadt Berlin-Adlershof, der MediaPark Köln, die mediacity Leipzig, das Zentrum für Kunst und Medientechnologie in Karlsruhe, die MediaDocks in Lübeck, das Mediengelände „Unter den Eichen“ in Wiesbaden und das Kenniswijk-Projekt in der Region Eindhoven.

Öffentliche Förderung hat eine besondere Bedeutung bei der Initiierung von Projekten, bei der Überbrückung von Entwicklungsschwierigkeiten und für nicht-kommerzielle Projekte. In den letzten Jahren wurden öffentliche Förderungen aber gerade auch zur Entwicklung kommerzieller Standorte, die im Wettbewerb zu anderen Standorten stehen, genutzt. Beispiele dafür sind der Aufbau von Studioüberkapazitäten in der Region Köln, die „Abwerbung“ von Unternehmen z.B. von Hamburg nach Berlin. Kommunale Wirtschaftsförderer beklagen häufig die großen Budgets einzelner Bundesländer (Bayern, Baden-Württemberg, Berlin, Nordrhein-Westfalen, Sachsen) für die Standortwerbung. Öffentliche Förderungen sollten den Wettbewerb zwischen den Standorten nicht unnötig verzerren, sind aber häufig gerade für die Initiierung von Projekten ein wesentlicher Erfolgsfaktor.

2.14 Promotoren

Wichtig für die Kontinuität von Projekten wie auch für die finanzielle Förderung von Projekten sind Akteure, die die Konzeptentwicklung und -umsetzung garantieren. Gerade im Bereich der technologieorientierten Stadtentwicklungskonzepte gab es bisher nur wenige Akteure, die als Promotoren einer integrierten Strategie auftraten. Allein in vier deutschen Städten geht die Initiierung von integrierten technologieorientierten Stadtentwicklungskonzepten auf gleiche Akteure zurück. Wichtig sind Promotoren aber auch bei der Entwicklung und Umsetzung von Einzelprojekten. Anders als alle anderen Faktoren sind die Promotoren in allen Projekttypen (Stadtquartiere, Einzelprojekte, Cluster, Technologieprojekte) ein entscheidender Erfolgsfaktor. Dabei erweist es sich offensichtlich als ausgesprochen schwierig Promotoren mit dem nötigen Branchenwissen zu rekrutieren, die gleichzeitig über Know How der städtebaulichen Projektentwicklung wie auch der kommunalen Handlungsmöglichkeiten verfügen. Dies führt dazu, dass immer wieder die gleichen Akteure in unterschiedlichen Projektkonstellationen zusammenkommen.

Die Entwicklung der Akteursstrukturen seit den 1990er Jahren zeigt auf Seiten der Städte eine deutliche Professionalisierung der Befassung mit IuK-Technologien als strategischem Thema des technisch-ökonomischen Strukturwandels und verbunden damit die Ausbildung spezifischer Akteursmuster. Dabei zeigen sich Vorreiter der Entwicklung, Übertragungen von Mustern sowie Modifikations- und Anpassungsprozesse, die in politischen und organisatorischen Veränderungen ebenso wie in technologischen Veränderungen und deutlichen Themenkonjunkturen begründet sind. Die Stadt(entwicklungs)planung in den Kommunen ist an den Entwicklungen zum Thema IuK-Technik bisher kaum beteiligt.

Beispiele für eine enge Beteiligung der Stadt(entwicklungs)planung als Promotoren der Entwicklung von Standorten für die Kommunikations- und Medienwirtschaft und die Integration von IuK-Technolgien sind etwa der MediaPark in Köln, das dortmund-project, der Medienhafen in Düsseldorf, das Nordwolle-Gelände in Delmenhorst oder der Lasipalatsi in Helsinki.

2.15 Kontinuität und politischer Rückhalt

Gerade für Großprojekte zur Entwicklung neuer Stadtquartiere ist die Kontinuität von ideeller und finanzieller Unterstützung von besonderer Bedeutung für den Erfolg der Projekte. In zunehmendem Maß werden solche Projekte modular organisiert und wandeln sich von liegenschaftsorientierten zu eher moderativen Projekten, die sich vor dem Hintergrund einer bestimmten Gebietskulisse auf die Vernetzung von Akteuren konzentrieren. Der Vorteil, dass solche Projekte eine höhere Reversibilität aufweisen, auf veränderte Märkte und technologische Veränderungen daher besser reagieren können, ist mit dem Nachteil verbunden, dass sie auch schneller zurückzuziehen sind. In den Städten konkurrieren immer mehr Projekte um Finanzierung und Aufmerksamkeit. Eine deutlichere Prioritätensetzung bei den Projekten, die langfristig angelegt ist, könnte die Planungssicherheit erhöhen. Kontinuität ist damit eine unabdingbare Voraussetzung für solche Projekte. Dies gilt ganz besonders auch für den politischen Rückhalt. Die Verankerung von technologieorientierten Projekten als Chefsache (Stabsstelle) hat sich in einigen Städten als erfolgreich herausgestellt (z.B. Köln, Mannheim, Ulm). Beispiele für umfassende Konzepte und Strategien, deren Entwicklung auf Kontinuität angelegt ist, sind etwa Köln, Düsseldorf, Dortmund oder Nürnberg.

Köln verfolgt seit Mitte der 1980er Jahre den Ansatz einer integrierten technologieorientierten Stadtentwicklungsplanung, die trotz organisatorischer Veränderungen in der Verwaltung, wechselnder politischer Mehrheiten und Wechsel der Akteure ein hohes Maß an Kontinuität und politischem Rückhalt aufweist. Die Strategie hat sich dabei als so robust und reversibel erwiesen, das sie sich bisher gut an die technologischen Veränderungen ebenso wie die Veränderungen des Marktes anpassen ließ. Ähnliches gilt für Düsseldorf.

In Dortmund wurde vor drei Jahren eine derartige Strategie entwickelt, die in hohem Maß auf Kontinuität angewiesen ist. Ob sich diese Kontinuität einstellen wird ist derzeit noch nicht absehbar.

Am Beispiel Nürnberg wird auch deutlich, dass integrierte technologieorientierte Stadtentwicklungsstrategien auch über die Projekte, die im Kern zur Strategie zählen, hinaus wirken können. Im Rahmen der Strategieentwicklung und –umsetzung werden Akteursstrukturen entwickelt und etabliert, die es beispielsweise erleichtern andere Konzepte zu entwickeln. In Nürnberg war es z.B. möglich in kurzer Zeit aus dem Akteurskreis derjenigen, die zur Nürnberger Initiative für die Kommunikationswirtschaft gehörten, einen Beitrag für den Wettbewerb Media@Komm des Bundeswirtschaftsministeriums zur Entwicklung virtueller Rathäuser und Marktplätze zu entwickeln, der schließlich in nicht unerheblichem Umfang Fördermittel für Nürnberg zur Verfügung stellte. Die Entwicklung flexibler Akteursgruppen ist ein Nebeneffekt der kontinuierlichen Entwicklung einer integrierten technologieorientierten Stadtentwicklungsstrategie.

3 ZUSAMMENWIRKEN DER ERFOLGSFAKTOREN

Das Zusammenwirken aller genannten Faktoren in unterschiedlichem „Mischungsverhältnis“ bestimmt die Art und Weise wie sich Projekte entwickeln; letztendlich sind sie in großem Umfang Determinanten des Projekterfolgs.

Die spezifischen Konstellationen der Erfolgsfaktoren unterscheiden sich z. T. erheblich. Es lassen sich aber bestimmte Muster von Konstellationen für unterschiedliche Projekttypen erkennen. Nach dem Muster der Erfolgsfaktoren lassen sich folgende Projekttypen zusammenfassen:

- großflächige Projekte und die Entwicklung großer Stadtquartiere
- kleinere Einzelstandorte und Einzelprojekte
- gewachsene urbane Cluster, die sich im Zuge des New-Media-Booms Ende der 1990er Jahre weiterentwickelt haben
- vor allem auf technologische Innovation setzende Projekte

Promotoren sind für alle Projekte ein unabdingbarer Erfolgsfaktor. Gerade mit hohen Unsicherheiten behaftete technologieorientierte Projekte brauchen Promotoren. Auch der politische Rückhalt ist von besonderer Bedeutung für den Erfolg der Projekte vor allem modular angelegte Großprojekte sind auf diesen Rückhalt angewiesen, um Technologiebrüche und weniger erfolgreiche Entwicklungsphasen „überstehen“ zu können. Die für die Entwicklung von Stadtquartieren der Informationsgesellschaft wichtigen Erfolgsfaktoren sind von allen Projekttypen am breitesten gestreut. Je thematisch breiter das Projekt angelegt ist (wie beispielsweise die Wissenschaftsstadt Berlin-Adlershof), desto mehr Erfolgsfaktoren sind relevant. Die Spezialisierung auf bestimmte Nutzertypen, Branchen oder Unternehmen spielt für die Großprojekte eher eine untergeordnete Rolle.

Für Einzelstandorte spielt beispielsweise eine gezielte Funktionsmischung von Wohnen und Arbeiten für den Erfolg des Projekts kaum eine Rolle. Zu unterscheiden sind bei diesem Typ Projekte, die rein privatwirtschaftlich organisiert sind, wie etwa die TinFactory in Hamburg, der Spreespeicher in Berlin-Friedrichshain, das Kreativ-Zentrum im Nordpark in Mönchengladbach und solchen, die massiv öffentlich unterstützt werden und für die diese Förderung ein wesentlicher Erfolgsfaktor ist, wie z. B für die mediacity Leipzig.

Für die untersuchten gewachsenen Cluster spielen planerische Eingriffe kaum eine Rolle. Einige der Projekte haben sich gerade im „Windschatten“ der von der Stadtentwicklungsplanung und kommunalen Wirtschaftsförderung betriebenen Projekte entwickelt. Auch die Spezialisierung auf Nutzergruppen, Unternehmen oder Branchen spielt ebenso wie die Einbindung traditioneller Unternehmen nur eine untergeordnete Rolle. Die urbane Vielfalt, die ergänzungsfähige Wirtschaftsstruktur, die Funktionsmischung, integrierte Freizeitangebote, öffentlich-private Kooperation, Promotoren und – bei allen Strukturbrüchen – Kontinuität in der Entwicklung sind die „Erfolgsrezepte“ dieser Stadtquartiere.

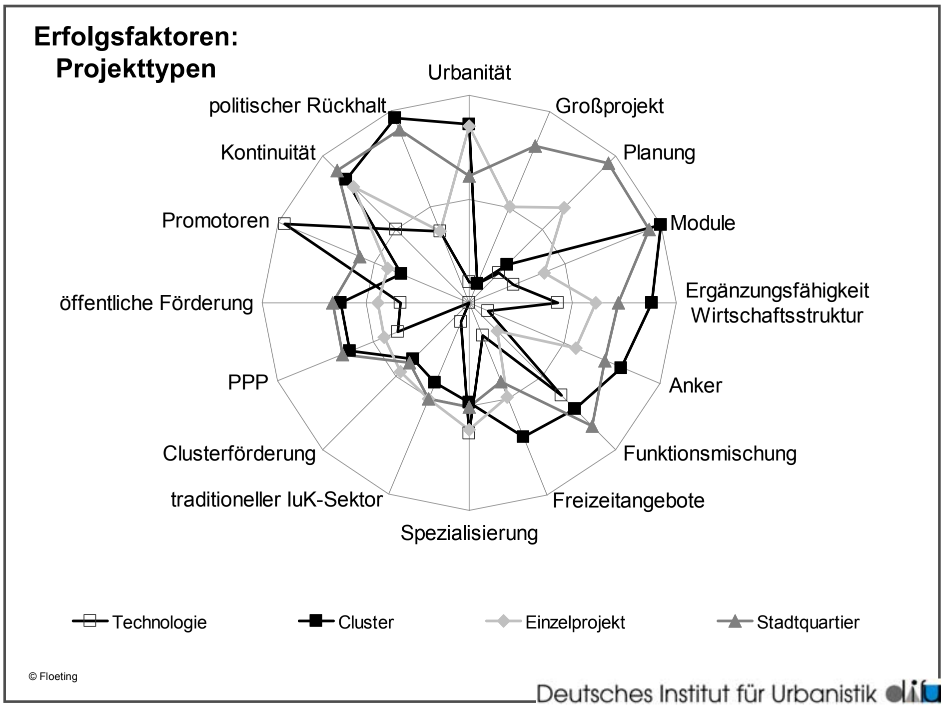

Abb.1: Erfolgsfaktoren nach Projekttypen

Auch für die allein auf den Technologiepfad setzenden Projekte wie die Televillages, das Kenniswijk-Projekt oder die Netzgemeinde Oberhambach spielt die Planung für den Erfolg kaum eine Rolle. Die Ergänzungsfähigkeit der Wirtschaftsstruktur ist allein eine wichtige Erfolgsbedingung für das Kenniswijk-Projekt. Die drei anderen Projekte setzten vor allem auf die Spezialisierung als Telearbeitsprojekte und öffentliche und/oder private Promotoren.

4 FAZIT

Patentrezepte für den Erfolg von Stadtentwicklungsprojekten, die sich mit IuK-Technologien und/oder der Kommunikations- und Medienwirtschaft beschäftigen, gibt es nicht: zu unterschiedlich sind die spezifischen Konstellationen an den einzelnen Orten. Dennoch gibt es eine Reihe von Faktoren, die den Erfolg der Projekte wesentlich mitbestimmen und zahlreiche gute Beispiele für die erfolgreiche Umsetzung. Die Erfolgsfaktoren gelten dabei nicht allein für den Bereich der IuK-Technologien, sondern lassen sich z.T. auch auf andere Bereiche der technologieorientierten Stadtentwicklungspolitik übertragen. Die untersuchten Projekte sind seit Mitte der 1980er Jahre entstanden, d.h. sie sind nicht nur Ausdruck des NewMedia-Booms. Viele der Projekte sind gerade aus der Notwendigkeit des technologisch-ökonomischen Strukturwandels in den Städten entstanden, also Krisenbewältigungsstrategien und keine „Schönwetterprojekte“.

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StadtTechnopole_Kaiserslautern: IuK als Motor der Stadtentwicklung.

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1 ENTWICKLUNGSBEDINGUNGEN

Viele Städte stehen mittelfristig vor gravierenden Veränderungen. Die Liste der aktuellen Herausforderungen ist lang: "Demographischer Wandel", "Pluralisierung der Lebensstile", "Beschleunigung und Virtualisierung der Lebenswelten", "Globalisierung und Strukturwandel"(Steinebach 1998).

Ebenso wie diese Trends tiefgreifende Anpassungen und neue Lösungsstrategien (Steinebach 1999) in Gesellschaft und Wirtschaft erfordern, muss das Stadtgefüge diesen veränderten Rahmenbedingungen gerecht werden. Die Stadt von gestern ist hinsichtlich der Ansprüche der Wissensgesellschaft zu überprüfen. Insgesamt ist die Beschäftigung mit und die Reaktion auf eine Vielzahl komplexer raumwirksamer Entwicklungen geboten. Im Fokus der Bemühungen steht, die Bevölkerungsentwicklung am Standort zu stabilisieren und eine lebendige Stadt zu erhalten.

2 DER TECHNOPOLE-ANSATZ

Der Begriff der "Technopole" erfährt in den letzten Jahren eine verstärkte Anwendung, allerdings in sehr unterschiedlicher Ausprägung. In Bezug auf Ursprung, Charakter und Entwicklungsprozesse liegen die unter dem Label "Technopole" firmierenden Erscheinungsformen weit auseinander (Rallet 1997). Eine eindeutige wissenschaftliche Definition für Technopole existiert noch nicht.

Gemein ist allen Anwendungsbereichen lediglich eine räumliche Bezugsebene sowie eine Technologieorientierung, ist der Begriff etymologisch doch auf die griechischen Wortstämme polis (= Stadt) und tekhnê zurückzuführen. Dabei ist zu berücksichtigen, dass das Wort tekhnê seinem Ursprung nach mehr bedeutet als "Technik" bzw. "Technologie" im heutigen Sinne. Tekhnê vereint die - im Gegensatz zur Natur - vom Menschen geschaffenen Bereiche Kunst, Wissenschaft, Handwerk und Geschäft. Diesem umfassenden Begriffsverständnis wird jedoch kaum eine Technopole gerecht.

Im Raumbezug zeigt die Praxis eine enorme Bandbreite zwischen gebäudebegrenzten Einrichtungen (z.B. Technologie- und Gründerzentrum), Wissenschaftsparks und der Ausrichtung der gesamten Stadtentwicklung auf die Anforderungen des Technologiesektors.

Der Ansatz der Leitkonzeption StadtTechnopole_Kaiserslautern ist ideell an Strategien aus zwei "Vorreiterländern" orientiert: Zum einen Frankreich, in dem erste Ansätze für eine technologieorientierte Stadtentwicklung mit dem Beispiel Montpellier bereits seit Ende der 1960er Jahre gibt, und zum anderen Japan, in dem seit den 1980er Jahren eine von Staatsseite forcierte Technopole-Strategie existiert.

<u>Frankreich</u>

In Frankreich steht Technopole für eine Strategie, die eine gesamte Stadt bzw. Agglomeration dominant auf die Entwicklung der High-Tech-Branchen ausrichtet. Das Ziel ist nicht nur eine punktuelle Wirtschaftsförderung, sondern eine Stadtentwicklung, in der sämtliche Planungsaspekte unter Berücksichtung dieses Leitbildes integriert werden (Kolmer 1997). Entsprechend ist die Weiterentwicklung der High-Tech-Branchen als wirtschaftsstrukturelle Basis eines Standorts eng verknüpft mit einer Bündelung aller ökonomischen, intellektuellen und politischen Kräfte sowie einem urbanistischen Konzept (Kolmer 1997). In nachgeordneten Einheiten, den "pôles", konzentrieren sich Schwerpunktkompetenzen, die durch ihre räumliche Nähe und ihre personellen Netzwerke besondere Synergien erzeugen. In diesem Sinne ist „la technopole", wie Brunet es ausdrückt, eine „Stadt, die von der Technologie lebt und diese verkauft" (Brunet 1988). Die Personen, die hinter den Strukturen stehen, spielen, im Sinne des Milieuansatzes, eine entscheidende Rolle (Kolmer 1997).

<u>Japan</u>

Wirtschaftliche, gesellschaftliche und demographische Veränderungen führten Mitte der 1970er Jahre zu zwei neuen Ansätzen der Wirtschafts- und Regionalentwicklungspolitik: Einerseits sollte Japan zu einem auf Spitzentechnologien ausgerichteten "Technologiestaat" entwickelt und andererseits sollte - im "Zeitalter des Regionalismus" - die ökonomische Bedeutung der Regionalindustrie gestärkt werden (Obermauer 1996). Der Technopolis-Ansatz wird als geeignetes Instrumentarium gesehen, diese Bestrebungen zu erreichen. Fühlungsvorteile aus der Bündelung von Aktivitäten an geographisch definierten Stellen und die Zusammenführung unterschiedlicher Elemente und Systeme des ökonomisch-gesellschaftlichen Handelns spielen dabei eine zentrale Rolle (Quiehl 1995). Darüber hinaus findet eine bewusste Berücksichtigung des Lebensumfelds der Arbeitskräfte und ihrer Familien statt. Die Gestaltung des sozialen und kulturellen Umfelds spielt eine wesentliche Rolle.

3 STADTTECHNOPOLE_ KAISERSLAUTERN

Mit der Zukunftsfähigkeit des Wirtschafts- und Lebensstandorts Kaiserslautern befasst sich das interdisziplinäre Forschungsvorhaben StadtTechnopole_Kaiserslautern. Aufgabe der Untersuchung ist die Auseinandersetzung mit den für den Standort relevanten raumwirksamen Zukunftstrends, die Identifizierung endogener Entwicklungspotenziale und Anspruchsprofile sowie die Ableitung konzeptioneller Ansätze und Handlungsempfehlungen für eine positive Zukunftsentwicklung.

Als StadtTechnopole_Kaiserslautern wird eine ganzheitliche Stadtentwicklungskonzeption bezeichnet, die durch drei Dimensionen geprägt ist. Neben einer raum- und wirtschaftsstrukturellen Komponente beinhaltet sie den Baustein "Kommunikationsstruktur", der nicht nur ideell angelegt, sondern bereits im Verfahrensablauf implementiert ist.

Eine StadtTechnopole ist eine Stadt, in der Technik-Pole, die jeweils auf ein Segment spezialisiert sind, als wissenschaftliche Einrichtungen und privatwirtschaftliche Unternehmen mit kulturellen, politischen und verwaltungsbezogenen Polen in einem Kreativen Milieu zusammen wirken. Dabei ist eine Leittechnologie im Hinblick auf eine hervorgehobene wissenschaftliche und wirtschaftliche Bedeutung zu identifizieren. Die Entwicklung der Stadt wird daran profiliert.

Mit der Etablierung dieser Pole zielt StadtTechnopole in der Stadtentwicklung auf räumliche Konsequenzen. In diesem Zusammenhang sind insbesondere die Überlagerung von Bedürfnissen aus der Technologieentwicklung zu nennen (z.B. Arbeitsplatzqualität mit Anforderungen an die Entwicklung von Wohn- und Gewerbegebieten sowie die technische Infrastruktur). Hinzu kommen die Kommunikations- und Organisationsstruktur als wichtige weitere Elemente der StadtTechnopole.

Basis für die Entwicklung zur StadtTechnopole ist eine technologieorientierte Wirtschafts- und Forschungsstruktur mit einem tragfähigen Potenzial zukunftsfähiger Arbeitsplätze. Da "Arbeitsplätze" als alleinige Determinante nicht hinreichend sind, einen Raum zu profilieren, gilt es im Weiteren, die Standortausstattung nach den Ansprüchen der Beschäftigten und deren Familien zu ermitteln, zu bewerten und weiterzuentwickeln. Zudem sind die veränderten standortrelevanten Anforderungen der Unternehmen zu berücksichtigen.

Die Dynamisierung der wirtschaftlichen Aktivitäten sowie die Veränderung des raum- und infrastrukturellen Gefüges bedürfen einer ausgeprägten Kommunikation zwischen den lokalen Akteuren (Politik, Verwaltung, Wirtschaft, Forschung, Bevölkerung). Die Bildung eines Kreativen Milieus wird deshalb angestrebt. Zur Unterstützung des breit angelegten Informations- und Kommunikationsprozesses werden – dem Status eines Technologiestandorts angemessen - innovative IuK-Technologien eingesetzt.

3.1 Ausgangslage: Zwischen Umbruch und Aufbruch

Kaiserslautern steht im Zuge des ökonomischen, demographischen, sozialen und technologischen Wandels vor tiefgreifenden Umbrüchen und vielfältigen Herausforderungen. Die Stadt befindet sich schon heute in einem Transformationsprozess.

Im Rahmen der allgemeinen wirtschaftsstrukturellen Veränderungen werden alteingesessene Betriebe im sekundären Sektor aufgegeben. Damit verbunden ist ein starker Rückgang des Arbeitskräftebedarfs im verarbeitenden Gewerbe. Einen Tiefpunkt erreichte die Stadt 1997 mit einer Arbeitslosenquote von 14%.

Die leistungsfähige Bevölkerungsschicht wandert in die Peripherie ab, während gleichzeitig die sozial schwächere Bevölkerungsschicht im Kernbereich zunimmt – mit allen negativen Folgewirkungen.

Im Hinblick auf die Entwicklungen im Zuge des demographischen Wandel wird sich die Lage Kaiserslauterns zukünftig noch verschärfen. Die grundlegenden Daten für die Bevölkerungsentwicklung des Statistischen Landesamts Rheinland-Pfalz prognostizieren für den Zeitraum bis 2050 für die Stadt Kaiserslautern (www.statistik.rlp.de):

- eine absolute Bevölkerungsabnahme um mehr als 30 %,
- eine Abnahme von Kindergartenkinder (3-6 - Jährige) von 40-45 %,
- eine Abnahme der Erwerbsfähigen (20-60 - Jährige) um 35-40 %,
- eine Zunahme älterer Menschen (über 60 - Jährige) von ca. 25 %.

Gleichwohl sind auch positive Entwicklungen zu verzeichnen. Innerhalb von nur 35 Jahren ist die Stadt Kaiserslautern mit der Ansiedlung der technisch-naturwissenschaftlichen Universität 1970 als Impulsgeber rasant zu einem bedeutenden Wissenschaftsstandort herangewachsen. Kaiserslautern ist keine historische Universitätsstadt im engeren Sinne, aber eine Stadt der Technik- und Naturwissenschaften mit dynamischer Entwicklung, die in den letzten Jahren vermehrt auch Arbeitsplatzeffekte in Form von Institutsgründungen und Spin Offs erzeugt.

Darüber hinaus wurden seit Anfang 1990 wirtschaftsstrukturell wegweisende und stadtbildprägende Groß- und Imageprojekte auf den Weg gebracht. Zahlreiche Initiativen der Stadtspitze, örtlicher Investoren und von außerhalb bewirken sichtbare Veränderungen der Stadt. Diese ziehen positive Effekte für die Stadtgestalt wie auch eine Steigerung der Lebensqualität nach sich. Die erfolgreiche Implementierung der Gartenschau nach der Landesgartenschau im Jahr 2000, die Gründung des PRE-Parks und die Umsetzung des PRE-Uni-Parks (Errichtung Fraunhofer-Zentrum), die Umgestaltung des Bahnhofsareals, der Bau des Justizzentrums können stellvertretend genannt werden. Darüber hinaus verleiht der Zuschlag als Austragungsstätte bei der WM 2006 Selbstvertrauen und eröffnet die Chance, bedeutsame Maßnahmen der Stadtentwicklung zu bündeln und zeitlich vorzuziehen.

Der PRE-Technologie-Park stellt ein beispielhaftes Konversionsprojekt (Steinebach 1996) dar, das mit dem 5-Schalen-Modell in 5 Jahren 2.500 Arbeitsplätze geschaffen hat und demonstriert, dass das Konzept "auf Wissenschaft bauen" erfolgreich sein kann. In Kombination mit den praktizierten Kommunikationsstrukturen hat dieses Projekt bundesweit Modellcharakter erreicht. Der dort tätige "Technologieworkshop" mit Vertretern aus Wissenschaft, Wirtschaft und Verwaltung ist ein Kreatives Milieu im Kleinen. Durch die Umsetzung des PRE-Parks wurde die Entwicklung zum Technologiestandort auch ökonomisch angestoßen.

Im PRE-Park konzentriert sich Kaiserslauterns Cluster der Informations- und Kommunikationstechnologien und –systeme (IKTS). Die Segmente Software-Engineering, Techno- und Wirtschaftsmathematik spielen dabei eine wesentliche Rolle. Die hohe Dichte der IKTS-Unternehmen im Technologiepark erzeugt ein enormes Synergiepotenzial: Von entscheidender Bedeutung für diesen Weg war die Ansiedlung der beiden Fraunhofer Institute Experimentelles Software Engineering (IESE) und Techno- und Wirtschaftsmathematik (ITWM) sowie weiterer führender Unternehmen aus der Softwareentwicklung und Techno- und Wirtschaftsmathematik (wie z.B. das Unternehmen Tecmath) (www.pre-park.de).

Mit dieser strategischen Positionierung entstand im PRE-Park die Keimzelle für erfolgreiche Zukunftstechnologien. Diese positiven Entwicklungen kennzeichnen einen ersten, richtungsweisenden Aufbruch, jedoch ist noch kein Durchbruch erreicht. Die Strukturen bedürfen einer Stabilisierung, um künftig tragfähig zu sein. Mit der StadtTechnopole wird die Stadtentwicklung an einer Leittechnologie orientiert und der Strukturwandel systematisch gestaltet.

In diesem Zusammenhang müssen auch mentale Barrieren überwunden werden. Trotz der beachtlichen Entwicklung des wissenschaftlichen Potenzials ist die Identifikation der Bevölkerung mit Forschung und Entwicklung verbesserungsbedürftig. Noch immer wird mit Kaiserslautern in erster Linie eine alte Industriestadt, eine Fußballhochburg oder eine Stadt im Grünen assoziiert. Der Bevölkerung soll der Wissenschaftsstandort näher gebracht werden.

3.2 IuK als Leittechnologie

Der notwendige Strukturwandel der (deutschen) Wirtschaft wird insbesondere wegen der informationstechnischen Revolution, der wachsendenb Bedeutung der Dienstleistungsmärkte sowie die Globalisierung der Wirtschaft gefordert. Wissen gilt als der zentrale Produktionsfaktor und als eine der treibenden Kräfte im wirtschaftlichen Strukturwandel und im internationalen Wettbewerb. Die wissensintensiven Bereiche bieten sich als Schwerpunkte (Profilierungsfelder) der (westeuropäischen) Wirtschaft an. Die Basis für einen stabilen Wirtschaftsstandort liegt somit im Vorhandensein einer kritischen Masse potenter Forschungseinrichtungen und technologieorientierter Wirtschaftsunternehmen. Demnach wird die Zukunftschance des Raumes im Ausbau und in der Fortentwicklung der Hochschul-, Forschungs- und Unternehmensstrukturen gesehen.

Im Hinblick auf ihre wirtschaftliche und demographische Entwicklung müssen sich Städte der Herausforderung der Wissensgesellschaft stellen. Einheiten, die "Wissen" besitzen, generieren und verteilen, gehört die Zukunft. Den Schlüssel hierzu stellen innovative, technologieorientierte Unternehmen dar.

Die ökonomische Wettbewerbsfähigkeit besteht nach neuen theoretischen und empirischen Erkenntnissen in der Stärke von Wirtschaftskomplexen, sogenannten Clustern (Steiner 2003). Erfolgreiche Wirtschaftsregionen zeichnen sich meist durch die Konzentration von Unternehmen aus verwandten Branchen, Zulieferern und nachgelagerten Dienstleistungs- und Produktionsunternehmen aus, die in ihrer Komplexität eine höhere Produktivität und mehr Innovationsfähigkeit zur Folge haben als räumlich disperse Strukturen. Als Beispiele können die erfolgreichsten europäischen Wirtschaftsregionen Emilia Romagna und Baden-Württemberg sowie Wolfsburg als eine erfolgreiche Clusterung im städtischen Bezug genannt werden.

Im Rahmen des Stadtentwicklungsgutachtens StadtTechnopole_Kaiserslautern werden die technologieorientierten Branchen und Unternehmen, von denen man sich Innovationspotenzial und wirtschaftliches Wachstum erhofft, als "Leittechnologie" und "Motor" der gesamtstädtischen Entwicklung gesehen. Grundbaustein der StadtTechnopole bilden technologische Grundkompetenzen, die gleichermaßen in Forschung und Wirtschaft (vorzugsweise in Korrespondenz) verfügbar sind. Diese sind zunächst zu identifizieren und hinsichtlich ihrer wirtschaftlichen Tragfähigkeit und Arbeitsmarktbedeutung einzuschätzen.

Durch die Abgrenzung über Branchencodes, die Recherche in Datenbanken sowie Expertenrunden wurden die verfügbaren technologieorientierten Unternehmen des Standorts erfasst und aus diesen Schwerpunktbereiche der lokalen Wirtschaft ermittelt. Die darauf aufbauend gebildeten Cluster des Standorts stellen eine kritische Masse von Unternehmen dar, die durch Tätigkeitsfeld oder Qualifikation verbunden sind.

Im Zuge einer ersten Analyse für den Standort Kaiserslautern wurde die herausragende Position des Clusters IKTS bestätigt. Der Cluster IKTS bildet mit 134 technologieorientierten Unternehmen den größten Cluster, im Cluster Maschinenbau beispielsweise konnten 22 technologieorientierte Unternehmen ermittelt werden. Der Cluster IKTS stellt mit seinen Unternehmen und Forschungsinstituten die Leittechnologie für die künftige Entwicklung dar. Neben diesem Schwerpunkt-Cluster werden sowohl potenzielle wie auch optionale Cluster dargestellt, denen eine zukünftig wachsende Bedeutung prognostiziert wird. Durch die Clusterbildung soll für Kaiserslautern - über eine allgemeine Verbesserung des Standorts hinaus - eine spezifische Qualifizierung erreicht werden.

Nach der Herausbildung standortauthentischer Cluster werden diese mit ihrem Netzwerk aus Herstellern, Zulieferern, Dienstleitungsanbietern, Hochschulen und Forschungsinstituten dargestellt sowie clusterspezifische Kenndaten analysiert. Durch das Visualisieren der Clusterstruktur wird neben der Darstellung der Standortkompetenz der Anreiz zu Kooperationen bzw. zur Bildung von Netzwerken gefördert. Im Weiteren sollen spezifiziert nach Clustern räumliche Pole gebildet werden.

Darüber hinaus gilt es, die Bedürfnissen aus der Technologieentwicklung mit ihrer Wirkung auf und ihren Ansprüchen gegenüber anderen städtischen Nutzungen zu berücksichtigen.

3.3 Leittechnologie als Motor

Die Prosperität von Standorten basiert seit jeher auf spezifisch günstigen raumstrukturellen Bedingungen (Lage an wichtigen Verkehrswegen, Verfügbarkeit von Rohstoffen, Freizeit- und Erholungswert etc.). Betrachtet man die Entstehung von Wirtschaftsstandorten ist festzustellen, dass über die verschiedenen Entwicklungsphasen und in Abhängigkeit von der jeweiligen Ausrichtung eines Standorts stets ein "Bündel" unterschiedlicher Aspekte erfolgsentscheidend war. Mit der Veränderung von Wirtschaft und Gesellschaft ergaben sich immer wieder veränderte Standortansprüche.

Gegenwärtig stehen Standorte vor der Herausforderung, nicht nur den Bedürfnissen von Unternehmen, sondern auch den Standortansprüchen ihrer Beschäftigten und deren Familien gerecht zu werden. Neben zukunftsfähigen Arbeitsplätzen wird ein adäquates "Standortpaket" gefordert, das die "privaten" Bedürfnisse der Beschäftigten und insbesondere deren Familien befriedigt. Die (Nicht-) Verfügbarkeit spezifischer Bildungs-, Kultur- und Freizeiteinrichtungen oder ein (nicht) stimmiges städtisches Ambiente können mitunter für die "Ansiedlung" einer Familie an einem Standort ausschlaggebend sein. Die Zukunftsfähigkeit von Städten wird auch davon abhängen, inwieweit sie diesen Bedürfnissen entsprechen können.

Die bisherige Praxis der vorsorgenden Stadtentwicklung greift diesbezüglich zu kurz. Für die Bereiche Wohnen und Gewerbe findet im Rahmen der Flächennutzungsplanung zwar eine flächenquantitative und standortorientierte Angebotsplanung statt, indem der künftige Flächenbedarf prognostiziert und Bauflächen vorgehalten werden. Die zunehmend relevanten qualitativen Komponenten werden höchstens am Rand berücksichtigt. Allein über die Verfügbarkeit von Wohn- und Gewerbebau*flächen* können jedoch weder Bürger noch Unternehmen an den Standort gebunden werden. Zusätzlich bedarf es einer differenzierten Auseinandersetzung mit qualitativen Ansprüchen.

Für die Bereiche Gesundheit, Bildung, Handel, Verkehr, Kultur und Freizeit / Erholung / Sport findet eine "Überprüfung" der Ausstattung lediglich partiell, bezogen auf die Erfüllung zentralörtlicher Funktionen statt. Die maßgebenden Kataloge sind dabei funktionalorientiert. Die grundsätzliche Verfügbarkeit bestimmter Einrichtungen sagt jedoch nichts über die Qualität und die Differenzierung des Angebots aus. Diesbezüglich muss auf den Unterschied zwischen der grundsätzlichen Aufgabenerfüllung und einer befriedigenden Erfüllung der Nachfrage im Rahmen des Anspruchs der Bürger hingewiesen werden. Der Ausstattungskatalog "Zentralörtliche Funktion" geht hinsichtlich der Überprüfung der "Zukunftsfähigkeit" eines Standorts nicht weit genug, denn er erfasst nicht alle entwicklungsrelevanten Bereiche in der notwendigen Tiefe.

Für eine zukunftsfähige Stadt besteht letztendlich die Notwendigkeit, funktionale und quantitative Kriterien verstärkt mit qualitativen Komponenten in der Stadtplanung zu verbinden.

Eine Grundlage hierfür ist eine Kenntnis der Bedürfnisse / Anspruchsprofile "der Bevölkerung". Diese Aufgabe wird bezogen auf die Gruppe der qualifizierten IKTS-Beschäftigten am Standort Kaiserslautern begleitend untersucht. Die IKTS-Beschäftigten stellen in der StadtTechnopole_Kaiserslautern eine - zukünftig prägende - Bevölkerungsgruppe dar. Ziel ist, über die Identifizierung der Lebensstile der IKTS-Beschäftigten spezifische Raumansprüche zu ermitteln, und auf dieser Basis die momentane Standortausstattung zu bewerten. Entsprechend den daraus abgeleiteten Bedürfnissen sollen an den Raumansprüchen orientierte Pilotkonzepte für Wohnen und Arbeiten entwickelt werden.

3.4 Kreatives Milieu als Bindeglied und Prozesselement der StadtTechnopole

Die StadtTechnopole als gesamthafter Ansatz zur Entwicklung einer Stadt beinhaltet neben dem räumlichen Bezug, der in der Untersuchung im Vordergrund steht, kommunikations- und organisationsstrukturelle Dimensionen. Dabei geht es um den Aufbau von Netzwerken zwischen den Unternehmen, den Forschungseinrichtungen, den kulturellen Einrichtungen, den Interessenverbänden, der Verwaltung und der Politik.

Wissen und Informationsvernetzung sind zentrale Standortfaktoren und werden Basis für die gesellschaftliche und wirtschaftliche Entwicklung. Wissen wird disziplinär generiert, es zu vernetzen, ist eine interdisziplinäre Aufgabe. Die Kooperation der Akteure ist ein Prozess im Stadtorganismus, da Stadt und Wissenschaft in einem Regelkreis verbunden werden können.

Als Teil der angestrebten Dynamisierung wird bereits in der Gutachtenerarbeitung eine fortlaufende Beratung und Beteiligung von Akteuren der Bereiche Forschung, Unternehmen sowie Öffentliche Hand und Politik praktiziert. Orientiert an den unterschiedlichen abzudeckenden Aufgaben- und Kompetenzfeldern sind folgende Kommunikationsebenen definiert worden, die in dieser Phase zur Etablierung eines Kreativen Milieus beitragen sollen.

Mit der unmittelbaren Integration eines breiten Spektrums lokaler Akteure (Steinebach/Reinhard 1999) wird zum einen dem Gutachten eine fundierte Basis zugrundegelegt und zum anderen eine breit abgestimmte Konzeption mit einem hohen Identifizierungsgrad erzielt. Über einen intensiven Diskussionsprozess von Praktikern und Wissenschaftlern hinaus, ist mit dem Zusammenführen diverser Akteure jedoch auch die Hoffnung auf die Bildung langfristiger Netzwerke zwischen den relevanten lokalen Entscheidungsträgern verbunden. Damit sollen die Grundlagen für positive Synergieeffekte im Sinne kumulativer Wirkungen im kurz-, mittel- und langfristigen Bezug identifiziert und geschaffen werden.

Die StadtTechnopole bedarf im Vollzug der Langzeitunterstützung aus den Spitzenpositionen von Unternehmen, Wissenschaft, Kultur und Politik. Für die langfristige Entwicklung der StadtTechnopole Kaiserslautern ist eine besondere Kommunikationsstruktur erforderlich. Als wesentliches Element wird ein Kreatives Milieu gesehen – eine Verbindung von Vertretern aus Wirtschaft, Verwaltung, Politik, Wissenschaft und Kultur, die durch persönliche Kontakte den Standort und seine Kompetenzen weiterentwickeln. Als "Kopf" eines solchen Milieus und als Spitzengremium der StadtTechnopole werden die Unternehmensvorstände repräsentativer Branchen, die Präsidenten der Hochschulen, die Leiter der Forschungsinstitute, der Intendant des Pfalztheaters, SpitzenvertreterInnen von Kultureinrichtungen (u.a. Pfalzgalerie, Kulturzentrum Kammgarn) und der Oberbürgermeister als Identifikations- und Integrationsfiguren der Leitkonzeption zusammengeführt. Einen wesentlichen Beitrag hierzu leistet der Wettbewerb "Stadt der Wissenschaft 2005" des Stifterverbands für die Deutsche Wissenschaft, an dem sich die Stadt Kaiserslautern beteiligt. In diesem Rahmen sind ein Jahr lang besonders öffentlichkeitswirksame Aktionen in der Vernetzung von Wissenschaft, Forschung und Kultur vorgesehen.

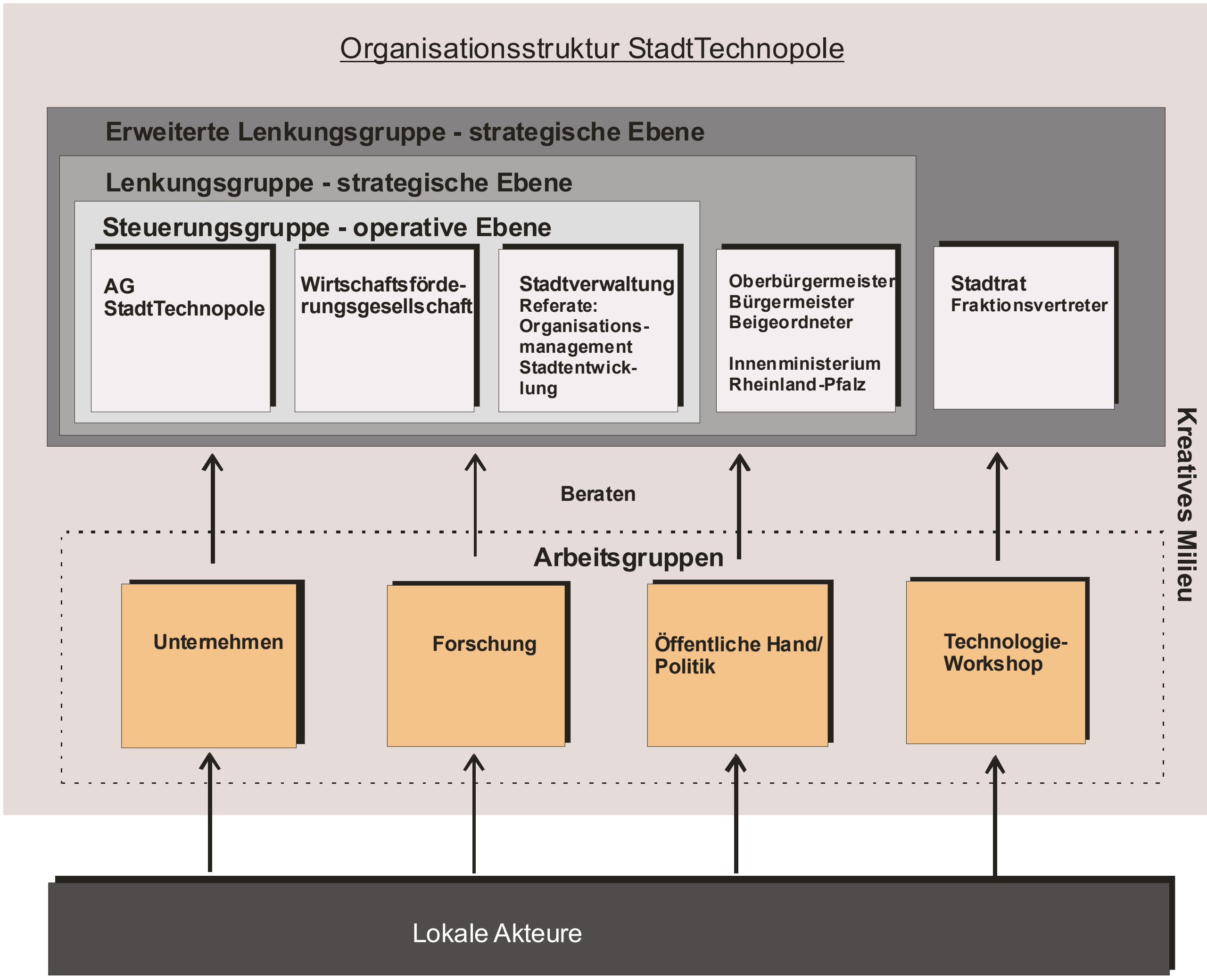

Abb.1: Kommunikationsstruktur Stadtentwicklungsgutachten StadtTechnopole_Kaiserslautern (eigene Darstellung)

3.5 Iuk zur Prozessunterstützung

Als zentrales Instrument zur Unterstützung der inhaltlichen Arbeit und der Verfahrensorganisation werden moderne Informations- und Kommunikationstechnologien eingesetzt. Das Gutachten soll im inhaltlichen und verfahrensbezogenen Zusammenhang selbst die Technologiekompetenz in der nachhaltigen Stadtentwicklung repräsentieren, praktizieren und als "Antriebseinheit" den Entwicklungsprozess dynamisieren. Die IuK-Systeme werden als qualitätssteigernde und zentrale Beschleunigungsinstrumente für den Arbeitsablauf in den Bereichen Information, Publikation, Diskussion, Innovation und Anregung eingesetzt.

Basis des Technologieeinsatzes sind ein Suse-Server für die interne Kommunikation der Projektbeteiligten sowie eine Homepage für die Außenkommunikation (www.stadttechnopole.de). Darüber hinaus wird bspw. ein Stadtinformationssystem entwickelt (Hard- und Software, Inhalte, Betreibermodell), das die neue Identität des Standortes nach außen transportiert und das Standort-Know-how unmittelbar erfahrbar macht. Mit diesem System soll Bürgern und Besuchern die StadtTechnopole Kaiserslautern im Alltag erschlossen werden. Als besonderes Anwendungsfeld wird die WM 06 gesehen.

4 ZUSAMMENFASSUNG

StadtTechnopole entwickelt eine Zukunftskonzeption für Kaiserslautern. Der dabei angestrebte Prozess ist vielschichtig, viele Rädchen müssen zum Gelingen ineinander greifen.

Unterstützt durch die Erfahrungen anderer Standorte, die ähnliche Strategien betreiben (Montpellier, Dortmund, Wolfsburg), können folgende Aspekte als erfolgsrelevant betrachtet werden:

- Das Grundkapital eines Standorts liegt in der Verfügbarkeit zukunftsfähiger Arbeitsplätze. Entsprechend bildet eine qualifizierte Identifizierung der wirtschaftlich-technologischen Schwerpunktkompetenzen ("Standortbegabung" – möglichst mit Alleinstellungsmerkmal) und eine diesbezüglich jeweils verfügbare kritische Masse an Unternehmen und Forschungseinrichtungen (möglichst in Korrespondenz) die Basis für die Herausbildung einer StadtTechnopole. Die Standortbegabung ist die Grundlage für die angestrebte Pol- und die damit einhergehende Profilbildung.

- Im Weiteren gilt es in raumstruktureller Hinsicht ein adäquates "Standortpaket" (funktionale, qualitative und quantitative Standortausstattung) zu entwickeln, um die Bevölkerung am Standort zu binden. Grundlage hierfür bildet eine Kenntnis der Anspruchsprofile der "Zukunftsbevölkerung". Über die Identifizierung von Lebensstilen und damit einhergehenden spezifischen Raumansprüchen von Unternehmen, ihren Beschäftigten und deren Familien können die Standortausstattung bewertet und notwendige Modifizierungen festgestellt werden.
- Hinsichtlich der Realisierung abgeleiteter stadtplanerischer Maßnahmen bedarf es einer strategischen Liegenschaftspolitik. Mittels wegweisender "Großprojekte" kann es gelingen, die Identifikation der Bevölkerung mit der Leitkonzeption zu verstärken.
- Die Erfüllung der komplexen Aufgabenstellung fordert ein breites Engagement der lokalen Entscheidungsträger. Zur Dynamisierung und Verstetigung des Prozesses erscheint ein Kreatives Milieu unabdingbar. Um die notwendigen Spitzenpositionen von Unternehmen, Wissenschaft, Kultur und Politik für eine Prozessbeteiligung zu gewinnen, müssen "Win-win-Situationen" herausgearbeitet werden.
- An der Spitze des Prozesses steht vorzugsweise eine charismatische Führungspersönlichkeit (Leitfigur), die Rückendeckung durch sämtliche politische Lager hat. Die Leitung des Stadtentwicklungsprozesses sollte unmittelbar der Verwaltungsspitze zugeordnet sein (Stabsstelle).
- Die Implementierung einer StadtTechnopole bedarf keiner erheblichen Finanzausstattung, aber einer ausreichenden personellen Basis.
- Günstig kann sich als Rahmen eine landesweite Clusterkonzeption erweisen, die – orientiert an der verfügbaren Substanz - Städte verschiedenen Schwerpunktkompetenzen "zuordnet" und ihre Förderaktivitäten damit verbindet.

PROJEKTBETEILIGTE

StadtTechnopole_Kaiserslautern ist ein interdisziplinäres Forschungsvorhaben an der Technischen Universität Kaiserslautern.

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Das Forschungsprojekt StadtTechnopole_Kaiserslautern wird durch das Ministerium des Innern und für Sport des Landes Rheinland-Pfalz, die Stadt Kaiserslautern und die Wirtschaftsförderungsgesellschaft der Stadt und des Landkreises Kaiserslautern finanziell gefördert.

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Vienna-SPIRIT – Intermodale Reiseinformation als Beitrag zu einer nachhaltigeren städtischen und regionalen Verkehrsentwicklung

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1 ABSTRACT

The main objective of this paper is to point out the potentials for generating a more sustainable urban and regional transport development by means of the integration of traveller and traffic information of public and individual road transport in an intermodal travel information system. Several studies forecast that intermodal travel information systems will contribute to the increase of road network efficiency and public transport use. By means of this modal shift to public transport – at least on trip sections – traffic expenditure, i.e. vehicle kilometres, of motorised individual transport can be decreased and, hence, negative effects of transport on environment and humans can be reduced.

Starting from the identification of the state-of-the-art the first part of this paper describes the obejctives, innovations and the technological and economic concept of the intermodal travel information system Vienna-SPIRIT. The Austrian research project is initiated by the Verkehrsverbund Ost-Region (VOR) and is partly funded within the thematic programme "Intelligent Infrastructure" of the Austrian Ministry for Transport, Innovation and Technology. The project develops an innovative concept for an intermodal and interoperable travel information system which will be demonstrated and validated in a pilot system. By means of mobile devices (such as mobile phone, PDA and in-car navigation system) the user will be able to plan intermodal routes considering the current traffic situation (pre-trip) and to be navigated during the trip including alternative route proposals in case of incidents on his route (on-trip). Therefore, it is necessary and innovative to integrate location-based travel and traffic information of all means of transport including parking information and to develop an appropriate market and business model for a good performance of later operation of the technological solution.

The second part of this paper deals with the effects of intermodal travel information on individual travel behaviour and the transport system in general. Since no results of Vienna-SPIRIT are available so far, analyses and results of the new intermodal timetable information of VOR are used. Both, statistical data and qualitative statements obtained by questionnaires were analysed.

In the concluding part consequences are drawn for the future implementation and operation of such an intermodal travel information system in the Vienna Region and recommendations are given for an intermodal and inter-regional integration.

2 STATE-OF-THE-ART

Die Verkehrstelematik ist heutzutage gekennzeichnet durch eine Vielzahl von innovativen Technologien und Anwendungen. Allerdings weisen sie meist noch eine fehlende Vernetzung und Interoperabilität auf. In vielen Bereichen der Verkehrstelematik haben sich Insellösungen entwickelt, bei denen ein intermodaler Informationsaustausch sowie darauf aufbauende Produkte und Dienstleistungen nicht bzw. nur eingeschränkt möglich sind. Auf dem Sektor der Reiseinformationssysteme existieren bisher meist nur monomodale Systeme und Dienste nebeneinander, d.h. entweder als Fahrplanauskünfte nur für den öffentlichen Verkehr (und diese nur für bestimmte Regionen) oder als Routenplanungs- und Navigationssysteme für den individuellen Verkehr.

In einigen elektronischen Fahrplanauskünften (EFA) sind Informationen mehrerer Verkehrsbetreiber und -verbünde (Fern- und Nahverkehr) integriert und als „Tür-zu-Tür"-Reisen planbar. Das europäische Reiseinformationssystem EU-SPIRIT[1] verknüpft die Informationen verschiedener Auskunftssysteme über offene Schnittstellen sowie harmonisierte Meta-Daten und ermöglicht dadurch die Berechnung von durchgängigen ÖV-Verbindungen von „Tür-zu-Tür" zwischen verschiedenen europäischen Städten und Regionen. Die Auskunft umfasst alle Verkehrsträger im öffentlichen Nah- und Fernverkehr einschließlich des Flugverkehrs.

Im EU-Forschungsprojekt ISCOM[2] entstand unter Beteiligung des Verkehrsverbundes Ost-Region (VOR) ein intermodales Reiseinformationssystem, in dem der Nutzer das Verkehrsmittel (zu Fuß, Fahrrad, Taxi, Auto) für den Zu- und Abgangsweg zur und von der Haltestelle wählen kann. Auf der Grundlage eines digitalen Verkehrsnetzes konnten tatsächliche Wege und Linienführungen sowie Wege innerhalb von Bauwerken erfasst werden. Dadurch ist auch eine barrierefreie Routensuche (z.B. mit Ausschluss von festen Treppen) für mobilitätseingeschränkte Personen möglich. Seit November 2003 ist diese intermodale Fahrplanauskunft auf der Website des VOR[3] und für WAP-Handys in den operativen Betrieb übergegangen.

[1] www.eu-spirit.com, www.vbb-fahrinfo.de

[2] www.iscom-ec.de

[3] www.vor.at

Routenplanungssysteme für den MIV stellten bisher statische Reiseinformationen bereit. Fahrzeugnavigationssysteme greifen heutzutage auf Straßenkarten zu, die auf CD-ROM oder DVD gespeichert sind, und gleichen diese mit der satellitengestützten Positionierung (map-matching) ab. Nach Einführung der RDS-TMC-Technologie (in Österreich werden die aktuellen Verkehrsinformationen über den Traffic Message Channel (TMC) durch den ORF bereitgestellt) und deren Integration in Fahrzeugnavigationssysteme ist die Routensuche auch basierend auf dynamischen Verkehrsinformationen möglich.

3 VIENNA-SPIRIT

3.1 Ziele und Innovationen

Die Hauptziele des Projektes Vienna-SPIRIT, welches im Rahmen des Impulsprogrammes „Intelligente Infrastruktur“ des österreichischen Bundesministeriums für Verkehr, Innovation und Technologie gefördert wird, sind einerseits die zukunftsweisende technologische und wirtschaftliche Konzeption eines intermodalen und interoperablen Reiseinformationssystems für den mobilen Nutzer und andererseits die Implementierung eines Pilotsystems zur Demonstration der innovativen Technologien. Schließlich werden die Projektergebnisse die Grundlage für Investitionsentscheidungen in den zukünftigen operativen Betrieb eines solchen intermodalen Reiseinformationssystems bilden.

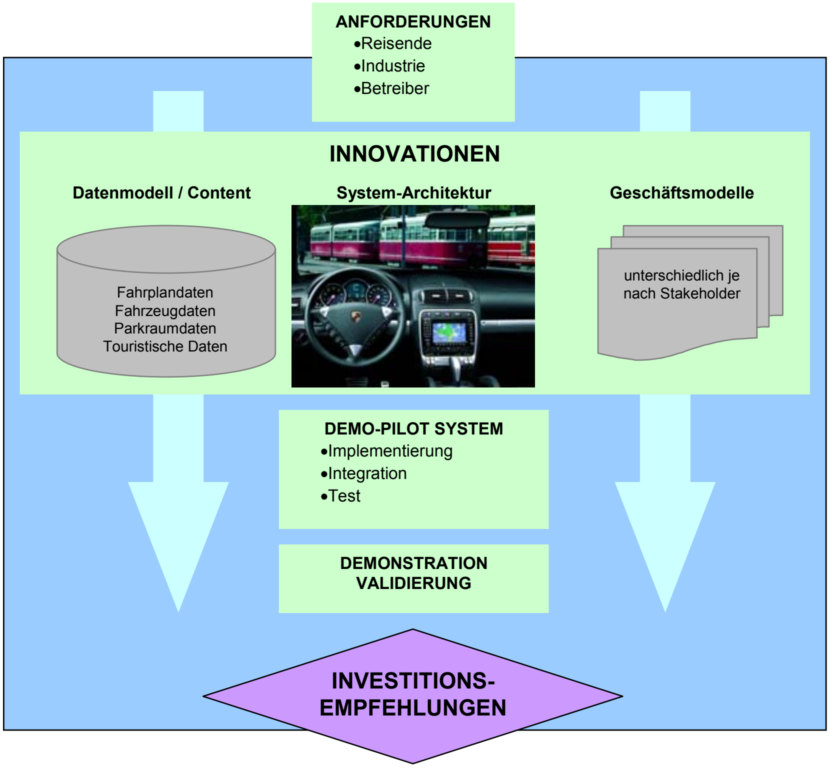

Abbildung 6: Vorgehensweise im Forschungsprojekt Vienna-SPIRIT

Dabei liegen die Innovationen des Vienna-SPIRIT-Systems in der:

- **Intermodalität:** Durch die Zusammenführung von Informationen über die verschiedenen Verkehrsmittel, insbesondere von Autonavigations- und Daten des öffentlichen Verkehrs, wird eine intermodale Routensuche ermöglicht und somit die Verkehrsmittelwahl in Richtung einer verstärkten Nutzung des öffentlichen Verkehrs beeinflusst.
- **Mobilität:** Durch mobile Endgeräte (PDA, Mobiltelefon) und Integration des intermodalen Reiseinformationssystems in Fahrzeugnavigationsgeräte wird eine permanente Verfügbarkeit des Dienstes hergestellt. Dadurch werden „on-trip“ Navigation und die Integration von dynamischen Verkehrsinformationen für jede Reise und jedes Verkehrsmittel ermöglicht.
- **Interoperabilität:** Die Berücksichtigung von Standards in der Systemarchitektur, die Erweiterung bestehender Datenmodelle, sowie die Gestaltung von offenen Schnittstellen ermöglicht die Einbindung verschiedenster Inhalte (Contents) und die Integration des regionalen Systems in internationale Netzwerke.

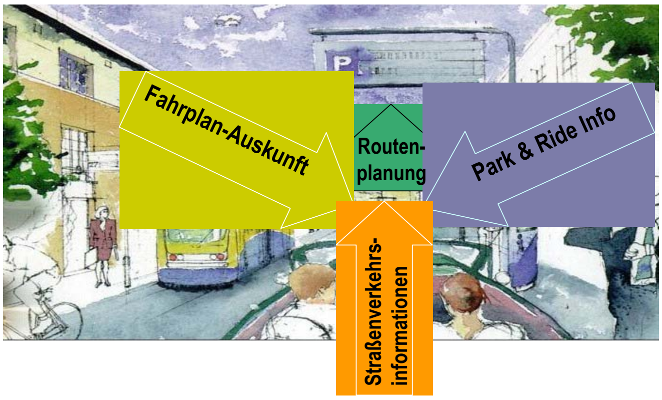

Abbildung 7: Zusammenführung der verschiedenen Informationen in ein Reiseinformationssystem (Bild: ERTICO)

3.2 Technologisches und wirtschaftliches Konzept

Mittels mobiler Endgeräte wird dem Nutzer ermöglicht, unter Berücksichtigung der aktuellen Verkehrssituation intermodale Routen sowohl vor Reiseantritt (pre-trip) zu planen als auch entlang der gewählten Route (on-trip) navigiert zu werden. Dazu ist es notwendig, standortbezogene Reise- und Verkehrsinformationen aller Verkehrsmittel zu integrieren und zu dieser im Pilotsystem entwickelten technischen Lösung ein passendes Markt- und Geschäftsmodell zu erstellen.

Beispielhaft sollte Vienna-SPIRIT u.a. wie folgt funktionieren: Ein Geschäftsmann, der in Wiener Neustadt wohnt, hat in Wien einen Besprechungstermin. Er wählt das Auto für die Fahrt nach Wien und plant vor Fahrtantritt im Navigationsgerät mit Vienna-SPIRIT seine Route. Das System berechnet unter Einbeziehung der aktuellen Verkehrslage eine reine Autoroute als die Beste. Während der Fahrt führt ihn das Navigationssystem auf der Route und aktualisiert fortwährend die erwartete Ankunftszeit aufgrund des aktuellen Verkehrs. Nachdem das Navigationssystem über TMC eine Staumeldung nach einem Unfall auf seiner Route empfängt, berechnet das Vienna-SPIRIT-Systen eine alternative intermodale Route. Um rechtzeitig zu seinem Termin zu erscheinen, entscheidet er sich dafür zum Park&Ride-Platz zu fahren und umzusteigen. Über Vienna-SPIRIT kann er gleich Parkticket und Fahrkarte kaufen. Nach dem Aussteigen am Parkplatz wählt er sich mit seinem PDA in das Vienna-SPIRIT-System ein. Da seine Position auch jetzt über eine mit dem PDA verbundene GPS-Maus erfasst wird, kann er sich zum Bahnsteig der Schnellbahn und nach dem Aussteigen zu seiner Zieladresse navigieren lassen.

Die Vienna-SPIRIT-Systemarchitektur ist in Abbildung 3 dargestellt. Grundsätzlich wird ein Vier-Schichtenmodell verwendet, welches das klassische drei-schichtige Architekturmodell von Web-Anwendungen um eine zusätzliche logische Schicht erweitert, um den Anforderungen der heterogenen mobilen Endgeräte gerecht zu werden. Dazu wird zwischen Endgerät und Applikationslogik eine eigene Adaptation-Schicht mit verschiedenen Gateways eingezogen.

- **Device Layer:** Diese Schicht besteht aus den verschiedenen Endgeräten und den Benutzeroberflächen auf diesen. Als Endgeräte sind vorgesehen das Navigationssystem mit eingebautem GPS-Empfänger zur Positionierung und TMC-Empfänger zum Erhalt von aktuellen Verkehrsinformationen. Für die mobilen Endgeräte (PDA, Mobiltelefon) werden abhängig von der Generation der Endgeräte verschiedene Benutzerschnittstellen zur Verfügung gestellt. Auch die Position der Nutzer von mobilen Endgeräten wird mittels GPS-Maus erfasst und über Bluetooth zu einem dementsprechend ausgestatteten PDA oder Mobiltelefon übermittelt. Ein wichtiger Bestandteil ist außerdem das Voice User Interface, über das eine sprachgesteuerte Nutzung der Vienna-SPIRIT-Dienste ermöglicht wird.
- **Adaptation Layer:** Diese Schicht dient zur Harmonisierung der Client-Anfragen bzw. zur Aufbereitung der Ergebnisse für das jeweilige Endgerät. Dadurch soll die Unterstützung von sehr heterogenen Endgeräten sichergestellt werden
- **Trip Management Layer (Middleware):** Diese Schicht beinhaltet das Herzstück der Vienna-SPIRIT-Plattform. Die Vienna-SPIRIT-Middleware besteht aus mehreren Komponenten, die den Datenfluss koordinieren und die Bearbeitung der verschiedenen Aufgaben erledigen. Anfragen vom Nutzer müssen durch den Gateway Interaction Handler an die verschiedenen Teilmodule verteilt sowie Ergebnisse von diesen zusammengeführt und an die Gateways weitergeleitet werden. Die verschiedenen Trip-Management-Module erfüllen die gesamte Applikationslogik für das Vienna-SPIRIT-System. Der wichtigste Bestandteil ist dabei das Trip-Planning-Modul, welches die Zusammenführung der verschiedenen Teilrouten, die z.B. von der intermodalen Fahrplanauskunft oder dem Autoroutenplaner berechnet werden, und den Alternativroutenvergleich gewährleistet. Die Mapping Engine generiert Karten in den gewünschten Formaten und Skalierungen. Das User-Location-Modul erlaubt die Umrechnung von Adressen in geografische Koordinaten und vice versa. Das User-Profile-Management-Modul ermöglicht die Bearbeitung der Anfragen abhängig von den Benutzerpreferenzen.
- **Legacy System Layer:** Diese Schicht besteht einerseits aus den verschiedenen Content-Komponenten und andererseits aus Administrations-Datenbanken. Die wichtigsten Content-Komponenten sind dabei Fahrplan- und später Echtzeitdaten des öffentlichen Verkehrs, Parkrauminformationen, aktuelle Straßenverkehrsinformationen sowie Geo-Informationen. Da diese Komponenten oder Plattformen meist schon bestehen, werden die Schnittstellen zwischen Vienna-SPIRIT-Middleware und diesen Komponenten an existierende Formate angepasst. Für die Einbindung von weiteren Daten Dritter wird eine offene Schnittstelle zur Verfügung gestellt. Außerdem wird es in dieser Schicht verschiedene Datenbanken geben, die der Administration von Nutzerprofilen, der Speicherung von Routenergebnissen, Points of Interests sowie Daten zu den vom Nutzer verwendeten Endgeräten und deren Fähigkeiten dienen.

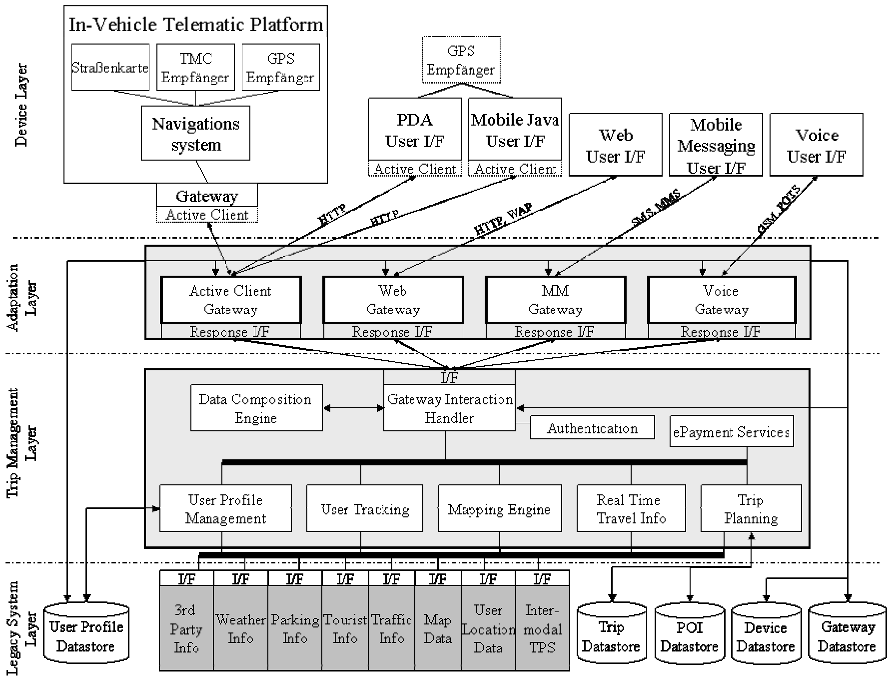

Abbildung 8: Vienna-SPIRIT-Systemarchitektur

Im laufenden Projekt Vienna-SPIRIT werden des Weiteren Markt- und Geschäftsmodell für einen intermodalen Reiseinformationsdienst entwickelt und insbesondere Anreize für die verschiedenen Beteiligten in der Wertschöpfungskette identifiziert.

Zielgruppen von Vienna-SPIRIT sind Pendler, Touristen und Freizeitreisende sowie Geschäftsreisende. Der Vienna-SPIRIT-Service wird dabei intermodale Reise- und Verkehrsinformationen sowie positionsbezogene Mehrwertdienste anbieten. Dabei sind die zwei Hauptservices die intermodale Routenplanung pre-trip und die on-trip Navigation einschließlich der Alternativroutenberechnung, beides unter Berücksichtigung von aktuellen Verkehrsinformationen. Neben Informationen des öffentlichen Verkehrs und des Straßenverkehrs müssen auch Parkrauminformationen (aktuelle Auslastung und Kosten) eingebunden werden, um den Umstieg zum öffentlichen Verkehr zu erleichtern. Mehrwertdienste werden neben dem elektronischen Fahrkarten- und Parkticketkauf insbesondere touristische Dienste wie Hotelbestellung, Sehenswürdigkeits- oder Kulturinformationen sein. Der Reisende soll Vienna-SPIRIT-Dienste möglichst jederzeit und and jedem Ort nutzen können. Somit ist Vienna-SPIRIT auf mobile Endgeräte augerichtet, das sind neben dem Fahrzeugnavigationsgerät Mobiltelefone und Personal Digital Assistants (PDA). Eine permanente Lokalisierung des Nutzers wird ermöglicht durch die Kopplung mit oder Integration eines GPS-Empfängers. Die großen Übertragungskapazitäten und -geschwindigkeiten, die z.B. für Straßenkarten benötigt werden, werden durch den Einsatz von GPRS und UMTS als Kommunikationstechnologien sichergestellt.

Die Wertschöpfungsketten der Hardware- und Software-Seiten für Vienna-SPIRIT sind in Abbildung 4 dargestellt. Im Projekt werden insbesondere die Investitionsanreize für die Beteiligten der Software-Seite, d.h. der Informations- und Kommunikationsdienste, untersucht. Die Entwicklung der Geschäftsmodelle beinhaltet die Kosten- und Einnahmenanalyse für die Content-, Service- und Mobilfunkanbieter abhängig von den im Marktmodell prognostizierten Nutzerzahl und Zahlungsbereitschaft. Je nach Geschäftsmodell werden die Zahlungsströme zwischen Endnutzern, Vienna-SPIRIT-Betreibern sowie den anderen Beteiligten in der Wertschöpfungskette und demnach auch die Investitionsanreize dieser verschieden sein.

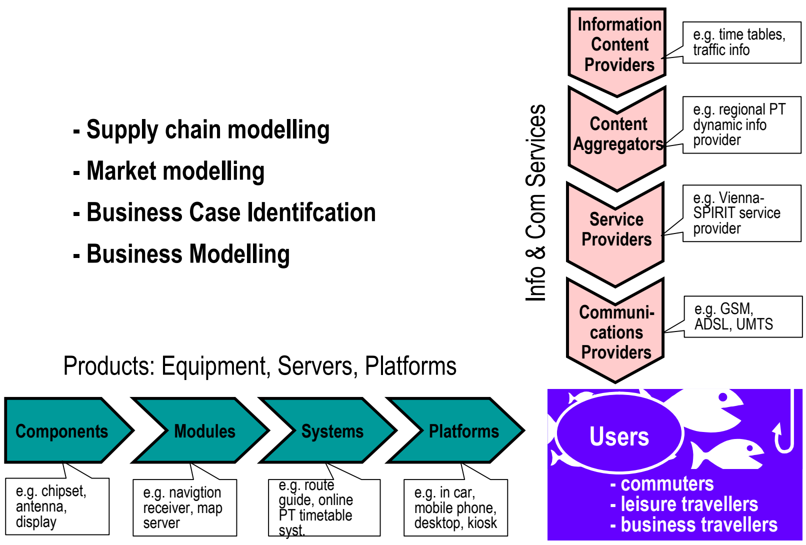

Abbildung 9: Hardware- und Software-Wertschöpfungskette

4 AKZEPTANZ, NUTZEN UND AUSWIRKUNGEN VON INTERMODALEN REISEINFORMATIONEN

4.1 Potenziale von intermodalen Reiseinformationen

Bei der Untersuchung der Potenziale von Verkehrstelematik und insbesondere von intermodalen Reiseinformationssystemen muss man zwischen den Nutzen für die Gesellschaft, den Nutzen für die Betreiber und den individuellen Nutzen unterscheiden. Dabei muss es das Ziel sein, System-, Betreiber- und Nutzer-Optimum zu einem Gesamtoptimum zu vereinigen. Mit dem Einsatz von Verkehrstelematiksystemen werden generell drei für die Allgemeinheit relevante Hauptziele verfolgt: die Steigerung der Verkehrssicherheit, die Erhöhung der Effizienz des Verkehrssystems sowie die Verringerung von negativen Einflüssen des Verkehrs auf Mensch und Umwelt[4]. Die Bereitstellung von intermodalen Reiseinformationen hat insbesondere eine Effizienzerhöhung des Verkehrssystems zum Ziel.

Laut Einschätzung des Wissenschaftlichen Beirates beim deutschen Verkehrsminister[5] liefern intermodale Reiseinformationssysteme einen Beitrag für alle drei Bereiche einer nachhaltigeren Entwicklung des Verkehrssystems. Die „soziale Nachhaltigkeit" wird gestärkt durch die Verbesserung und Erleichterung des Zugangs zum Verkehr und damit zu den gesellschaftlichen Austauschprozessen. Durch die bessere modale, räumliche und zeitliche Verteilung der Verkehrsströme wird die Effizienz des Verkehrssystems gesteigert und somit zur „ökonomischen Nachhaltigkeit" beigetragen. Auf die Umwelt („ökonomische Nachhaltigkeit") wirken sich intermodale Reiseinformationen positiv aus (Reduktion der Lärm- und Schadstoffemissionen), wenn durch Effizienzsteigerung und modale Verlagerung kein Neuverkehr induziert wird. Dies muss durch geeignete verkehrsplanerische und -politische Lenkungsstrategien gesichert werden.

Daneben ergeben sich aber auch für den einzelnen Verkehrsteilnehmer Zusatznutzen, denn durch modale, zeitliche und räumliche Verlagerung der Reise aufgrund des Informationsgewinns können Zeit und Kosten eingespart sowie Komfort und Befinden gesteigert werden. Des Weiteren entsteht auch für andere Beteiligte der Wertschöpfungskette ein Mehrwert durch den Einsatz von intermodalen Reiseinformationssystemen.

Genauer betrachtet gestalten sich die Nutzen des intermodalen Vienna-SPIRIT-Systems für die verschiedenen Beteiligten wie folgt:

- **für den Endkunden:** Die individuelle Planung ist die Voraussetzung für die Teilnahme am und die Orientierung im Verkehr. Das intermodale Reiseinformationssystem Vienna-SPIRIT stellt positionsbezogene Informationen und Dienste für Reisen von „Tür zu Tür" bereit. Durch den Einsatz von mobilen Endgeräten ist der Nutzer im Stande, jederzeit und überall informiert zu sein. Aktuelle Verkehrsinformationen über Staus und Störungen ermöglichen das Ausweichen auf Alternativrouten und -verkehrsmittel. Somit erlaubt die intermodale Information das Auffinden der nutzeroptimalen Alternativen bezüglich Zeit, Kosten und Komfort.
- **für den Verkehrs- und Infrastrukturbetreiber:** Durch ein intermodales Reiseinformationssystem werden Barrieren gegenüber dem öffentlichen Verkehr (ÖV) abgebaut und der Kreis potentieller ÖV-Nutzer vergrößert. Das Ergebnis der verstärkten intermodalen Routenwahl ist ein Fahrgastzuwachs beim ÖV sowie ein Kapazitätsgewinn der Straßeninfrastruktur. Eine bessere Auslastung des ÖV steigert die Wirtschaftlichkeit des Verkehrsunternehmens und kann zu Angebotsverbesserungen führen. Für den Straßeninfrastrukturbetreiber heißt der Kapazitätsgewinn eine Verbesserung der Leistungsfähigkeit ohne zusätzliche Ausbaumaßnahmen.
- **für die Informationsserviceanbieter:** Ein intermodales Reiseinformationssystem für mobile Nutzer erschließt für die Anbieter dieser mobilen Dienste einen Massenmarkt, denn jede Person ist ein Verkehrsteilnehmer. Dabei sind für verschiedene Teilnehmer der oben dargestellten Wertschöpfungskette Anreize (mehr Kommunikation, mehr Servicenutzung, mehr Kunden) vorhanden, ein intermodales Reiseinformationssystem zu unterstützen.
- **für die Allgemeinheit:** Intermodale Reiseinformationssysteme ermöglichen eine Verknüpfung der Verkehrsträger auf der Informationsebene. Dadurch kann eine Erhöhung des Anteils intermodaler Wege und der Nutzung von öffentlichen Verkehrsmitteln erzielt werden, was eine modale Verlagerung zugunsten des ÖV sowie eine Verkürzung der Wege mit dem motorisierten Individualverkehr (MIV) zur Folge hat. Das bringt eine Verringerung der Verkehrsleistung des MIV und somit eine Reduktion der negative Auswirkungen des Verkehrs auf Mensch und Umwelt mit sich.

Quantitative Abschätzungen der Auswirkungen der Nutzung intemodaler Reiseinformationen auf das Verkehrssystem wurden in der Vergangenheit von einigen Studien vorgenommen. PROGNOS[6] sagt für das Jahr 2010 folgende Veränderungen voraus. Ausschlaggebende Verhaltensänderungen der Verkehrsteilnehmer durch die intermodale Informationsbereitstellung sind neben der Änderung des Verkehrsmittelwahl vor allem eine räumliche und zeitliche Verlagerung der Reise. Unter der Annahme, dass intermodale und dynamische Verkehrs- und Reiseinformationen für 80% der Verkehrsteilnehmer verfügbar sind, wird es eine modale Verlagerung zugunsten des ÖV von bis zu 3% geben. Außerdem sind individuelle Reisezeitersparnisse von bis zu 4% zu erwarten. Durch die oben genannten Effekte lässt sich des Weiteren eine bessere räumliche, zeitliche und modale Verteilung auf die Verkehrsinfrastruktur und somit ein Kapazitätsgewinn von bis zu 4% erreichen.

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4 u.a. in Europäische Kommission DG TREN: Intelligent Transport Systems, in Ergänzung zum Weißbuch „Europäische Verkehrspolitik bis 2010", Brüssel, 2003

5 Wissenschaftlicher Beirat beim Bundesminister für Verkehr, Bau- und Wohnungswesen: Möglichkeiten und Grenzen des Einsatzes von Telematik im Verkehr, Internationales Verkehrswesen S. 599-607, 55. Jg., 12/2003

6 PROGNOS: Wirkungspotentiale der Verkehrstelematik zur Verbesserung der Verkehrsinfrastruktur- und Verkehrsmittelnutzung, Forschungsbericht im Auftrag des BMVBW, Basel, 2001

4.2 Auswertungen zur intermodalen Fahrplanauskunft des VOR

Seit November 2003 betreibt der Verkehrsverbund Ost-Region eine neue intermodale Fahrplanauskunft. Der Nutzer kann entweder über das Internet oder via WAP-Handy eine „Tür-zu-Tür"-Reise basierend auf georefernzierten Punkten., Wegen und Linienführungen sowie Wegen innerhalb von Bauwerken in einem digitalen Verkehrsnetz planen. Für den Zu- und Abgangsweg von und zur Haltestelle kann der Nutzer nun zwischen zu Fuß gehen oder der Fahrt mit dem Auto zu oder von einer Park&Ride-Möglichkeit wählen.

Im ersten Monat des Vollbetriebs der neuen Fahrplanauskunft wurden insgesamt etwa 1,1 Millionen Abfragen getätigt. An einem durchschnittlichen Werktag werden mittlerweile ca. 45.000 Fahrplanauskünfte pro Tag erteilt (siehe Abbildung 5). Nach dem Fahrplanwechsel waren sogar 85.000 Abfragen pro Tag zu verzeichnen.

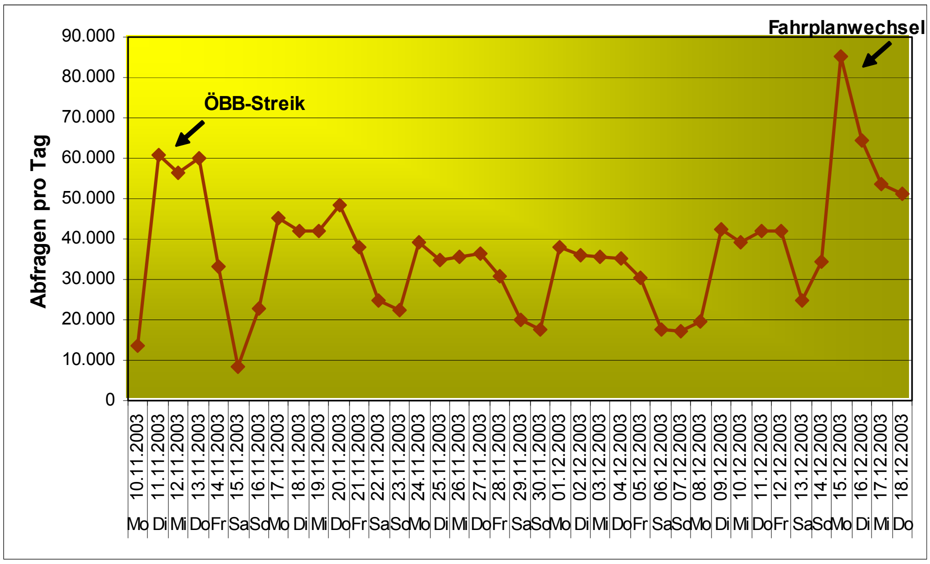

Abbildung 10: Ganglinie der VOR-Abfragen vom 10.11.2003 bis 18.12.2003[7]

Während des Testbetriebes der neuen intermodalen Fahrplanauskunft des VOR im Rahmen des EU-Forschungsprojektes ISCOM im Jahr 2002 wurde eine schriftliche Befragung zur Ermittlung der Nutzerakzeptanz und Verhaltensänderungen durchgeführt[8]. Insgesamt füllten 254 Personen die Fragebögen aus. Betrachtet man die Verhaltensänderungen, die ein Verkehrsteilnehmer durch die Planung einer Fahrt mit der intermodalen Fahrplanauskunft unternimmt (siehe Abbildung 6), lässt sich erkennen, dass immerhin knapp 20% der Nutzer ein anderes Verkehrsmittel als vorher wählen. Etwa ein Drittel der Verkehrsteilnehmer legen die geplante Reise auf einer anderen Fahrtroute zurück. Die größte Auswirkung hat die intermodale Reiseinformation auf die Planung bzw. Einschätzung der Fahrtzeit. Knapp die Hälfte der Nutzer beginnen ihre Reise zu einer anderen Abfahrtszeit.

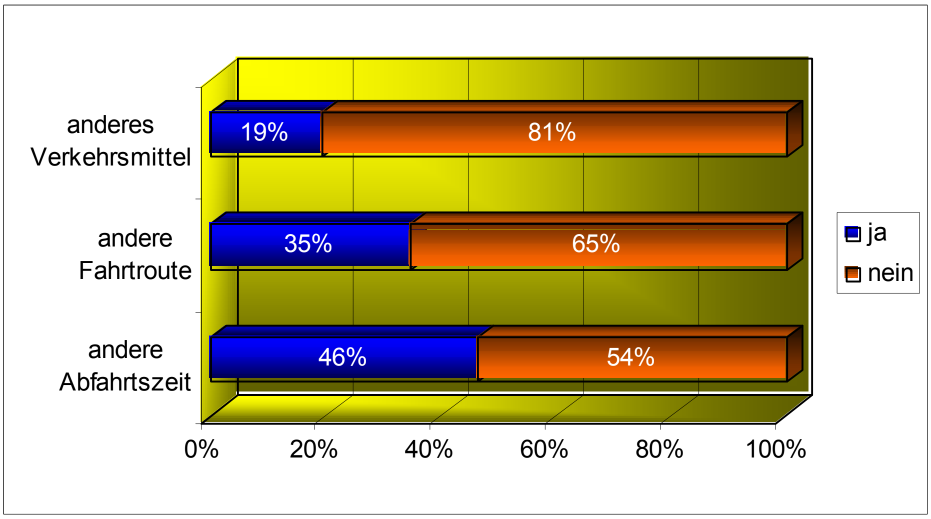

Abbildung 11: Verhaltensänderungen durch intermodale Reiseinformationen[6]

[7] VOR: Statistik der intermodalen Fahrplanauskunft EFA9, Wien, Dezember 2003

[8] VOR: Nutzerbefragung zum Testbetrieb der intermodalen Fahrplanauskunft EFA9, Wien, Dezember 2002

In Abbildung 7 wird dargestellt, welche Verbesserungen die Nutzer der intermodalen Fahrplanauskunft empfinden. Knapp ein Drittel der Befragten dokumentierten eine Reisezeiteinsparung von durchschnittlich 12 Minuten. 8% der Nutzer konnten ihre Reiseroute im Mittel um 8 km reduzieren. 39 % der Verkehrsteilnehmer verhalf die intermodale Fahrplanauskunft zu einer bequemeren Fahrt, 29 % mussten weniger umsteigen. Auf die Reisekosten hat die intermodale Fahrplanauskunft nur geringere Auswirkungen.

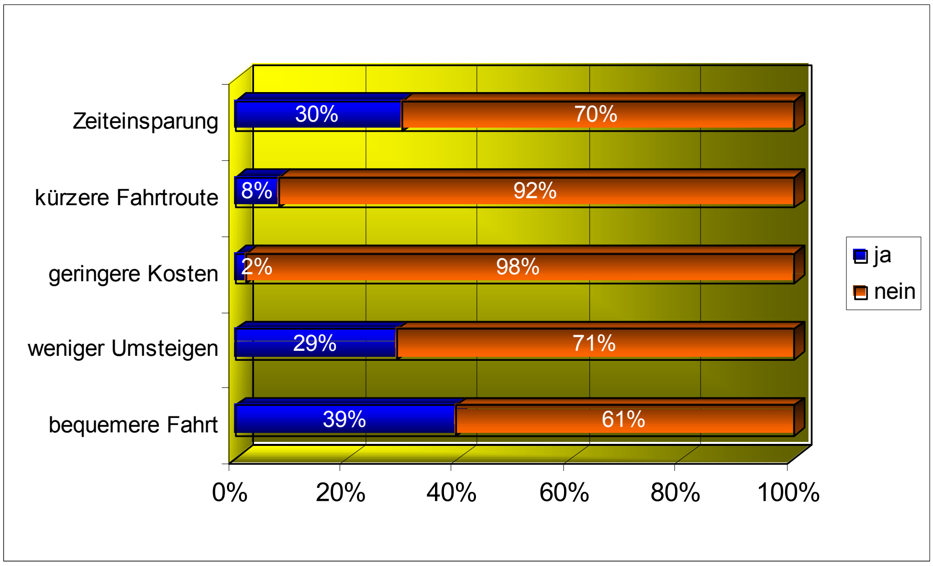

Abbildung 12: Verbesserungen durch die intermodale Fahrplanauskunft[6]

5 SCHLUSSFOLGERUNGEN

Intermodale Reiseinformationen liefern einen Beitrag zu einer nachhaltigeren städtischen und regionalen Verkehrsentwicklung. Obwohl die Effekte intermodaler Reiseinformationen quantifiziert nur relativ geringe Änderungen hinsichtlich einer nachhaltigeren Verkehrsentwicklung ausmachen, zeigt sich, dass sich sowohl für die Allgemeinheit, für jeden einzelnen Verkehrsteilnehmer sowie für die Betreiber der Verkehrs- und Informationssysteme positive Auswirkungen ergeben. Dadurch wird es mit großer Wahrscheinlichkeit in naher Zukunft eine immer größere Verbreitung dieser intermodalen Reiseinformationsdienste geben, die immer mehr Verkehrsteilnehmer aufgrund des leichten Zugangs über mobile Endgeräte und die Einbindung aller Verkehrsmittel nutzen werden.

Das Projekt Vienna-SPIRIT wird mit der Konzeption und Pilot-Demonstration eines intermodalen Reise- und Verkehrsinformationssystems für mobile Nutzer in der Vienna Region Grundlagen für Investitionsentscheidungen in ein solches System in Österreich schaffen. Es wird angenommen., dass ein Vienna-SPIRIT-Dienst aufgrund der vielen Anreize und Vorteile für die verschiedenen Beteiligten in der Wertschöpfungskette alsbald umgesetzt wird. Durch die angestrebte Offenheit und Interoperabilität des Vienna-SPIRIT-Systems wird eine Einbindung von immer mehr reisebezogenen Informationen und Diensten möglich. Weiter gedacht geht es bis hin zu der Vision, einen europäischen E-Marktplatz für verkehrs- und reisebezogene Informationen und Dienste zu schaffen.

6 REFERENZEN

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www.vbb-fahrinfo.de: Europäische Fahrplanauskunft des Verkehrsverbundes Berlin-Brandenburg basierend auf EU-SPIRIT

www.iscom-ec.de: ISCOM-Website, Forschungsprojekt im 5. EU-Rahmenprogramm zu intermodalen Reiseinformationssystemen auf der Basis digitaler Netze

www.vor.at: Website des Verkehrsverbundes Ost-Region mit intermodaler Fahrplanauskunft

Europäische Kommission DG TREN: Intelligent Transport Systems, in Ergänzung zum Weißbuch „Europäische Verkehrspolitik bis 2010“, Brüssel, 2003

PROGNOS: Wirkungspotentiale der Verkehrstelematik zur Verbesserung der Verkehrsinfrastruktur- und Verkehrsmittelnutzung, Forschungsbericht im Auftrag des BMVBW, Basel, 2001

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VOR: Statistik der intermodalen Fahrplanauskunft EFA9 des Verkehsverbundes Ost-Region, Wien, Dezember 2003

VOR: Nutzerbefragung zum Testbetrieb der intermodalen Fahrplanauskunft EFA9, Wien, Dezember 2002

OpenSource für Geodateninfrastrukturen − eine echte Alternative?

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1 EINLEITUNG

Geodateninfrastrukturen (GDI) lassen sich meist nur unter Aufwendung umfangreicher Ressourcen erstellen. Die schlechte finanzielle Situation der öffentlichen Haushalte erfordert die Suche nach kostengünstigen Lösungen. Die praktischen Erfahrungen bei der Umsetzung von Geodateninfrastrukturen im Umfeld von GDI-NRW zeigen, dass kommerzielle Produkte nicht immer das leisten, was ihr Preis erwarten lässt. Beim Aufbau einer Geodateninfrastruktur kann der Einsatz von freier oder OpenSource-Software helfen, Kosten zu sparen. OpenSource bietet außerdem die Möglichkeit, ein Produkt stärker an die individuellen Anforderungen anzupassen.

Im vorliegenden Beitrag wird an Hand des Beispiels FLUMAGIS aus dem Planungsumfeld aufgezeigt, wie sich bestehende weitgehend auf kommerziellen und nicht offenen Produkten basierende GDI-Architekturen auf bestimmte verfügbare Lösungen aus dem OpenSource-Umfeld übertragen lassen. Der Fokus liegt hierbei auf standardisierten Web-Diensten (WMS, WFS, etc.) für Geobasisdaten. Die Umstellung von GDI-Komponenten kann entscheidend davon abhängen, wie interoperabel diese auch auf den verschiedenen System-Ebenen sind. Wichtigste Grundannahme für diesen Beitrag ist, nicht nur einzelne GDI-Komponenten auszuwechseln, sondern eine vollständig OpenSource-basierte Geodateninfrastruktur aufzubauen.

Zunächst werden die verschiedenen Begriffe rund um Geodateninfrastrukturen und OpenSource erläutert. Danach werden die verschiedenen System-Ebenen einer GDI näher beleuchtet und auf den Anwendungsfall des Projektes FLUMAGIS bezogen. Daraufhin werden ausgewählte OpenSource Produkte vorgestellt, die zum Aufbau von Geodateninfrastukturen eingesetzt werden können. Die praktischen Erfahrungen beim Einsatz und Zusammenspiel dieser OpenSource Software werden im letzten Teil dieses Beitrags beschrieben und im Fazit abschließend bewertet.

2 BEGRIFFE

2.1 Geodateninfrastruktur

Geoinformationen haben eine gesellschaftlich und wirtschaftlich hohe Bedeutung. Typische Einsatzbereiche sind die Entscheidungsunterstützung bei räumlichen Planungen und Entwicklungsmaßnahmen, die Optimierung beim Einsatz natürlicher und ökonomischer Ressourcen sowie die Modellierung komplexer räumlicher Zusammenhänge z.B. bei Hochwasserprognosen (IMAGI 2003). Geoinformationen müssen nicht nur umfassend und aktuell vorliegen, sondern auch für den öffentlichen und privaten Sektor leicht zugänglich sein.

Geodateninfrastrukturen verfolgen das Ziel, den Zugang zu Geoinformationen zu erleichtern. Eine Geodateninfrastruktur bietet „a basis for spatial data discovery, evaluation, and application for users and providers within all levels of government, the commercial sector, the non-profit sector, academia and by citizens in general." (NEBERT 2001, S.8)

In verschiedenen nationalen und internationalen Initiativen haben sich Firmen, öffentliche Institutionen und Universitäten zusammengeschlossen, um Geodateninfrastrukturen aufzubauen. Beispiel für eine nationale GDI ist GDI-NRW (http://www.gdi-nrw.org/). INSPIRE (Infrastructure for Spatial Information in Europe) ist eine Initiative der europäischen Kommission um eine europäische Geodateninfrastruktur zu fördern (http://www.ec-gis.org/inspire/).

Geodateninfrastrukturen bestehen aus verschiedenen Komponenten: Zum einen aus der Datenbasis, die aus den Geobasisdaten und Geofachdaten und den dazugehörigen Metadaten besteht. Zum anderen bilden GI-Dienste und das sie miteinander verbindende Netzwerk die Kernkomponenten einer GDI. Die Dienste ermöglichen beispielsweise den schreibenden und lesenden Zugriff auf die Geodaten. Auch die Suchdienste nach Geodaten oder anderen Diensten kommen typischerweise in einer Geodateninfrastruktur zum Einsatz.

Um eine umfassende kooperative Nutzung der verteilten GI-Dienste zu erreichen, ist der Einsatz von Standards beim Aufbau einer GDI unerlässlich. Wichtigste Grundlage sind Standardisierungen der internationalen Standardisierungs-Organisation (ISO), wie beispielsweise von Metadaten für Geodaten (ISO 19115) und die weltweit anerkannten Schnittstellenspezifikationen für Webdienste des OpenGIS Konsortiums (OGC). Dieses internationale Konsortium aus Unternehmen, Behörden, Verbänden und Forschungsinstituten hat bereits einige Schnittstellenspezifikationen webbasierter Dienste verabschiedet, zu denen bereits Referenzimplementierungen existieren (vgl. Kap 5): Für den Zugriff auf vektorielle Geodaten wurden die Schnittstellen von Web Feature Services (WFS) spezifiziert. Die Schnittstellen von Web Coverage Services (WCS) wurden für den Zugriff auf gerasterte Geodaten festgelegt. Web Map Services (WMS) dienen der kartographischen Visualisierung von Geoinformationen. Weitere OGC Webdienste sind Web Catalog Services, die der Recherche nach Geodaten und GI-Diensten dienen und Web Coordinate Transformation Services durch die eine Transformation zwischen unterschiedlichen Koordinatensystemen durchgeführt werden kann. Außerdem wurde vom OGC die Geography Markup Language (GML) als XML-basierte Beschreibungssprache für Geoobjekte spezifiziert (http://www.opengis .org/).

Durch die Standardisierung können diese GI-Dienste zu Diensteketten kombiniert werden, bei denen beispielsweise ein WMS eine Anfrage an weitere Web Map Services weiterschickt und die Ergebniskarte somit aus verschiedenen Quellen durch unterschiedliche Dienste zusammengestellt wird.

Die Vorteile, die eine Geodateninfrastruktur bietet, sind vielfältig. Aus der dezentralen Organisation von Geodaten und GI-Diensten resultiert eine Qualitätssteigerung, da die Daten dort wo sie erfasst wurden gepflegt und Dienste weiterentwickelt werden. Der erleichterte Zugang bietet eine Effizienzsteigerung im Umgang mit Geoinformationen (BERNARD & STREIT 2002). Die kooperative Nutzung verteilter Geoinformationsdienste ermöglicht die Erschließung des Geodatenmarktes bzw. des Wirtschaftsgutes Geodaten für einen breiten Markt.

2.2 OpenSource – Freie Software

Die Grundidee von OpenSource bzw. freier Software geht auf den Ursprung der Wissenschaft zurück. Traditionell basiert Wissenschaft auf freiem Austausch von Wissen und Gedanken. Angeregt durch diese Idee wurde 1984 die Free Software Foundation (FSF) gegründet, die die Vision von freiem Austausch von Wissen in Form von programmierter Software verfolgt.

Nach Definition der FSF sind vier Basisfreiheiten für freie Software zu unterscheiden (http://www.fsf.org/philosophy/free-sw.html):

- Freiheit 0:: Die Freiheit, das Programm für jeden Zweck zu nutzen.
- Freiheit 1:: Die Freiheit, zu verstehen, wie das Programm funktioniert und wie man es für seine Ansprüche anpassen kann. Dazu ist der Zugang zum Quellcode Voraussetzung.
- Freiheit 2:: Die Freiheit, Kopien weiterzuverbreiten, so dass man seinem Nächsten weiterhelfen kann.
- Freiheit 3:: Die Freiheit, das Programm zu verbessern und die Verbesserungen der Öffentlichkeit zur Verfügung zu stellen, damit die ganze Gemeinschaft davon profitieren kann. Auch hier ist der Zugang zum Quellcode Voraussetzung.

Der Begriff ‚OpenSource' war der Versuch, der OpenSource Initiative (OSI), freier Software einen Namen bzw. einen geschützten Begriff, ein Marketing-Programm zu geben. Die Definition der OSI für OpenSource folgt nahezu deckungsgleich der Definition der FSF. Die Bedeutung von OpenSource geht weit über die Offenlegung des Quelltextes hinaus, dies ist aber essentielle Voraussetzung dafür. (http://www.opensource.org/docs/definition_plain.php)

Um diese Rechte und Freiheiten zu schützen, gibt es eine Vielzahl von Lizenzmodellen, auf die in ihrer Vielgestalt an dieser Stelle nicht eingegangen werden kann. Beispielhaft soll die GNU General Public License (GNU GPL) kurz skizziert werden. GNU ist ein rekursives Akronym für „GNU is Not Unix". Die GNU GPL gewährt nicht nur die Basisifreiheiten, darüber hinaus schützt sie sie auch. Das bedeutet, dass Software, die anhand von GNU GPL-lizensierten Komponenten erstellt wird, auch wieder unter der GNU GPL veröffentlicht werden muss. Andere Lizenzmodelle (z.B. die GNU Lesser General Public License (GNU LGPL)) gewähren die Freiheiten, schützen sie aber nicht. (http://www.fsf.org/licenses/license-list.html)

Das „frei" in freier Software bedeutet nicht, dass das Programm kostenlos verbreitet werden muss. Entgegen gebräuchlicher Vorurteile ist es legitim, OpenSource bzw. freie Software zu verkaufen. Der Unterschied zu „closed-source"-Software ist lediglich, dass die Nutzungsbedingungen im Sinne der vier Freiheiten nicht eingeschränkt sind. (http://www.fsf.org/philosophy/selling.html)

Freie bzw. offene Schnittstellen und Datenformate müssen unabhängig von freier Software betrachtet werden. Sie dienen nur dem Austausch von Informationen beispielsweise zwischen den verschiedenen Komponenten einer GDI. Auch „closed-source"-Software versteht freie Datenformate und kann mit offenen Schnittstellen kommunizieren. Eine Standardisierung von Schnittstellen und Datenformaten ist nicht direkt Bestandteil der Grundidee von freier Software, unterstützt sie aber maßgeblich. Folgendes Diagramm versucht, bestehende Software (Kreise) anhand der verschiedenen Begrifflichkeiten in den verschiedenen Richtungen zu kategorisieren.

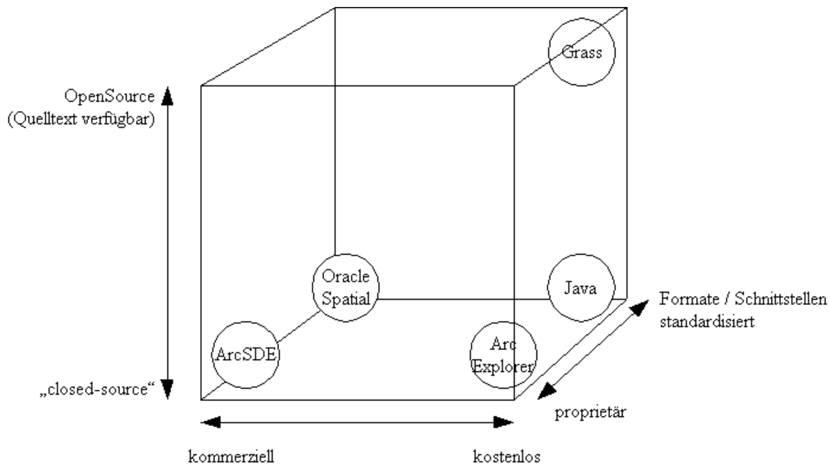

Abb. 13: Software und ihre Zuordnung zu häufig verwendeten Begrifflichkeiten (Quelle: Eigene Darstellung)

Der Vorteil der Verwendung von OpenSource bzw. freier Software liegt in der größeren Unabhängigkeit von einem Softwarehersteller und dessen Produkt-Spektrum, zum Beispiel wenn dieser seine Produkte nur so verkauft, dass aufgrund von Nichtoffenlegung von Schnittstellen und Quelltext eine freie Kombination von verschiedenen verfügbaren Komponenten nicht möglich ist, sondern der Kunde auf seine Produkte angewiesen ist. Ein Nachteil der Verwendung von OpenSource bzw. freier Software kann sein, dass der Benutzer, da er nicht bezahlt hat, und so wenn nicht selbst an der Entwicklung beteiligt ist, keine einklagbaren Rechte bezüglich erwarteter Funktionalität oder Entwicklungsgeschwindigkeit hat. Dies wird jedoch inzwischen in den meisten Projekten im Vorhinein festgelegt und dokumentiert.

3 SYSTEM-EBENEN EINER GDI

Für das allgemeine Verständnis sei an dieser Stelle erklärt, dass mit dem Begriff des Dienstes in diesem Artikel nicht die spezialisierten Web- oder GI-Dienste gemeint sind, sondern zunächst einmal funktionale Einheiten, die anhand bestimmter Eingabedaten und Anweisungen ein erwünschtes Ergebnis erstellen können. Wie dies geschieht, ist zunächst nicht näher festgelegt – im Zweifelsfall wäre beispielsweise auch die manuelle Aufbereitung von Eingangsdaten in das gewünschte Ergebnis ein Dienst – der jedoch gewiss mit Verzögerung arbeiten würde.

Die Aufgabe von Geodateninfrastrukturen ist, Geodaten verschiedener Art und Herkunft in Verbindung mit bestimmten Funktionalitäten verfügbar zu machen. Dabei können auch Eigentum und Nutzungsrechte eine große Bedeutung haben. Die Verteilung solcher Daten kann die Wartung vereinfachen, Aktualität erhöhen, Redundanzen verhindern und kooperatives Arbeiten erleichtern. Damit dies funktioniert, müssen die jeweiligen Teildatenbestände in den Teilen der GDI syntaktisch und semantisch korrekt interpretiert werden – wozu die Spezifikation anhand von Schnittstellen dient. Größere kommerzielle Anbieter von entsprechender Software integrieren diese häufig in ihre Software und liefern „application programming interfaces“ (APIs) mit, die dem Software-Entwickler die Verwendung der Schnittstellen so einfach wie möglich machen soll. Die Schnittstelle selbst tritt dabei u.U. sehr in den Hintergrund. Allen Web-Diensten gemein ist wohl, dass sie auf grundlegende Protokolle zur Übermittlung von Daten-Paketen zurückgreifen, wie z.B. TCP/IP. Darüber hinaus ist in einigen Fällen wenig Information zu erhalten, wie die Kodierung erfolgt (z.B. Klartext oder binär) und welche Syntax verwendet wird – d.h. es handelt sich um eine nicht offen gelegte Schnittstelle. Einige Hersteller legen zwar ihre Schnittstellen offen, allerdings wird die Wartbarkeit von darauf basierenden Komponenten nicht in jedem Falle erhöht, da Veränderungen der Schnittstelle im jeweiligen Anwendungsfall ungeahnte Veränderungen bei den abhängigen zusätzlichen Komponenten der Benutzer nach sich ziehen können, jedoch ausgehend vom Hersteller erfolgen.

‚Hinter’ solchen Schnittstellen können sich beliebige Strukturen befinden, um den GI-Dienst zu realisieren. Im klassischen Falle ist dies eine mehrschichtige Web-Applikation, die wiederum verteilt arbeiten kann und selbst aus Diensten zusammengesetzt ist. So wird man hier eine Datenbank ggf. mit einer Erweiterung um räumliche Operatoren finden, die die Daten und eingeschränkte GIS-Funktionalität vorhält. Ein Applikations-Server sorgt für den Zugriff auf die Datenbank, integriert Benutzerrechte und stellt u.U. mehrere Dienste in seiner Umgebung zur Verfügung und sorgt für ihre Verbindung.

Um den Begriff des Geo-Dienstes zu fassen, wird die Beschreibung aus einer bestehenden größeren GDI herangezogen: GDI-NRW. Im Testbed 1 wurde dort der folgende Rahmen angeführt:
„Allen GI-Services in GDI ist gemein, daß sie

- über einen definierten Raumbezug verfügen
- über einen Mindestsatz an Metadaten beschrieben werden
- über das Internet (HTTP) aufgerufen werden
- geringe Anforderungen an die technische Ausstattung der GI-Nutzer stellen
- geringe Einstiegshürde für Anbieter und Nutzer von GI-Services

GI-Services implementieren die ihrem ServiceTyp entsprechende und im Testbed spezifizierte Service-Schnittstelle. Ein GI-Client nutzt einen oder mehrere GI-Services. Eine GI-Applikation steht dem Endnutzer zur Verfügung und ist ein (komplexer) GI-Client am Ende einer Kette von GI-Services. Der Zugriff auf eine GI-Applikation erfolgt via einer URL als Schnittstelle.“ (TestbedI).

Eine wichtige Eigenschaft von GI-Diensten ist darüber hinaus ihre Beschreibbarkeit in Form von Metadaten, wie es die folgende Abbildung verdeutlicht:

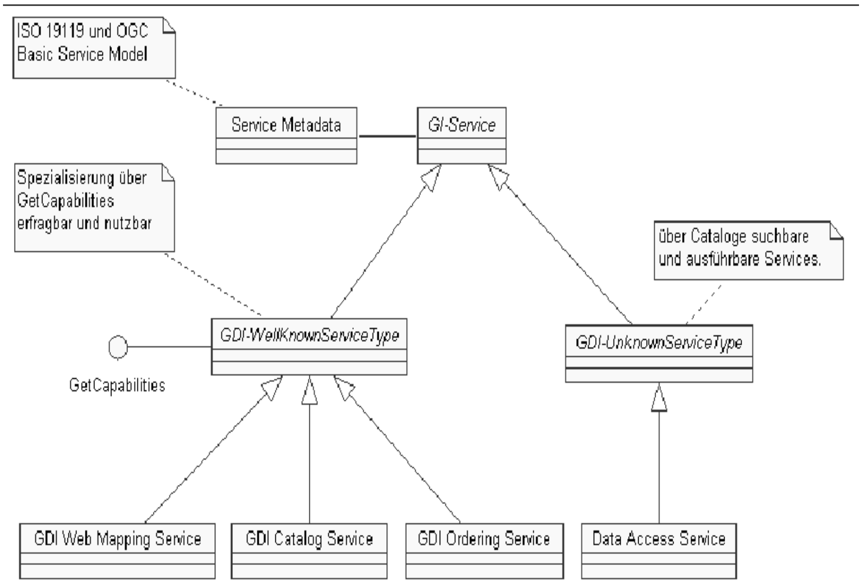

Abb. 2: Klassendiagramm GI-Dienste (Quelle: TestbedI)

In diesem Beispiel wird angedeutet, dass ein GI-Dienst anhand einer Menge von Eigenschaften und Methoden beschrieben werden kann. Die Zusammenhänge zwischen verschiedenen Diensten müssen nicht notwendiger Weise in einer Klassen-Hierarchie abgebildet werden. Ein Dienst kann im Allgemeinen beliebige Aktionen ausführen, um eine zu ihm passende Anfrage entsprechend seiner Spezifikation zu erfüllen.

Die Anfrage an einen Dienst wird von einem Client gestellt. Die Antwort muss nicht notwendiger Weise auch wieder an diesen zurückgeliefert werden. Ein Dienst kann selbst gleichzeitig ein Client sein, wenn er für die Bearbeitung von Anfragen auf andere Dienste zugreifen kann.

Der klassische Fall einer Webmapping-Applikation wird in etwa wie folgt zusammengesetzt sein:

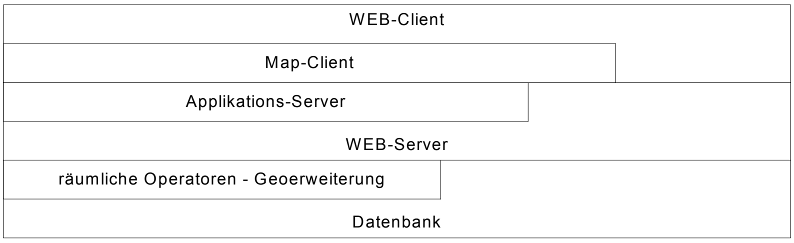

Abb. 3: Zusammensetzung einer Web-Applikation (Quelle: Eigene Darstellung)

4 MACHBARKEIT EINER GDI ANHAND EINES BEISPIELS AUS DEM PLANUNGSUMFELD (FLUSSEINZUGSGEBIETS-MANAGEMENT)

FLUMAGIS ist ein Forschungsprojekt des BMBF, das ein spezialisiertes planungs-unterstützendes GIS entwickelt. Es handelt sich um ein „spatial decision support system“ (SDSS), das anhand einer Wissensbasis Expertenwissen zum experimentellen Planen interaktiv nutzbar macht. Dies orientiert sich weitgehend an den Vorgaben der EG-Wasserrahmenrichtlinie (WRRL) der Europäischen Union.

FLUMAGIS stellt den klassischen Fall eines Systems dar, das im planerischen Umfeld Entscheidungen unterstützen soll. Es basiert auf Geodaten, die anhand ihrer Geometrie, Topologie und Semantik hinsichtlich spezifischer Fragestellungen untersucht werden. Insbesondere werden spezialisierte Ursache-Wirkungs-Zusammenhänge in einer Wissensbasis modelliert, die dazu auf bestimmte weitgehend im Vorhinein als Funktionskomplexe verkettete GIS-Funktionen zurückgreift, die von einer zentralen Stelle des Systems (Controller) zur Ausführung gelangen.

Diese System-Architektur enthält somit Komponenten, die über eine klassische GDI hinaus gehen – die Funktion einer Wissensbasis gehört nicht direkt dieser Software-Domäne an. Wir betrachten also hier die Komponenten Datenbank, Geo-Erweiterung der Datenbank, Geo-Services bzw. Schnittstellen und GIS als GDI, auf die durch den Controller bzw. dahinter liegende Komponenten zugegriffen wird.

Da es sich bei FLUMAGIS um einen Prototypen handelt, sind bestimmte Fragestellungen bei der Ausführung von Abfragen selbst Gegenstand der Forschung. Dies gilt beispielsweise für die Koppelung mit der Wissensbasis und die Einbindung diverser Modelle. Allerdings sind grundlegende Funktionen zu unterscheiden, die erforscht und praktisch direkt einsetzbar sind.

Beispielsweise ist ein Funktionskomplex die Selektion des Untersuchungsgebietes, bei der ein bestimmter Bereich als Arbeitsgrundlage ausgewählt wird. Fachliche Zusammenhänge werden hierbei darüber entscheiden, wie dies für verschiedene Geodatentypen vollzogen werden muss. Beispielsweise kann für linienhafte oder flächige Geoobjekte teilweise eine Verschneidung notwendig sein – teilweise jedoch auch die Auswahl des vollständigen Objektes. Am Ende dieses Vorgangs steht eine Sammlung von Geoobjekten, die im Zustand ‚ausgewählt' befindlich sind. Dieser kann entweder durch eine Arbeits-Kopie oder über zusätzliche Felder in den Original-Daten abgebildet werden. Beide Varianten verursachen Probleme: Die Abbildung über zusätzliche Felder kann beliebig komplex werden und die Verarbeitungsgeschwindigkeit drastisch senken. Die Schaffung einer Arbeitskopie schafft ein Redundanz-Problem, das bei der späteren Abspeicherung des Arbeitsstandes berücksichtigt werden muss.

Unabhängig davon wird jedoch deutlich, dass der Transfer der Geodaten durchaus bidirektional vollzogen werden muss. Proprietäre kommerzielle GIS- bzw. GDI-Systeme realisieren dies über transaktionale Dienste, die meist direkt Bestandteil der Kommunikations-Schicht einer Applikation sind. Es ist zu berücksichtigen, dass diese meist nicht oder nur beschränkt offenen Schnittstellen-Spezifikationen folgen. Die Ab- oder Rückspeicherung der Daten schließt die Arbeiten des Benutzers ab und ist wie die im vorherigen Absatz beschriebene Selektion zu Beginn als vorhandene Funktionalität anzusehen, die in geeigneter Weise eingebunden werden muss.

Bestimmte weitere Funktionen lassen sich ohne Weiteres mit den ausgewählten Daten aus einem bestimmten Bereich durchführen, die jedoch in FLUMAGIS einer direkten Plausibilitätsüberprüfung durch die Wissensbasis unterliegen. Beispielsweise kleinräumige Abfragen, wie: Gibt es einen Nutzungskonflikt zwischen zwei benachbarten Nutzungen, etc. sind so bis auf wenige Ausnahmen am Rande des ausgewählten Gebietes durchführbar. Andere Abfragen, wie die Ursachen-Suche entlang dem Flussverlauf aufwärts werden unabhängig von der Größe des Auswahlgebietes immer dessen Grenze erreichen – es sei denn, man wählt das vollständige Gewässer aus, was jedoch aufgrund der Vorgaben durch die Wasser-Rahmen-Richtlinie nur die Arbeit mit der kleinmaßstäbigen Variante darstellt und somit nicht generell möglich ist. Welche Untersuchungen aus Experten-Sicht dazu notwendig sind, ist in der Wissensbasis modelliert und zunächst einmal nicht Gegenstand dieses Dokuments.

Betrachten wir die benötigten GIS-Funktionen darauf hin, welche auf dem Client und welche auf dem Server benötigt werden, so ergibt sich die folgende Aufteilung:

Client	Server
Kartendarstellung Auswahlbox Attributänderung Objekt geometrisch ändern Feature-Klasse neues Objekt hinzu fügen Analyse-Funktionen	Erzeugung eines Vorschlagslayers Erzeugung eines Ergebnislayers Datenhaltung Ausführung von komplexen Abfragen Erzeugung eines Projekt-Datensatzes Versionierung

Tab. 1: Aufteilung von GIS-Funktionalitäten auf Client- und Serverseite (Quelle: Eigene Darstellung)

Die System-Architektur von FLUMAGIS ist auf die folgenden vereinfacht dargestellten Datenflüsse zugeschnitten.

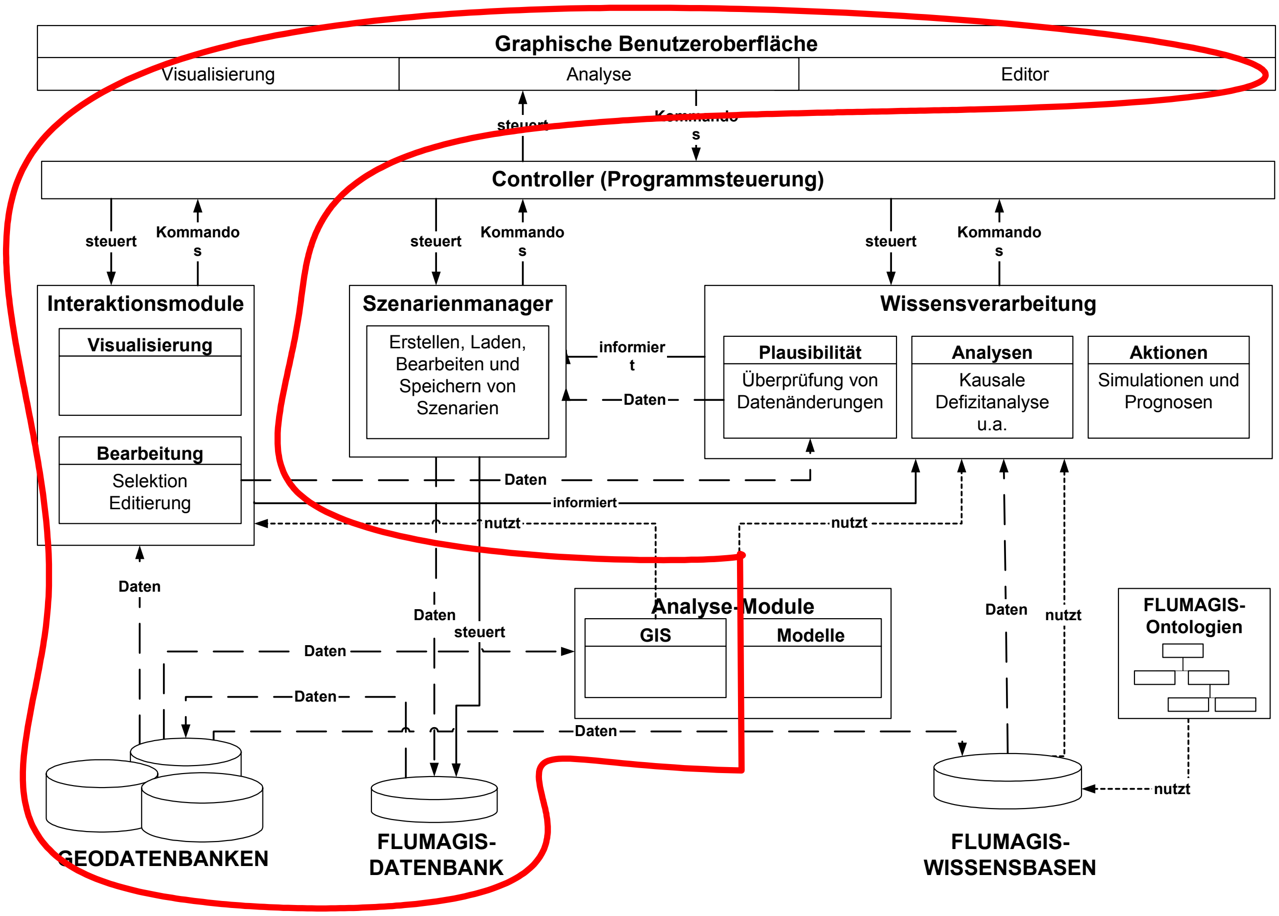

Abb. 4: Systemarchitektur von FLUMAGIS (Quelle: Eigene Darstellung)

Die aufgelegte Linie verdeutlicht, welche Teile des Systems für die hier angestellten Betrachtungen relevant sind und im weitesten Sinne mit den Systemebenen aus dem vorhergehenden Kapitel zur Deckung zu bringen sind. Dies bedeutet, dass die Anbindung der weiteren Komponenten zu einem späteren Zeitpunkt separat betrachtet werden muss.

5 AUSGEWÄHLTE OPENSOURCE PRODUKTE FÜR GEODATENINFRASTRUKTUREN

Der Aufbau einer Geodateninfrastruktur erfordert den Einsatz unterschiedlicher Softwarekomponenten. Zur Speicherung und Verwaltung der Geodaten wird eine Datenbanksoftware benötigt, die räumliche Daten verarbeiten kann. Für den Zugriff auf die Daten werden Applikationen oder Webdienste benötigt. Für letzte ist zusätzlich der Einsatz eines Webservers notwendig. Diese Softwarekomponenten erfordern eine leistungsfähige Serverhardware mit einem leistungsfähigen Betriebssystem.

Nachfolgend soll eine Übersicht über ausgewählte OpenSource Produkte gegeben werden, durch die die oben genannten Anforderungen erfüllt werden können:

OpenSource-Software	Version	Kategorie	Internet-Ressourcen
PostgreSQL	7.4	Datenbank	http://www.postgresql.org/
PostGIS	0.8	räumliche Erweiterung für PostgreSQL	http://postgis.refractions.net/
UMN MapServer	4.0	OpenGIS Map Service	http://mapserver.gis.umn.edu/
Deegree		OpenGIS Web Services	http://deegree.sourceforge.net/
Geoserver	1.0.1	OpenGIS Web Feature Service	http://geoserver.sourceforge.net
Grass	5.0.3	Geoinformationsystem	http://grass.itc.it/

Tab. 2: ausgewählte OpenSource Produkte, Stand: Dez. 2003 (Quelle: Eigene Darstellung)

5.1 PostgreSQL / PostGIS

PostgreSQL ist ein objekt-relationales Datenbankmanagementsystem (ORDBMS). Es basiert auf POSTGRES, das im Rahmen eines universitären Projektes an der University of California am Berkeley Computer Science Department entstanden ist. PostgreSQL wird als OpenSource Projekt von einer Vielzahl von Entwicklern in der ganzen Welt ständig weiterentwickelt und kann kostenlos genutzt werden.

PostgreSQL ist eine der am weitesten entwickelten OpenSource Datenbanken. Es werden die Standards SQL92 und SQL99 unterstützt und fortgeschrittene Operationen angeboten wie Subselects, Mengenoperationen, Joins, Views, Trigger, Regeln sowie ein Transaktionsmanagement. PostgreSQL lässt sich um eigene Datentypen, Operationen und Funktionen erweitern und bietet eine beachtliche Menge von Schnittstellen an. Durch die objektrelationalen Eigenschaften lassen sich nichtatomare Datentypen in Arrays oder in geometrischen Datentypen speichern. (http://www.postgresql.de/)

Für die Verarbeitung räumlicher Daten in Form von geographischen Objekten dient die PostgreSQL-Erweiterung PostGIS (http://postgis.refractions.net/). PostGIS wird von der Firma Refractions Research als ein Forschungsprojekt im Bereich OpenSource Datenbanktechnologie entwickelt. In der Version 0.8 unterstützt es alle Funktionen der OpenGIS "Simple Features for SQL" Spezifikationen (OGC 1999). PostGIS bietet die Möglichkeit PostgreSQL an Geoinformationssyteme anzubinden und räumliche Daten in PostgreSQL zu speichern.

5.2 OpenSource Web Dienste

5.2.1 UMN MapServer

Der MapServer wird im Rahmen von Forschungsprojekten der University of Minnesota (UMN) in Kooperation mit der NASA und anderen Partnern entwickelt und ist eine OpenSource-Paket für Internetanwendungen mit GIS Funktionalitäten (http://mapserver.gis.umn.edu/). Der MapServer ist für den Einsatz unter UNIX oder UNIX-Derivaten in Kombination mit dem Apache Web Server konzipiert, er läuft aber auch unter Windows. Auf die Funktionalität kann über verschiedene Sprachen wie Java, Perl, PHP, Python etc. zugegriffen werden.

Neben den Entwicklungsmöglichkeiten kann der MapServer auch in Form einer CGI-Anwendung genutzt werden, die einige GIS-Funktionalitäten für das Internet zur Verfügung stellt. Dazu gehört die Unterstützung verschiedener Vektor- und Rasterformate, Selektionsmöglichkeiten, automatisches Generieren der Legende und des Maßstabsbalkens, thematische Kartengenerierung mit Klassifikation durch logische und reguläre Ausdrücke, Beschriftung mit automatischer Ausrichtung und on-the-fly Projektion. Der MapServer unterstützt auch die WMS und WFS Schnittstellenspezifikationen des OGC.

Für den UMN MapServer gibt es eine Reihe weiterer OpenSource Werkzeuge, wie beispielsweise MapLabs (http://www.maptools.org/maplab/). Diese Webanwendung ist eine Sammlung von Werkzeugen durch die das Erstellen und Konfigurieren von MapServer Webmapping Anwendungen vereinfacht wird.

5.2.2 Deegree

Im OpenSource Projekt Deegree der Firma Lat/Lon werden wesentliche Webdienste für den Aufbau einer Geodateninfrastruktur entwickelt. Dabei werden konsequent die Standards vom OpenGIS Konsortium und von ISO/TC 211 umgesetzt. Deegree beinhaltet folgenden OGC konforme Webdienste: Web Map Service (WMS), Web Feature Service (WFS), Web Coverage Service (WCS), Web Catalog Service, Web Gazetteer Service, Web Terrain Service (WTS), Web Coordinate Transformation Service (WCTS).

Alle Webdienste werden komplett in Java implementiert und sind damit plattformunabhängig auf diversen Betriebssystemen einsetzbar. Es werden für den lesenden und schreibenden Zugriff Schnittstellen zu Datenbanken wie ORACLE Spatial, PostgreSQL/PostGIS, allgemein JDBC-fähige Datenbanken, ESRI Shapefiles und Rasterdatenformate unterstützt. Andere OGC konforme Dienste wie beispielsweise andere Web Map Server lassen sich auch über Dienstketten einbinden (http://deegree.sourceforge.net/).

5.2.3 Geoserver

Geoserver ist ein transaktionaler Web Feature Service der nach den OpenGIS Web Feature Server Spezifikationen 1.0 entwickelt wird (http://geoserver.sourceforge.net/). Er ermöglicht den standardisierten Zugriff und die Manipulation von geographischen Daten. Als Datengrundlage kann der Geoserver in der Version 1.0.1 auf PostgreSQL in Kombination mit PostGIS, auf Oracle Datenbanken sowie auf ESRI Shape-Dateien zugreifen und liefert geographische Features in GML 2.1.2. Geoserver nutzt die OpenSource Bibliothek GeoTools (http://geotools.org/) und wird in Java entwickelt. Er kann somit plattformunabhängig eingesetzt werden.

5.3 GRASS GIS

GRASS (Geographic Resources Analysis Support System) ist ein OpenSource Geoinformationssystem. Es bietet umfangreiche GIS-Funktionalitäten für die Verarbeitung von Raster-, Vektor- und Volumendaten (3D-Voxel). Der Funktionsumfang reicht von Raster- und Vektoranalysen über Bildverarbeitung und Visualisierung bis hin zu Simulationen. GRASS verfügt über eine Datenbank-anbindung an Oracle und PostgreSQL und kann falls eine Lizenz für die ESRI-SDE-Client-API vorliegt, auch auf die SDE von ESRI zugreifen (frühes Stadium der Implementierung). Neben dem Einsatz auf Unix und Linux ist GRASS auch für Windows und PDAs mit Linuxbetriebsystem verfügbar. GRASS ist modular aufgebaut, so dass beliebige Entwickler unterschiedliche Module entwickeln und integrieren können.

6 UMSETZUNG DER GDI

6.1 Installation der Software

Als Hardware-Plattform wurde eine SUN Ultra-Sparc 1 mit zwei 200 MHz 64-Bit Prozessoren verwendet. Das System verfügt über 512 MB Hauptspeicher und 20 GB SCSI-II Festplatten und ist mit 100 Mbit in das lokale Netzwerk eingebunden.

Als Betriebssystem wurde die Linux-Meta-Distribution Gentoo 1.4 verwendet. Gentoo erlaubt ein vollständiges vollautomatisches Kompilieren, sodass sämtliche System-Komponenten an die Hardware-Fähigkeiten angepasst werden können. Dies ist für eine Vielzahl von Plattformen möglich und beliebig konfigurierbar (http://www.gentoo.org/). Als Kernel kommt der 64-Bit-fähige Linux-Kernel 2.4.21 zum Einsatz. Da Gentoo zur Installation hochgradig aktuelle Source-Versionen direkt von Gentoo-Servern verwenden kann und installierte ältere Versionen auf Wunsch automatisch aktualisiert, gestaltet sich die weitere Wartung des Systems äußerst komfortabel und die Installation der weiteren benötigten Software muss nicht durch mühseliges und zeitaufwändiges manuelles Einspielen von gerade benötigten Versions-Nummern vorbereitet werden.

Auch alle weiteren Software-Komponenten wurden bei der Installation kompiliert – bis auf die virtuelle Maschine für Java, die zwar kostenlos ist, jedoch in den wesentlichen Teilen nicht im Quelltext vorliegt. Dies gilt für die von SUN entwickelten Versionen und für die von Blackdown für Linux.

Als Datenbank kommt die objekt-relationale Datenbank PostgreSQL in der Version 7.3.4 zum Einsatz, die auf einige standardmäßig vorhandene System-Bibliotheken angewiesen und um Schnittstellen zu Perl, Java und verschlüsselte Datenübertragung optional erweiterbar ist.

Die Datenbank wurde mit der Geo-Erweiterung PostGIS 0.8.0 ausgestattet, die die Datenbank PostgreSQL und die Bibliothek *proj* erfordert. *proj* macht kartographische Projektionen und zugehörige Werkzeuge verfügbar (http://www.remotesensing.org/proj/).

Web- und Applikationsserver ist Tomcat 4.1.4-r1 (http://jakarta.apache.org/), der das Vorhandensein einer Java virtuellen Maschine erfordert. Das Blackdown Java Development Kit 1.4.1 wurde bereits mit dem System installiert.

Als Web Feature Service kommt Geoserver 1.0.1 zum Einsatz. Geoserver ist eine java-basierte Serverapplikation, die als Web-Applikation in entsprechenden Applikations-Server-Umgebungen verwendet werden kann (hier Tomcat).

Für die Installation des Web Map Services UMN MapServer sind folgende Bibliotheken nachzuinstallieren:

- *xerces-c* (XML-Parser)
- *gdal* (Bibliothek zur Rasterdatenverarbeitung)
- *ogr* (Bibliothek zur Vektordatenverarbeitung)
- *proj* (s.o.)

Tomcat wurde für den UMN Mapserver zusätzlich als cgi-Umgebung konfiguriert.

6.2 Funktionstest/Probleme

Die Installation anhand mitgelieferter bzw. online verfügbarer Anleitungen der verwendeten Komponenten verlief weitestgehend problemlos. Bei der Installation der Bibliothek *gdal* (s.o.) war es nicht möglich, die neueste Version 2.4.0 des XML-Parsers *xerces-c* zu verwenden. Es musste die ältere Version 1.6.0 installiert werden, was der Mailing-Liste zu entnehmen war. Die Verbindung der Layer des Geoservers auf die Datenbanklayer war aufgrund knapper Dokumentation aufwändig und wurde erst nach längerem Ausprobieren abgeschlossen. Kleinere administrative Probleme ergaben sich bei der Verteilung der verschiedenen Nutzerrechte.

Als Beispieldatensätze wurden verschiedene Punkt-, Linien- und Polygonlayer verwendet. Mit dem PostGIS-Skript *shp2pgsql* wurden die Layerdaten aus dem ESRI-Shapefile Format (offenes Format) in die Datenbank eingepflegt. Vorsicht war bei der Wahl des entsprechenden Referenzsystems geboten. Die PostGIS-internen Referenzsystemcodierungen nach der European Petroleum Survey Group (EPSG) waren nicht auf dem neusten Stand (EPSG 2003) und führten zu falscher Referenzierung beim Auslesen durch den Geoserver. Da die Codierungen Teil der Datenbank sind, konnten sie ohne Probleme angepasst werden, da die entsprechenden Referenzparameter bekannt sind.

Das Auslesen der Layer aus der Datenbank durch die WFS-Komponente (Geoserver) funktionierte ansonsten einwandfrei. Die Konformität der Anfrage und des Datenformats nach OGC WFS Spezifikation (OGC 2002) war gegeben. Auch räumlich begrenzte Abfragen waren möglich. Die bisher selten implementierte Transaktionalität wurde durch manuelles Einfügen eines Layers durch den

Geoserver in die Datenbank gezeigt. Die Kommunikation von WFS und WMS (Mapserver) über die durch WFS standardisierte Schnittstelle verlief problemlos. Die Konformität beider Komponenten zur Simple Feature Specification (OGC 1999) ist gegeben.

7 FAZIT

Mit Linux-Kenntnissen und Erfahrungen im Geo-Software Umfeld, beispielsweise dem Gespann ArcSDE/OracleSpatial/etc., und mit geringem Zeitaufwand (ca. drei Tage) wurde eine lauffähige und in ihren Ansprüchen als GDI voll funktionale Systemumgebung geschaffen. Ein Leistungs- bzw. Lasttest steht noch aus. Das System machte trotz der veralteten Hardware subjektiv einen durchaus performanten Eindruck.

Bei der Zusammenstellung der Komponenten wurde aus einer Vielfalt von Produkten gewählt. Für die Zukunft wäre ein vergleichender Test verschiedener Lösungen für die einzelnen Komponenten hilfreich. Darüber hinaus wurde festgestellt, dass die Entwickler dieser Programme sehr aktiv sind (im Durchschnitt einmal pro Monat ein abwärtskompatibles Update) und gute Dokumentationen und viel benutzte Mailinglisten als Recherche- und Anfragemöglichkeit bei Problemen und Supportwünschen vorhanden sind. Speziell für die PostGIS Komponente muss gesagt werden, dass nur ein Bruchteil der Funktionalität untersucht wurde und diese Geodatenbankerweiterung Gegenstand weiterer Forschungsarbeiten sein wird.

Abschließend ist festzustellen, dass eine aus OpenSource bzw. aus freier Software zusammengestellte GDI im beschriebenen Umfang und weitgehend unter Einhaltung bzw. Verwendung von Standards machbar ist. Eine „Alltagstauglichkeit" kann allerdings nur durch Last- und Leistungstest jeder einzelnen Komponente und durch eine Vielzahl von Anwendern und Zugriffen unter Beweis gestellt werden. Die Standard-Konformität wurde nur stichproben-artig untersucht, was nicht zuletzt durch die Vielzahl der Standards im Rahmen dieser Arbeit nicht anders möglich war.

Die Autoren waren angesichts der Vielzahl der entwickelten und aufeinander aufbauenden Programme und Bibliotheken aus den verschiedensten Hersteller-Kreisen überrascht, dass eine so reibungslose Inbetriebnahme möglich war. Es war sehr schnell möglich, einen ungewöhnlich detaillierten Eindruck vom Zustand einzelner Komponenten zu gewinnen. Die teilweise schon sehr langlebigen Software-Produkte belegen zusätzlich die Verlässlichkeit, die trotz sehr heterogener und räumlich weit verstreuter Entwickler-Gruppen erreicht wird.

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Open Source als Applikation: Content-Management-Systeme in Kommunal- und Regionalportalen

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1 OPEN SOURCE IM ÖFFENTLICHEN SEKTOR

Open Source Software hat sich in den vergangenen Jahren zu einer ernsthaften Konkurrenz gegenüber kommerzieller proprietärer Software entwickelt. Verschiedene Studien wie z.B. von Berlecon, Gartner und IDC zeigen, dass immer mehr Unternehmen und öffentliche Einrichtungen verstärkt nach solchen alternativen Lösungen suchen. Besonders deutlich wird die Brisanz der Entwicklung in der Reaktion von Microsoft, die spezielle Sonderfonds gebildet haben, um bei Großaufträgen in jedem Falle eine Auftragsvergabe an Linux-Anbieter zu verhindern (Lau 2003).

Das Beispiel von Linux als alternative Open Source Software ist gegenwärtig zwar sehr populär, steht aber auch für eine oftmals nur einseitige Betrachtung der Thematik. Wenn von Open Source gesprochen wird, ist im engeren Sinne eine Software gemeint, die kostenlos und mit Quellcode der Allgemeinheit zur Verfügung steht. Der Quellcode darf modifiziert, vervielfältigt und kostenlos weiterverbreitet werden, wobei auch hier spezielle Lizenzbedingungen, wie z.B. die GNU General Public License (GPL), zu beachten sind (Hang, Hohensohn 2003, S. 10 f.). Die vielfältigen Lizenzbedingungen, die sich inzwischen herausgebildet haben, erschweren eine genaue Einordnung der Software. Die **Open Source Initiative (OSI)** hat deshalb einen allgemein anerkannten Anforderungskatalog erstellt, dem die Software-Lizenzbedingungen entsprechen müssen, damit sie im engeren Sinne auch als Open Source bezeichnet werden kann (Open Source Initiative 2003). Daneben existieren die verschiedensten Facetten von Lizenzmodellen, Public Domain Software und Freeware, die natürlich ebenso als Alternative zu kommerzieller proprietärer Software in Frage kommt (Hang, Hohensohn 2003, S. 7-10). Den folgenden Ausführungen soll jedoch das engere Begriffsverständnis der OSI zugrunde gelegt werden.

In der Diskussion um den Einsatz von Linux offenbart sich noch ein weiteres Problem: mit Linux steht ein **Betriebssystem** zur Debatte. Im Client- bzw. Desktop-Bereich bedeutet dies, dass durch eine Umstellung auf Linux notwendigerweise ebenfalls eine Anpassung aller Anwendungsprogramme erforderlich wäre, was letztlich die Tragweite einer solchen Entscheidung maßgeblich beeinflusst. Ein prominentes Beispiel für einen solchen Fall ist die **Stadt München**, die sich im Mai 2003 für eine Migration von Windows NT auf Linux als Client-Betriebssystem und ein Office-Paket aus dem Open-Source-Bereich entschied. Bemerkenswert dabei war nicht nur das Ausmaß der anstehenden Veränderungen (14.000 PC-Systeme und Notebooks mit über 16.000 Anwendern), sondern dass die Entscheidung zugunsten Linux ausfiel, obwohl das Ergebnis einer eigens in Auftrag gegebenen Studie das Angebot von Microsoft als vorteilhafter bewertete. Begründet wurde der Entschluss mit „qualitativ-strategischen" Überlegungen, die über die auf fünf Jahre ausgelegte Kostenvergleichsrechung der Studie hinausgehen. Zum anderen spielten auch politische Motive eine Rolle, denn mit der Entscheidung sollte ein Signal zur „langfristigen Weichenstellung" in Richtung Open Source gesetzt werden (Wilkens 2003).

Open Source muss aber nicht immer gleich als eine alles umfassende globale Softwarelösung eingesetzt werden. In mehreren Studien wie z.B. von Berlecon Research (Wichmann 2002), von der Robert Frances Group (RFG 2002), vom Bundesministerium für Wirtschaft und Technologie (BMWi 2001) sowie von Soreon Research (Soreon 2003) wird nachgewiesen, dass mit Open Source in verschiedenen Einsatzfeldern bedeutende **Kosteneinsparungen** möglich sind. Dabei zeigt sich, dass Open Source im **Server-Bereich** und insbesondere beim **Webhosting** bereits eine **dominierende Stellung** eingenommen hat. Bekannte Beispiele sind der Webserver Apache mit einem Marktanteil von 67,4 % im November 2003 (www.netcraft.com), die Datenbank MySQL sowie Programmiersprachen wie Perl und PHP, aber auch Linux im ausschließlichen Einsatz als Server-Betriebssystem.

Im **Desktop-Bereich** bestehen ebenfalls differenzierte Anwendungspotenziale, auch unabhängig von Linux als Client-Betriebssystem in Verbindung mit diverser zugehöriger Software. An erster Stelle ist das Office-Programm OpenOffice zu nennen, welches sowohl auf Linux wie auch auf Windows und anderen Plattformen einsatzfähig ist. Der Verbreitungsgrad von Open Source Client-Software bleibt zwar deutlich hinter der von Server- und Webanwendungen zurück, doch lassen die Ergebnisse der Studien sowie diverse Pressemitteilungen (vgl. z.B. www.heise.de) zukünftig auf stark wachsende Marktanteile schließen.

Generell bietet Open Source Software, die entweder isoliert (z.B. im Serverbetrieb, bei Webanwendungen) oder auf verschiedenen Plattformen einsetzbar ist (z.B. Linux, Unix, Windows, Macintosh), die größten Einsatzchancen, da Integrations- und Umrüstkosten wie im Beispiel München nicht von Bedeutung sind. Ein Anwendungsfall, für den beide Bedingungen zugleich zutreffen, soll im Folgenden anhand eines **Web-Content-Management-Systemes (WCMS)** detailliert erörtert werden. Zunächst werden allgemein Prinzipien und Einsatzmöglichkeiten von WCMS dargestellt. Anschließend wird am Beispiel von Typo3 ein Open Source WCMS vorgestellt, das sich bereits vielerorts im professionellen Einsatz befindet. Zum Schluss wird untersucht, welche Bedeutung WCMS in Kommunal- und Regionalportalen besitzen, wobei auf Ergebnisse einer eigenen empirischen Erhebung zurückgegriffen werden kann.

2 WEB-CONTENT-MANAGEMENT-SYSTEME (WCMS)

2.1 Begriffsbestimmung und -abgrenzung

Ein WCMS besteht aus einer komplexen Software, die dem Management von interaktiven Inhalten für Webseiten dient. Mit Management sind Funktionen wie z.B. Erstellung, Bearbeitung, Verwaltung, Überwachung, Veröffentlichung und Archivierung gemeint. Interaktive Inhalte können aus Text, Bildern, Sounds, Videos bestehen. Der Aufbau von WCMS entspricht grundsätzlich dem eines allgemeinen Content-Management-Systems (CMS) mit dem Unterschied, dass der Zweck eines WCMS ausschließlich in der Gestaltung von Webseiten liegt. Darüber hinaus erfolgt oftmals auch die Steuerung und Redaktion des WCMS über Webseiten bzw. über den Webbrowser. Ein wesentliches Merkmal von WCMS ist die Trennung von:

- darzustellenden Inhalten (Content),
- Aussehen (Layout) der Webseite sowie
- der zugrunde liegenden Funktionalität (z.B. Datenbank-, Serversystem, Navigation).

In Abgrenzung dazu weisen Dokumenten-Management-Systeme (DMS) diese Trennung nicht auf, Redaktionssysteme sind weniger komplex aufgebaut und in der Funktionalität auf das Publishing spezifiziert, beide sind nicht auf das Web ausgerichtet (Krüger, Kopp 2002, S. 20-22, Zschau et al. 2002, S. 70 f.). Inhaltlich stehen in diesem Beitrag **WCMS im Mittelpunkt**. Dass in mehreren Abschnitten dennoch der allgemeinere Begriff **CMS** verwendet wird, hat seine Ursache in der Terminologie der zugrunde liegenden Datenquellen, die gewahrt werden soll. Beide Bezeichnungen können in diesem Kontext aber als **synonym** angesehen werden, da die Anwendung für das Web in jedem Fall gegeben ist.

2.2 Aufbau und Arten von WCMS

Der Aufbau von WCMS lässt sich prinzipiell durch fünf Komponenten beschreiben (Abb. 1). Als zentrale Bestandteile fungieren dabei das **Assetmanagement** (Aufbaukomponente), mit dem die Webseite unter Berücksichtigung der Trennung von Inhalt und Layout verwaltet wird, sowie die **Workflowkomponente** (Ablaufkomponente), mit der die Contentelemente (Assets) prozessual in einem teamorientierten Arbeitsablauf eingebunden werden. Durch die **Benutzer- und Zugriffsverwaltung** werden die Rechte der Benutzer im System geregelt und Fremdzugriffe verhindert. **Import- und Export-** sowie **Programmierschnittstellen** (API, Application Programming Interface) stellen den Datenaustausch sowie die Einbindung von Zusatzapplikationen sicher (Zschau et al. 2002, S. 201-243).

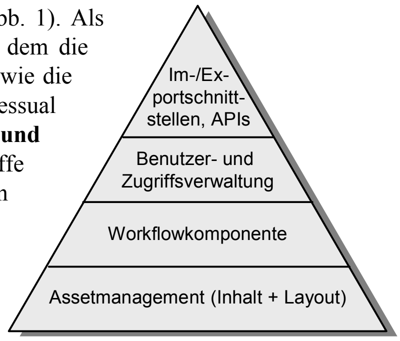

Abb. 1: Komponenten eines WCMS

In Theorie und Praxis ist keine klare Systematik von verschiedenen WCMS zu finden. Bei Zschau et al. werden sieben Klassen von WCMS unterschieden, die gleiche Klassifizierung wird auch in dem von Zschau gegründeten Informationsportal Contentmanager.de verwendet (Zschau et al. 2002, S. 319-327, 421). Die WCMS-Klassen eignen sich gut für eine schnelle Informationssuche auf dem Portal, jedoch ist die Klassifizierung nicht konsistent, d.h. es liegen ihr keine einheitlichen Unterscheidungskriterien zugrunde. Die vorliegenden Klassen wurden daher verschiedenen Kriterien zugeordnet und ergänzt, so dass im Ergebnis eine Systematik entstand, die in Abb. 2 dargestellt ist.

Kriterium	**Arten von WCMS**		
Lizenzmodell	Lizenzsoftware	Mietsoftware (ASP)	Open Source Software
Einsatzzweck	Enterprise-WCMS	publishingorientierte WCMS (Redaktionssysteme)	
Entwicklung	Eigenentwicklung	Agenturentwicklung	Community Entwicklung
Sonderformen	Intranet-Lösungen	Groupware-Lösungen	

Abb. 2: Arten von WCMS (eigene Klassifizierung in Anlehnung an Zschau et al. 2002, S. 319-327)

2.3 Nutzenbetrachtung von WCMS

2.3.1 Allgemeine Bedingungen und Nutzenpotenziale von WCMS

WCMS haben sich evolutionär in der Realisierung von praktischen Anforderungen und im Kontext der technologischen Entwicklung herausgebildet. Die zentralen Aspekte in dieser Entwicklung waren, dass der Umfang der zu publizierenden Inhalte immer größer wurde, wobei gleichzeitig die technischen Möglichkeiten (Datenbankunterstützung, multimediale Gestaltung, Forum etc.) zunahmen. Da redaktionelle Arbeiten nur mit technischen Kenntnissen möglich waren, lag ein Lösungsansatz darin, die inhaltlichen Informationen bzw. den Content (Texte, Dokumente, Bilder etc.) vom Layout (Darstellung der Inhalte) und der Funktionalität (Aufruf von Menüs, automatische Abfragen, Download-, Druck-, Suchfunktion etc.) zu trennen.

Aus dieser konzeptionellen Trennung, die ein WCMS charakterisiert, resultieren die **Einsatzbedingungen und Vorteile** von WCMS, die von den Anbietern solcher Systeme immer wieder genannt werden. Dazu zählt eine dezentrale Informationseingabe (Redaktion) durch viele Mitarbeiter, die fachspezifisch ihre Inhalte selbständig betreuen, dabei aber keine technischen Kenntnisse zur Webgestaltung besitzen müssen. Dadurch verkürzen sich die Aktualisierungszeiträume, wodurch die Aktualität der Inhalte steigt. Gleichzeitig können durch die dezentrale Redaktion wesentlich mehr Inhalte online gestellt werden und die fachliche Kompetenz steigt (Zschau et al. 2002, S. 59-63, 76-78).

Die Gegenüberstellung in Tab. 1 polarisiert die Unterschiede zwischen dem Webpublishing mit WCMS im Vergleich zum traditionellen statischen Webpublishing. Dazwischen können natürlich verschiedene Lösungen eingeordnet werden, die vom individuell programmierten dynamischen Webauftritt (z.B. mit Java, PHP, Perl, MySQL) über fertige Softwareprodukte (z.B. Redaktionssysteme) bis hin zu Kombinationen aus diesen Möglichkeiten reichen. Damit kann im Einzelfall die Funktionalität eines WCMS durchaus erreicht werden, nur sind dazu eben mehrere unterschiedliche Softwaretools bzw. Programme notwendig, die zu einem wesentlich höheren Implementierungs- und Administrationsaufwand führen.

Abgrenzungskriterien	Traditionelles Webpublishing	Webpublishing mit WCMS
Notwendige Kenntnisse zur Pflege der Webseiten	inhaltliches und technisches Know how	nur inhaltliches Know how
Anzahl der Redakteure	wenige, zentrale Redaktion über Webmaster	viele, dezentrale verteilte Redaktion möglich
Ablauf des Arbeitsflusses	manueller Workflow	automatisierter Workflow durch Benutzer- und Freigaberechte mit Informationssystem
Aktualisierungszeitraum	relativ lang, abhängig vom Informationsfluss	sehr kurz, direkte Informationseingabe
Aktualität,Variabilität der Inhalte	geringer	sehr hohe Aktualität möglich
Anzahl/Umfang der Webseiten	begrenzt durch manuelle Administration	wesentlich höher
Redesign	relativ aufwendig	relativ einfach über Templates
Funktionalität	mehrere Zusatztools notwendig	Integrierte Funktionalität im WCMS
Cross-Media-Fähigkeiten	eingeschränkt	umfangreich möglich (Print, CD/DVD, WAP)
Investitionskosten	abhängig von Erstellung Webdesign und inhaltlichem Umfang	vergleichsweise höher: Erstellung Webdesign, Einführung CMS, Definition/Anpassung des Informationsflusses, Anwenderschulungen
Laufende Betriebskosten	proportional mit Inhalten ansteigend	gering ansteigend, da nur Informationseingabe

Tab. 1: Vorteile des Webpublishing mit WCMS im Vergleich zum traditionellen Webpublishing (in Anlehnung an Zschau et al. 2002, S. 62 f.)

Im Umkehrschluss können aus den Vorteilen und dem strukturellen Aufbau eines WCMS auch die Bedingungen formuliert werden, unter denen der Einsatz eines WCMS sinnvoll ist:

- neben einer ausreichenden Größe des Webauftritts
- sollte eine relativ hohe Änderungshäufigkeit (Aktualisierungsgrad) sowie
- die notwendige Beteiligung mehrerer Mitarbeiter an der Redaktion gegeben sein.

Sind diese Voraussetzungen erfüllt, amortisieren sich schnell die höheren Implementierungskosten eines WCMS, die in der Regel durch die Systemeinführung, die Integration in den betrieblichen Workflow sowie durch Anwenderschulungen verursacht werden. Dies gilt insbesondere dann, wenn Lizenzkosten durch die Verwendung von Open Source Lösungen eingespart werden können.

2.3.2 Anforderungen an CMS – Ergebnisse einer Untersuchung von Ti·KOM

Die dargestellten Vorteile von WCMS aus der Sicht der Anbieter decken sich im Wesentlichen mit den Ergebnissen einer Untersuchung, die von Ti·KOM und dem Institut für Wertprozessmanagement/Wirtschaftsinformatik der Universität Innsbruck im Jahre 2002 durchgeführt wurde (Weber 2002). Gegenstand der Studie, an der 790 österreichische Unternehmen und öffentliche Einrichtungen verschiedener Branchen teilnahmen, waren WCMS, auch wenn in der Auswertung vereinfacht von CMS gesprochen wird.

Als Hauptnutzer von CMS konnten in der Studie IT- und Telekommunikationsunternehmen, Tourismuseinrichtungen sowie öffentliche Einrichtungen identifiziert werden. Diese gaben zugleich auch für die nächsten Jahre das höchste Content-Wachstum (über 50%) sowie eine hohe Änderungsfrequenz der Webseiten an. Bei der Frage nach den wichtigsten Argumenten für den Einsatz eines CMS setzten sich zwei Punkte besonders deutlich ab: die Sicherung von Aktualität und Qualität sowie die Möglichkeit der Pflege ohne technische Kenntnisse (Abb. 3). Der große Abstand zu den folgenden Nennungen kann nur dahingehend interpretiert werden, dass trotz der Argumentation seitens der Anbieter der Nutzen von CMS bei den Anwendern noch nicht hinreichend bekannt ist bzw. diesen auch im Einsatz nicht bewusst wird.

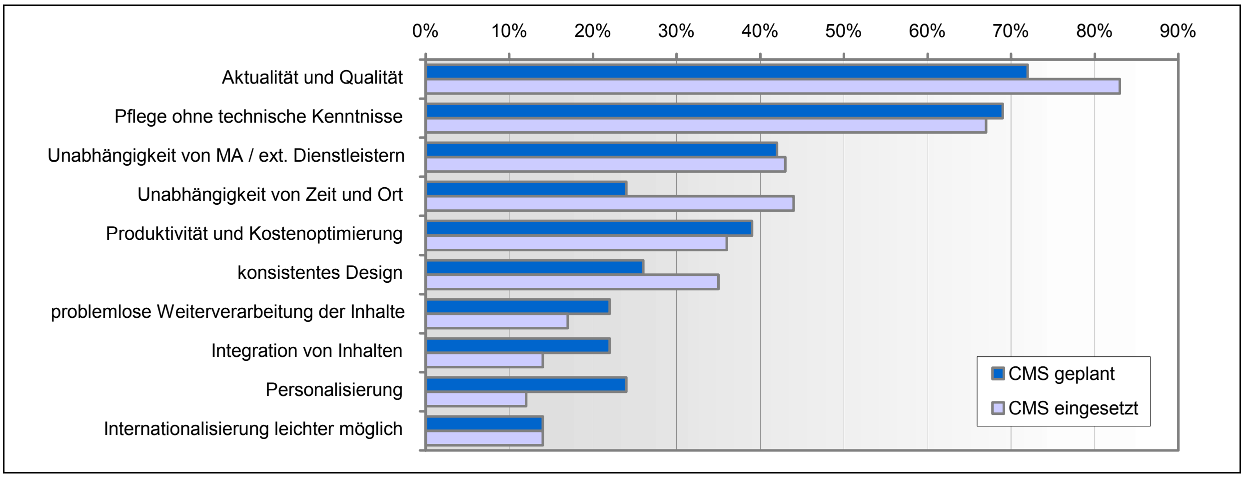

Abb. 3: Argumente für den CMS-Einsatz (Weber 2002)

Das fehlende Nutzenverständnis – ein Großteil der Befragten findet die Situation ohne CMS als durchaus befriedigend – geht mit einem mangelnden Kostenverständnis einher. Die Kosten für die Entwicklung und Pflege der Webseiten wurden von Kleinunternehmen bei lediglich 730 € pro Jahr angegeben, während mittelgroße Unternehmen zu 3.600 € und große Unternehmen durchschnittlich 72.700 € und mehr im Jahr ausgeben. Die geringen Werte zeigen, dass die Unternehmen vermeintliche Kosten bei externen Dienstleistern sparen, dabei aber oftmals enorme interne Kosten nicht berücksichtigen. Im übertragenen Sinne gilt dies ebenfalls für Anwender von CMS, bei denen Kosteneinsparung durch Tätigkeitsverlagerungen von technischen Spezialisten hin zu den einzelnen Fachbereichen wirksam werden.

2.4 Verfügbares Angebot an CMS

Der gegenwärtige Markt bietet für potenzielle Anwender ein sehr breites Spektrum an CMS. Das Angebot hat sogar ein solches Ausmaß angenommen, dass sich in den letzten Jahren mit **Contentmanager.de** eine eigene Informationsplattform im Internet etabliert hat, die einen sehr umfassenden Überblick über verfügbare Systeme gibt. Auf www.contentmanager.de waren im Dezember 2003 insgesamt **1.083 Content Management-Produkte** gelistet (Tab. 2), die nach den in Abschnitt 2.2 bereits angesprochenen sieben Klassen unterteilt sind. Neben Produktinformationen bietet die Informationsplattform auch die Möglichkeit des Produktvergleichs, verschiedene Foren zum Meinungsaustausch sowie vielfältige Informationsangebote.

	Produkte insgesamt	Davon im Produktfinder
Alle Content Management-Produkte	**1.083**	**521**
1. Enterprise Content Management	305	165
2. **Open Source Lösungen**	**63**	**30**
3. Agenturlösungen	82	41
4. Groupware-Lösungen	61	30
5. Redaktionssysteme	564	293
6. ASP-Lösungen	191	89
7. Intranet-Lösungen	120	50
Summe (mit Mehrfachnennungen)	**1.386**	**698**

Tab. 2: Content Management Produkte nach Kategorien bei Contentmanager.de
(www.contentmanager.de/itguide/produktfinder.html, 11.12.2003)

Der Anteil der 63 aufgeführten **Open Source Lösungen** beträgt im Verhältnis zu den gesamten 1.083 CM-Produkten 5,8%. In der von der EU finanzierten und von Berlecon Research durchgeführten FLOSS-Studie gaben umgerechnet 3,9% aller Unternehmen an, ein Open Source CMS zu nutzen. Unter Berücksichtigung der in der Zukunft geplanten Installationen erhöht sich der Anteil sogar auf 6,3% (Wichmann 2002, S. 44). Da sicher nicht alle der 395 befragten Unternehmen ein CMS besitzen werden, liegt der Anteil an Open Source Systemen im Vergleich zu den angebotenen Lösungen in Tab. 2 überproportional hoch.

Obwohl im Produktfinder von Contentmanager.de immer nur etwa die Hälfte der gesamten Produkte angegeben sind, können doch bei vielen Auswahlkriterien alle Produkte berücksichtigt werden. Eine entsprechende Abfrage bezüglich der Lauffähigkeit auf verschiedenen **Betriebssystem-Plattformen** ergab beispielsweise folgendes Bild in Abb. 4.

- Die Verteilung zeigt zum einen, dass Linux zwar am häufigsten unterstütz wird, aber durchaus nicht klar dominiert.
- Vielmehr werden CMS für sehr viele verschiedene Betriebssysteme angeboten, so dass für jeden Anwendungsfall mehrere integrationsfähige Lösungen zur Verfügung stehen.
- Die Anzahl der Werte bei solchen Betriebssystemen wie z.B. Sun Solaris, IBM AIX, HP-UX deutet darauf hin, das viele Lösungen gerade im professionellen Bereich Anwendung finden können.
- Schließlich wird am Beispiel der CMS offensichtlich, dass Open Source Lösungen nicht unbedingt Open Source Betriebssysteme erfordern, denn 12 CMS, vor allem umfassendere Lösungen, laufen auch mit verschiedenen Windows-Versionen.

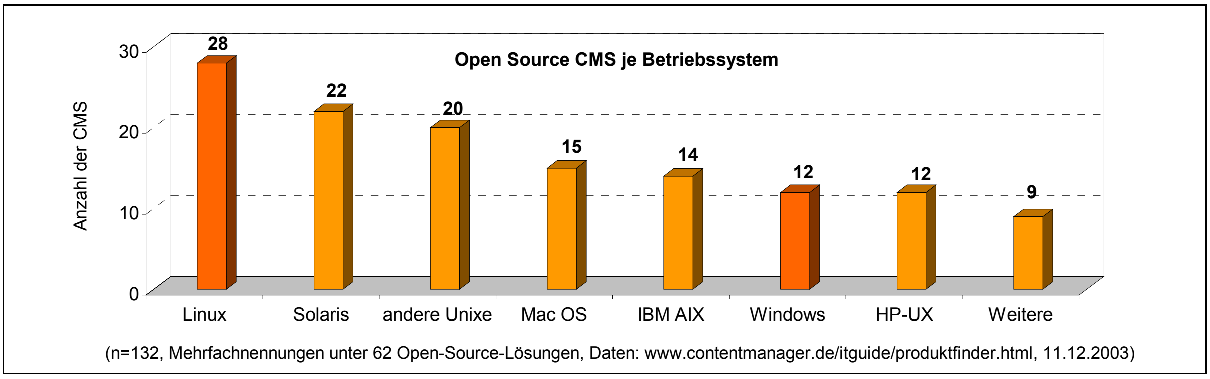

Abb. 4: Verfügbare Open Source CMS je Betriebssystem-Plattform bei Contentmanager.de

Will man eine Auswahl unter den verfügbaren Open Source CMS treffen, können weitere Vergleiche bezüglich verschiedener Merkmale getroffen werden. Neben der **Leistungsfähigkeit der Software** können noch zwei weitere grundlegende Entscheidungsparameter hinzugezogen werden: die Nutzerakzeptanz und verfügbare Serviceleistungen. Indikatoren für die **Nutzerakzeptanz** sind z.B. Beiträge in den sehr aktiv genutzten Foren von Contentmanager.de sowie Referenz-Webseiten, auf denen die CMS eingesetzt werden (auch diese sind auf Contentmanager.de abrufbar).

Ein wesentlicher Kritikpunkt, der in Zusammenhang mit Open Source Software häufig genannt wird, ist die Unsicherheit bezüglich der **Weiterentwicklung** und der Verfügbarkeit von **Serviceleistungen**. Speziell diese Unsicherheiten können aber durchaus bei der Entscheidung für ein CMS reduziert werden, indem ein solches System ausgewählt wird, welches von möglichst vielen **Dienstleistern (z.B. Webagenturen)** unterstützt wird. Bei Contentmanager.de besteht die Möglichkeit einer gezielten Dienstleistersuche, die für alle aufgeführten Open Source CMS durchgeführt wurde. Das **Ergebnis der Top 10 in Abb. 5** verdeutlicht, dass für solche Systeme wie Typo3, eZ publish oder Zope kaum ein baldiges Ende der Weiterentwicklung oder mangelnder Support zu befürchten ist. Gleiches gilt auch für Open CMS sowie das CMS des Linux-Distributors Red Hat, zumal in Abb. 5 nur die bei Contentmanager.de gelisteten Dienstleister enthalten sind.

Gleichzeitig soll an dieser Stelle noch einmal darauf hingewiesen werden, dass eine Open-Source-Software nicht vollkommen dezentral von einer unabhängigen Community entwickelt werden muss, entscheidend sind die Lizenzbedingungen (siehe Abschnitt 2.1). Beispielsweise ist der Hersteller von eZ publish die norwegische Firma eZ system, das CMS Contenido wurde von der deutschen four for business AG entwickelt. Bei einem offen verfügbaren Quellcode stellen die zusätzliche Entwicklergemeinde sowie eigene individuelle Gestaltungsmöglichkeiten deutliche Vorteile gegenüber proprietärer kommerzieller Software dar, die ihrerseits wiederum auch kostenlos angeboten werden kann (z.B. www.interlogics.de).

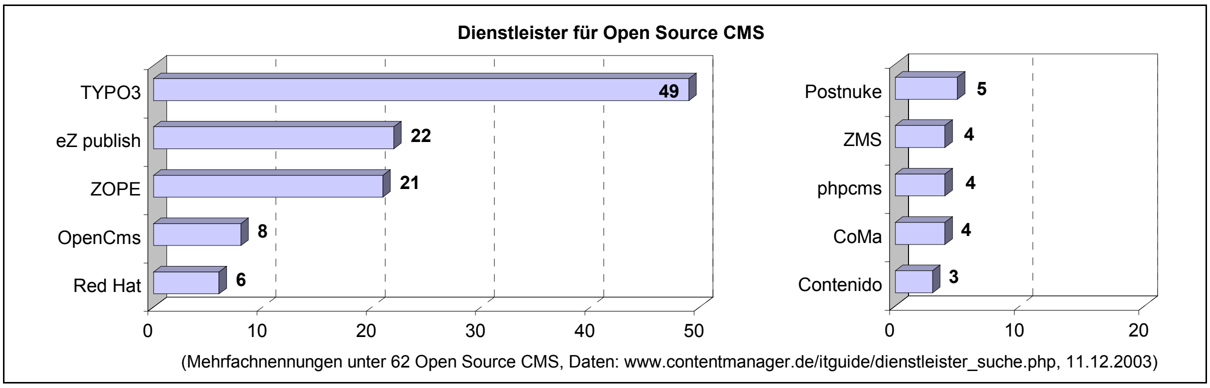

Abb. 5: Aufgeführte Dienstleister für Open Source CMS bei Contentmanager.de

3 TYPO3 ALS BEISPIEL EINES OPEN SOURCE WCMS FÜR DEN PROFESSIONELLEN EINSATZ

Im Folgenden soll beispielhaft das bekannte Open Source WCMS Typo3 kurz vorgestellt werden, welches laut Contentmanager.de von 49 Dienstleistern im deutschsprachigen Raum unterstützt wird. Die Anfänge von Typo3 gehen auf den dänischen Programmierer Kasper Skårhøj (Curby Soft, Kopenhagen) zurück, der nach Beginn der Entwicklung 1997 auch heute noch die Weiterentwicklung koordiniert (Typo3.org). Typo3 steht unter der GPL (Gnu Public Licence) und ist ein in PHP geschriebenes CMS für Webseiten, also ein echtes WCMS, das seine Inhalte in einer MySQL-Datenbank verwaltet. Neben der grundsätzlichen Möglichkeit, die Seiten dynamisch aus der Datenbank zu erzeugen, eignet sich Typo3 auch für die Bearbeitung statischer Seiten. Zur Administration des Systems und zur Redaktion der Inhalte genügen ein Internetzugang und ein Web-Browser.

Typo3 läuft plattformunabhängig sowohl unter Linux, Windows sowie unter diversen Unixen und Mac OS. Es unterstützt als Web-Server unter anderem Apache oder den Windows-IIS, PHP und MySQL (als vollständige Open Source Variante auch als LAMP: Linux, Apache, MySQL und PHP). Die Software steht zum kostenlosen Download auf der Typo3.org-Homepage in verschiedenen Varianten, u.a. als komplettes AMP-Installationspaket (Apache, MySQL, PHP) für Linux und Windows, zur Verfügung.

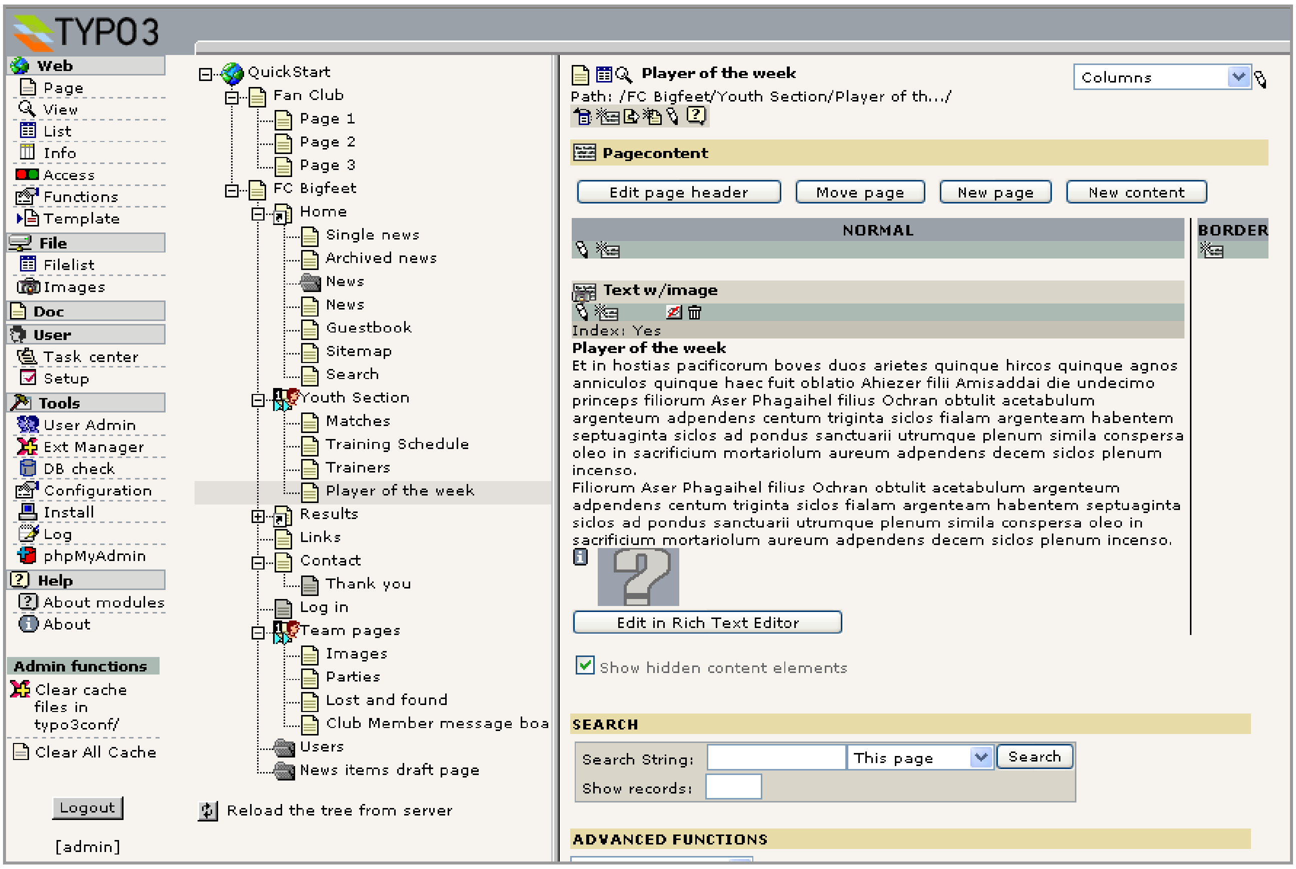

Abb. 6: Screenshot des Backends von Typo3

Aufgrund seiner Leistungsfähigkeit kann Typo3 als vollwertige Alternative zu kommerziellen proprietären Lösungen selbst in umfangreichen Web-Projekten eingesetzt werden. Typo3 bietet im **Backend** für den Administrator eine ausgefeilte **Funktionalität:**

- eine sehr differenzierte Benutzerverwaltung bis hin zu einzelnen Absätzen,
- Versionscontrolling,
- Mehrsprachigkeit (auch die Typo3-Oberfläche ist in 16 Sprachen verfügbar),
- extreme Erweiterungsmöglichkeiten (über 200 fertige Module, z.B. News, Newsletter-Versand inkl. Opt-in/Opt-out, Volltextsuche, passwortgeschützte Bereiche, Shopsystem, Adressverwaltung, Diskussionsforum, Formularmail u.a.),
- die automatische Erzeugung statischer HTML-Dateien (wichtig für Suchmaschinen) sowie
- als Highlight die dynamische Erzeugung und Bearbeitung von Bildern und Navigationselementen.

Die Steuerung der Funktionalität erfolgt mittels der eigenen Skriptsprache TypoScript. Eine **große weltweite Community** trägt zur Weiterentwicklung von Typo3 bei, die Kernfunktionalität wird aus Qualitätsgründen zentral kontrolliert und hergestellt. Der Support ist einerseits durch professionelle Dienstleister sichergestellt (siehe Abb. 5), darüber hinaus gibt es etliche Diskussionsforen und Tutorials, sowohl bei Typo3.org als auch bei diversen Dienstleistern (Altmann 2003, S. 98-100).

Webagenturen, die sich Typo3 als WCMS bedienen, heben immer wieder die leichte Bedienung und die schnelle Einarbeitung im **Frontend-Bereich** hervor. Die Bearbeitung erfolgt ähnlich wie mit herkömmlicher Textverarbeitungssoftware im WYSIWYG Modus (RichText Editor), d.h. Text kann direkt formatiert und auch über Copy & Paste eingegeben werden (alles über Web-Browser). Darüber hinaus können nicht nur Inhaltselemente, sondern ganze Seiten und Seitenbäume per Copy & Paste kopiert und verschoben werden.

Die weite Verbreitung von Typo3 geht bereits aus Abb. 5 hervor: mit 49 Dienstleistern ist Typo3 das mit Abstand am meisten verwendete bzw. unterstützte CMS. Direkt bei den verschiedenen Dienstleistern, bei den gelisteten Dienstleistern auf Contentmanger.de oder auf der Homepage von Typo3 (http://typo3.org/1342.0.html) finden sich zahlreiche **Referenzen für den Einsatz von Typo3** als CMS. Einige Referenzen für den deutschsprachigen Raum sind in Tab. 3 zusammengefasst, wobei der Schwerpunkt auf Webseiten von Kommunen (Gemeinden, Städte, Landkreis) oder von anderen öffentlichen Einrichtungen liegt.

Referenzen	Homepage	Agentur
Auerbergland (LEADER+ Projekt)	www.auerbergland.de	www.dpool.net
Bodenseekreis	www.bodenseekreis.de	www.netzwerte.de
Gemeinde Schwangau (Bayern)	www.schwangau.de	www.netzwerte.de
Gemeindeverband Surselva	www.gvsurselva.ch	www.icsurselva.ch
Kreis Warendorf	www.kreis-warendorf.de	(keine Angabe)
Landkreis Ostallgäu	www.ostallgaeu.de	www.netzwerte.de
Stadt Füssen (Königswinkel)	www.fuessen.de	www.netzwerte.de
Stadt Lübbenau (Spreewald, Lausitz)	www.luebbenau-spreewald.de	www.artplan21.de
Stadt Viernheim (Hessen)	www.viernheim.de	www.pixelegg.de
Berliner Feuerwehr	www.berliner-feuerwehr.de	www.artplan21.de
Berliner Philharmoniker	www.berliner-philharmoniker.de	www.bgm-gmbh.de
Bündnis 90 / Die Grünen NRW	www.gruene-nrw.de	www.netfielders.de
Deutscher Sportbund	www.dsb.de	www.dkd.de
e-Government Bund-Länder-Gemeinden	http://reference.e-government.gv.at	(eigene Installation)
Schloss-Schule Heppenheim	www.schloss-schule-hp.de	www.dkd.de
Zoo Zürich	www.zoo.ch	www.icsurselva.ch

Tab. 3: Referenzbeispiele für die Anwendung von Typo3 im öffentlichen Sektor

Trotz der vielen Vorteile und der weiten Verbreitung muss im Einzelfall die Eignung von Typo3 überprüft werden. Aufgrund des mächtigen Funktionsumfanges gelten für Typo3 insbesondere die allgemeinen Bedingungen für den Einsatz eines CMS. Für kleine Webseiten erscheint Typo3 überdimensioniert und zu unhandlich, zudem erfordert der komplexe Aufbau eine längere Einarbeitungszeit für den Administrator. Für größere Projekte eignet sich Typo3 dagegen sehr gut, es lässt sich für fast alle Einsatzfälle konfigurieren und hält für eine Vielzahl von Funktionen bereits fertige Module bereit. Bei der vorhandenen weltweiten Entwicklergemeinde kann davon ausgegangen werden, dass Pflege und Support des Open Source Projektes auf längere Zeit gesichert sind. Ebenso stellen die technischen Voraussetzungen, hardware- wie softwareseitig, für den breiten Einsatz keine grundsätzlichen Hindernisse dar.

4 GEGENWÄRTIGER ANWENDUNGSSTAND VON CMS IN KOMMUNAL- UND REGIONALPORTALEN

CMS eignen sich für den Einsatz größerer Webauftritte mit einer hohen Änderungsfrequenz, insbesondere wenn verschiedene Personen zeitnah und unabhängig voneinander die Inhalte pflegen sollen. Ein solcher Anwendungsfall ist bei Kommunal- und Regionalportalen gegeben, die von Kommunen, Tourismusverbänden, Webagenturen und anderen Unternehmen und Einrichtungen betrieben werden. Kommunal- und Regionalportale bieten eine Vielzahl von Informationen und Dienstleistungen auf ihren Webseiten an und stellen damit ein Abbild des vielfältigen gesellschaftlichen Lebens im räumlichen Bezug dar.

Kommunal- und Regionalportale waren im Frühjahr 2003 Gegenstand einer **eigenen empirischen Erhebung**. Im Gegensatz zu anderen Untersuchungen, die sich auf die Analyse der Webseiten beschränkten, wurden erstmals die Portale direkt befragt. Die webbasierte Befragung verlief sehr erfolgreich, es nahmen **1.478 Portalbetreiber** von Gemeinde-, Gemeindeverbund-, Stadt- und Landkreis-Portalen (kommunale Portale) sowie von nicht-kommunalen, privaten Regional-Portalen teil. Aus den Ergebnissen, die vollständig unter www.local-ecommerce.de verfügbar sind, werden im Folgenden einige spezielle Auswertungen zu CMS präsentiert.

Die Anwendung eines CMS wurde in der Frage nach der Organisation der Informationsbeschaffung thematisiert (Abb. 7). Von den Antwortenden gaben nur 15% an, die Informationen dezentral über ein CMS zu erfassen. Der Rest der Portalbetreiber (85%) stellt die Inhalte selbst online, wobei 29% immerhin bei der Informationsbeschaffung mit regionalen Partnern zusammenarbeiten. Gerade für dieses knappe Drittel an Portalen ist der Einsatz eines CMS besonders sinnvoll, um die Informationen kostengünstig und aktuell veröffentlichen zu können.

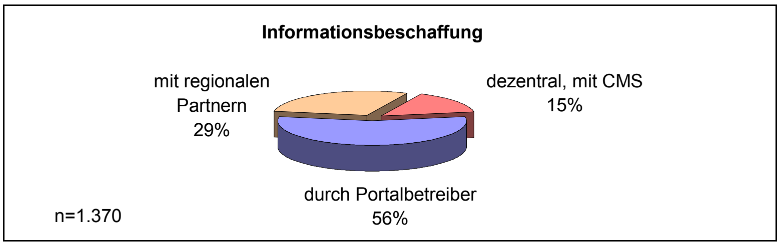

Abb. 7: Organisation der Informationsbeschaffung für das Portal

In der Befragung und in der Auswertung wurde besonderer Wert darauf gelegt, Unterschiede zwischen den Portalarten herauszuarbeiten. Wie die differenzierte Analyse in Abb. 8 zeigt, lassen sich drei Gruppen voneinander unterscheiden:

- Stadt- und Regional-Portale weisen mit etwa 20% den höchsten Anwendungsgrad an CMS auf. Unter Berücksichtigung von Kooperationen mit regionalen Partnern zur Informationsbeschaffung verbleibt in dieser Gruppe noch ein Anteil von 46% (Stadt-Portale) bzw. 51% (Regional-Portale), die sich ausschließlich allein um ihre Informationen kümmern.
- Einen ähnlich hohen Anteil in der Nutzung von CMS besitzen die Landkreis-Portale. Nur ist bei diesen der Teil, die noch keine externen Informationslieferanten besitzen, mit 60% schon sichtbar größer.
- Am wenigsten werden CMS bei den Gemeinde- und Gemeindeverbund-Portalen eingesetzt (ca. 10%). Dementsprechend hoch (ca. 60%) ist wie bei den Landkreis-Portalen der Anteil an Portalen, die allein ihre Informationen beschaffen.

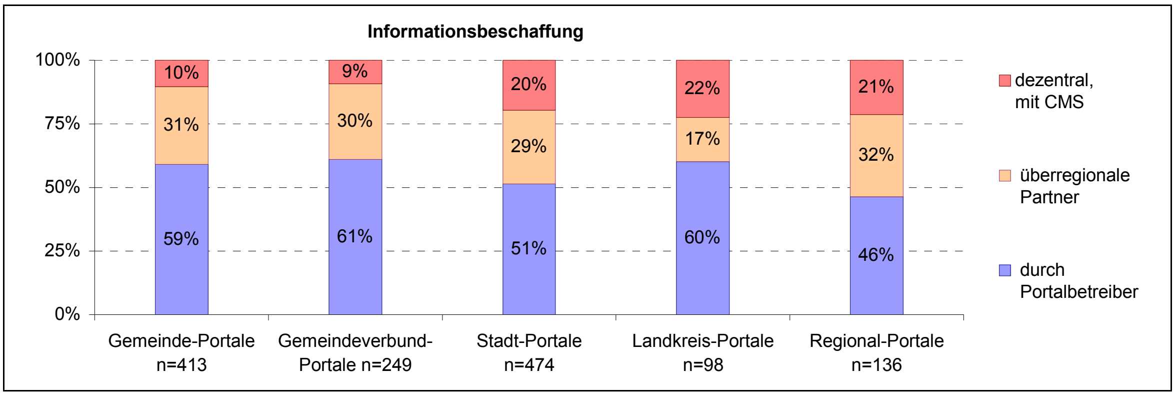

Abb. 8: Vergleich der Organisation der Informationsbeschaffung für das Portal in Abhängigkeit von der Portalart

Die Befragung der Portalbetreiber war inhaltlich sehr breit angelegt. Damit besteht die Möglichkeit zu überprüfen, ob **Zusammenhänge zwischen dem Einsatz eines CMS und anderen Variablen** bestehen. Die Antwortenden entsprechend Abb. 7 wurden dazu in zwei Gruppen unterteilt: die 15% CMS-Anwender bilden die erste Gruppe (210 Portale), die restlichen 85% (29%+56%) bilden die zweite Gruppe, die noch kein CMS nutzt (insgesamt 1.160 Portale). Die Überprüfung des Antwortverhaltens beider Gruppen mittels Varianz- und Kontingenzanalysen führte zu folgenden Ergebnissen:

- Signifikante Unterschiede zeigen sich beim **Hosting**: Portale mit CMS verfügen zu 19%, Portale ohne CMS nur zu 11% über einen eigenen Server. Letztere nutzen dafür stärker überregionale Provider (42% gegenüber 34% der CMS-Nutzer).
- Der **Einsatz eines CMS** hängt signifikant mit einer **häufigeren Aktualisierung der Inhalte** zusammen. 47% der Portale mit CMS aktualisieren mindestens täglich die Inhalte (davon 25% mehrmals und 22% einmal am Tag). Bei Portalen ohne CMS sind es nur 26% (10% mehrmals und 16% einmal am Tag).
- Bei den **inhaltlichen Zuständigkeiten** für das Portal weisen die Angaben der Portale mit CMS signifikant höhere Werte auf hinsichtlich der Regionalportalbetreiber (16% mit | 8% ohne CMS), privaten Aktivitäten (19% | 11,5%) und Werbe-/Web-Agenturen (11% | 7%). Ebenfalls signifikant größer ist der Anteil von Werbe-/Web-Agenturen bei der **technischen Zuständigkeit** des Portalbetriebs (42% | 33%).
- Auch beim Portal-Controlling schneiden Portale mit CMS signifikant besser ab: 72% der Portale mit CMS gegenüber 58% ohne CMS erfassen regelmäßig ihre **Zugriffszahlen**. Ebenso ist das Verhältnis bei der **Anpassung der Portalinhalte**, was sich mit Hilfe eine CMS wesentlich einfacher realisieren lässt (55% der Portale mit und 40% ohne CMS).
- Portale, die ein CMS einsetzen, schätzen die **Akzeptanz des eigenen Portals** signifikant besser ein (Mittelwert 3,8 gegenüber 3,6 bei den anderen Portalen). Auf einer Skala von 1 (sehr schlecht) bis 5 (sehr gut) gaben beispielsweise 16% der CMS-Nutzer eine sehr gute Akzeptanz an, bei den übrigen Portalen waren es nur 8%.
- Bei der Frage, in welchem Maße verschiedene Gruppen **beim Portalbetrieb mitwirken sollten**, konnten nur bezüglich der Unternehmen signifikante Unterschiede festgestellt werden. 80% der Portale mit CMS wünschen eine mindestens teilweise

Mitwirkung, von den restlichen Portalen waren es nur 70%. Während die anderen Nennungen (Vereine, Regionalmarketing) in die gleiche Richtung gingen, gab es zur Mitwirkung der Bevölkerung eine gegensätzliche Tendenz: 51% der CMS-Anwender wünschen keine direkte Mitwirkung, gleicher Meinung sind bei den anderen Portalen nur 41%.

- Eine direkte Mitwirkung ist also nicht immer im Zusammenhang mit einem CMS erwünscht; positiver gestaltet sich dagegen die **allgemeine Zusammenarbeit** (z.B. zur Informationsbeschaffung). Zu allen genannten 14 regionalen Akteuren (von der Bevölkerung über Vereine, Handel, Gewerbe, Tourismus bis hin zur Presse) war der Anteil der CMS-Nutzer grösser, die eine Zusammenarbeit angaben. Am deutlichsten fiel die Differenz bei Unternehmen und Händlern, Bildungseinrichtungen und verschiedenen Vereinsgruppen (9%-10%) sowie bei der lokalen/regionalen Presse (8%) aus.
- Interessante Ergebnisse liefert der Vergleich der Antworten zu den **Problemfeldern**. In der Befragung sollte zu sechs vorgegebenen Problemkategorien angegeben werden, ob bei diesen in der **Vergangenheit** und/oder in der **Gegenwart** Probleme aufgetreten sind bzw. noch bestehen. **Sicherheits- und Organisationsprobleme** traten in der Vergangenheit bei Portalen mit CMS häufiger auf, im Vergleich zur Gegenwart reduzierten sich diese Probleme aber wesentlich stärker als bei Portalen, die kein CMS nutzen. Auch hinsichtlich der **Aktualisierung der Inhalte** gaben Portale mit CMS gegenüber der Vergangenheit weniger Probleme an als andere Portale. Bemerkenswert ist die entgegengesetzte Entwicklung bei **Problemen mit der technischen Umsetzung**, diese hat bei CMS-Nutzern zwar auch abgenommen, aber im geringeren Maße als bei den übrigen Portalen. Bezüglich Finanzierungs- und Personalproblemen konnten keine Unterschiede im Zeitablauf festgestellt werden.

5 FAZIT

Aufgrund der breiten inhaltlichen Ausrichtung von Kommunal- und Regionalportalen ist für diese ein WCMS in jedem Fall zweckmäßig und empfehlenswert. Mit umfassenderen und aktuelleren Inhalten unter Einbeziehung vieler regionaler Akteure können die Portale besser ihrer Funktion als zentrale regionale Informations- und Kommunikationsplattformen im Internet gerecht werden. WCMS dienen dabei nicht nur der quantitativen und qualitativen Verbesserung der Portalangebote, durch ein optimiertes Informationsmanagement können auch Kosten eingespart werden, indem Contentarbeiten von technischen Fachkräften auf die inhaltlich betreffenden Mitarbeiter übertragen werden. Für Kommunalportale kann sogar eine weitere Entlastung von Verwaltungsmitarbeitern erfolgen, wenn nicht-administrative Informationen durch regionale Partner direkt redaktionell betreut werden (bis hin zu Public-Private-Partnerships bei großen Portalen).

Aus diesen Gründen sollten auch in Zeiten besonderer Belastung finanzielle Engpässe allein kein Grund sein, auf ein WCMS zu verzichten. Mit Open Source Applikationen besteht die Möglichkeit, entscheidende Lizenzkosten einzusparen, wobei auf professionellen Support nicht verzichtet werden muss. Ebenso muss keinesfalls gleich die gesamte IT-Infrastruktur umgestellt werden, denn diverse Open Source Applikationen können auf verschiedenen Plattformen eingesetzt und durch den offenen Quellcode flexibel angepasst werden. Diese Fakten sollten zumindest am Beispiel von Open Source WCMS und insbesondere an Typo3 deutlich geworden sein, gleiches gilt natürlich auch für weitere Vertreter von WCMS.

Zahlreiche Referenzseiten zeugen bereits jetzt schon davon, dass WCMS als Open Source Lösungen auch im öffentlichen Bereich genutzt werden. Dennoch stellt sich die Frage, warum der Anteil nicht noch höher ausfällt. Als ein zentrales Problem scheinen sich Informationsdefizite verbunden mit Unsicherheiten herauszukristallisieren. Stellvertretend dafür steht die ausführliche Diskussion zum Thema „Bestes CMS für die öffentliche Hand?“ unter www.contentmanager.de/community/forum/2/6022/6022.html. Viele der dort angeführten Vorbehalte konnten in diesem Beitrag entkräftet werden, dennoch erscheinen sie immer wieder. Um zu einer kostenoptimalen Lösung zu gelangen, stehen gerade öffentliche Einrichtungen vor der Notwendigkeit, sich umfassend zu informieren. Dazu wäre es durchaus sinnvoll, durch Open Source Lizenzkosten einzusparen und dafür in eine ausführlichere professionelle Beratung für die Systemauswahl und -implementierung zu investieren.

6 QUELLENVERZEICHNIS

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Dienste-basierte Aufbereitung von Geländemodellen für die 3D-Geovisualisierung

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1 EINLEITUNG

In der 3D-Geovisualisierung ist das Geländemodell das Geoobjekt, das aufgrund seiner direkten Verbindung mit vielen weiteren abzubildenden Geoobjekten, deren Eigenschaften oder komplexen räumlichen Modellen (z.B. Bauwerke, Verkehrsinfrastruktur, Atmosphäre und deren jeweilige Modellierung in Abhängigkeit von der Zeit bzw. in Zusammenhang mit Simulationsmodellen) häufig Gegenstand von wissenschaftlichen Arbeiten ist. In monolithischen GIS (vollständig auf einem lokalen System installiert – evtl. mit Ausnahme der Datenhaltung) existieren meist spezialisierte Werkzeuge, anhand derer bestimmte geometrische Anpassungen vorgenommen werden können. Dies ist häufig entweder unter Anwendung von spezialisierten Werkzeugen oder ener weitgehend händischen Datenaufbereitung und Einarbeitung bestimmter Erfordernisse in die Datengrundlage bzw. das Datenmodell durch GIS-Experten verbunden. Durch verschiedene fachliche Fragestellungen ergeben sich häufig grundsätzlich verschiedene Anforderungen an die Art der Modellierung. Insbesondere eine weitgehend parametrisierte Generierung von angepassten Geländemodellen für bestimmte Fragestellungen wäre wünschenswert.

Dieser Beitrag soll die Fragestellung der weitgehend automatisierten Geländemodellerzeugung für den konkreten Anwendungsfall von Flusseinzugsgebieten vertiefen. Hierbei wird auf bestehende Methoden der algorithmischen Geometrie zurückgegriffen, die als spezialisierte Web-Dienste gemäß OGC gekapselt werden. Da ein solcher Beitrag keinen Anspruch auf Vollständigkeit erheben kann, liegt der Fokus auf einem Modul aus einer Dienstekette. Dies liefert ausgehend von einem generalisierten Dreiecksnetz (triangulated irregular network – TIN) und einem aus Polylinien von Flussprofilen erzeugten TIN ein Geländemodell, das eine möglichst realitätsnahe 3D-Visualisierung von Flussauen ermöglicht und durch die Verbindung zwischen Geoobjekt und Visualisierungsobjekt gleichzeitig weitergehende Interaktionsmöglichkeiten vorbereitet. Die Idee von Modulen oder Dienst-Modulen folgt den Anregungen von Bernardinello (BERNARDINELLO ET AL. 1992) und hat die Zielsetzung, komplexe Programmabläufe in generische funktionale Einheiten zu unterteilen, die nach Bedarf auch verteilt oder parallel ablaufen können und wiedernutzbar sind. Dieser Text baut auf die allgemeine Architektur-Beschreibung aus „Dienste-basierte Architekturen für die Web-basierte 3D-Geovisualisierung“ (SCHMIDT ET AL. 2003) auf, und bewegt sich mit dem Geländemodell im Wesentlichen auf der Ebene der ‚Features’ aus der folgenden Abbildung:

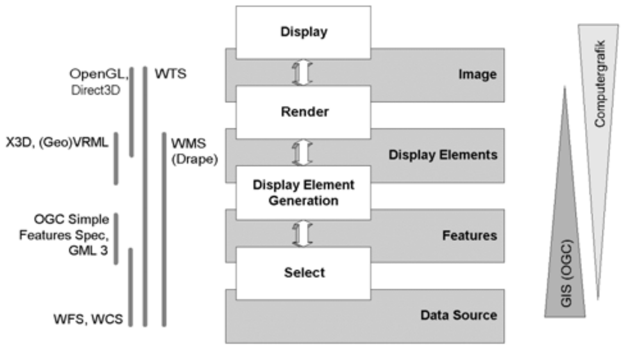

Abb. 1: OGC-Modell des Visualisierungsprozesses (leicht modifiziert) mit potenziell beteiligten Diensten und Beschreibungssprachen (Quelle: SCHMIDT ET AL. 2003)

2 GRUNDLAGEN

Gegenstand dieser Betrachtungen ist Software, die in etwa der breit angelegten Kategorie „multidisziplinäre ViSC-Werkzeuge“ zuzuordnen ist (FUHRMANN 2001, S. 6). Diese ist eine Untergruppe aus der Software-Domäne der 3D-Geovisualisierung. Die Kategorien werden anhand einer Vielzahl von Eigenschaften der jeweiligen betrachteten Software ermittelt.

3D-Geovisualisierung im Internet verwendet in gängigen Visualisierungs-Systemen meist Geländemodelle, die als ein Teil eines Visualisierungsdaten-Pakets verpackt oder als separater Teil zu einem Client gesendet werden. In welchem Zustand sich das Geoobjekt Geländemodell vor seinem Eintritt in die Applikation befindet, unterliegt unter Ausklammerung der womöglich nötigen Aufbereitung von Rohdaten dem Anwendungszweck. Beispielsweise können die Basisdaten, die häufig in Form von Höhenrastern vorliegen, zu einem für den Visualisierungs- oder Interaktionszweck geeigneten Geländemodell umgeformt werden. Geländemodelle können unterschiedlich großen Vorverarbeitungsaufwand verursachen und die späteren Interaktionsmöglichkeiten und die Koppelungsfähigkeit von externen Modellen beeinflussen. Dabei muss berücksichtigt werden, dass das Geoobjekt Geländemodell mit vielen weiteren Geoobjekten in Verbindung steht und als solches ebenfalls durch eine Visualisierungspipeline in ein oder mehrere Visualisierungsobjekte umgewandelt werden muss (SCHMIDT ET AL. 2003).

Häufig verwendet werden die Ausgangsdaten des Grids in einer Punkt- oder Kanteninterpretation der Rasterzellen als Geoobjekt. So können für die Erzeugung des Visualisierungsobjekts die jeweils in einer Zelle des regelmäßigen Gitters aus einer Approximation des Grids (RASE 1998) stammenden vier Punkte, anhand von zwei Dreiecken vermascht werden, um eine flächige Repräsentation zu erreichen. Auch wenn die Dreiecke unter Berücksichtigung von umgebenden Zellen ausgerichtet werden, um die Kantenverläufe der Grid-Information so weit wie möglich anzunähern, sind nur bestimmte Winkel möglich und somit eine geringe Flexibilität, um das

Relief zu gestalten (siehe nächster Absatz und vgl. CEBECAUER ET AL. 2002). Vorteile solcher Grid-basierten Geländemodelle sind insbesondere bei größeren in Frage kommenden zu visualisierenden Arealen die unaufwändige Auswahl von beliebigen rechteckigen Bereichen und die recht einfache Erweiterungsmöglichkeit von schon auf den Client transferierten Geländeabschnitten. Dies gilt sowohl für das Geoobjekt als auch für das Visualisierungsobjekt des Geländes, sofern die Rasterstruktur noch in ihm repräsentiert wird. Beispielsweise sind eine Vielzahl von Lösungen für Level-of-Detail-Darstellungen (Entfernungsabhängige Anpassung des Detailgrads von Visualisierungsobjekten) von Raster-basierten Geländevisualisierungen bekannt, die Teile des Geländes in Abschnitten oder sogar in kontinuierlichen Übergängen anhand des „continous level-of-detail"-Verfahrens (CLOD) angepasst visualisieren können (BARBISCH 2002, S. 6). Sollen feinere Geländestrukturen anhand von Visualisierungen, die auf diesen basieren, durch Erhöhung der Auflösung beispielsweise durch Interpolation sichtbar gemacht werden, wird das zu übermittelnde Datenvolumen bei dieser Methode trotz stark gewachsener Netz- und Rechnerressourcen schnell kritisch, da eine Verdoppelung der Auflösung für den gleichen Geländeabschnitt eine Vervierfachung der Datenmenge nach sich zieht. Es muss hierbei zusätzlich berücksichtigt werden, dass solche Verfahren für die Darstellung von Details insbesondere im Zusammenhang mit auf dem Geländemodell zu positionierenden 3D-Objekten nur bedingt geeignet sind, da das Problem der ‚Klaffung' nicht nur bei statischen Visualisierungsobjekten (GRÖGER 2003, S. 337), sondern insbesondere auch bei dynamischen auftritt. Eine mögliche Lösung für die Vermeidung von offensichtlichen Klaffungen zwischen Gelände und Gebäude ist die Einfügung von Sockeln zwischen den Visualisierungsobjekten. Diese Lösung ist zwar ohne Eingriff in die Geometrien möglich, führt jedoch zu offensichtlichen Abweichungen von der Realität und müsste ebenfalls kontinuierlich an ein CLOD-Verfahren angepasst werden. Unabhängig davon, wie genau die verwendeten Rasterdaten sind, wird jedoch die Visualisierung von weiteren Objekten basierend auf dieser Geländerepräsentation selbst ohne Verwendung von LODs immer Probleme verursachen, weil diese nur begrenzt mit der ursprünglichen Rasterinformation zur Deckung zu bringen sind. Als Beispiele seien hier Gebäude, Gewässer und Trassen genannt.

Eine andere Repräsentation einer Geländeoberfläche ist das unregelmäßige Dreiecksnetz (TIN). Bei der Erzeugung aus Raster-Daten wird die zellenbasierte Höheninformation des Grids auf eine geringst mögliche Anzahl von Dreiecken reduziert – soweit dies die einzigen Maßgaben sind. Gängige Generalisierungs-Verfahren lassen dabei die Angabe einer Abweichung zu. Aus einer Eingabe-Punktmenge (dem Raster) wird eine reduzierte Ausgabe-Punktmenge erzeugt, die nach der Vermaschung anhand bestimmter Eigenschaften (beispielsweise Delauney-Triangulation) eine Geländeoberfläche ergibt (BENDER ET AL. 2003, S. 210). Geländemodelle aus Dreiecksnetzen sind populär, weil sie eine wenig komplexe Datenstruktur darstellen und durch Standard-Hardware in der Regel einfach gerendert werden können. Da die Auflösung von TINs gut skalierbar ist, kann hier ein Mittelweg zwischen Datenvolumen und Genauigkeit beschritten werden (vgl. BISHENG).

Weitere Vorgaben über das Standard-Verfahren hinaus können hierbei feste Flächen, Kanten oder Punkte sein. Unter der Einschränkung, dass an dieser Stelle eindeutig die oben angegebene Software-Kategorie verlassen wird, sind 3D-Modellierungsumgebungen nutzbar, die die Verarbeitung von Grids unter Einarbeitung von Kanten und das manuelle Nachverarbeitung erlauben. So ist die Schaffung von Dreiecksnetzen beliebiger Genauigkeit möglich – allerdings unter Verwendung von spezialisierter Software und durch Experten. Die zugehörige Software-Kategorie ist die der „Terrain-Modeler" (FUHRMANN 2001, S. 6).

Der Abgrenzung halber sei hier die Kategorie der photorealistischen Landschafts-Renderer genannt. Da sie nicht echtzeitfähig sind, sind sie häufig so ausgelegt, dass sie zur Laufzeit eine Glättung der Basisdaten des Geländemodells vornehmen. Hierbei kommen fest integrierte beispielsweise fraktale Algorithmen zur Anwendung, die Glättungen und Schärfungen von Objekten bewirken können. Wird das TIN als Geländemodell nicht unterstützt, kann dies allerdings dennoch selbst in diesen Systemen, die deutlich mehr Rechenzeit zur Verfügung haben, das Ergebnis der Visualisierung sehr negativ beeinflussen, da beispielsweise die gezielte Modellierung von Geländekanten durch die Verwendung von TINs möglich wird – durch Grids jedoch nicht (BÜSCHER 2002, S. 81), was sich auch auf andere Software-Kategorien übertragen lässt.

Weitere hier nicht in Frage kommende Ansätze der Geländemodellierung sind für bestimmte Anwendungen vorstellbar, beispielsweise die Organisation anhand von Höhen- bzw. Isolinien. Auch die Reduktion auf Punktwolken, also die Vernachlässigung der Kanteninformation ist möglich und für bestimmte Operationen gut zu verwenden. Allerdings scheint für die Unterbringung von topologischen Informationen die Bildung von Verbindungskanten sinnvoll, die gleichzeitig zur Vermaschung in Form von Dreiecken nutzbar gemacht werden kann. Neben der Verwendung von Dreiecken sind auch andere planare Geometrien als Teil des Geländemodells denkbar, beispielsweise Polygone. So können plane Flächen im Gelände als eine Einheit modelliert werden. Bei den weiteren Betrachtungen bleiben auch ‚echte' 3D-Datenmodelle außen vor, d.h. es wird nur die Oberfläche des Geländes und nicht etwa das darunter liegende Volumen modelliert. Der volumen-basierte Ansatz wird Gegenstand weiterer Arbeiten sein. Für 3D-Analysen, wie z.B. Volumen-Berechnungen, werden bis dato haupsächlich Voxel-Daten-Modelle genutzt, also „3d-Raster". Die Ursache hierfür ist, dass derartige Funktionen in Anwendungen, die Vektor- oder Kanten-Formate nutzen, nur mangelhaft unterstützt werden (vgl. HANNUSCHKA 2002).

Zudem gibt es Erweiterungsmöglichkeiten, wie zum Beispiel verschiedene Modelle miteinander zu vermischen. Dies kann für die Betrachtungen im Rahmen der dienste-basierten Geländemodellierung zu einem späteren Zeitpunkt vorgenommen werden. So könnten basierend auf einem hybriden Mdoell einige Teile als Grid andere als TIN zugegriffen werden.

Der Phantasie sind bezüglich der Geländemodellierung keine Grenzen gesetzt. Entscheidend ist letztendlich der Zweck der Anwendung (MARTINONI ET AL. 1998).

3 PROBLEM-BESCHREIBUNG

Im Forschungsprojekt FLUMAGIS wird ein entscheidungs-unterstützendes Geoinformationssystem realisiert, das als eine Komponente eine echtzeitfähige 3D-Geovisualisierung mit auf bestimmte Anwendungsfälle bezogenen Interaktionsmöglichkeiten enthält. FLUMAGIS soll das Flusseinzugsgebiets-Management unterstützen und hat einen starken Bezug zur Wasser-Rahmen-Richtlinie (WRRL) der Europäischen Union.

Die folgende Grafik stellt eine Auswahl der für die weiteren Betrachtungen wichtigen möglichen Verarbeitungsschritte für das Geländemodell dar, die entweder als Teil der Visualisierungspipeline oder aber zur Aufbereitung der Datengrundlage durchgeführt werden.

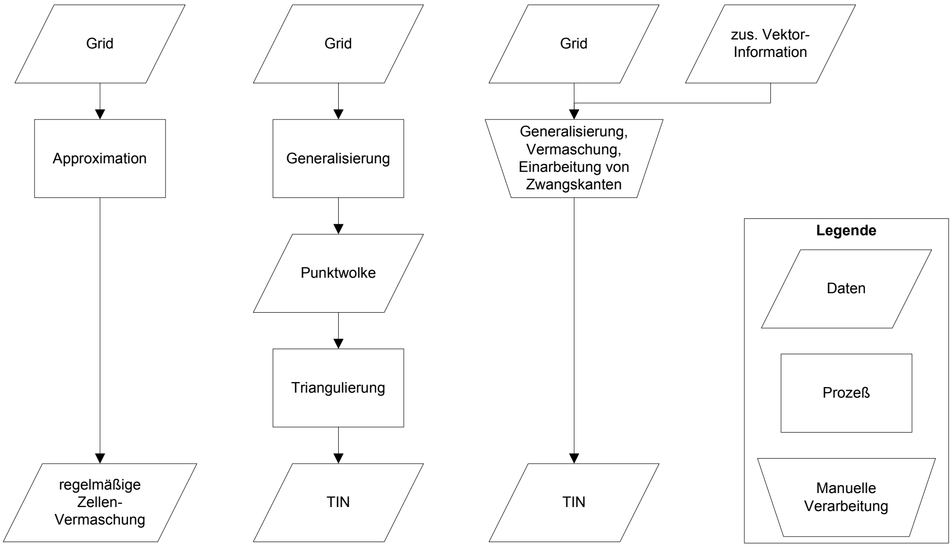

Abb. 2: Geländeaufbereitung vom Grid zum TIN (Quelle: Eigene Darstellung)

Um dem Planungsgegenstand gerecht werden zu können, müssen Fachfragen aus verschiedenen wissenschaftlichen Disziplinen Berücksichtigung finden. Aus den Anwendungsfällen und der Anforderungsanlyse ergeben sich für die 3D-Visualisierungskomponente folgende mit der Geländemodellierung in Verbindung stehenden Maßgaben (Allgemeine Anforderungen, wie die Echtzeitfähigkeit bleiben hier außen vor):

- Die Höhenverhältnisse in und um das Flussbett müssen denen der natürlichen Umwelt insoweit entsprechen, dass die Wasseroberfläche in ihrem gemessenen gemittelten Verlauf interpoliert zwischen bestimmten Stationen des Gewässers dargestellt werden kann.
- Eines der eingebunden Modelle kann den Wasserstand an bestimmten Punkten des Gewässers in Abhängigkeit von weiteren modifizierbaren Parametern ermitteln. Die Ergebnisse hieraus sollen zumindest näherungsweise darstellbar sein.
- Der visualisierte Geländeabschnitt soll anhand von fachlich festgelegten frei wählbaren Punkten im Auenverlauf selektierbar sein, dies ist nicht durch eine rechteckige Auswahlbox zu gewährleisten.
- Altarme des Gewässers sollen anbindbar sein.
- Der Verlauf des Gewässers soll (innerhalb definierter Grenzen) geändert werden können.
- Obwohl die im Projekt verwendeten Modelle noch nicht ohne Weiteres auf modifizierte Geländemodelle (aus der vorherigen Anforderung) angewendet werden können, muss der Rückbezug vom Visualisierungsobjekt zum Geoobjekt (Grid oder TIN!) vorhanden sein.
- Nutzbarkeit des Systems auch für nicht-Experten der Geländemodellierung.

Die Darstellung der Daten in ihrem nicht eingearbeiteten Zustand ist in Abbildung 3 zu sehen:

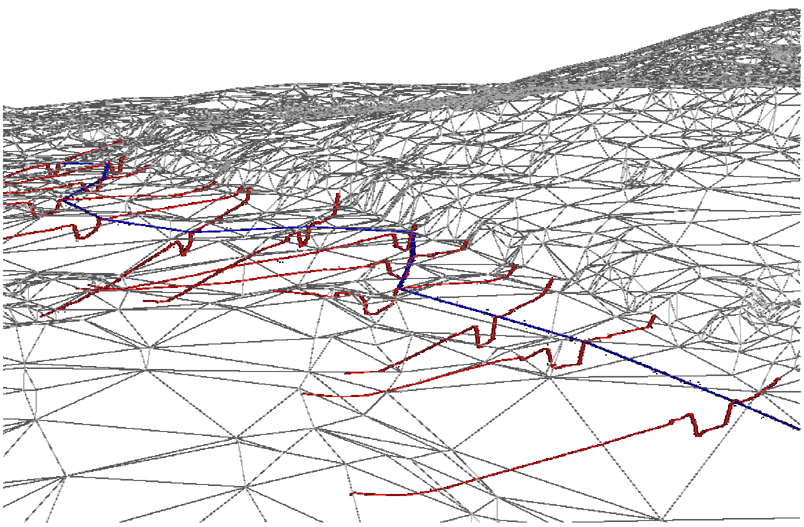

Abb. 3: TIN (weiß), Profile (rot) und Gewässerverlauf (blau) (Quelle: Eigene Darstellung)

Betrachten wir zunächst nur die erste Anforderung, so zeigt sich bei der Verwendung eines nicht weiter verarbeiteten Grids, das wie im vorigen Kapitel beschrieben regelmäßig vermascht und so in ein Visualisierungsobjekt umgesetzt wurde, dass probeweise eingefügte Wasserflächen deutliche „Treppen-Effekte" im Uferverlauf aufweisen (siehe Abb. 4). Hierfür liegen mehrere Gründe vor:

- Das erhältliche Grid aus Geobasisdaten hat eine Auflösung von 10 Metern.
- Die Breite des Gewässers schwankt zwischen 2 und 15 Metern.
- Das Grid enthält an den wasserbedeckten Stellen des Gländes nur unzulängliche Höhen-Informationen, da es im Überflug erstellt wurde. Die hierbei verwendeten Mess-Verfahren können die Wasseroberfläche nur wenige Zentimeter tief durchdringen.

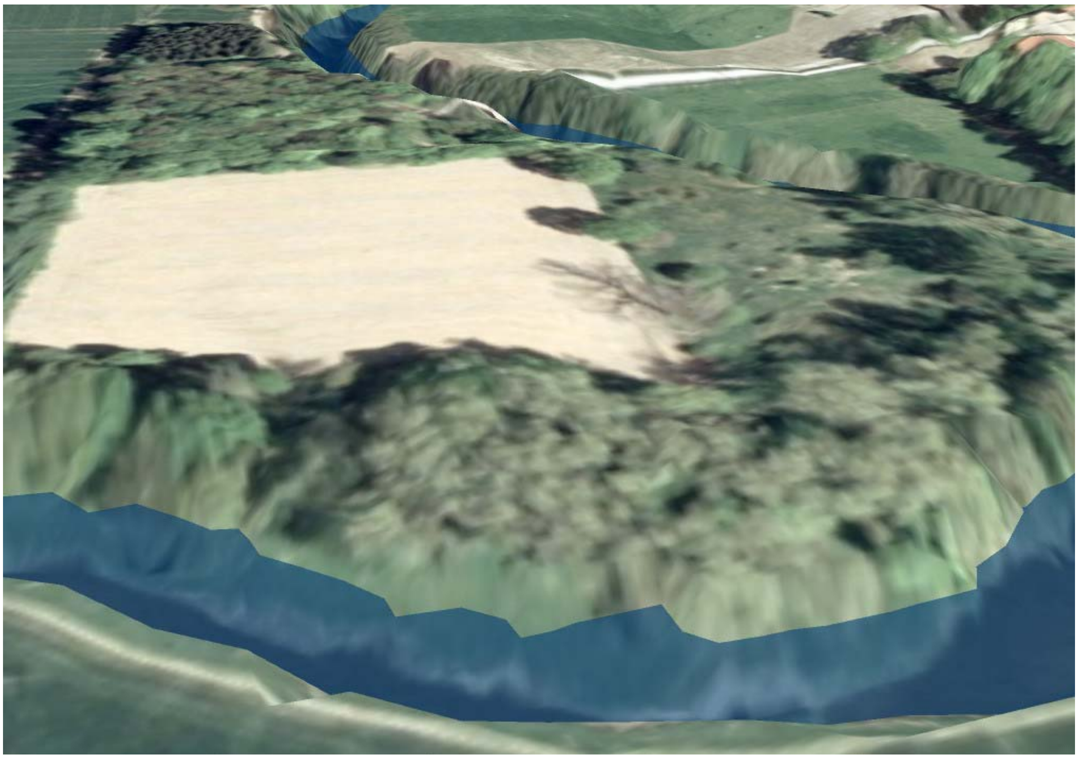

Abb. 4: Treppen-Effekt bei Grid-Vermaschung mit Wasserverschneidung (Quelle: Eigene Darstellung)

Die hier dargestellten sich ergebenden Probleme sind wie oben dargestellt hinlänglich bekannt und werden je nach Anwendungszweck entweder durch die Verwendung von Terrain-Modellern (s.o.) oder durch die Erhöhung der Auflösung des Grids anhand entsprechender Interpolationsverfahren behoben. Da die erste Variante für das gesamte Einzugs-Gebiet einen nicht leistbaren Aufwand verursachen und die Erhöhung der Auflösung das zu verarbeitende Datenvolumen exponential steigern würde, muss eine andere Lösung gefunden werden.

Desweiteren ergibt sich aus der Anforderung der möglichst genauen Darstellung der mittleren Wasserstände die Notwendigkeit, diese entweder durch Verschneidung mit dem Geländemodell zu ermitteln, oder die direkt auf die Gewässerprofile bezogenen Ufer-Informationen zu verwenden. An dieser Stelle ergibt sich das Dilemma, dass die Verschneidung der Wasserstandsinformation mit dem Geländemodell nur dann sinnvoll ist, wenn die Datengrundlage hinreichend genau ist. Um diese Genauigkeit zu erreichen, müssten die Profildaten ohnehin eingearbeitet werden – die zeitgleiche Berücksichtigung der vorhandenen Ufer-Information liegt nahe. Das Geoobjekt ‚Gewässer' wäre durch die Interpolation der Oberfläche zwischen den Profilen entlang dem Flussverlauf darstellbar und könnte in seiner flächenhaften Repräsentation sogar für die Synthese eines Volumenmodells in Form eines Polyeders genutzt werden. Wie oben dargestellt, kommt dann jedoch die Verwendung eines Grid-basierten Geländemodells nicht in Frage, da weder Wasseroberfläche noch Flussbett hinreichend genau modellierbar sind.

Neben der geometrischen Problemstellung der Altarmanbindung ist auch die Einhaltung bzw. Anpassung der topologischen Information des Gewässer-Netzes notwendig. Diese und der Verlauf des Gewässers wird in FLUMAGIS als Polylinie vorgehalten. Die Verbindung zum Geländemodell wird indirekt anhand von Flussprofilen möglich, die ebenfalls als Polylinien vorliegen. Zur Verdeutlichung siehe Visualisierung im experimentellen Prototyp (Abb. 5), in der die Wasseroberfläche lediglich als transparente waagerechte Ebene modelliert ist. Die Altarme werden sichtbar, sind jedoch als solche nicht identifiziert.

Abb. 5: Experimenteller Prototyp, Altarme werden sichtbar (Quelle: Eigene Darstellung)

Aus dem auch im Projekt praktizierten interdisziplinären Arbeiten und dem angestrebten Partizipations-Ansatz ergibt sich, dass die beschriebenen Vorbereitungen des Geländemodells so weit wie möglich automatisiert umgesetzt werden müssen. Es wird also ein Dienst-Modul benötigt, das den ‚Fußabdruck' von 3D-Geoobjekten in ein umgebendes Geländemodell hineinschneiden kann. Der ‚Fußabdruck' des Gewässers wird in einem weiteren Modul als ungleichmäßiges Dreiecksnetz aus den Flussprofilen erstellt (was auch Teile der umgebenden Flussaue einschließt). Wie dies geschieht, ist nicht Gegenstand dieses Dokuments und orientiert sich an den fachlichen Vorgaben aus den anderen Projektteilen (vgl. Abb. 5). Mit ‚Fußabdruck' ist also nicht nur die umgebende Polylinie gemeint, sondern eine aus mehreren Dreiecken zusammengesetzte Fläche, also ein TIN. Der Begriff ‚footprint' wird beispielsweise auch in der OGC Abstract Specification (OGC 1999, S. 6) verwendet.

Zur Verdeutlichung des Dienstmoduls dient die folgende Abbildung:

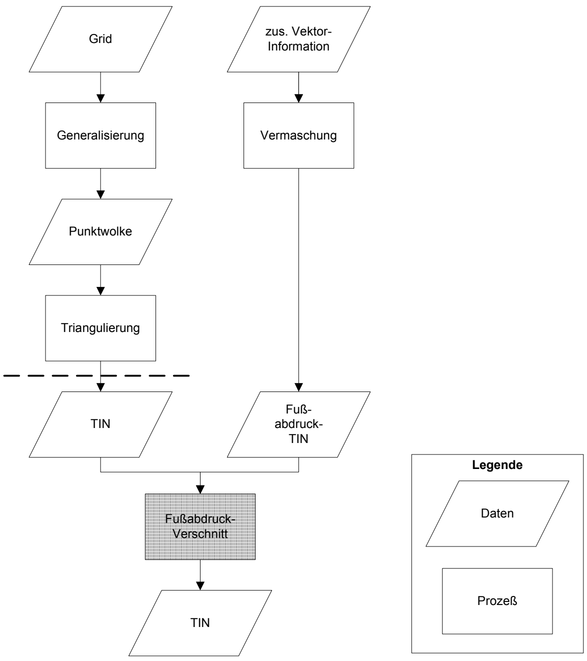

Abb. 6: Vorgehensweise zur Integration von Geländemodell und Flussprofilen (Quelle: Eigene Darstellung)

4 HERLEITUNG EINES VERFAHRENS

Dieses Kapitel soll die Entwicklung eines Dienst-Moduls ‚Fußabdruck-Verschneider' (Arbeitstitel) verdeutlichen. In diesem Modul werden zwei topologische Dreiecksnetze zu einem neuen topologischen Dreiecksnetz verschnitten. Dabei gibt es ein TIN (im Weiteren Ausgangs-TIN genannt), von dem eine zusammenhängende Teilfläche durch ein zweites (im Weiteren Fußabdruck-TIN genannt) ersetzt werden soll.

Das Ausgangs-TIN wird als ungleichmäßiges Dreiecksnetz vorgehalten. Die Geländemodelle sind mit Topologie modelliert, es sind die Entitäten Punkt, Knoten, Kante und Dreieck bekannt. Es handelt sich also um eine vereinfachte Datenstruktur, die sich an die Topologie-Spezifikation für Surfaces aus GML3 anlehnt (OGC 2003, S. 134). Das ‚TopoSurface' enthält gerichtete Oberflächen und Kanten, was hier zunächst vernachlässigt wird.

Das hier beschriebene Verfahren basiert auf folgenden Eigenschaften des Datenmodells für beide TINs:

- Verwendung eines vereinfachten Dreiecksnetz, das sich aus beliebig vielen Dreiecken zusammensetzt, die genau drei Kanten haben. Jede Kante hat eine Assoziation zu mindestens einem aber höchsten zwei Dreiecken und zu genau zwei Knoten. Jeder Knoten ist verbunden mit beliebig vielen Kanten und genau einem Punkt. Der Punkt enthält die geometrische Komponente als xyz-Koordinaten, ist also aus R^3. Abbildung 7 veranschaulicht dieses in einem vereinfachten Diagramm.
- Das Netz enthält für jede xy-Koordinate innerhalb seiner Außengrenzen mittelbar (durch Interpolation) oder unmittelbar (an den Knoten-Positionen) genau eine Höheninformation z, ist also eine eindeutige Funktion $z = f(x,y)$. Dies bedeutet, dass Überhänge, Höhlen und Löcher in der Geländeoberfläche bei dieser Betrachtung nicht berücksichtigt werden. Dies ist für aus Grids erzeugten Dreiecksnetzen zweifelsfrei unproblematisch, da diese ebenfalls eindeutig sind bzw. falls ein Zellen-Wert nicht vorliegt meist als Fehler oder fehlend interpretiert und daher interpoliert wird. Für aus weiteren Polylinien zusammengesetzte Dreiecksnetze muss dies jedoch berücksichtigt werden.

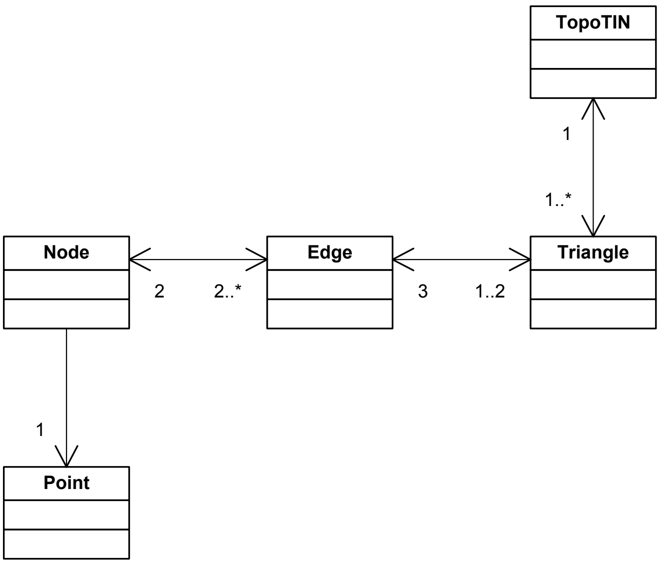

Abb. 7: Vereinfachte Topo-TIN-Datenstruktur für das Dienst-Modul (Quelle: Eigene Darstellung)

Das Dienst-Modul „Fußabdruck-Verschneider" bearbeitet somit folgende Datenflüsse, die in Abbildung 8 in verallgemeinerter Form dargestellt werden:

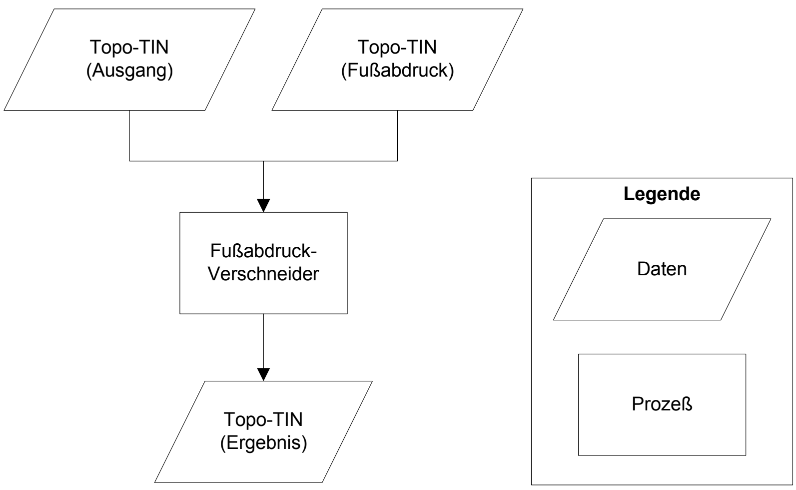

Abb. 8: Ein- und Ausgangsdaten (Quelle: Eigene Darstellung)

Verfahrensschritte:

1. Ermittlung der Außen-Kanten des Fußabdruck-TINs
2. Verschneidung der Außen-Kanten-Segmente mit den Kanten-Segmenten des Ausgangs-TINs
3. Erweiterung der Schnitt-Polylinie um die ermittelten Schnittpunkte
4. Neu-Vermaschung der außerhalb liegenden Teile der zu den geschnittenen Kanten gehörenden Dreiecke des Ausgangs-TINs
5. Entfernung der innerhalb gelegenen verbleibenden Teile des Ausgangs-TINs
6. Verbindung der beiden Teil-TINs anhand der ermittelten Knoten

Verfahren:

Zu 1.: Das Finden der äußeren Polylinie des Fußabdruck-TINs ist möglich, indem ausgehend von einer Kante, der nur ein Dreieck zugeordnet ist, alle Knoten und Kanten durchlaufen werden, für die dies gilt.

Zu 2.: Die Ermittlung der Schnittpunkte der Segmente wird dadurch vereinfacht, dass die beiden TINs unter schlichter Vernachlässigung der Höheninformation als auf die XY-Ebene projezierte Polygone betrachtet werden können. Die Kante des Fußabdruck-TINs wird unter Vernachlässigung der Höhen-Information zu einer Polylinie in derselben Ebene. Die Kanten der Dreiecke des triangulierten projezierten Polygons des Ausgangs-TINs und die Kanten dieser Polylinie stellen zwei Mengen von Linien-Segmenten dar, für deren Verschneidung der geometrische Algorithmus von Chan eingesetzt werden kann. Dieser ist exakt für die Aufgabe der Ermittlung der Schnittpunkte von zwei Segment-Mengen optimiert (CHAN 1994). Dieser Algorithmus kommt der hier gewählten Vorgehensweise entgegen, weil die End-Punkte der Kanten des TINs ohne die Unterscheidung zwischen den beiden Mengen zusätzliche Schnittpunkte ergeben würden, da sich die Kanten in eben diesen Punkten treffen. Das Ergebnis des Algorithmus nach Chan ist die Information, welche Segmente sich miteinander schneiden und der jeweilige Schnittpunkt.

Zu 3.: Der Außenrand des Fußabdruck-TINs wird dazu genutzt, die Höhenwerte der Schnittpunkte durch lineare Interpolation zu ermitteln. Die Kanten werden dann durch diese neuen Knoten ergänzt. Dies erzwingt die Unterteilung des jeweils zugehörigen Dreiecks in zwei neue unter Einfügung einer weiteren Kante.

Zu 4.: Anhand der ermittelten geschnittenen Kanten des Ausgangs-TINs können die geschnittenen Dreiecke neu gebildet werden. Dabei muss berücksichtigt werden, ob zwei oder ein Eckpunkt außerhalb liegen und ob zwischen den geschnittenen Kanten Eckpunkte der Schnitt-Polylinie liegen. Hierbei können sich verschiedene Möglichkeiten der Verknüpfung ergeben, die zunächst nicht näher betrachtet werden und ggf. dazu genutzt werden können, diese „Übergangsbereiche“ so gut wie möglich an die ursprüngliche Höheninformation anzunähern. Die Höheninformation muss jedoch für alle neuen Knoten aus dem Verbindungspolygon aus Schritt 1 übernommen werden.

Zu 5.: Die nicht mehr eingebundenen Knoten aus Schritt 4 können genutzt werden, um die innerhalb der Schnitt-Kante liegenden Teile des Ausgangs-TINs topologisch zu ermitteln und zu entfernen. So kann eine weitere geometrische Suche vermieden werden.

Zu 6.: Da das Verbindungspolygon nun in beiden überarbeiteten Teilen vorhanden ist, können diese unter Reduktion der beiden Polygone auf eines miteinander verbunden werden, ohne dass weitere geometrische Operationen benötigt würden.

Das hier dargestellte Verfahren macht deutlich, wie anhand einer vereinfachten Datenstruktur ein Laufzeit-optimierter Algorithmus zur Anwendung gebracht werden kann. Der Algorithmus von Chan wird auf 2-dimensionale Linien-Segmente angewendet, was hier keine Probleme bereitet, da die Höheninformation sowieso durch lineare Interpolation ermittelt werden müssen.

5 FAZIT

Das vorgestellte Verfahren zeigt, wie für die spezifischen Anforderungen für eine echtzeit-interaktive 3D-Landschaftsvisualisierung ein Modul konzipiert werden kann, um bestimmte Teile eines Geländemodells in ihrer Genauigkeit zu steigern. Dazu wurde ein vereinfachtes Geländemodell verwendet und das gewählte Verfahren stark auf ein geometrisches Problem reduziert. Vorteil dieser Vorgehensweise ist, dass das entwickelte Modul gut wiederverwendbar ist. Beispielsweise kann es auch verwendet werden, um das Geländemodell auf andere 3D-Objekte als das Gewässer vorzubereiten. Solange sich um Objekte handelt, deren Polylinien-Außenkanten (ohne Höheninformation!) sich nicht schneiden, ist auch eine mehrfache Verwendung des Moduls nacheinander möglich, da die Knoten außerhalb des neuen Fußabdrucks nicht verändert werden – somit also auch nicht die Kanten von vorher eingefügten, da diese ja eine vollständig geschlossene Verkettung von Kanten darstellen. Ebenso ist ein Einsatz an verschiedenen Stellen der Visualisierungspipeline vorstellbar, so lange das Dreiecksnetz dem spezifizierten Modell entspricht.

Das vorgestellte Verfahren hatte ursprünglich das Ziel, auch eine Echtzeit-Editierung des Benutzers zu ermöglichen. Die Möglichkeit wurde anhand der Verwendung von leistungsfähigen Datenstrukturen und Algorithmen mit optimierter Laufzeit vorbereitet. Fachspezifische Fragen, die die Bildung des eigentlichen Fußabdrucks betreffen, können in weiteren Dienst-Modulen verpackt werden. An dieser Stelle muss auch die Art der Interaktion modelliert und gegenläufig zur Visualisierungspipeline eingespeist werden. Die modulare Spezialisierung im Sinne der Einleitung legte eine Unterteilung an dieser Stelle nahe, um dieses Modul wiederverwendbar zu machen.

Als Schwachpunkt des Verfahrens ist anzusehen, dass beispielsweise die eingearbeiteten Veränderungen nicht rückgängig zu machen sind, sondern der Rückgriff auf Vorgänger-Versionen notwendig ist. Verschiedene Versionen einer Planung und die Aufeinander-Folge mehrerer Anwendungen des Moduls kann somit die Vorhaltung einer Vielzahl von vollständigen Geländemodellen erzwingen. Hierzu werden weitere Forschungen auf der konzeptuellen Ebene erfolgen, die nicht zuletzt die im Kapitel zwei erwähnten Mängel von 3D-Analyse-Funktionalitäten ebenfalls zum Gegenstand haben werden.

Sollte sich die Verwendung dieses Moduls in Zusammenhang mit den weiteren benötigten generischen Modulen für die 3D-Geovisualisierung als zweckmäßig herausstellen, wäre die Möglichkeit der Ausarbeitung einer Spezifikation als spezialisierter Web-Feature-Service (WFS) (OGC 2002) unter Verwendung einer GML3-kompatiblen TIN-Datenstruktur (OGC 2003) zu überprüfen.

Da sich als weitere Perspektive die Parallel-Verarbeitung und die Kaskadierung in Form von mehreren ähnlich spezialisierten Web-Services andeutet, wird eine verallgemeinernde Betrachtung hinsichtlich der Schaffung von Dienstnetzen für die 3D-Geo-visualisierung angestrebt. Besonders vielversprechend erscheint in dem Zusammenhang die nähere Betrachtung von allgemeineren (nicht-geo) Dienste-Modellen, wie z.B. Business-Prozess-Modellen.

6 LITERATUR

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Steckt der Teufel im Detail? Eignung unterschiedlicher Detailgrade von 3D-Landschaftsvisualisierung für Bürgerbeteiligung und Entscheidungsunterstützung

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1 ENTWICKLUNG UND EVALUATION VON 3D-LANDSCHAFTSVISUALISIERUNGEN

Bereits seit mehreren Jahrzehnten wird daran gearbeitet, Planungen durch 3D-Computervisualisierungen zu unterstützen, und heute ist es technisch ohne weiteres möglich, fotorealistisch wirkende Landschaftsbilder am PC zu generieren. Bisher ließen sich Softwareprogramme zur 3D-Landschaftsvisualisierung im Wesentlichen danach unterscheiden, ob sie auf detailreiche, fotorealistische Standbilder bzw. Animationen oder auf die Erstellung von Echtzeit-Umgebungen ausgerichtet sind. Dieses Unterscheidungsmerkmal wird durch aktuelle Entwicklungen in der Landschaftsmodellierung und durch Fortschritte in der Computergrafik und Computerhardware zunehmend hinfällig, so dass Softwarelösungen mit Echtzeit-Unterstützung, GIS-Integration sowie hohem Detailgrad technisch machbar werden. Je breiter aber die verfügbaren technischen Möglichkeiten sind, desto dringender stellt sich für Landschaftsvisualisierer und Planer die Frage nach der Wahl einer zweckentsprechenden Visualisierungsmethode (Appleton/Lovett 2003). Wichtige Kriterien für die Verwendung von Visualisierungen als Kommunikationsmittel in der Bürgerbeteiligung sind dabei die Auswahl geeigneter Detail- bzw. Abstraktionsgrade und Maßstäbe.

Die Autoren kommen aus zwei Forschungsverbünden, die sich auf unterschiedlichen Ebenen mit interaktiven Visualisierungstechniken zur Unterstützung der Kommunikation und Partizipation bei der Landschaftsentwicklung beschäftigen. Das von der Deutschen Bundesstiftung Umwelt (DBU) geförderte Projekt Lenné3D (www.lenne3d.de) entwickelt und erprobt ein prototypisches Softwaresystem zur auf GIS-Daten basierten, interaktiven 3D-Landschaftsvisualisierung aus Spaziergängerperspektive und Kartensicht (Paar 2003; Paar/Rekittke 2003). Im Vortrag werden aktuelle Forschungsergebnisse aus der Landschaftsvisualisierung und eine Live-Demo einer interaktiven Landschaftsvisualisierung präsentiert.

Die Forschergruppe an der ETH Zürich hat es sich im Rahmen des bereits auf der CORP 2003 vorgestellten EU-Projekts VisuLands zum Ziel gesetzt, die Entwicklung neuer Visualisierungsinstrumente zum Einsatz in der öffentlichen Beteiligung zu unterstützen. Vorgestellt wird eine empirische Methode zur Evaluation von unterschiedlichen Visualisierungsmethoden mit verschiedenen Maßstäben und Detailgraden. Für diesen empirischen Test wird die Lenné3D-Software im Vergleich mit weiterer Visualisierungssoftware auf Landnutzungsszenarien für ein Fallbeispiel in der Schweiz angewandt und mit lokalen Akteuren zusammen getestet. Im Mittelpunkt stehen dabei die Kriterien Detail- und Maßstabsgrad, Interaktivität und Inhaltsverständnis. Der Beitrag verbindet den Ausblick auf hochaktuelle Techniken der Landschaftsvisualisierung aus dem Projekt Lenné3D mit einer methodischen Diskussion der Anforderungen, den die partizipative Landschaftsentwicklung an diese stellt.

2 EIGNUNG UNTERSCHIEDLICHER DETAILGRADE FÜR BÜRGERBETEILIGUNG UND ENTSCHEIDUNGSUNTERSTÜTZUNG

2.1 Methodische und technische Ansätze zur Produktion von 3D-Landschaftsvisualisierungen

Unabhängig von der Software liegt den meisten Visualisierungen, welche reale Landschaften abbilden, ein ähnlicher Arbeitsablauf zugrunde. Die Basis für jedes 3D-Landschaftsmodell ist das Digitale Höhenmodell (DHM) zur Abbildung der Topografie. Auf das Höhenmodell werden Orthofotos oder Satellitenbilder im so genannten „Draping"-Verfahren projiziert. Alle weiteren Details müssen mithilfe zusätzlicher 3D-Objekte, z.B. Gebäude oder Vegetation, oder mithilfe von Oberflächen, so genannten Texturen, abgebildet werden. Gebräuchliche Arten von 3D-Objekten sind Billboards und 3D-Modelle. Bei Billboards handelt es sich um Texturen, die auf senkrecht stehende, ebene Flächen projiziert werden. Mit dieser Methode können z.B. Bäume mit relativ geringen Anforderungen an die Hardware dargestellt werden. 3D-Modelle dagegen nähern sich als dreidimensionales Netz aus Polygonen an die Form von Objekten an. Die Polygone lassen sich dann je nach gewünschtem Detailgrad mit Texturen belegen. Nach der Verteilung der 3D-Objekte lässt sich ein noch höherer Realitätsgrad durch die zusätzliche Einbindung von atmosphärischen Bedingungen wie der Witterung, durch eine natürliche Beleuchtung oder durch die Simulation dynamischer Prozesse erreichen (Achleitner et al. 2003, Ervin 2001).

Die einzelnen Arbeitsschritte stellen unterschiedliche Anforderungen an die Software und bislang muss noch auf Kombinationen aus verschiedenen Programmen zurückgegriffen werden, da sich mit keiner Software alle Aufgaben in gleicher Qualität erfüllen liessen. Notwendig sind in der Regel ein GIS zur Vorbereitung der Daten, Modellierungssoftware für Gebäude und Pflanzen sowie die eigentliche Software zur Landschaftsvisualisierung. Je nach Bedarf können noch weiter spezialisierte Programme zur Texturengenerierung, zur Verarbeitung von CAD-Daten oder zur Präsentation der Animationen sinnvoll sein. Generell kommen für die Erstellung von Realtime-Modellen drei Kategorien von GIS gestützter Visualisierungssoftware in Frage, die sich jedoch stark nach Kosten, Detailgrad der Darstellung und Benutzerfreundlichkeit unterscheiden. Real-Time Visualisierungssoftware aus dem

Highend-Bereich stellt die teuerste Lösung dar, bietet aber auch hohe Detailgrade. Beispiele dafür sind die 3D-Softwarepakete Creator von Multigen Paradigm und Terravista von Terrex. Besonders interessant für die Landschaftsplanung sind die Produktreihen World Construction Set (WCS) und Visual Nature Studio (VNS) von 3D-Nature, da diese im Bereich der 3D-Standbilder bereits fest etabliert sind und seit Oktober 2003 mit Scene Express auch ein Plugin für den Export in das, hohen Ansprüchen allerdings nicht mehr gerecht werdende, Echtzeitformat VRML anbieten. Etwas günstiger sind die aktuellen 3D-Plugins Imagine Virtual GIS von Erdas und 3D Analyst von ESRI. Für ArcView/ArcGIS bieten ausserdem die Drittanbieter Multigen Paradigm mit Sitebuilder3D und The Orton Family Foundation mit CommunityViz zusätzliche 3D Plugins an. Mit dem Virtual Terrain Project gibt es schliesslich auch eine Open-Source-Lösung, welche zwar noch nicht den Detailgrad der kommerziellen Produkte bietet aber dafür alle Vorteile von Open-Source-Software (freie Lizenz, Zugriff auf den Quellcode) besitzt. Das bereits erwähnte WCS/VNS ist auch bei der Produktion von Standbildern eine weit verbreitete Lösung, darüber hinaus existiert für Standbilder eine noch grössere Vielfalt an Software, die an dieser Stelle aber nicht weiter dargestellt werden kann (vgl. Dorau 1998, Geier et al. 2001, Jünemann et al. 2001).

2.1.1 Ergebnisse aus der Lenné3D-Vorstudie: Bedarf an verbesserter Vegetationsdarstellung

Aus Sicht der Landschaftsplanung besteht beim aktuellen Angebot an 3D-Software noch Verbesserungsbedarf wie die Vorstudie zum Lenné3D-Projekt (Paar 2003, Jünemann et al. 2001) gezeigt hat. Im Sommer 2000 hat die Hochschule Anhalt in einer repräsentativen Umfrage über 1000 potenzielle Softwareanwender bzw. -auftraggeber von Landschaftsvisualisierungen befragt (Buhmann/Jünemann 2000). Als Grundgesamtheit wurden freie Landschaftsarchitekten, Planungsbüros mit einem Arbeitsschwerpunkt in der Landschaftsplanung, staatliche und kommunale Behörden aus der räumlichen Fach- und Gesamtplanung sowie Dienstleister von Landschaftsvisualisierungen in Deutschland angesprochen.

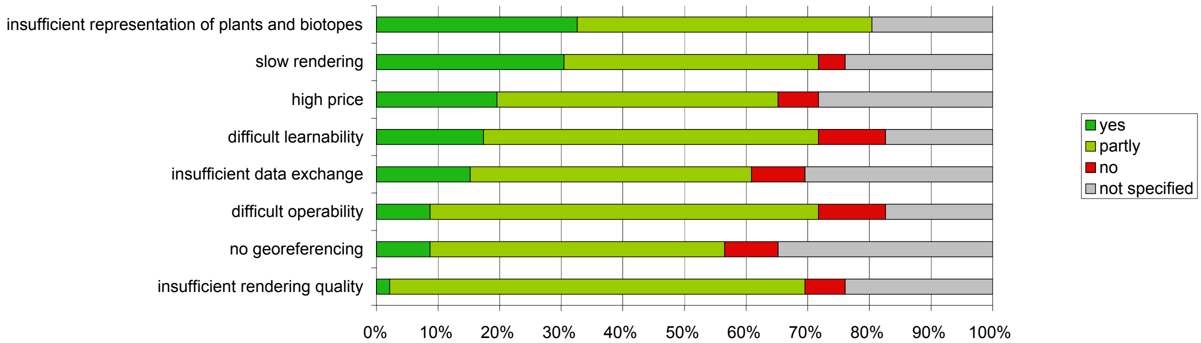


Abb. 16: Probleme mit verfügbarer Software zur 3D-Landschaftsvisualisierung, Befragte (46) mit Anwendererfahrung (nach Buhmann/ Jünemann 2000)

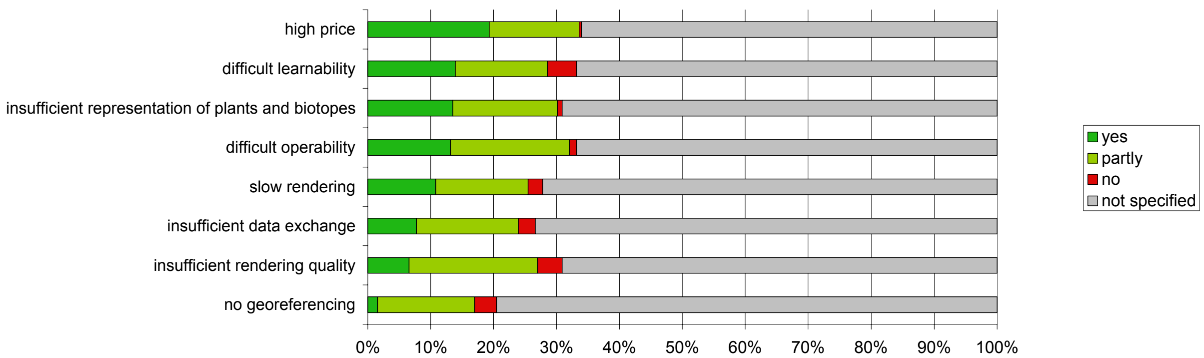


Abb. 17: Probleme mit verfügbarer Software zur 3D-Landschaftsvisualisierung, Befragte (259) ohne Anwendererfahrung (nach Buhmann/ Jünemann 2000)

Auf die Frage, welche Probleme mit 3D-Visualisierungssoftware assoziiert werden, gaben Anwender an erster Stelle die unzureichende Darstellung von Pflanzen und Biotopen sowie technische Probleme des langsamen Bildaufbaus an (Abb. 16). Die Befragten ohne diesbezügliche Anwendungserfahrung sehen an erster Stelle ein Kostenproblem (Abb. 17). Die Schwierigkeiten des Erlernens und der Bedienbarkeit werden von beiden Gruppen ähnlich eingeschätzt.

2.1.2 Neue Möglichkeiten zur Vegetationsdarstellung mit hohem Detailgrad im Nahbereich

An diesen Schwachpunkten bestehender 3D-Visualisierungssoftware setzt das Forschungsprojekt Lenné3D an, indem es an Verfahren zur heuristisch-algorithmischen Modellierung und computergrafischen Methoden zur fotorealistischen Darstellung von Vegetation arbeitet. Hierbei werden auf der Grundlage von Biotoptypendaten und Referenzkartierungen oder Vegetationskartierungen und mittels Interpretation von topografischen Standortdaten Pflanzenverteilungen berechnet. Die Pflanzenstandorte können durch Symbole oder hochqualitative 3D–Pflanzenmodelle dargestellt werden. Dank neuartiger Rendering-Methoden soll trotz des hohen Detailgrades ein flüssiger Bildaufbau gewährleistet bleiben. Damit werden erstmals hoch detaillierte Vegetationsdarstellungen im Nahbereich für Echtzeit-Anwendungen ermöglicht. Abb. 3 zeigt ein Beispiel für eine GIS-datengestützte, fotorealistische und interaktive 3D-Landschaftsvisualisierung mit hohem Detailgrad im Nahbereich.

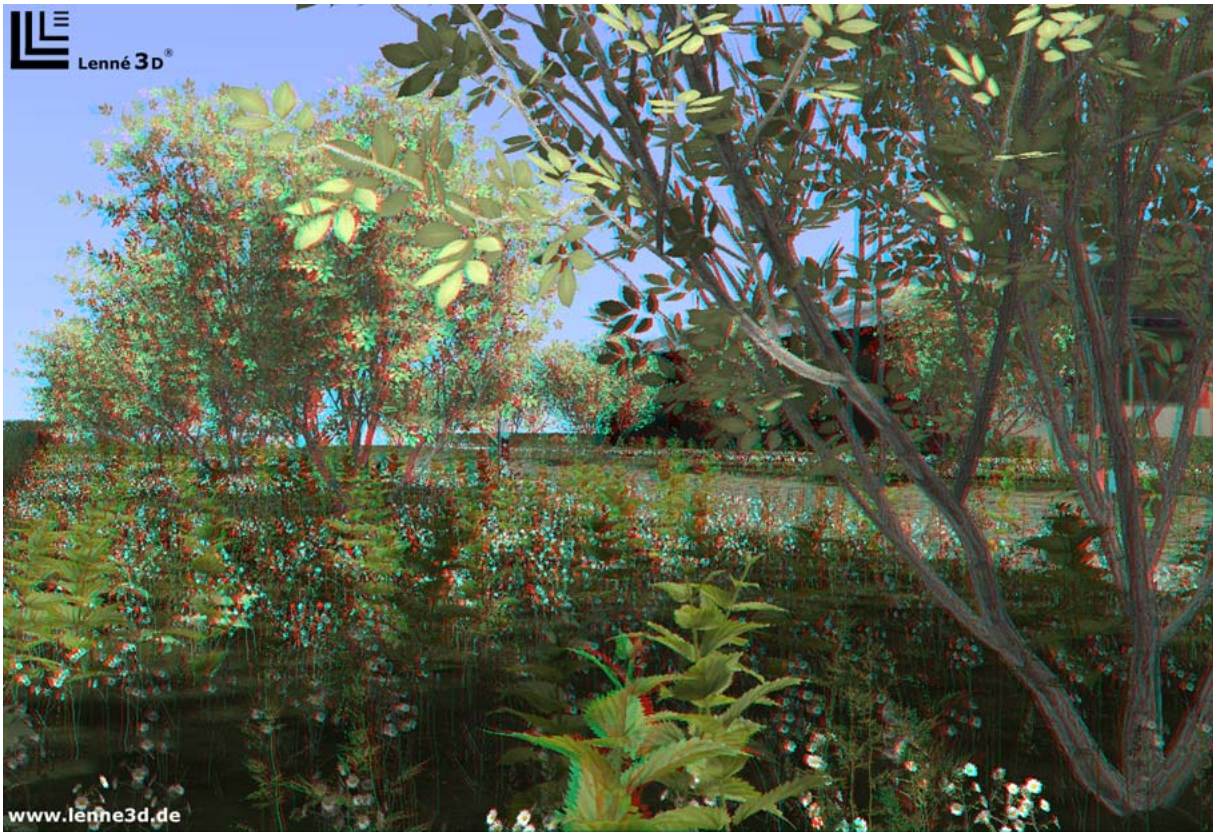


Abb. 3: Bildschirmfoto vom prototypischen Lenné3D-Player (L. Coconu, ZIB, 11/2003), GIS-Daten aus der Uckermark, Anaglyphenbild benötigt Rot-Cyan-Brille für die Stereo-Betrachtung

2.2 Anwendung empirisch sozialwissenschaftlicher Methoden zur Evaluierung von 3D-Landschaftsvisualisierungen in partizipativen Planungsprozessen

In Kapitel 2.1 sind die neuen Möglichkeiten zur Landschaftsvisualisierung in Echtzeit dargestellt worden. Aus Sicht der Planung stellt sich nun die Frage, inwieweit mit den neuen technischen Möglichkeiten auch Potenziale zur Verbesserung des Planungsprozesses einhergehen. Sowohl für Lenné3D als auch für VisuLands steht dabei die Frage im Mittelpunkt, welche Anforderungen an Visualisierungstools gestellt werden müssen, damit sie einen Mehrwert für die partizipative Landschaftsentwicklung bedeuten. Es ist zu vermuten, dass der potenzielle Mehrwert darin besteht, dass in GIS gestützten Landschaftsvisualisierungen zum einen komplexere Datengrundlagen berücksichtigt werden können (Input), und dass sie zum anderen vielfältigere Möglichkeiten zur Visualisierung von Geodaten bieten (Output). Damit stellt GIS basierte Visualisierungssoftware nach Ervin (2003:8) eine Schnittstelle zwischen computergestützten Modellen und menschlicher Urteilskraft dar: „Complex internal representations, making best use of computational tools and techniques, coupled with more simple external representations, calibrated for the human mind-eye inferential system, are the best possible way to combine human intelligence with computer-based models."

2.2.1 <u>Fussgängerperspektive und flexible Detailgrade als Anforderungen aus partizipativen Planungsprozesse</u>

Im Rahmen von VisuLands hat der britische Projektpartner Forest Research eine explorative Studie zur ersten Abschätzung von möglichen Präferenzen bezüglich Detailgrad und Maßstab durchgeführt. Dazu sind 16 Bewohnerinnen und Bewohner aus dem schottischen Studiengebiet „Clashindarroch" in fokussierten Interviews[1] befragt worden, welche Arten von 3D-Visualisierungen ihnen bei der Bestimmung von Waldflächen zur Abholzung eine Hilfe seien. Als Grundreiz dienten computergenerierte 3D-Abbildungen und Animationen. Die 3D-Visualisierungen lagen dabei in unterschiedlichen Detailgraden, d.h. von abstrakten Falschfarbenabbildungen bis hin zu fotorealistischen Bildern, vor. Bezüglich des gewünschten Detailgrades lässt sich dabei keine klare Präferenz für oder gegen einen bestimmten Detailgrad ermitteln. Vielmehr haben sich die Teilnehmer sowohl abstrahierte als auch fotorealistische Abbildungen gewünscht. Einer der Befragten brachte seine Aussage damit auf den Punkt, dass er eine Umschaltmöglichkeit zwischen unterschiedlichen Detailgraden für ideal halte. Im Hinblick auf geeignete Perspektiven und Massstäbe ist wiederholt der Wunsch nach einem „menschlichen Maßstab", d.h. nach Bildern aus der Fussgängerperspektive,

[1] In fokussierten Interviews, einer qualitativen Methode der empirischen Sozialforschung, werden alle Teilnehmer eines Interviews auf denselben „Grundreiz", z.B. einen Film oder ein Bild, hin befragt (Hopf 2003).

geäussert worden. Dem entgegen sind Betrachtungen aus der Vogelperspektive in dieser Befragung als interessant aber nur eingeschränkt hilfreich beurteilt worden (Hislop 2003).

Für zukünftige Evaluierungen von 3D-Landschaftsvisualisierungen wäre es wünschenswert, eine den Anregungen entsprechende Umschaltmöglichkeit zwischen verschiedenen Detailgraden anzubieten. Möglicherweise liesse sich dann auch noch weiter differenzieren, wann welcher Detailgrad den Testpersonen als ausreichend erscheint. Ausserdem bekräftigt die Voruntersuchung, dass zukünftige Tests Abbildungen aus der Fussgängerperspektive mit einbeziehen müssen. Im Vergleich zu diesem Test bietet Lenné3D nun erstmals die Möglichkeit, entsprechende 3D-Echtzeitumgebungen sowohl aus Fussgängerperspektive als auch in sehr hohem Detailgrad anzubieten.

2.2.2 Test des Detailgrades in Abhängigkeit von der Planungsfrage

Eine genauere Überprüfung des Mehrwertes für den Planungsprozess gestaltet sich verhältnismässig komplex, weil sowohl technische Darstellungsfaktoren als auch Einflüsse aus dem Planungsprozess als Variablen zu berücksichtigen sind. Als Darstellungsfaktoren kommen dabei Maßstab, Detailgrad, Perspektive und Grad der Interaktivität in Frage, der Planungsprozess dagegen kann nach der Planungsfrage, nach der Planungsphase oder auch nach den Partizipationsmöglichkeiten untersucht werden.

Wie beschrieben, hat die Befragung in Clashindarroch noch keine eindeutigen Antworten auf die Frage nach geeigneten Detailgraden und Maßstabsebenen ergeben. Eine geeignete Darstellung ist jedoch die Voraussetzung für alle weiteren Forschungen, weshalb die virtuellen Landschaften weiter danach hinterfragt werden sollten, ob die Art der Darstellung für einen bestimmten Zweck ausreichend ist (Lange 1999). Ausschlaggebend ist dabei zunächst die abzubildende Planungsfrage, weshalb im folgenden Versuchsdesign zunächst nur die Planungsfragen variiert werden, eine Differenzierung nach Planungsphasen und nach Partizipationsmöglichkeiten ist aber für spätere Tests zu empfehlen.

Planungsfrage	Darstellungsmittel										
	Szene			Detailgrad			Perspektive		Interaktivität		
	Hintergrund	Mittelgrund	Vordergrund	hoch	mittel	gering	Spaziergänger	Vogelschau	Realtime	Animation	Standbild
Planungsfrage											
Landwirtschaftliche Entwicklung											
Siedlungsentwicklung und Landschaft											
Forstwirtschaftliche Entwicklung											

Tab. 1: Verschiedene Darstellungsfaktoren in Abhängigkeit von exemplarisch ausgewählten Fragen der Landschaftsentwicklung

In den Planungsfragen sollen aktuelle Probleme eines realen Fallbeispiels aufgegriffen werden, die eine Beteiligung der Bevölkerung im Planungsprozess zulassen. Um die Übertragbarkeit der Testergebnisse der Visualisierungsinstrumente auf andere europäische Gebiete sicher zu stellen, werden die Planungsfragen übergeordneten Kategorien zugeordnet. Für das VisuLands-Projekt ist als Fallbeispiel die partizipative Planung in der Schweizer UNESCO Biosphäre Entlebuch ausgewählt worden. Diese konzentriert sich auf drei Themen, welche in Gesprächen mit den Akteuren vor Ort als relevant herausgearbeitet wurden: Alternative Beweidungssysteme, Ausbreitung des Borkenkäfers und ihre Auswirkung auf die Waldwirtschaft sowie die Siedlungsentwicklung. Diese Themen fallen in die aktuell europaweit diskutierten Problembereiche „Landwirtschaftsentwicklung“ und „Zersiedelung der Landschaft“ oder lassen sich allgemeinen Aufgaben der Landschaftsplanung wie die Entwicklung von Managementplänen in der Forstwirtschaft zuordnen.

Für diese exemplarisch ausgewählten Planungsfragen wird die Ablesbarkeit von visuellen Indikatoren für die Bestandsaufnahme und Bewertung vor dem Hintergrund der jeweiligen Planungsfrage getestet. Dies sind visuelle Indikatoren zur Beurteilung der Komplexität, Diversität etc. eines Landschaftsraumes, die im engen Zusammenhang mit der Landnutzung stehen. Um die weitgehende Standardisierung des Experiments zu gewährleisten, werden jeweils dieselben georeferenzierten Objekte abgebildet und die Perspektive beschränkt sich zunächst auf die Fussgängerperspektive. 3D-Visualisierungen, die exemplarisch in dieser Phase eingesetzt werden könnten, werden in jeweils drei unterschiedlichen Detailgraden und Maßstäben für den Test generiert.

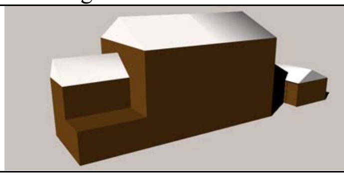
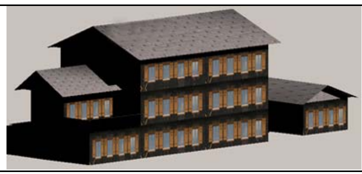
2.2.3 Variation der Szene und des Detailgrades in einem Experiment

Landschaftsplanung findet auf unterschiedlichen Maßstabsebenen statt, die sich auch auf die Visualisierung übertragen lassen wie Orland (1992) am Beispiel der Forstvisualisierung darstellt. Einerseits bestehe der Wunsch, mit Regionalbezug zu planen und andererseits spezifische Waldbaustrategien auf lokaler Ebene zu entwickeln („tree-by-tree scale“). Hinzu kommt ein „mittlerer Maßstabsbereich“ für die akkurate Abbildung von Plänen auf Gemeindeebene und von größeren Projekten der Objektplanung wie er von Dorau (1998) auch für die Visualisierung gefordert wird. Diese drei Maßstabsebenen lassen sich in der 3D-Visualisierung in Abhängigkeit von der Sichtweite auch als vom Vordergrund, Mittelgrund und Hintergrund dominierte Szene beschreiben.

Szenen	**Hintergrund**	**Mittelgrund**	**Vordergrund**
Abzubildende Landschafts-formen	• Grundlegende Topografie • Geschlossene Waldbereiche • Offene Bereiche • Grosse Wasserflächen • Siedlungen	• Kleinmaßstäbige Topografie • Nadel- und Laubwald • Texturen für eine Vielzahl von • offenen und halb geschlossenen • Landschaften • Seen und Flüsse • Siedlungen und markante Einzelgebäude • Strassen • Markante Einzelbäume	• Kleinmaßstäbige Topografie mit typischen Details • Wald mit unterschiedlichen Spezies • Einzelelemente für eine Vielzahl von offenen und halb geschlossenen Landschaften • Seen und Flüsse • Siedlungen und markante Einzelgebäude mit Texturen • Strassen • Vielzahl von künstlichen Objekten (Zäune, Strommasten etc.) • Markante Einzelbäume
Visualisierung	DHM mit Orthofoto	DHM mit Orthofoto, zusätzlichen Bodentexturen und 3D-Modellen	DHM mit Orthofoto, Bodentexturen und texturierten 3D-Modellen

Tab. 2: Visualisierungselemente in Hinter-, Mittel- und Vordergrundszenen

Allerdings lassen sich auch hier die Variationen eingrenzen, denn für Mittel- und Hintergrund liegen bereits Einschätzungen des Realitätsgehaltes in Abhängigkeit vom Detailgrad vor. Daraus lässt sich ableiten, dass für den Hintergrundbereich in der Regel DHM und Orthofoto ausreichend Realtitätsgrad bieten, um eine Bewertung des Landschaftsbildes vorzunehmen (Lange 1999). Bei interaktiven Landschaftsvisualisierungen sind im Vordergrundbereich bislang nur niedrige Detailgrade möglich gewesen, so dass hier unter Verwendung von Lenné3D auch Abbildungen in hohen Detailgraden getestet werden. Aus den zuvor dargestellten technischen Grundlagen ergibt sich, dass der Detailgrad eines 3D-Objektes zum einen durch die Annäherung an die Form des Objektes, d.h. durch die Zahl der Polygone, und zum anderen durch die Auflösung der Oberflächentexturen bestimmt werden. Generell gilt dabei, dass höhere Polygonzahlen und höher aufgelöste Texturen mehr Computerressourcen und in der Regel auch mehr Modellierungsarbeit erfordern.

Detailgrad und Merkmale	**Niedrig**	**Mittel**	**Hoch**
Form	Die grundlegenden Formen sind sichtbar; der visuelle Informationsgehalt ist gering	Formen sind individuell unterscheidbar, aber die Unterscheidungsmerkmale sind wenig detailliert	Individuelle Formen sind genau definiert; der visuelle Informationsgehalt ist hoch
Textur	Einfarbige Texturen	Generische Texturen	Hochauflösende Texturen
Beispiel			

Tab. 3: Typologie unterschiedlicher Detailgrade nach Form und Textur (Schroth 2004)

Den Testteilnehmern wird die Aufgabe gestellt, anhand der Visualisierungen unterschiedliche Landnutzungsformen zu differenzieren und das Landschaftsbild zu bewerten, wobei Landnutzungsformen und Landschaftsbild für die drei Kategorien von Planungsfragen variieren. Perspektive und Grad der Interaktivität sollten hier konstant gehalten werden, um die Zahl möglicher Korrelationen einzugrenzen. Das Versuchsdesign ist aber auf Tests zur Bedeutung der Perspektive und des Interaktivitätsgrades übertragbar. Für die Bewertung des Landschaftsbildes durch die Testteilnehmer bietet sich weiterhin die Verwendung von Skalierungstechniken an, wie sie bereits von Lange (2001) zur Ermittlung des Realitätsgehaltes computergenerierter Landschaftsvisualisierungen angewandt worden sind. Eine statistische Auswertung der Ergebnisse liefert dann bei ausreichender Grundgesamtheit eine Bewertung der bevorzugten Detailgrade in Abhängigkeit vom abgebildeten Indikator.

2.2.4 Untersuchung des Einflusses der Visualisierungsinstrumente auf den Planungsprozess in teilnehmenden Beobachtungen, qualitativen Interviews und Fokusgruppen

Um die Grundlagen einer allgemeinen Visualisierungsmethode voran zu bringen, wird im Folgenden eine Methodentriangulation vorgeschlagen, d.h. verschiedene methodische Vorgehensweisen werden aus unterschiedlichen Perspektiven auf ein Problemfeld angewandt. Allerdings ist zu bedenken, dass dieses Vorgehen nicht zu einer beliebigen Konvergenzsteigerung führen kann, sondern dass sich auch gegensätzliche Sichtweisen ergeben können (Gutscher et al. 1996). Für eine Methodenkombination spricht jedoch, dass sich der Einfluss der technischen Darstellungsfaktoren in einem Experiment angemessen wiedergeben lässt, wohingegen die komplexen Wechselwirkungen mit dem Planungsprozess zu viele Faktoren für ein solches standardisiertes Vorgehen beinhalten.

Bis zu diesem Punkt ist schließlich der Einfluss der Instrumente auf den Planungsprozess, d.h. auf die Qualität der Partizipation, noch unberücksichtigt geblieben. Hier bieten sich teilnehmende Beobachtungen und fokussierte Interviews mit den Teilnehmern des Experiments an. Darin können dann die Einflüsse, die für die Standardisierung des Experiments ausgeklammert wurden, z.B. die Bedeutung des Planungskontextes, der Einfluss der Perspektive und des Grades an Interaktivität, die Rolle der Visualisierungsinstrumente für den Planungsprozess usw., abgefragt werden (Hopf 2003). Die Einflüsse der neuen Techniken auf Partizipation als Gruppenprozess lässt sich am Ehesten im Rahmen eines Fallbeispiels in Fokusgruppen untersuchen. Dabei werden die Visualisierungsinstrumente in einem Beteiligtenforum unter realen Bedingungen angewandt und die sich daraus ergebenden Diskussionen aufgezeichnet (Merz 1996).

3 AUF DEM WEG ZU EINER METHODE ZUR 3D-LANDSCHAFTSVISUALISIERUNG

Mit dem Einzug der 3D-Landschaftsvisualisierung in den hoch detaillierten Vordergrundbereich haben sich neue Potenziale zur Verbesserung des Partizipationsprozesses eröffnet. Eine Evaluierung dieser Potenziale erfordert die Anwendung der neuen Technologien unter der gleichzeitigen Begleitung des Planungsprozesses mit empirisch sozialwissenschaftlichen Methoden. Erste Visualisierungen und eine entsprechende Testmethode für eine solche Evaluation sind im vorliegenden Artikel vorgestellt worden, die Ergebnisse aus den Experimenten mit den Visualisierungsinstrumenten und aus deren Einsatz in Fokusgruppen stehen allerdings noch aus. Die zu erwartenden Erkenntnisse könnten jedoch den Ausgangspunkt für eine systematische Visualisierungsmethodik bilden, die allen Planungsdisziplinen zugute käme. Für unterschiedliche Planungsfragen liessen sich Empfehlungen ableiten, in welchem Maßstab und welchem Detailgrad 3D-Landschaftsvisualisierungen sinnvoll sind und wie sich diese Visualisierungen in der Bürgerbeteiligung und im Entscheidungsprozess einsetzen lassen. Ein hoher Detaillierungsgrad für die Beteiligung kann auch im Widerspruch zur Datengrundlage und inhaltlichen Aussageschärfe des Planungsschrittes stehen. Beispielsweise geraten im kommunalen Landschaftsplan die Spaziergängerperspektive und eine fotorealistische Visualisierung mittels GIS-Daten in Konflikt mit dem herkömmlichen Maßstab von 1:10.000 (Paar/Rekittke 2003). In der Entwurfsphase könnte eine skizzenhafte Visualisierung eher verdeutlichen, dass Kritikpunkte, Änderungswünsche und Verbesserungswünsche zu verhandelbaren Aspekten noch immer in die Planung einfließen können und sollen (Demuth/Fünkner 2000). Der Detaillierungsgrad einer Visualisierung könnte also auch der Planungsphase angepasst sein.

Auch nach einer Beantwortung der Detail- und Maßstabsfrage bleiben noch zahlreiche Fragen offen. Wie wirken sich die Perspektive und der Grad an Interaktivität auf die Wahrnehmung der Visualisierungen aus? Ebenso wichtig ist eine weitere Untersuchung des Mehrwertes, den 3D-Landschaftsvisualisierungen für die Qualität des Planungsprozesses bieten. Wie wirkt sich der Einsatz dieser Instrumente auf das Inhaltsverständnis, auf die Entscheidungssicherheit und auf die Machtverteilung im Planungsprozess aus? Das Instrumentarium zur Erarbeitung einer Methode und begleitender Hilfsmaterialen liegt nun vor und damit rückt auch die Beantwortung dieser Fragen zur 3D-Landschaftsvisualisierung in greifbare Nähe.

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Eine Stadt wird dreidimensional: 3D Stadtmodell Bamberg

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1 ABSTRACT / ZUSAMMENFASSUNG

In Zusammenarbeit der Stadt Bamberg und der Universität Kaiserslautern ist im Rahmen eines studentischen Projekts eine Forschungsarbeit zum Thema 3D-4D-Stadtmodelle entstanden.

Begleitet wird die gesamte Arbeit durch den Aufbau einer Internetseite, die mit Hilfe eines Content Management Systems (CMS) den Stand der Arbeit ständig aktuell hält und als eine Art Online-Referenz zum Thema 3D-4D-Stadtmodelle fungiert (http://3d-4d.arubi.uni-kl.de). Als "offenes System" konzipiert, erlaubt das CMS den Teammitgliedern eine dynamische Weiterentwicklung der Homepage und in relativ einfacher und effizienter Art und Weise, die Ergebnisdokumentation nach Außen. Die Website wächst sozusagen mit den gesammelten Informationen stetig und ist somit Präsentationsplattform und Werkstatt zugleich.

2 PROBLEMSTELLUNG

Ausgangspunkt für dieses Projekt war die im Frühjahr 2003 geborene Idee zwischen Vertretern der Stadt Bamberg und der Universität Kaiserslautern, ein Stadtmodell nicht wie bisher physisch in Holz zu bauen, sondern die Anstrengungen in den Versuch des Aufbaus eines virtuellen Stadtmodells zu bündeln.

Stadtplanung und Stadtentwicklung sind politische und gesellschaftsorientierte Handlungsfelder, in denen nicht nur die Ergebnisse einer Planung, sondern auch vorangehende Analyse-, Planungs-, Bewertungs- und Entscheidungsprozesse öffentliches Interesse bezeugen [Luser&Lorber1997]. Vielen Menschen sind planungstheoretische Abläufe und das damit verbunden Fachvokabular sowie die Abstraktion der Situation von der dritten Dimension in die planare zweite Dimension schwer verständlich und wenig transparent [Besser & Schildwächter 2000].

Ziel dieses Projektes ist aber nicht nur die Herstellung eines virtuellen Stadtmodells im dreidimensionalen Raum, sondern vielmehr auch die damit verbundenen Fragestellungen zu erörtern, wie erstellt man in einem optimierten Workflow kostengünstig ein 3D-Modell, welche Daten benötigt man dazu und können dadurch kommunale Daten einem wirtschaftlichen Mehrwert zugeführt werden. Weiterhin soll untersucht werden, in welchen städtebaulichen Einsatzfeldern 3D-Stadtmodelle Planungen vereinfachen oder verbessern können bzw. die Kommunikation zwischen den einzelnen Akteuren verbessert werden kann. Des weiteren soll die Anwendbarkeit und Übertragbarkeit der gewonnenen Daten auch für die Bereiche Autonavigationssysteme, Location Based Services, Tourismus, Standortmarketing bis hin zum Facility Management untersucht werden.

3 ZIELE UND ANFORDERUNGEN

Ziel ist die prototypische Umsetzung eines 3D-Stadtmodells unter folgenden Aspekten:

Erstellung eines speichervolumensparenden 3D-Modell durch die Transformation vorhandener Planungsdaten wie ALK, ALB, ATKIS; ALKIS, Luftbildern, Digitalen Höhenmodellen der Landesvermessungsämtern und durch die Datenaufnahmen vor Ort. Beispielhaft sind hier die Höhenaufnahme von Gebäuden, die Erstellung von Bildern für Fassaden-Mappings und zur Archivierung nach Straßenzügen. Weiterhin interessant ist die Aufnahme von kulturhistorisch besonders bedeutender Bausubstanz mithilfe von terrestrischen Laserscan- Methoden.

Das generierte Modell soll in Varianten auf seine mobile, lokale und Internetanwendbarkeit untersucht werden und anhand der gewonnen Ergebnisse auf die Bedürfnisse der einzelnen Zielgruppen bzw. Anwenderkreise zugeschnitten werden.

Unabhängig von den technischen Lösungswegen soll auch dem visuellen Anspruch genüge getan werden, denn oftmals wird gerade in öffentlichen Planungsprozessen schlechte Informationsvermittlung mit schlechtem Inhalt und eine minderwertige Präsentation mit minderwertigem Inhalt gleichgesetzt. Aufwändige Grafiken hingegen werden als qualitativ hochwertig eingestuft, und können durch ihre beim Betrachter ausgelösten positiven Effekten Planungsentscheidungen günstig beeinflussen [Luser&Lorber1997].

Bei der Beurteilung der vorhandenen Daten und deren Verwendung sowie zur Erstellung des 3D-Modell selbst, standen folgende Kriterien im Vordergrund:

- Genauigkeit des Modells möglichst im Zentimeterbereich;
- Einfache Erstellung, Modellbildung aus vorhandenen Daten;
- Hoher ästhetischer Anspruch und Detaillierungsgrad;
- Rasche Aktualisierbarkeit und umfassende Modifikationsmöglichkeiten des erzeugten Modells;
- Möglichst kostengünstige Weiterführung;
- Offene Datenschnittstellen und Kompatibilität mit gängigen Softwareapplikationen.

Weiterhin sollte das erstellte „Rohmodell“ folgende Möglichkeiten bieten:

- Detaillierungsgrad entsprechend gängiger Level-of-Detail Spezifikationen (LOD 0-3);
- Anbindung an Datenbanken;
- Integration in Webbrowser und mobile Endgeräte;
- Integration von Laserscandaten.

4 PROJEKTABLAUF

Die recht komplexe Projektaufgabe, ein möglichst exaktes und vor allem umfassend einsetzbares Stadtmodell der historischen Innenstadt von Bamberg zu schaffen, erforderte eine Projektgliederung in mehren Arbeitsphasen. Neben der Beschaffung und Erstellung von Datengrundlagen, die sich zu Anfang des Projekts recht zeitintensiv gestaltete, kristallisierten sich vor allem Arbeitsschwerpunkte in der Modellbildung und der Definition von Anwendungsfeldern heraus.

4.1 Datenerhebung / Grundlagenermittlung

Unterschieden wurden Datengrundlagen, die bereits vorhanden waren und solche, die noch ermittelt werden mussten sowie deren spezifischer Verwendung im Modell selbst. Dementsprechend ergaben sich vier Arbeitsbereiche:

- Erstellung des digitalen Höhenmodells (DGM) als Basisplatte für das 3D-Stadtmodell;
- Aufnahme der Gebäudekubaturen und das daraus resultierende Quadermodell;
- Stereoskopische Auswertung der Dachlandschaft;
- Aufbau einer Fassadenbibliothek als Grundlage für das gerenderte Stadtmodell.

Vorhandene Datenbestände, wie das DGM des Landesvermessungsamtes im ASCII-Format, georeferenzierte Kanaldeckelmesspunkte als dxf-File, Straßenvermessungspunkte des Stadtplanungsamtes Bamberg im ASCII-Format, die digitale Flurkarte als Grundlage für Gebäudekubaturen im dxf-Format, Luftbilder aus mehreren Überfliegungsstreifen etc. wurden auf deren Anwendbarkeit in den jeweiligen Arbeitsbereichen überprüft und durch aufzunehmende Daten ergänzt.

Fehlende, und damit im Laufe des Projekts aufzunehmende Daten waren die Bilder der Fassaden im jpg-Format, die exakten Höhe der jeweiligen Gebäude von Oberkante Strasse zu Unterkante First nebst eindeutige Gebäude-Identifikationsnummer. Neben diesen Informationen galt es, Baukörper besonderer Bedeutung (Points of Interrests) genauer zu vermessen und in einer weiteren Arbeitsphase mit terrestrischen Laserscanaufnahmen zu detaillieren.

Aus diesem Datenbestand war es möglich, ein dreidimensionales Modell anhand der nachfolgend beschriebenen Techniken zu generieren.

4.2 Modellbildung

Primäres Ziel dieses Arbeitsschrittes ist die Erstellung des 3D-Stadtmodells als Wireframe-CAD-Datei, die das digitale Höhenmodell, die auf das DGM montierten Gebäudehüllen sowie die mit den Kubaturen verschnittenen Dächer beinhaltet.

Im Vergleich zu anderen Stadtmodellen ist an das Modell Bamberg aufgrund der räumlichen Lage und der dortigen Topografie von Anfang an die Vorgabe gestellt worden, nicht auf einer „platten“ und horizontalen Oberfläche zu arbeiten, sondern vielmehr ein digitales Geländemodell als Grundgerüst zu erzeugen.

Problematisch an dieser Zielvorstellung waren, hinreichend genau Datengrundlagen im Innenortsbereich zu beschaffen. Die vorhandene Datenbasis des Landesvermessungsamts (DLM) erwies sich hierbei als zu ungenau (50m Raster). Höhenversprünge wie Bruchkanten etc. waren teilweise nur fragmentarisch zu erkennen, viele Messpunkte lagen überdies auf bebauten Flächen. Dementsprechend waren fehlerhafte Messungen in Bezug auf die reale Situation mit Abweichungen von bis zu 10m vorhanden. Somit waren die DLM-Daten bestenfalls für die Außenbereiche nutzbar. Auf der Grundlage eigens vermessener Straßenzüge (durch das dortige Stadtplanungsamt), in Verbindung mit weiteren stereoskopischen Auswertungen nicht vorhandener Bereich konnte ein weitere Detaillierung erreicht werden und somit ein „Digitales Höhenmodell Bamberg“ erzeugt werden.

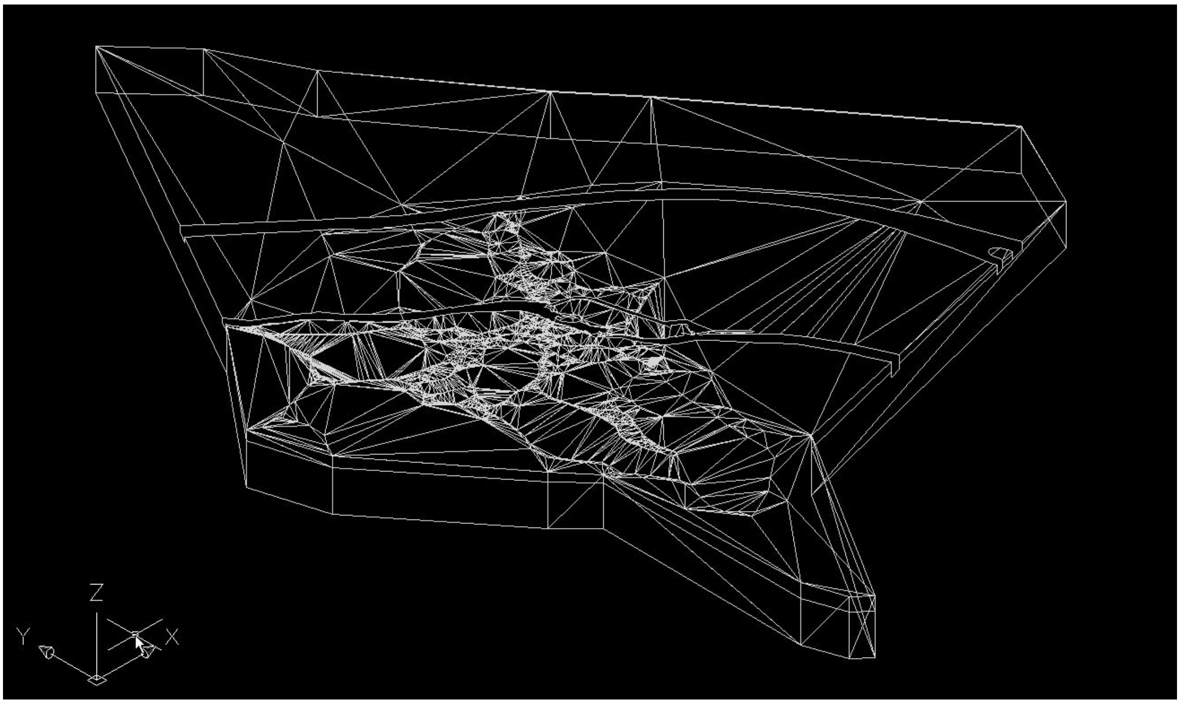

Abb.1: DGM-Basismodell mit Straßenzügen (eigene Darstellung)

Vorteilhaft wäre vor diesem Hintergrund, dass zukünftig die Katasterkarten und die darin enthaltenen Grundstücksgrenzpunkte nicht nur in x und y Koordinaten, sondern auch in der Höhe z aufgenommen wären. Dadurch könnte die Katasterkarte als Grundlage für die Erstellung des digitalen Höhenmodells herangezogen werden.

Im Zuge einer mehrtägigen Exkursion nach Bamberg wurden die Gebäudehöhen im Bereich des Weltkulturerbes mit Hilfe von Laserdistanzmessungen aufgenommen. Die aufgenommen Höhen wurden zunächst in so genannte Klötzchenmodelle aus extrudierten Quadern überführt und somit entstand sukzessive eine erste virtuelles Stadtmodell. Jedem Gebäude wurden, neben exakter Lage- und Höheninformation, eine eindeutige ID zugewiesen, die sich aus Gemarkungsnummer, Straßenschlüssel und Hausnummer zusammensetzt und die Baukörper somit (bundesweit) eindeutig identifizierbar macht. Weiterhin wurden in diesem Arbeitsschritt auch die ersten additiven Metainformationen zu Freizeit, Verkehr, Tourismus etc. analysiert und katalogisiert.

Das so erzeugte Klötzchenmodell wurde in einem weiteren Arbeitsschritt mit dem vorher erstellten digitalen Höhenmodell kombiniert um die Kubaturen an die Geländeoberfläche anzupassen. Als Ergebnis erhält man ein grobes Stadtmodell. Analog zur weiteren Vorgehensweise wird diese Stufe als „Level-of-Detail-1“(LOD 1) bezeichnet.

Der nächst höheren Detaillierungsgrad (LOD 2) beinhaltet zusätzliche Information wie Dachformen, Dachaufbauten etc. Dadurch erreicht man einen wesentlich höheren Widererkennungswert, was die Orientierung innerhalb des virtuellen Stadtgebildes entscheidend verbessert. Landmarken, im Stadtgebiet markante Gebäude usw., werden somit deutlich.

Die Dachlandschaften wurden auf der Basis flächendeckend vorliegender Luftbilder stereoskopisch ausgewertet. Die sich überlappenden Luftbildpaare auf der Basis gesicherter Vermessungspunkte (bevorzugt Kanaldeckeln wegen der freien Sichtbarkeit) georeferenziert, lieferten exakte Lage- und Höheninformationen im Zentimetergenauigkeitsbereich. Als AutoCAD-Datei eingelesen bzw. im dxf-Format exportiert waren diese universell weiterverwertbar.

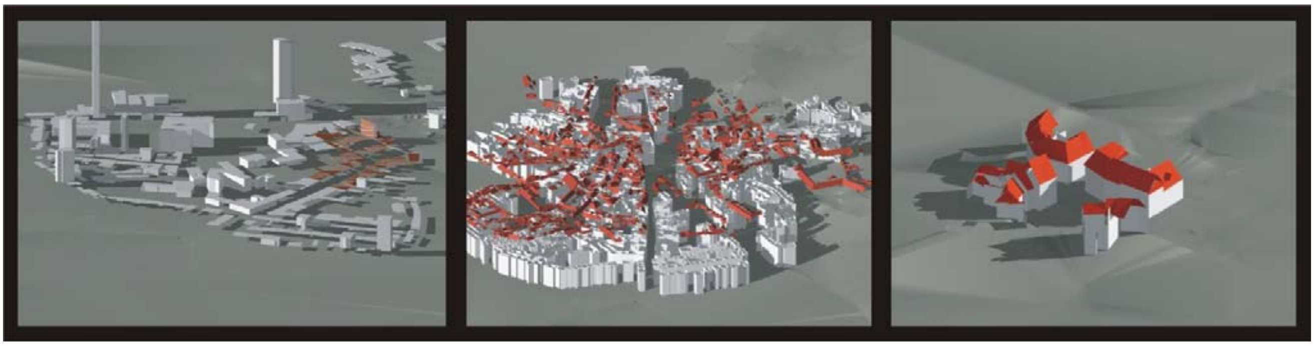

Abb.2: Mit DGM verschnittene Baukörper mit Verschneidungsfehlern, georeferenzierte Dächer und fertige Häusermodelle (eigene Darstellung)

Die höchste Detaillierungsschärfe (LOD 3) wurde durch 3D-Rendering-Techniken erreicht. In einer Datenbank abgelegte und mithilfe von Bildverarbeitungsprogrammen entzerrte, korrigierte und modifizierte Fassaden-Fotos wurden auf die Gebäudehülle „gemappt“. Als recht arbeitsintensiv gestaltete sich vor allem die Fotobearbeitung. Manche Gebäude waren aufgrund der örtlichen Situation nicht orthogonal zu fotografieren, oder Fassaden wurden durch parkende Autos, Vegetation, Baugerüste etc. verstellt. Um ein ideales 3D-Modell zu erzeugen, mussten solche Störfaktoren in oftmals mühevoller und zeitintensiver Handarbeit bereinigt werden.

Abb.3: Bildbearbeitung / Bildmontagen als Vorbereitung der Fassadenmappings (eigene Darstellung)

4.3 Einsatzbereiche / Anwendungsfelder

Stadtmodelle werden zu den verschiedensten Zwecken errichtet. Das eigentliche Stadtmodell ist dabei eine Grundlage für unterschiedliche Anwendungen, die sich grob in die Bereiche Visualisierung und Simulation gliedern lassen.

Dementsprechend wurde das erzeugte „Wireframe-Modell“, in all seinen Detaillierungsstufen, auf die Anwendbarkeit dieser klassischen Einsatzfelder hin untersucht. Neben den Möglichkeiten zur Simulation von z.B. Lärmausbreitungsmodellen, der Berechnung zur Ausleuchtung von Funkräumen etc. erscheinen vor allem die Einsatzmöglichkeiten in Tourismus, Stadt- und Standortmarketing, Dienstleistung, Planung/Architektur, technischer Infrastruktur bis hin zum Facility Management als besonders viel versprechend. Die zunehmende Leistungssteigerung drahtloser Endgeräte, wie z.B. Mobiltelefonen, Handhelds, Smartphones, PDA`s etc. sowie dem Trend, diese „Computer im Taschenformat“ als universelle Informations-, Interaktions- und Kommunikationslösung weiterzuentwickeln, lassen neue Anwendungsspektren von 3D-Stadtmodellen erwarten, die in Form von 3D-Navigationssystemen (Car-Navigationssystem), Location Based Services etc. Gestalt annehmen könnten.

Für die Umsetzung dreidimensionaler Stadtmodelle bedeutet dies, dass entsprechend der angesprochenen Nutzergruppe und des anvisierten Einsatzspektrums unterschiedliche Lösungswege aufgezeigt werden müssen, die technisch durchaus divergierende Ansätze verfolgen können.

5 VISUALISIERUNG VON 3D-STADTMODELLEN

Eine wichtige Anwendung von 3D-Stadtmodellen ist die Visualisierung. Bei der Visualisierung wird das Modell zur Betrachtung optimiert. Die Optimierung beinhaltet die standpunktbezogene Steuerung der Darstellung des Detailreichtums.

Eine Möglichkeit der Visualisierung ist der virtuelle. Spaziergang. Dabei kann sich der Betrachter frei in einer Szene bewegen. Insbesondere touristische oder historisch interessante Objekte sind hervorragend für diese Form der Visualisierung geeignet. Mit den entstehenden Ergebnissen werden häufig Werbemaßnahmen unterschiedlichster Art betrieben. Die Darstellung muss weitgehend detailgetreu sein und einen realistischen Eindruck hinterlassen.

Eine weitere Visualisierungsart ist die Rekonstruktion historisch verschwundener Szenarien, von denen nur Aufzeichnungen existieren. In einer weiteren Anwendungsart sind großflächige Bereiche visualisiert. Dabei wird versucht, die Situation realitätsgetreu nachzubilden. So kann man sich in ihr orientieren, Sichtlinien prüfen oder aber diese Darstellung als Basis für Simulationen (Integration beweglicher Objekte) verwenden.

Ein anderer Visualisierungszweck ist die Verwendung als virtuelles Exposee d.h. als Informationsbasis für den Verkauf von Immobilien. Ein Exposee ist eine Zusammenstellung aller für eine Immobilientransaktion (Verkauf bzw. Miete) notwendigen Informationen. Neben Zahlenangaben über das Objekt beinhaltet ein Exposee auch Pläne und Ansichten des betreffenden Objektes.

Stadtmodelle werden auch verwendet, um hochwertige Gebäudeobjekte oder Gebäudeensembles zu präsentieren. Für diese Objekte besteht häufig ein europaweites, oft auch ein weltweites Interesse. Ein Beispiel für ein solches Objekt ist z.B. der Industriepark Höchst, in dem freiwerdende Objekte weltweit operierenden Firmen der Chemie-Branche angeboten werden.[vgl. Koppers 2002]

5.1 Virtuelle Spaziergänge

Bei der Beschäftigung mit 3D-Stadtmodellen ist die Entwicklung der „Virtual Reality“ (VR) von Relevanz. Anfänglich ausschließlich auf Hightech-Rechnern in Speziallabors, den sog. CAVE`s (Computer Automatic Virtual Environment) einsatzfähig - bedienbar mittels kostspieligem VR-Equipment wie dem Datenhelm bzw. dem Datenhandschuh - entwickelte sich alsbald die Desktop-VR zu einer kostengünstigen Alternative. Das Eintauchen in virtuelle Welten, dem sog. „Cyberspace“ wurde möglich und eröffnete auch für die Planung eine neue Dimension räumlicher Erfahrungen.

Im Gegensatz zu Anwendungen anderer computergestützter Visualisierungstechniken, die aus den Bereichen GIS und CAD bereits seit geraumer Zeit in der Fachöffentlichkeit bekannt sind, stellt die Desktop-VR einen weitergehenden Ansatz der dreidimensionalen Repräsentation von Geometrien dar. Der Fokus liegt weniger auf der aufwendigen Inszenierung fotorealistischer Momentaufnahmen (Stils) oder virtueller Rundflüge durch z.B. städtebauliche Situationen (Fly through), sondern vielmehr auf der Integration einer multimedialen und vernetzten Informationsvermittlung mit Raumbezug. Im Gegensatz zu selbständig ablaufenden Filmsequenzen in der Highend-Visualisierung (Rendering) ermöglichen VR-Systemen die individuelle Navigation in der computergenerierten Welt. Insbesondere die *Virtual Reality Modeling Language* (VRML), als eine der wichtigsten Vertreter internetbasierender Visualisierungstechniken, sei an dieser Stelle genannt. „Analog zur Entwicklung des *World Wide Web* als Multimediateil des Internets, bildete auch bei der Entwicklung von *VRML* die Unabhängigkeit von genutzter Rechnerplattform und Betriebssystem sowie die Integration einer verteilten Informationsbasis die Grundlage.“[vgl. Lehmkühler 1999].

Neben dieser Technik gilt es weiterführende Entwicklungen zur Implementierung der o.g. Visualisierungsansätze zu untersuchen, die sich derzeit wohl am sinnvollsten in Kombinationen aus X3D, GML und Java3D ergeben.

5.2 Mobile Devices

Die Vorteile von Mobile Devices liegen im Zugang zu raumbezogenen Informationen für Jedermann und einer fast spielerischen - Navigation im Raum. In Kombination mit Loaction Based Services (LBS), die auch der Wirtschaft im Kontext städtebaulicher Planung ganz neue Perspektiven aufzeigen, könnten mobile Lösungen dem neuen Mobilfunkstandard UMTS zum Durchbruch verhelfen und auch für die Anwendungsfelder dreidimensionaler Stadtmodelle neue Ansätze bieten.

Durch den Einsatz mobiler Kommunikationstechnologien kann die Informationsgewinnung in vielen Bereichen vereinfacht, oder zumindest transparenter in Ihrer Visualisierung vor Ort gemacht werden. Gerade in den Stufen des allgemeinen Planungsablaufes, bei verfahrensrechtlichen, verwaltungsinternen Regelungen im Bau- und Planungsprozess sowie bei der Interaktion und Kommunikation im Prozess der (verwaltungsexternen) Beteiligung von Planungsakteuren bietet es sich an, die Effekte des mobile computings nicht nur im 2D-Bereich, sondern auch in Hinblick auf die Einsetzbarkeit im 3D-Bereich wie einem 3D-Stadtmodell genauer zu untersuchen. In einem weiteren Abschnitts des Projektes sollen grundlegende Fragestellungen hinsichtlich des Einsatzbereiches und der Anwendbarkeit mobiler Stadtmodelle erörtert werden, insbesondere die Möglichkeiten der exakten Verortung mobiler Endgeräte und zum anderen die reduzierte, speicherplatz- und prozessorschonende 3D-Darstellung sind hierbei von Relevanz.

5.3 Spiele-Engines

Ein weiteres VR-Element im Visualisierungsbereich sind, neben den bereits genannten VRML-Techniken, die 3D-Spiele-Engines. Sie bieten Echtzeit-3D-Rendering gepaart mit einfachen, logischen Navigationshilfen und könnten insbesondere im Tourismus, Stadt- und Standortmarketing, historischer Objekte sowie der Rekonstruktion historisch verschwundener Szenarien ihren Einsatz finden. Alle der nachfolgend aufgeführten Engines sind unter folgenden Gesichtspunkten zu testen:

- Datenschnittstellenkompatibilität und nachfolgende Exportmöglichkeiten
- Möglichkeiten zum nachträgliche Editieren bei Erstellung/Konstruktion/LOD/Datenmenge/Datengröße
- Benutzerfreundlichkeit der eingesetzten Engines
- Fokus auf mögliche Einsatzfelder

Folgende Engines wurden aufgrund guter Benutzerfreundlichkeit, vorhandenem integrierten Editor und guter Performance getestet:

- Unreal 2 – Engine©
- Half - Life – Engine©
- Quake 3 – Engine©
- Morrowind 3 – Engine©

Unreal 2 – Engine

UnrealED © Diese Engine wurde 2002-2003 als Nachfolger der Unreal-Engine von Digital-Extremes und Epic-Games entwickelt und ist extrem leistungsfähig in Hinsicht auf Detailreichtum (sprich LOD), kann sehr große Mengen an Daten verarbeiten und beherrscht alle gängigen Renderingmöglichkeiten wie „Advanced Ray-Tracing©", Photon-Tracing© und DTL© (Dynamic Texture and Lightning). Komplettiert wird die UnrealED durch eine Physik-Engine, die hochrealistische Gravitationsmodelle ermöglicht.

Editierbar ist die Unreal Engine zum Beispiel mit dem den Spielen beigefügten „Unrealeditor ©", der auch kostenlos im Netz unter www.golem.de/0310/28010.htm für nicht kommerzielle Zwecke verfügbar ist. Im Vergleich zu anderen Engine-Editoren ist er sehr bedienfreundlich, was einen schnellen Einstieg ins „Modellbuilding" ermöglicht. Für komplexere Modelle sind aber umfangreiche Programmier-, als auch Kenntnisse aus dem Bereich des Rendering und Shading erforderlich. Mit dem nötigen Hintergrundwissen lassen sich jedoch sehr gute Ergebnisse erzielen.

Prinzipiell ist die Engine zum Bau von 3D-Stadtmodellen geeignet, allerdings momentan nur für den stationären Desktop-Betrieb. Von einem webgestützten Einsatz ist derzeit noch abzuraten, da sehr große Internetbandbreiten benötigt werden, um die Ergebnisse dieser Engine nutzen zu können.

Quake 3 Engine©/ Quake 3 Radiant©

Die Quake 3 Engine wurde 1999 für das Computerspiel Quake 3 entwickelt. Ähnlich wie die Unreal-2-Engine kann auch diese Engine sehr hohe Datenmengen verarbeiten und dadurch aufwendig detaillierte Welten darstellen. Neu bei dieser Engine war, echte Rundungen ohne Triangulation darzustellen. Weiterhin wurden neue Licht- und Schatteneffekte wurden mit dieser Engine revolutioniert. Als Editor muss zusätzlich der Quake 3 Radiant©" installiert werden, der umfangreiche Funktionen und Einstellungsmöglichkeiten besitzt, aber auch gleichzeitig sehr hohe Programmierkenntnisse an den Benutzer stellt.

Im direkten Vergleich zur Unreal-2-Engine ist sie bei weitem unübersichtlicher und wesentlich benutzerunfreundlicher. Die erzeugten Ergebnisse unterscheiden sich nur unwesentlich im qualitativen Bereich.

Die Import- und Exportmöglichkeiten sind ohne Import/Export-Plugin sehr begrenzt. Umgehen kann man dieses Problem auch mit Zusatzprogrammen wie Quick3D oder Deep Exploration. Beim Einsatz dieser Engine gelten dieselben Einschränkungen wie bei der Unreal-2-Engine, d.h. sie ist momentan nur stationär sinnvoll einsetzbar.

Half-Life Engine

Die Engine kam 1997 mit dem gleichnamigen Spiel Half-Life auf den Markt. Auf Grund ihres Alters hat sie weniger viele und grafikaufwendige Darstellungsmöglichkeiten im Vergleich zu anderen Engines. Wegen der großen Anwenderbreite sind allerdings eine Menge Updates/Upgrades und so genannte Add-Ons entwickelt worden, die völlig neue Ergebnisse ermöglichen und so qualitativ hohe, denen der High-End-Engines fast ebenbürtige, Ergebnisse liefert. Editierbar ist die Engine mit Zusatzprogrammen wie dem Half-Life-Worldbuilder©, der relativ benutzerfreundlich ist sehr viele Einstellungsmöglichkeiten bietet. „Photorealistische Welten" kann man allerdings nicht erschaffen. Die Import/Exportmöglichkeiten programmseitig sind beschränkt; es gibt allerdings eine große Anzahl an Tools und externen Import/Exportfiltern. Der Einsatzbereich beschränkt sich auch hier wieder auf den stationären Einsatz.

Morrowind Engine /TES Construktion Set ©

Die Morrowind-3-Engine ist verhältnismäßig jung und kam 2002 mit dem Spiel „The Elder Scrolls 3©" auf den Markt. Ihre Kapazitäten liegen vor allem in der Fähigkeit, riesige virtuelle Welten zu erschaffen, die gleichzeitig einen hohen Detailreichtum ermöglichen. Der Einsatzbereich wird allerdings von der stark eingeschränkten Import/Export-Möglichkeit verringert. Auch ist die Engine sehr schwer zu bedienen, da nur vorgefertigte Polygonmodelle benutzt werden können. Um eigene Modelle zu entwerfen werden umfangreiche Engine- und 3D-Modellingkentnisse benötigt. Im Übrigen ist der dem Spiel beigefügte „TES-Editor©" recht unübersichtlich. Die Engine erfüllt fast alle gängigen 3D-Standarts und bietet sehr hohen Detailreichtum, was allerdings wieder einem webgestützten Einsatz entgegensteht.

6 FAZIT:

Der derzeitige Arbeitsstand des Projektes (Januar 2004) definiert sich wie folgt: Die Grobgenerierung von Quaderstrukturen, die Aufnahme der topografischen Geländepunkte zur DGM-Erstellung sowie das erste Wireframe-Modell sind umgesetzt. Die Visualisierung in Form von virtuellen Spaziergängen sowie die Integration in Spiele-Engines befindet sich in Vorbereitung. Bei der Anbindung mobiler Endgeräte ist derzeit noch nicht abzuschätzen in wie fern sich die Zielvorgaben (3D-Stadtmodelle mobil) realisieren lassen.

Die Auseinandersetzung mit diesem Thema sowie intensive Diskussionen im Kreise aller an der Arbeit Beteiligten haben gezeigt, dass es zumindest als sehr hilfreich erachtet wird und zukünftig wohl als unumgänglich erscheint, universell einsetzbare Stadtmodelle zu besitzen. Neben den vielfältigen Möglichkeiten im Planungsprozess selbst, werden vor allem Potentiale in der Darstellung räumlicher Zusammenhänge städtebaulicher Strukturen gesehen, die in planaren 2D-Darstellung oftmals nicht wahrgenommen werden. Die ästhetische Attraktivität sowie der hohe Detaillierungsgrad lässt überdies virtuelle Welten entstehen, die Dynamik und auch Spaß bei Auseinandersetzung mit dem Thema Stadt mit sich bringen.

Insbesondere durch die Probleme bei der Datenerstellung und dem damit verbundenen hohen Aufwand der Aufbereitung und Integration in gängige Softwareapplikationen werden vermehrt Fragen, nach einheitlichen Standards für 3D-Stadtmodelle aufgeworfen. Des Weiteren muss ein Bewusstsein für die Notwendigkeit der Fortführung und Pflege bestehender Modelle geschaffen werden, was möglichst einfach ohne größeren Technikaufwand von den Kommunen selbst zu bewerkstelligen sein sollte. Wünschenswert in diesem Zusammenhang wäre, ein 3D-Monitoring der Stadt, um Wachstums- oder auch Schrumpfungsprozesse, Veränderungen der Stadtgestalt etc. zu dokumentieren, zu archivieren oder auch zu simulieren.

In Anbetracht der knappen Haushaltskassen wird ein 3D-Stadtmodell insbesondere dann attraktiv, wenn neben den vielfältigen amtsinternen Anwendungsfeldern auch externe Interessen bedient werden. Der Fokus wird somit auf einer Workflowoptimierung liegen, die eine möglichst kostengünstige Erstellung von 3D-Stadtmodellen erlaubt, die in ihrer Qualität und Einsatzbreite vom Markt gefordert und auch bezahlt werden.

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Von einer Österreichgliederung nach Gemeinden zu Planquadraten: Statistik Austria erweitert sein regionalstatistisches Angebot

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1 PROBLEMSTELLUNG

Die regionale Aufgliederung der Statistiken auf der Gemeindeebene mag in der Vergangenheit genügt haben, da die Gemeinden, abgesehen von den Randgebieten der Großstädte, im wesentlichen „natürlich" gewachsene Gebilde darstellten. Den Anforderungen, die man heute an statistische Daten für räumliche Untersuchungen hat, genügt dies schon lang nicht mehr. Vor allem durch die Möglichkeiten von regionalstatistischen Auswertungen, die man mit Hilfe von Geographischen Informationssystemen hat, wird der Wunsch nach einem geographischen Bezugssystem laut, das sich gleichermaßen für kleinsträumliche, regionale, überregionale und gesamtstaatliche statistische Untersuchungen eignet. Dies wird nur von einem regelmäßig teilbaren bzw. zusammenfügbaren geometrischen Bezugssystem erfüllt. Um diesen Anforderungen gerecht zu werden, hat STATISTIK AUSTRIA sein regionalstatistisches Datenangebot erweitert und es werden auch statistische Daten auf der Grundlage von Planquadraten mit einer Seitenlänge von 250m, 500m, 1.000m, 2.500m, 5.000m und 10.000m zur Verfügung gestellt. Alle Planquadrate sind durch Landeskoordinaten definiert. Da es sich bei den Planquadraten um koordinatengebundene Netze handelt, stellen diese unveränderliche Bezugsflächen dar, und Veränderungen können im Gegensatz zu Gemeinden von einer Zählung zur nächsten genau festgestellt werden.

2 PLANQUADRATE AUF DER BASIS KOORDINATENGEBUNDENER NETZE

Bei einer Gebietsgliederung in Planquadrate (Gitternetze) unterscheidet man zwischen koordinatenunabhängigen und koordinatenabhängigen Netzfigurationen. Für die zeitliche Vergleichbarkeit von Daten benötigt man ein fix definiertes und damit ein koordinatenabhängiges Netz. Die Grenzen der Gitternetzmaschen (Planquadrate) werden dabei durch das jeweilige Koordinatensystem definiert. In erster Linie wird man solche Koordinatensysteme heranziehen, die in den amtlichen Karten verwendet werden. In den Österreichischen Karten im Maßstab 1:25.000 (ÖK25V), 1:50.000 (ÖK50) und 1:200.000 (ÖK200) ist dies das Gauß-Krüger-Netz bzw. Bundesmeldenetz, wobei zur Zeit ein Umstieg auf das UTM-Netz erfolgt (siehe Kapitel 2.1). Für die Übersichtskarte von Österreich 1:500.000 (ÖK500) bietet sich ein Lambert-Netz an (siehe Kapitel 2.2). Da man die digitalen topographischen Karte 1:500.000 auch als Grundlage für großmaßstäbige Kartendarstellungen verwenden kann, ist dieses Netz nicht nur für statistische Übersichts- sondern auch für Detaildarstellungen sehr gut geeignet.

Auf dem nationalen Kartenwerk, das man als Grundkarte für eine statistische Kartendarstellung auf der Basis von Gauß-Krüger-, UTM- oder Lambert-Netzen tatsächlich verwendet, muss aber nicht das Netz haben, das in der Grundkarte eingezeichnet ist. Welche Informationselemente (z.B. Gewässer-, Straßennetz, Wald) in welchem Generalisierungsgrad man aus den nationalen Kartenwerken benötigt, wird auch vom Zweck und Kartenmaßstab abhängig sein. Will man z.B. die in der Gauß-Krüger-Abbildung gehaltenen lagetreuen Informationsebenen der DKM mit einem UTM-Netz oder Lambert-Netz kombinieren, muss die Gauß-Krüger-Abbildung in die UTM-Abbildung oder Lambert-Abbildung transformiert werden. Genaue Informationen über die Kartenwerke und Netze können der Homepage vom Bundesamt für Eich- und Vermessungstwesen (BEV): www.bev.gv.at unter „Geobasisdaten" entnommen werden.

2.1 BUNDESMELDENETZ und UTM-NETZ

In Österreich ist in allen nationalen großmaßstäbigen Kartenwerken der ÖK25, ÖK50 und ÖK200 das Bundesmeldenetz aufgedruckt, da diese topographischen Karten auf dem Gauß-Krüger-Abbildungsverfahren basieren. Dieses Bundesmeldenetz ist zwar ein für das Staatsgebiet Österreichs optimiertes Ortsbezugssystem, ist aber räumlich eingeschränkt einsetzbar, da es nur in Österreich eingeführt ist. Mit dem Beitritt zum NATO-Programm „Partnerschaft für den Frieden" hat sich Österreich verpflichtet, die nationalen Kartenwerke hinsichtlich Bezugssystem und Projektion den internationalen Vorgaben anzupassen. Das BEV stellt daher diese Kartenwerke vom System der österreichischen Landesvermessung (Bessel-Ellipsoid, Gauß-Krüger-Abbildung) auf das weltweit standardisierte „Universale Transversale Mercator System" (UTM) um. Da der Übergang auf das internationale Referenzsystem nur schrittweise erfolgen kann, werden kontinuierlich jene Bereiche, die einer Aktualisierung unterzogen werden, durch neue ÖK-Kartenblätter im UTM-System ersetzt. Bei den Digitalen Katastralmappenblättern erfolgt die Umstellung von einem Gauß-Krüger-Abbildungsverfahren auf ein UTM-Abbildungsverfahren erst zu einem späteren Zeitpunkt. Für statistische Auswertungen auf Planquadratbasis von Bedeutung ist, dass das Gauß-Krüger-Netz in allen Digitalen Katastralmappenblätter am Kartenrande angerissen ist. Da in der DKM auch die Gebäudegrundrisse enthalten sind, kann man genau erkennen, welche Gebäude in welchem Planquadrat liegen. Dies ist dann von besonderer Bedeutung, wenn es sich um regionalstatistische Untersuchungen auf der Ebene der örtlichen Raumplanung handelt.

Für die derzeitigen ÖK-Blätter bis zum Maßstab 1:200.000 wird die Gauß-Krüger-Abbildung verwendet, und zwar in der drei Grad-Meridianstreifen-Abbildung mit den Mittelmeridianen 28°, 31° und 34° ostwärts von Ferro mit der Grundlage des Rotationsellipsoides nach Bessel. Dieses Bundesmeldenetz setzt sich aus 3 rechtwinkeligen, geodätischen Koordinatennetzen zusammen, deren Ursprung im Schnittpunkt des jeweiligen Meridianes mit dem Äquator liegt (siehe Abbildung 1). Das Österreichische Bundesmeldenetz entspricht dem Gauß-Krüger-Netz. Der Unterschied liegt darin, dass es beim Bundesmeldenetz im Gegensatz zum Gauß-Krüger-Netz bei der Kennzeichnung der Netzmaschen nur positive Rechtswerte gibt. Um diese positiven Werte bei der Kennzeichnung im Bundesmeldenetz gegenüber des Gauß-Krüger-Netzes zu erreichen, erhielten die Mittelmeridiane die Werte 150km (M28), 450km (M31) und 750km (M34).

Die neu überarbeiteten großmaßstäbigen Karten werden hingegen in zwei 6° breite Meridianstreifen in der Universalen Transversalen Mercator-Abbildung (UTM) – Grundlage ist das Rotationsellipsoid im World Geodetic System 1984 (WG 84) mit den Mittelmeridianen 9° und 15° ostwärts von Greenwich abgebildet. Als Ortsangabeverfahren wird das UTM-System herangezogen. Für das Gitternetz erhält der Mittelmeridian die Bezeichnung E für East, östlich von Greenwich und den Wert 500km als Additionskonstante für positive Rechtswerte der gesamten Zone. Der Hochwert gibt die Entfernung zum Äquator an. Dieser Hochwert ist 7-stellig und beginnt für Österreich immer mit einer „5“ d.h. 5.000km nördlich des Äquators (siehe Abbildung 2).

Sowohl bei der Gauß-Krüger-Abbildung als bei der UTM-Abbildung werden die Mittelmeridiane so gewählt, dass der Lagefehler gegenüber geographischen Koordinaten gering ist. Die Verwendung verschiedener Längenkreise als Bezugsmeridiane für Gitternetze hat aber den Nachteil, dass es an den Nahtstellen zwischen zwei Meridianstreifen zu Überlappungen kommt. Somit ist eine Einteilung der gesamten Fläche Österreichs in gleich große Gitternetzmaschen nicht möglich. Will man die Gesamtfläche Österreichs untergliedern, darf man nur einen einzigen Längenkreis als Bezugsmeridian heranziehen. Es liegt auf der Hand, dass man dann, wenn man Österreich nur mit einem einzigen rechtwinkeligen Koordinatensystem versehen will, bei der Gauß-Krüger-Abbildung den M31 und bei der UTM-Abbildung die Zone 33 heranziehen wird. Im Falle des Gauß-Krüger-Systems wird, vom 31. Längengrad östlich von Ferro (M31) ausgehend, das Netz nach Westen und nach Osten über das gesamte Bundesgebiet noch weiter ausgedehnt (siehe obere Karte in der Abb. 3) Im Falle des UTM-Systems muss die Zone 33 nur nach Westen hin erweitert werden (siehe untere Karte in der Abb. 3). Bei einer Untergliederung Österreichs mit einem einzigen Gitternetz ist es besser, statt eines Gauß-Krüger-Netzes oder UTM-Netzes ein rechtwinkeliges Gitternetz über eine lambert'sche konforme Kegelprojektion zu legen (siehe folgendes Kapitel).

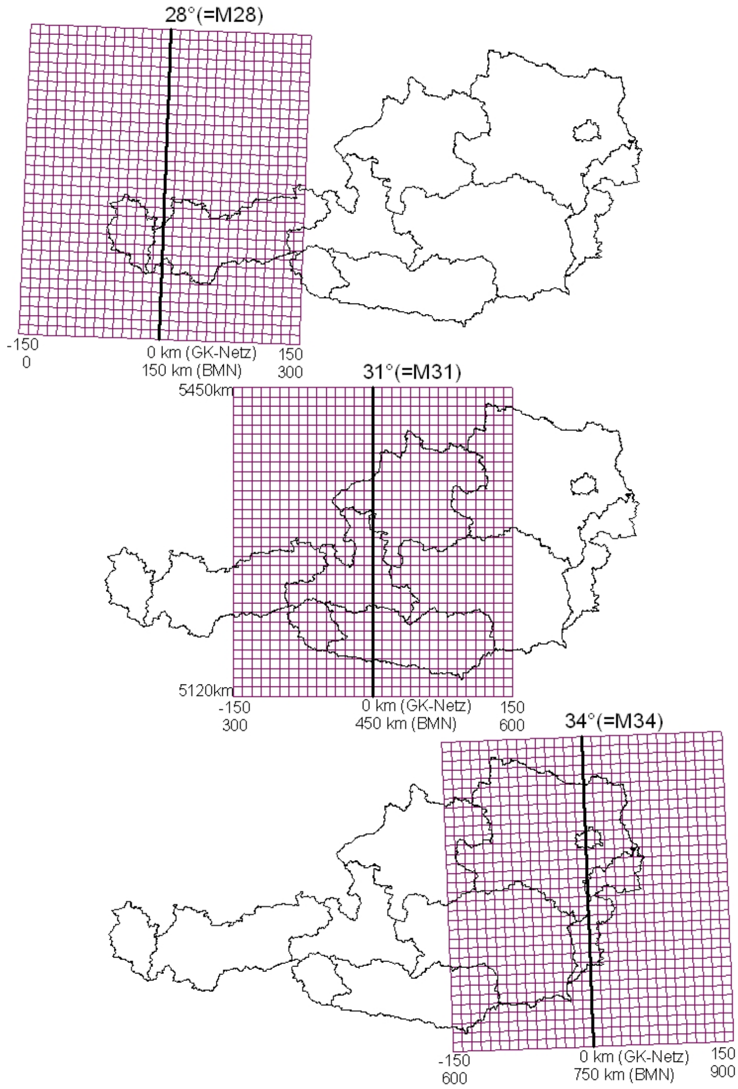

Abb.1 Die Bundesgebiet wird in den drei Meridianstreifen (M28, M31 und M34) der Gauß-Krüger-Abbildung abgebildet. Die Grundlage dafür ist das Rotationsellipsoid nach Bessel mit den Mittelmeridianen 28°, 31° und 34° ostwärts von Ferro. Über jeden dieser drei Mittelmeridiane werden die Gitternetzfelder (hier 10km) rechtwinkelig angeordnet. Dadurch kommt es auch zu einem Überlappungsbereich.

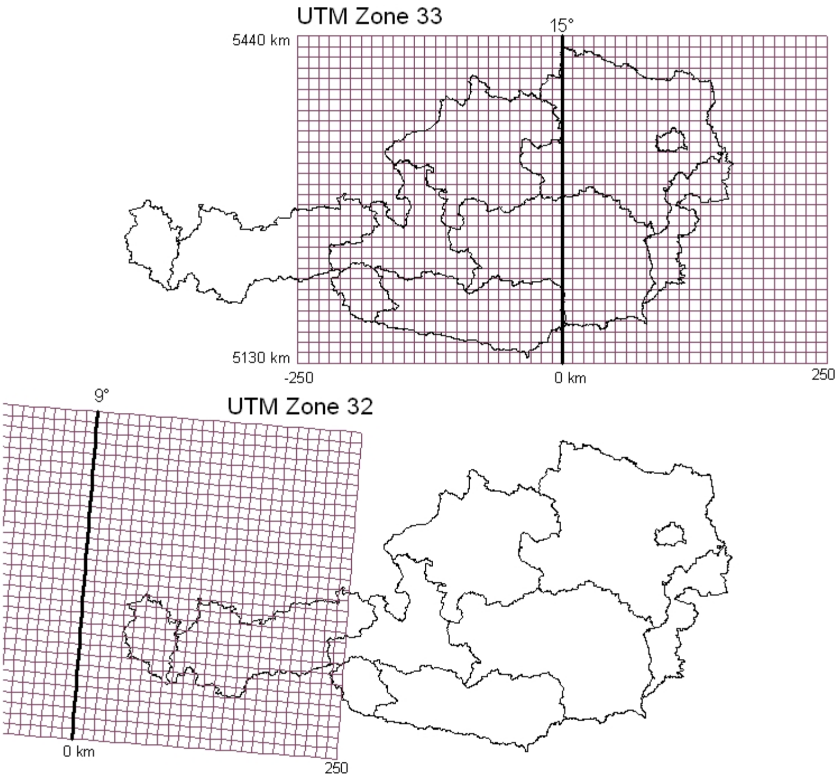

Abb.2: Das Bundesgebiet wird in den zwei Meridianstreifen (Zone 32 und 33) der Universalen Transversalen Mercator-Abbildung (UTM) abgebildet. Die Grundlage dafür ist das Rotationsellipsoid im World Geodetic System 1984 mit den Mittelmeridianen 9° und 15° ostwärts von Greenwich. Über jeden dieser zwei Mittelmeridiane werden die Gitternetzfelder (hier 10km) rechtwinkelig angeordnet. Auch hier kommt es zu einem Überlappungsbereich.

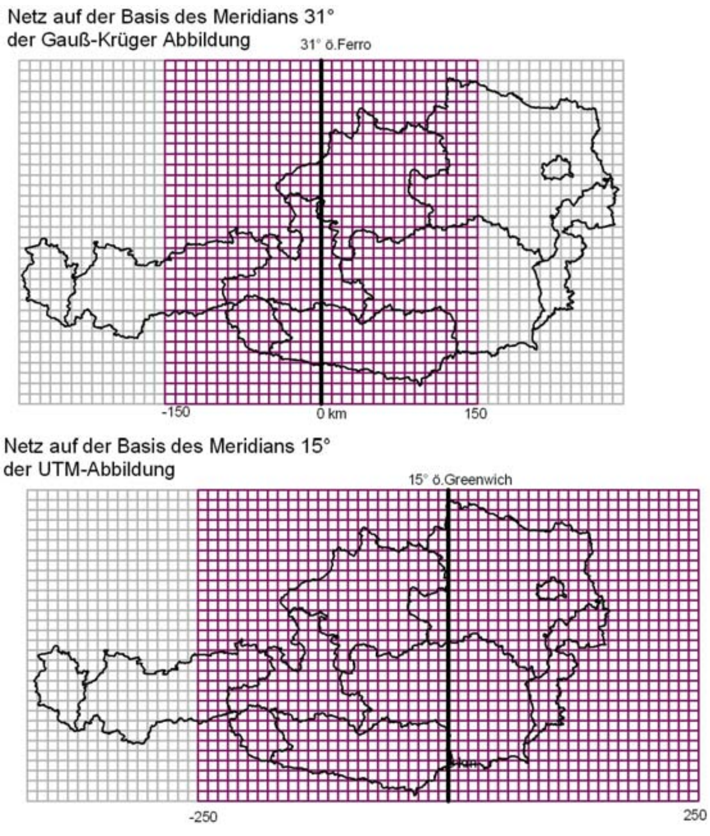

Abb.3: Österreichdarstellungen auf der Basis des Gauß-Krüger-Netzes und des UTM-Netzes. In der oberen Karte sind die Bundeslandgrenzen in der Gauß-Krüger-Abbildung abgebildet. Bei dieser Österreichdarstellung ist das Gitternetz 10x10km (dargestellt in dicken Linien) ident mit dem Gauß-Krüger-Netz des Meridianstreifens M31. In der unteren Karte sind die Bundeslandgrenzen in der UTM-Abbildung abgebildet. Bei dieser Darstellung ist das Gitternetz (dargestellt in dicken Linien) ident mit dem UTM-Netz der Zone 33.

2.2 LAMBERT-NETZ

Sowohl für großmaßstäbige Detailuntersuchungen als auch für eine statistische Auswertung im kleinen Maßstab eignet sich ein auf der lambert'schen konformen Kegelprojektion aufbauendes Gitternetz. Die Kartengrundlage ist in diesem Fall die Übersichtskarte von Österreich im Maßstab 1:500.000. D.h. auf einem einzigen Kartenblatt wird das gesamte Bundesgebiet dargestellt. Die Abbildung erfolgt durch die winkeltreue lambert'sche Schnittkegelprojektion mit den beiden längentreuen Parallelkreisen in 46° und 49° nördlicher Breite. Um zu einem rechtwinkeligen Gitternetz zu kommen, ist STATISTIK AUSTRIA so vorgegangen, dass als y-Achse der Zentralmeridian 13°20' und als x-Achse der Breitenkreis 47°30' genommen wurde. Der Zentralmeridian verläuft durch die Mitte Österreichs (siehe Abb.4). Die Projektionsparameter sind:

- Lambert'sche Projektion
- Bessel-Ellipsoid
- Längentreue Parallelkreise: 46° und 49°
- Bezugsmeridian (Zentralmeridian): 13°20' von Greenwich
- Bezugsbreitenkreis: 47°30'

Im Normalfall wird bei einer Übersichtskarte von Österreich die Seitenlänge der Quadrate mindestens 2,5km betragen. Das entspricht im A3-Format einem Kartenmaßstab von 1:1.500.000.

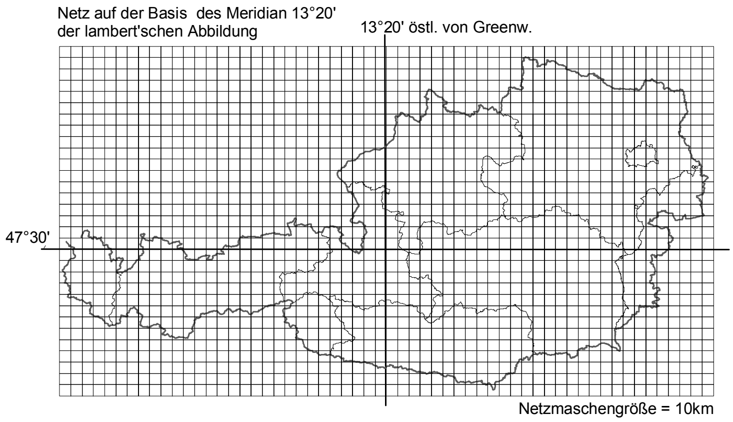

Abb.4: Für eine gesamtstaatliche Untersuchung eignen sich Gitternetzmaschen auf der Basis der lambert'schen konformen Kegelprojektion gut. Der Schnittpunkt des Meridian 13°20' östliche Länge und des Bezugsbreitenkreises 47°30' nördliche Breite ist ein fixer Eckpunkt aller Lambert-Netze.

3 DATENBEREITSTELLUNG FÜR PLANQUADRATE

Für die Ermittlung der Großzählungsdaten nach Planquadraten muss jede Gebäudadresse im Gebäuderegister von STATISTIK AUSTRIA, das als Lokalisationspunkt der statistischen Daten fungiert, ihrem entsprechenden Planquadrat zugewiesen werden. Dabei geht man so vor, dass zunächst für jedes als Datenträger in Betracht kommende Gebäude die Koordinaten bestimmt werden. Als Gebäudekoordinate wurde der Bauflächenpunkt aus der DKM des BEV genommen. Gespeichert ist dieser Bauflächenpunkt in der Grundstücksdatenbank des BEV. Da zwischen den Gebäudeadressen des Gebäuderegisters von STATISTIK AUSTRIA und der Grundstücksdatenbank vom BEV ein Adressabgleich vorgenommen wurde, kann der Koordinatenwert des Bauflächenpunktes von jeder Gebäudeadresse der Grundstücksdatenbank zu jeder Gebäudeadressen im Gebäuderegister überspielt werden. Die Zuteilung zu den einzelnen Planquadraten erfolgt gemäß den das Planquadrat begrenzenden Koordinatenwerten und zwar so, dass jedem Gebäude eine Rasternummer zugeordnet wird. Das Planquadrat ist durch das Koordinatennetz der Gauß-Krüger Projektion, UTM-Projektion oder Lambert'schen konformen Kegelprojektion definiert. Die Rasternummer besteht aus den Koordinaten des linken unteren Eckpunktes der Rastereinheit des entsprechenden Systems (siehe Tabelle 1).

Planquadratgröße	Planquadratname		
	im Gauß-Krüger-Netz	im UTM-Netz	im Lambert-Netz
250m x 250m	G31_250_40025-22025	U32_250_35025_22025	L_250_38325_35525
500m x 500m	G31_500_4005_2205	U32_500_3505_2205	L_500_3835_3555
1.000m x 1.000m	G31_1000_401-221	U32_1000_351_221	L_1000_383_355
2.500m x 2.500m	G31_2500_4025_2225	U32_2500_3525_2225	L_2500_3825_3525
5.000m x 5.000m	G31_5000_405_225	U32_5000_355_225	L_5000_385_355
10.000m x 10.000m	G31_10000_41_23	U32_10000_35_22	L_10000_38_35

Tab.1: Die Bezeichnung des Planquadrates beginnt mit der Abkürzung des Netzes (G=Gauß-Krüger-Netz, U=UTM-Netz, L=Lambert-Netz), wobei im Gauß-Krüger-Netz die beiden anschließenden Zahlen den Meridianstreifen 28, 31 oder 34 und im UTM-Netz die Zone 32 oder 33 bedeuten. Dann wird die Planquadratgröße angegeben (250m, 500m, 1000m, 2500, 5000, und 10000m). Die Kennzeichnung jedes einzelnen Planquadrates leitet sich aus den x- und y-Koordinatenwerten (in Meter) des linken unteren Eckpunktes ab. Eine von der Planquadratgröße abhängige Anzahl von Nullen wird gestrichen, sowie beim Gauß-Krüger- und UTM-Netz die führende 5 beim y-Koordinatenwert. Somit hat bei allen Netzen die erste Ziffer den Stellenwert 100.000. Z.B. U32_1000_351_221 bezeichnet das UTM-Netz der Zone 32 mit der Planquadratgröße 1.000x1.000m und der linken unteren Koordinate (x=351000, y=5221000).

Der Aufgabenstellung entsprechend werden verschiedene Kartenmaßstäbe und damit Planquadrate auf der Basis verschiedener Netzmaschenweite benötigt. Die Planquadratgröße ist aber nicht nur von der regionalstatistischen Aufgabenstellung abhängig, sondern auch vom Datenschutz. Während der Externe die Fallzahlen (z.B. Wohnbevölkerung, Gebäude, Wohnungen) für jedes standardmäßig erstellte Planquadrat bekommt, ist dies bei den Merkmalen zu diesen Fallzahlen nicht möglich (z.B. Wohnbevölkerung nach Altersgruppen). Dies deshalb, da die Merkmale zu diesen Fallzahlen aus Datenschutzgründen an externe Datenbankbenützer nur in aggregierter Form weitergegeben werden dürfen.

Einige ausgewählte statistische Merkmale werden standardmäßig auf der Basis von koordinatengebundenen Netzen angeboten. Z.B. Einwohner nach Geschlecht und Familienstand, Wohnungen nach Ausstattungskategorie und Heizungsart, Gebäude nach Bauperiode und Gebäudenutzung. Mit Hilfe einer Sonderauswertung bekommt der externe Datenbankbenützer von der Großzählung nicht nur die Fallzahlen und deren Merkmale, sondern es können auch die Merkmalsverknüpfungen durchgeführt werden. Z.B. die Zahl der männlichen Auspendler mit einem öffentlichen Verkehrsmittel.

Geplant ist auch, statistische Daten aus anderen Zählungen auf der Basis von koordinatengebundenen Planquadraten zu Verfügung zu stellen. Dies ist aber nur bei den Zählungen möglich, bei denen die Gebäudeadressen denselben Adresscode aufweisen, der auch im Gebäuderegister gespeichert ist.

4 GIS ANWENDUNGEN

Bei räumlichen Untersuchungen wird besonders häufig die Einwohnerzahl verwendet. Dabei will man nicht nur Informationen über die Einwohnerverteilung eines Untersuchungsgebietes bekommen, sondern auch über die der Einwohnerdichte. An Hand des Kartenbeispiels in der Abb. 5 wird gezeigt, wie unterschiedlich das Ergebnis sein kann, wenn man einmal als regionale Raumgliederung die Gemeinde und ein anderes Mal Planquadrate nimmt. Trotz gleicher Ausgangsdaten bei der Berechnung der Einwohnerdichte kommt es, je nachdem ob als Bezugseinheit die Gemeinde (untere Karte) oder die Planquadrate (obere Karte) herangezogen werden, zu unterschiedlichen Dichteverteilungen. Während die Bevölkerungsdichtekarte auf Gemeindebasis auch hohe Dichtewerte weit abseits der bewohnten Täler aufweist, ist dies bei der Bevölkerungsdichtekarte auf Planquadratbasis nicht so. Die Struktur der Täler wird trotz der abstrakt wirkenden Quadrate in vereinfachter Form gut wiedergegeben. Hohe Dichtewerte gibt es auch nur dort, wo die Ortschaftssignaturen sind. Der Kartenvergleich macht deutlich, dass nur eine auf Planquadraten aufbauende Datenbank über eine hohe Auskunftsbereitschaft verfügt und eine hinreichende Flexibilität aufweist.

Bei der Interpretation von Karten ist zu beachten, dass auch dann, wenn Gemeindegrenzen als räumliche Bezugseinheit zur kartographischen Darstellung von statistischen Daten verwendet werden, diese immer Verwaltungsgrenzen und keine Sachgrenzen des darzustellenden statistischen Sachverhaltes sind. Die räumlichen Zusammenhänge werden in der Karte deshalb nur überblicksartig gezeigt. Die kartographische Darstellung hat hier einen anderen Schwerpunkt. Gemeinden sind nicht nur Verwaltungseinheiten sondern auch „Planungseinheiten". Statistische Maßzahlen auf Gemeindebasis, gezeigt im räumlichen Zusammenhang, dienen als wichtige Grundlage für Planungsentscheidungen.

5 LITERATURVERZEICHNIS

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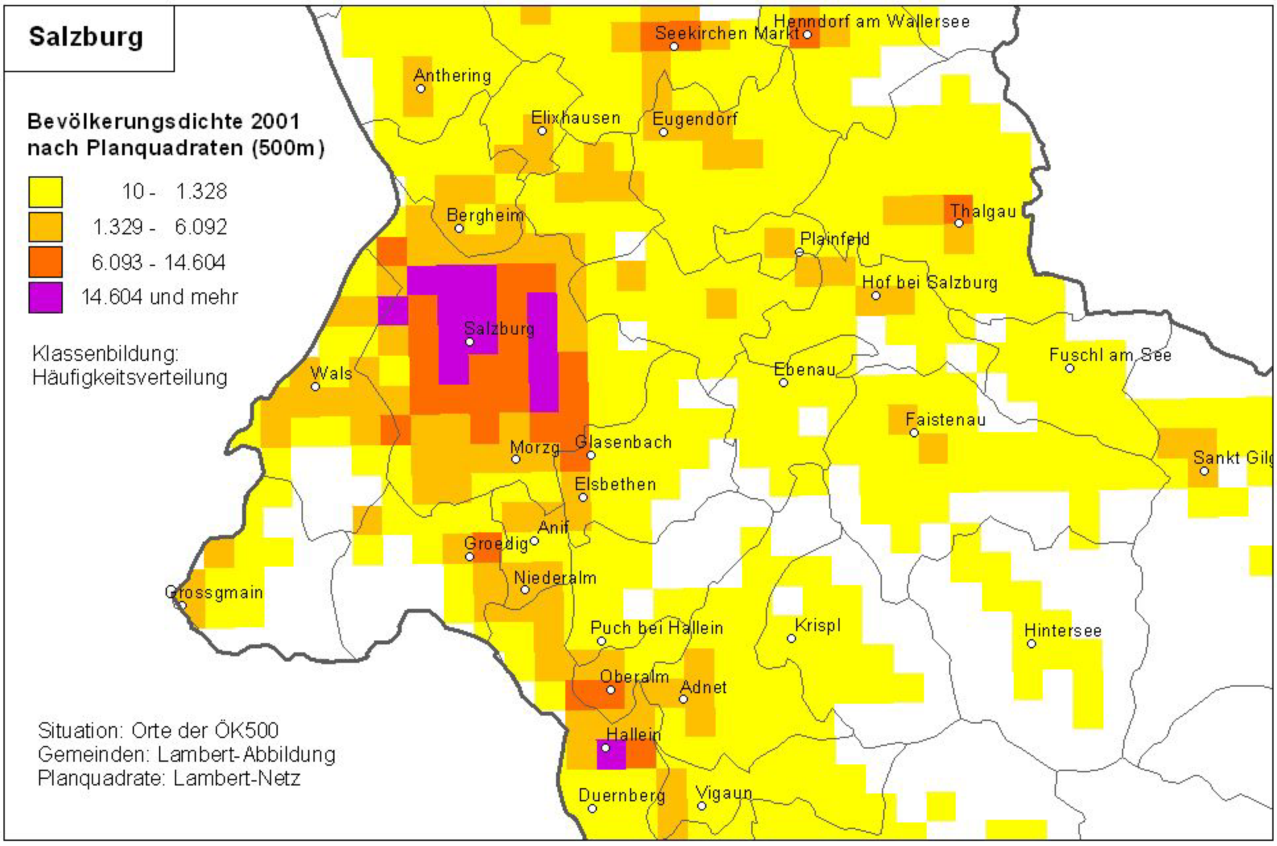

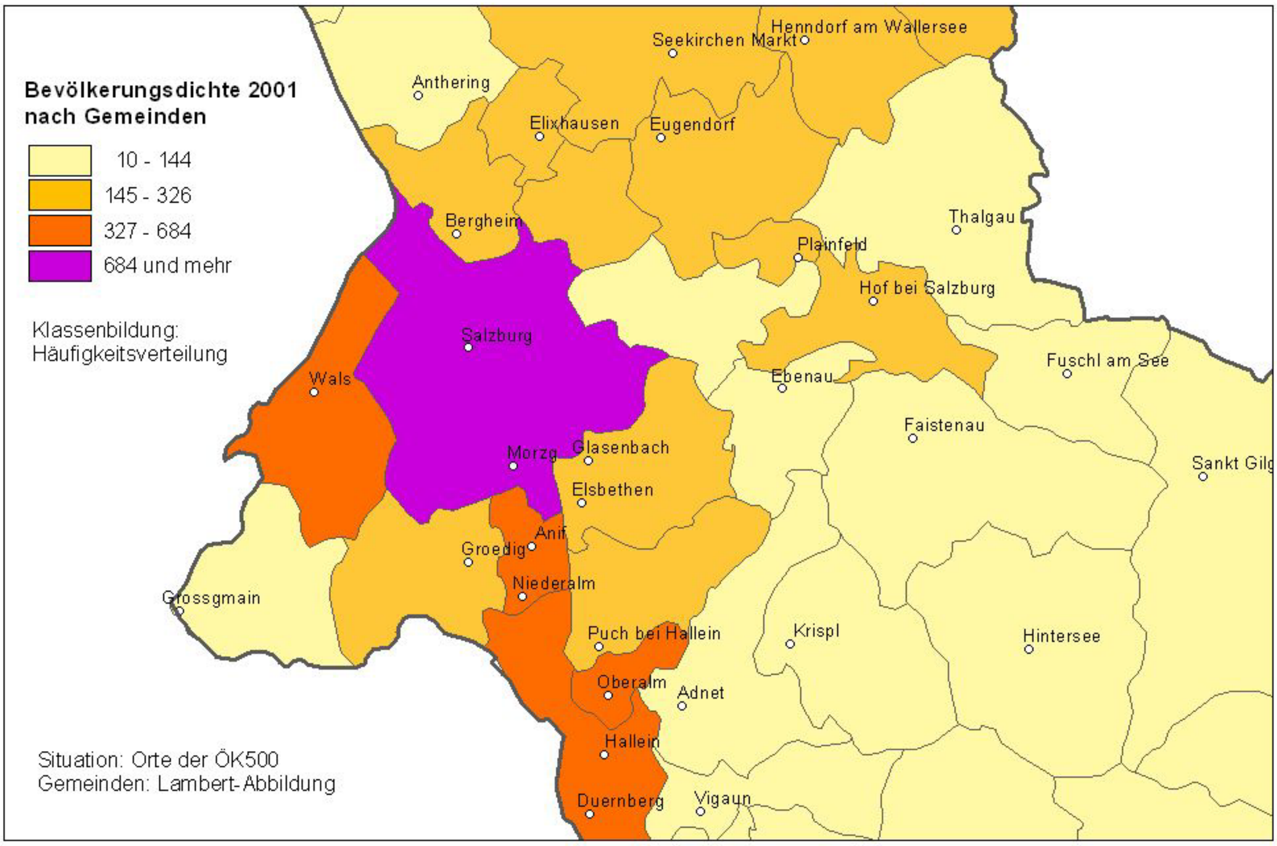

Abb.5: Wie der Vergleich der beiden Kartenausschnitte zeigt, kann man bei einer Planquadratgliederung im Gegensatz zu einer Gemeindegliederung in relativ große Maßstabsbereiche vordringen. D.h. man kann die Planquadratgröße (hier 500x500m) dem Maßstab entsprechend auswählen. Da in der Bevölkerungsdichtekarte auf Planquadratbasis auch die Gemeindegrenzen eingezeichnet sind, wird deutlich, wie unterschiedlich innerhalb einer Gemeinde die Dichtewerte sein können. Der Unterschied ergibt sich vor allem dadurch, dass die Gemeindegrenzen in keinem Zusammenhang mit dem Grenzverlauf des darzustellenden statistischen Sachverhaltes steht.

Adressgeokodierung bei der Österreichischen Post AG

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1 EINLEITUNG

Die Österreichische Post AG beabsichtigt im Rahmen ihres Projektes "Geo Adress" die räumliche Verortung sämtlicher Adressen Österreichs. Dabei soll die perfekte Ortskenntnis der einzelnen Zusteller innerhalb der jeweiligen Zustellbezirke (österreichweit ca. 9500) genutzt werden.

Die Vorgehensweise ist derart geplant, dass die Zusteller anhand ihrer Gangordnungen (Reihenfolge der Adressen in der Zustellroute) die einzelnen Hausadressen auf Basis einer entsprechenden digitalen Plangrundlage mit Hilfe eines speziell für diese Zwecke zu entwickelnden Software-Tools als Punkte identifizieren. Anschließend wird dieser Vorgang mit einer Digitalisierung der identifizierten Adresse beendet

Die verorteten Adressdaten stellen eine unverzichtbare Datengrundlage für eine effiziente Verwaltung von sämtlichen postalischen Infrastruktureinrichtungen dar und werden nahtlos in die bereits existierenden Datenbankstukturen integriert und in einem Geographischen Informations-System verwaltet.

2 INFRASTRUKTURDATEN DER POST AG

Die geokodierten Adressen bilden die Datengrundlage für die GIS-Integration der gesamten postalischen Infrastruktur.

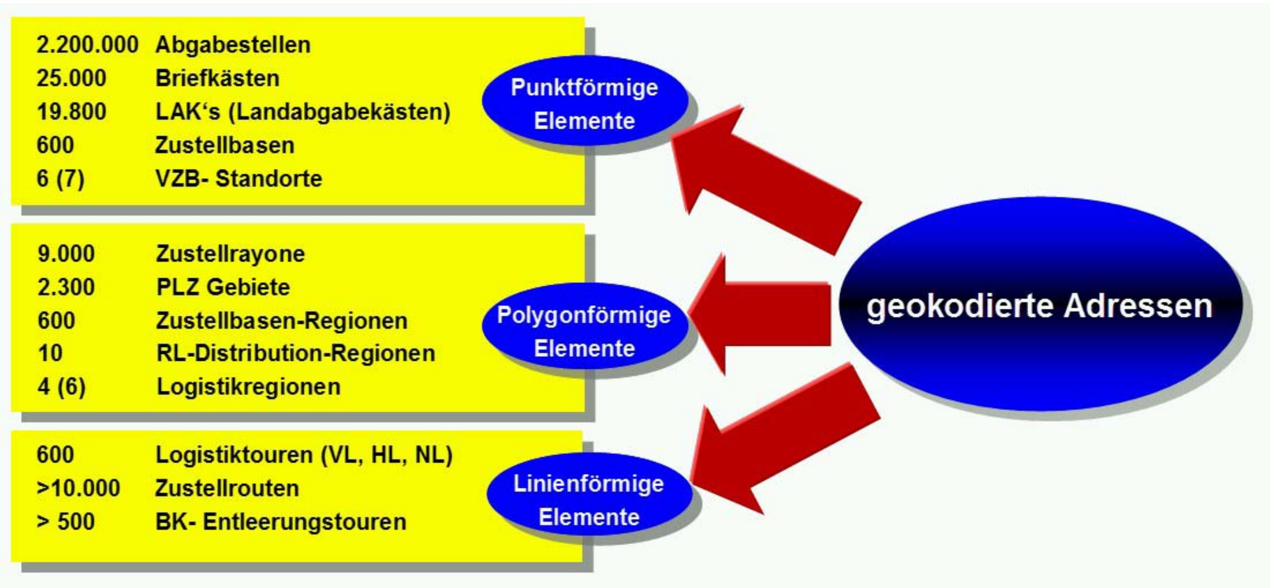


Abb.1: Infrastrukturdaten der Österreichischen Post AG

2.1 Verwaltung & Aktuellhaltung der Infrastrukturdaten durch GeoDataOffice

GeoDataOffice ist eine GIS-Kompetenzeinheit der ÖPAG innerhalb von Servicecenter Verteilszentren Brief

Die Hauptaufgabengebiete:

- Aktuellhaltung, Dokumentation & Archivierung der räumlichen Infrastrukturdaten der ÖPAG / GF Brief
- Integration von internen Infrastrukturdaten, internen Sachdaten & externen Geodaten in einem Geographischen Informations - System
- Providing der GIS-integrierten, aktuellen Datenbestände für die internen Optimierungen und Analysen / Tourenplanungen, Zustellroutenoptimierung, Standortoptimierung, Marketing & Vertriebsplanung,
- Konzept, Design & Einführung eines WEB – basierten, ö-weiten Auskunftssystemsfür die gesamten postalischen Infrastrukturdaten

Schematische Darstellung der GIS-Komponenten & Workflows

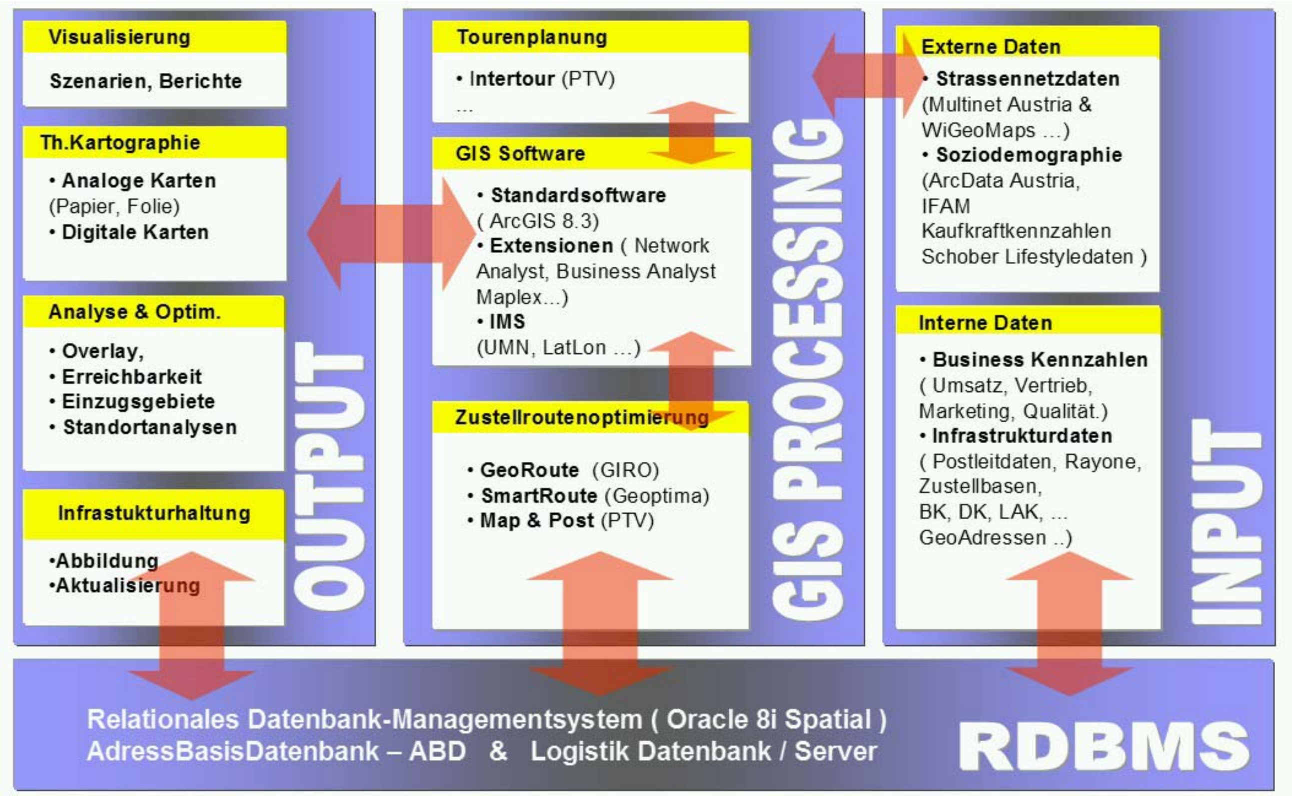


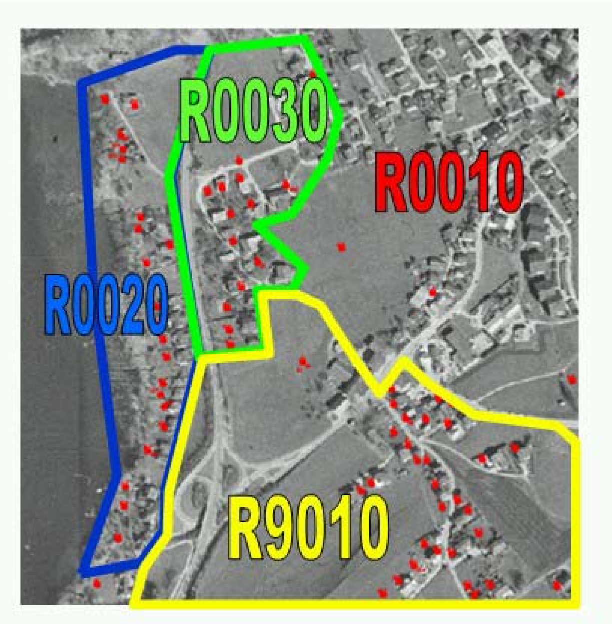
Abb.2: Komponentenschema & Workflow

2.2 Bedarf nach geokodierten Adressen bei der Post AG

Stellvertetend für die diversen Anwendergruppen und Themengebiete werden hier die folgenden Beispiele angeführt, bei deren mit geokodierten Adressen auf effiziente Weise die Planung und Optimierung von internen Abläufen ermöglicht wird .

- GIS-basierte Verwaltung und Aktuellhaltung der postalischen Infrastrukturdaten
(Visualisierungen, Analysen, Optimierungen)
- Briefkasten – Auskunftsystem für die Regulatorbehörde
(§ 5 der Universaldienstverordnung regelt die Rahmenbedingungen für die Erfüllung von postalischen Dienstleistungen (Erreichbarkeit der Briefkästen in ländlichen und dichtbesiedelten Gebieten …)
- Optimierung der Zustellrouten
(Integration der verorteten GeoAdressen /Zustelladressen ermöglicht die maximale Ausnützung des Optimierungssoftwares)
- Geomarketing & Business Mapping
(Zielgruppenanalysen für die Streuung der unadressierten Mailings, durch die Verortung der Adressen wird erstmals eine sgn. Rayonsstreuung ermöglicht)

Generiereung von Grenzen der postalischen Zustellbezirke, Visualiserung der Gangordnung (Reihenfolge der Zustelladressen innerhalb des Zustellbezirkes)



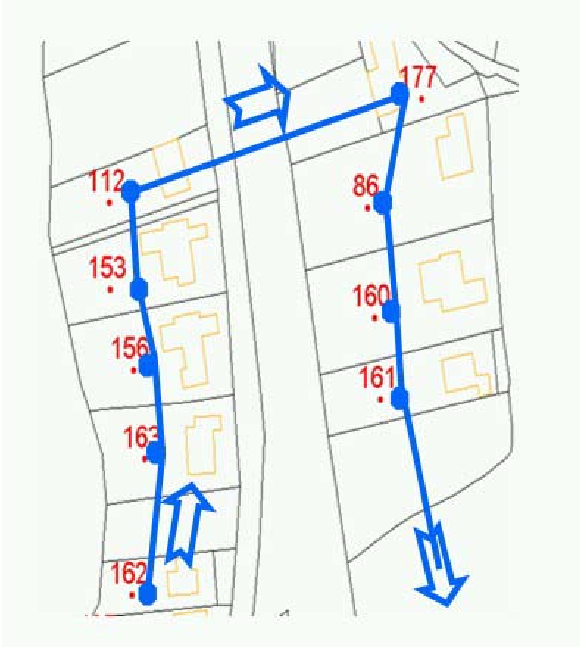


Abb.3: Zustellbezirkgrenzen in ländlichen Siedlungsraum und Visualisierung der Gangfolge

3 METHODIKBESCHREIBUNG

3.1 Voraussetzung Nr.1 – "postalische " Inputs

- Perfektes Ortskenntnis-Know-how der ca. 13.000 Zusteller durch tägliches Service innerhalb des Rayons und das meistens seit mehreren Jahren ! …
- Stabiles organisatorisches Schema Einteilung des gesamten Bundesgebietes in 9000 postalische Zustellrayone (ein Rayon = ca 300 Hausadressen / Abgabestellen)
- AdressBasisDatenbank ABD & normalisierte Gangordnungen bundesweiter topaktuell gehaltener Adressbestand. Für alle 9000 Zustellrayone existieren exakte Gangordnungen (Reihenfolgen von Hausadressen), die monatlich geprüft und aktualisiert werden …, alle ABD-Adresseinträge sind mit dem Gebäuderegister von Statistik Austria abgeglichen.
- Projektorganisation & IT - Infrastruktur Geokodierung von ca. 9.000 Zustellbezirken (a ca.300 Hausadressen) in ca.600 organisatorischen regionalen Einheiten (Zustellbasen), Bereitstellung der IT- Infrastruktur, Ablaufplanung & Koordination des Rollouts …

3.2 Voraussetzung Nr.2 – (Geo)Daten(Material)

- primäre Geodaten durch eine Projektkooperation mit der Fa. Tele Atlas GmbH wird die projektsbezogene Bereitstellung von geeigneten Kartenmaterial (Orthofotos) ö-weit gewährleistet
- sekundäre Geodaten Datenlayer: RoadNetwork & Built-up Areas aus dem Multinet Austria PLZ Gebiete, Zustellbasengebiete, Standorte von Zustellbasen und Postfilialen

3.3 Voraussetzung Nr.3 - Geokodierungstool

- Entwicklung von GeoAdress-Tools / Applikation auf der Basis von ESRI MapObjects - Spezifikation und Entwicklung des Geokodierungssoftwares durch Fa. PRISMA-Solutions und Integration in die bestehende IT-Infrastruktur der ÖPAG
- Generierung der Basisdatenpakete für die einzelnen Zustellbasengebiete Aufteilung und Aufbereitung der Geodatenpakete für die 600 Zustellbasen

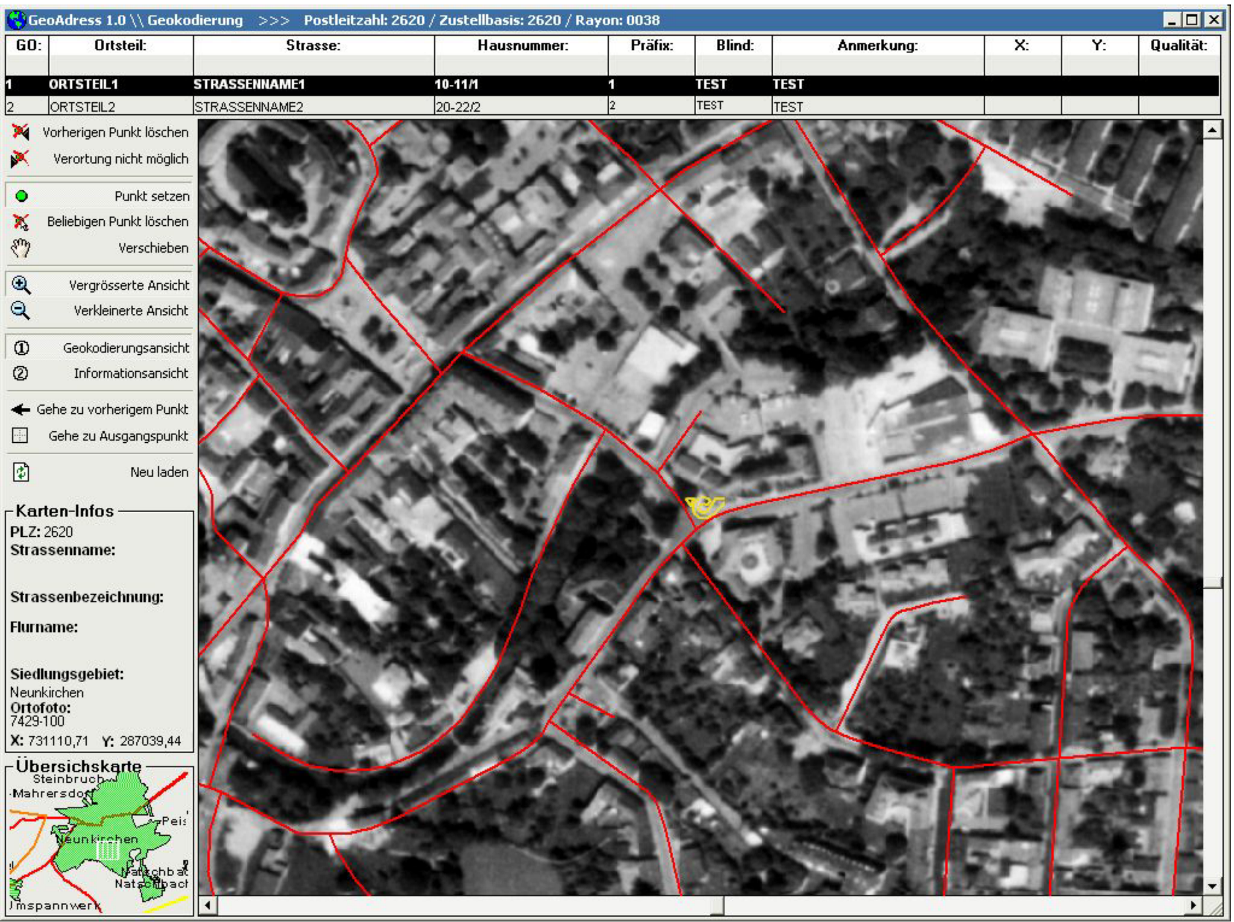


Abb.4: Geokodierungstool

4 PROJEKTPLANUNG

- **Q1/ 2003**
  Kooperationsvertrag mit TeleAtlas GmbH
- **Q2/2003**
  Softwareentwicklung durch PRISMA Solutions, Start Pilotprojektphase / Testgeokodierung
  Nachjustierung der Prozesse und Geokodierungtools
- **Q3,Q4/2003**
  Start Projektphase, ö-weit Projekt-Rollout
- **Q1,Q2/2004**
  Ende der Datenerhebungsphase, Datenfreigabe für AdressBasisDatenbank, Start Aktualiserungsphase …

ASTER-Höhendaten im Nationalen und internationalen Vergleich

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1 GRUNDLAGEN UND MOTIVATION

Zahlreiche Applikationen aus Bereichen wie Hydrologie, Morphologie, Klimatologie aber auch der Pedologie oder der Biologie zeigen deutlich, dass der Nutzwert digitaler Höhendaten gerade im Kontext von Begriffen wie Biodiversität und nachhaltiger Entwicklung in nächster Zeit sogar noch eine Steigerung erfahren dürfte. Im Lichte dieser Entwicklung resultieren daraus wesentliche Charakteristika, die in drei kurzen Statements zusammengefasst werden können: DGM's sind wichtige Planungsgrundlage und gerade in einem zusammenwachsenden Europa sollten auch DGM's nicht an den nationalen Grenzen enden sondern idealer Weise in einem Datensatz mit quasi-globaler Coverage bei gleichzeitig annähernd gleicher Charakteristik. DGM's werden in den seltensten Fällen direkt verwertet sondern eher in ihrer Form als primäre oder sekundäre topographische Attribute. Durch die damit verbundene rechnerische Veredelung ist allerdings auch die Möglichkeit der Fortpflanzung von Fehlern gegeben, sodass dieser Frage ein über das übliche Maß hinausgehendes Augenmerk zukommen muss.

Datenquelle	Eigenschaften
Terrestrische Lage-Höhe-Aufnahmen	Klassisches bodengebundenes Aufnahmeverfahren mit Totalstationen auf Basis der amtlichen Festpunktfelder. Erzielbare Höhengenauigkeit in Abhängigkeit von der Genauigkeit des Festpunktfeldes bis besser 3 cm. Es werden nur wenige, klar identifizierte repräsentative Strukturelemente bestimmt.
Terrestrisches Laserscanning	Aktuelles Verfahren der flächigen Erfassung auf Basis der Laserdistanzmessung. Keine Erfassung von Strukturelementen, sondern sehr hohe, jedoch stark variable Punktdichten. Genauigkeit vergleichbar mit der klassischen terrestrischen Lage-Höhe-Aufnahme.
Photogrammetrische Auswertung von Stereo-Luftbildern	Traditionelle „Airborne"-Methode der Akquisition großflächiger Oberflächendaten. Erzielbare Höhengenauigkeit in starker Abhängigkeit von der Flughöhe und dem Anschluss an das Festpunktfeld ca. 5 – 50 cm.
Airborne-Laserscanning	Relativ neuer „Airborne"-Ansatz auf Basis von Laserdistanzmessungen. Verfahren derzeit bei noch relativ hohen Kosten in intensiver Erprobungsphase. „Blindes" Messverfahren, Oberflächen werden ohne Aufnahme der Strukturelemente flächenhaft erfasst. Erzielbare Genauigkeiten: von ca. 20 - 100 cm
Satellitendaten (SPOT, IKONOS etc.)	Dem Vorteil der weiträumigen Abdeckung steht in erster Linie der Nachteil der relativ hohen Kosten gegenüber. Die erzielbare Genauigkeit liegt derzeit bei > 1 m
Radardaten (SRTM)	quasi – globaler Datensatz mit 90m Auflösung , allerdings gegenwärtig zumindest partiell noch in der Evaluierungsphase, für polnahe Gebiete nicht verfügbar (> 60° N und S)
digitalisierte Isolinien	Häufig verwendete, kostengünstig und weiträumig verfügbare, jedoch maximal sekundäre Quelle. In der Regel kaum dokumentierte und wenig gesicherte Ableitung aus photogrammetrisch erfassten Punkten mit anschließender Interpolation und Generalisierung. Sinnvoller Einsatz nur in Gebieten wo zwar topographische Karten jedoch keine DGM's vorliegen. Genauigkeit bestenfalls im Meterbereich, Abweichungen besonders im Gebirge oft im 100m-Bereich.

Tab.1: DGM-Daten nach Herstellungsmethode, Eigenschaften und erzielbarer Genauigkeit

Vergleicht man die Charakteristika der in Tab. 1 zusammengestellten Alternativen, so wird schnell klar, dass jede der dargestellten Methoden Schwächen im Sinne des oben skizzierten Anforderungsprofils aufweist, und zwar umso mehr je mehr die Kostenfrage in den Mittelpunkt der Betrachtung rückt.

Fazit der Betrachtung: Ein globaler digitaler Höhendatensatz mit einer Auflösung zwischen 30 und 50 m der zusätzlich noch beinahe kostenfrei verfügbar ist scheint in jedem Fall eine überdenkenswerte Alternative zu bestehenden Höhendatenquellen zu sein. Den potentiellen Anwender interessiert in diesem Zusammenhang vor allem die Frage, wie ein solcher Datensatz gegenüber nationalen

Datensätzen reüssieren kann, die - wohl nicht zuletzt aufgrund der Interessenslage – als qualitativ hochwertiger einzustufen sind als „fremde“ Datensätze? Diese Arbeit versucht Antworten auf diese Frage zu geben und konzentriert sich bei der Betrachtung auf drei Aspekte:

- Die Quantifizierung des Fehlers als Größe der Abweichung zwischen dem zu testenden Datensatz und einem nationalen Vergleichsdatensatz (wobei postuliert wird, dass der Vergleichsdatensatz fehlerfrei ist),
- die räumliche Verteilung der Abweichungen und
- möglicherweise bestehende Zusammenhänge zwischen anderen Reliefparametern und der räumlichen Fehlerverteilung

2 ASTER – DIE CHARAKTERISTIK EINES DATENSATZES

Das Advanced Spaceborne Thermal Emission and Reflection Radiometer – Sensor ist Teil der Terra – Instrumentenplattform, eines Erdbeobachtungssystems der NASA, das sich seit Februar 2000 in einer sonnensynchronen Polarumlaufbahn befindet. Versehen mit den Aufgabenbereichen Geologie, Hydrologie, Geomorphologie, Gefahrenmonitoring und Klimatologie werden diskontinuierlich (etwa 10 Minuten pro Umlauf) Daten der Erdoberfläche aufgezeichnet, sodass sich inzwischen (Stand: Mitte Dezember 2003) die beachtliche Menge von ca. 920.000 Bildern unterschiedlichster Sensoren angesammelt hat. Es kann davon ausgegangen werden, dass bei der gegenwärtigen Bearbeitungsrate durch das EROS Data Center (ein 60km x 60km Stereopaar pro Tag) etwa 2006 die letzten Bilder des Bereichs zwischen 82° N und 82° S der Öffentlichkeit zur Verfügung gestellt werden können (Abrams & Hook 2003; ASTER 2002).

Die für diese Arbeit wichtigsten Komponenten des ASTER – Systems sind die beiden VNIR – Kanäle 3N und 3B. Mit ihrer Hilfe wird im visible near infrared – Bereich (0,78 – 0,86 µ) entlang der Flugbahn mit einer Bodenauflösung von etwa 15 Metern sowohl nadir- als auch rückwärts gerichtet aufgezeichnet. Die daraus stereoskopisch abgeleiteten Höhendaten können – abgesehen von ihrer Verwendung als Grundlage für die atmosphärische und radiometrische Korrektur – auch in den traditionelleren Bereichen zum Einsatz gebracht werden. Dabei ist zu beachten, dass aufgrund der Systemkonfiguration prinzipiell 2 Varianten desselben Höhendatensatzes denkbar sind. Absolute DEM’s nutzen zur Georeferenzierung externe, von Anwender bereitzustellende Ground Control Points (GCP’s), bei den sogenannten relative DEM’s wird auf diese Miteinbeziehung externer Referenzen (GCP) verzichtet. Für die Praxis bedeutet dies, dass sich die horizontale bzw. vertikale Abweichung von maximal 7 Metern auf maximal 10 Meter vergrößert, was beispielsweise noch immer innerhalb der Toleranzgrenzen für US – Kartenmaterial der Maßstabsbereiche 1:250000 bis 1:50000 liegt (ASTER 1999, ASTER 2001, USGS 2003).

Die Auslieferung der Daten erfolgt in etwa 25 Mb großen tiles, die bei einer Bilddimension von 2500 Zeilen und 2500 Spalten und einer Auflösung von 30m pro Pixel etwa eine Fläche von 60 x 60 km zu abdecken. Als Datenformat aller ASTER-Daten findet die EOS – Variante von HDF (hierarchical data format) Verwendung, wobei in zusätzlichen MET – Dateien ein erweiterter Metadatensatz mitgeliefert wird.

3 DIE TESTSZENARIEN

Wenn – wie im vorliegenden Fall – die Qualität von Digitalen Geländemodellen durch den Vergleich mit bestehenden, präziseren Modellen überprüft werden soll, so kann dies nur nach einem festgelegten Regelwerk durchgeführt werden, das die Vereinheitlichung der unterschiedlichen Datenquellen und Datenformate (Datenfluss), der Controlling – Methoden und selbst den orographischen Eigenheiten der ausgewählten Testgebiete erwachsenden Problemen in ausreichendem Maße Rechnung trägt.

3.1 Der Datenfluss

Die Abgleichung der verwendeten Datensätze fokussiert in drei Arbeitsschritten: Ein erster dient der Konvertierung der Aster-Sensordaten, wobei weniger das lesbar machen an sich im Vordergrund der Überlegungen steht sondern vielmehr die Umgehung der Nachteile des nur von den wenigsten Softwarepaketen direkt lesbaren HDF-Formates. Ein eher den verbreiteten Standards entsprechendes Rasterdatenformat wie etwa GeoTIFF oder ArcInfo GRID bietet neben dem Vorteil der leichter zu manipulierenden Georeferenz auch eine Mehrzahl von Verarbeitungs- und damit Analysemöglichkeiten. In einem zweiten Schritt erfolgt die (Um-) Projektion der zu vergleichenden Datensätze (Abgleichung der Georeferenz); dabei sind durch die verfügbaren Metainformationen zwar beiderseits kaum Probleme zu erwarten, zur Beibehaltung der Integrität des Referenzdatensatzes wurden jedoch jeweils die ASTER-Daten in das jeweilige nationale Referenzsystem projeziert, sodass eventuell auftretende Fehler keinesfalls im Vergleichsdatensatz wirksam werden konnten. Bei der abschließend vorzunehmenden Festlegung der geeigneten Testauflösung (Bestimmung der Testpunktdichte) wurde auf die Verwendung mehr oder weniger repräsentativer Samples verzichtet und stattdessen eine der Auflösung des ASTER-Datensatzes angepasste Testpunktmatrix definiert. Neben den präziseren Ergebnissen konnten dadurch auch flächendeckende Erkenntnisse über die Datenqualität gewonnen werden. Abb.1 liefert eine detaillierte Darstellung des Datenflusses und der dabei durchlaufenen Verarbeitungsschritte.

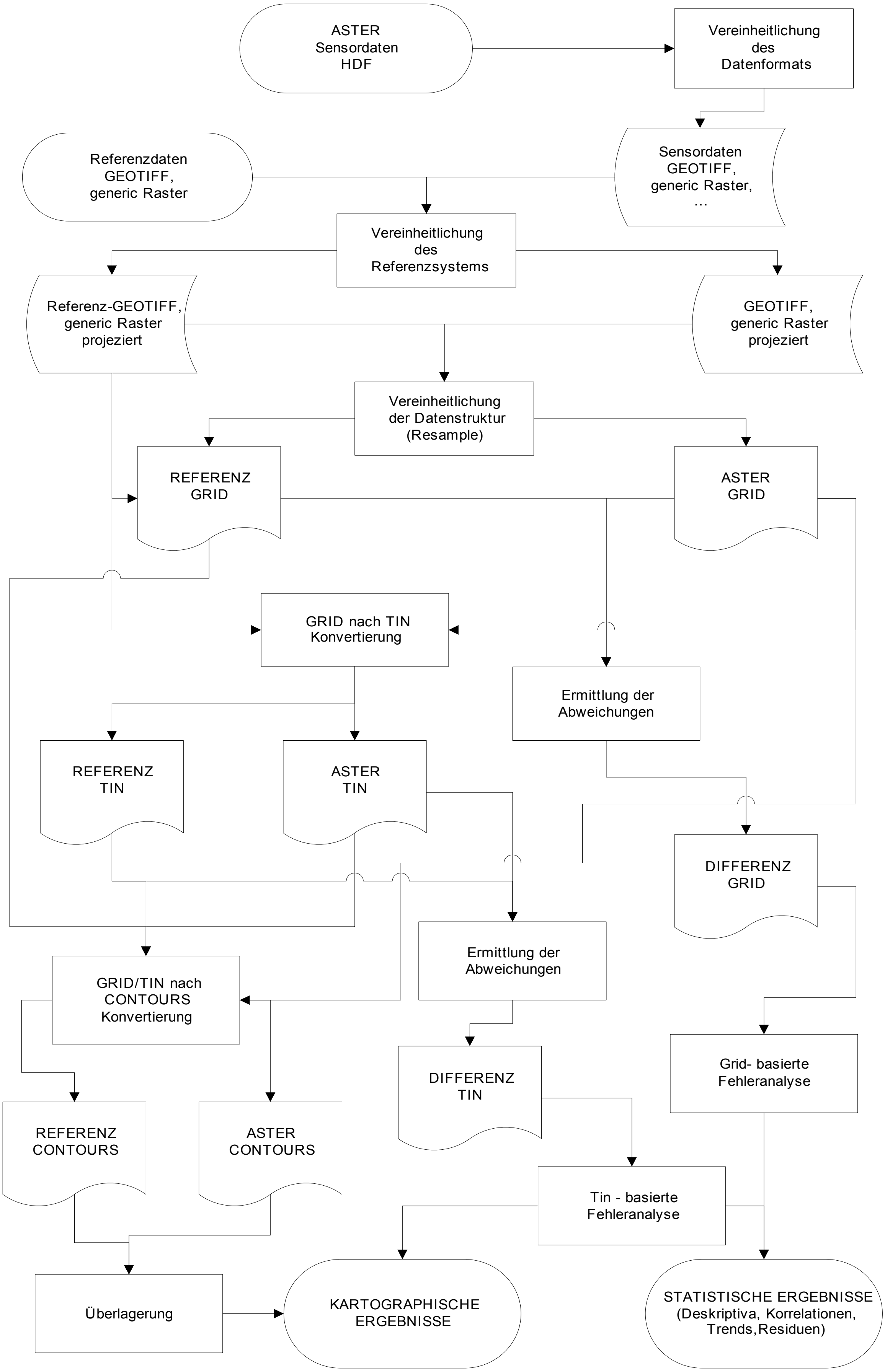

Abb.1: Die Verarbeitungsschritte im Testszenario

3.2 Methodische Überlegungen zur Evaluierung

Nicht zuletzt infolge der Aktualität der Problematik finden sich in der einschlägigen Literatur zahlreiche Hinweise und Vorschläge zur Evaluierung von Höhenmodellen (Monckton 1994, Barringer & Lilburne 1997, Li 1998, Carlisle 2000, King & Closs 2003 und Hirano et. Al. 2003 um nur einige zu nennen). Die simpelste ist wohl der meist mit einer Rekonvertierung verbundene Vergleich des Isolinienabbildes, eine Methode, die immerhin den Vorteil der problemlosen Erstellung mit der leichten Interpretierbarkeit der Ergebnisse verbindet. Die Möglichkeit Fehler auch lokal zuordnen zu können wird allerdings um den Preis der (in den meisten Fällen) zweifachen Interpolation mit einer fast zwangsläufigen Vergrößerung des Modellfehlers erkauft. Darüber hinaus lässt sich der Gesamtfehler nicht sauber in seine einzelnen Komponenten zerlegen, sodass eine betragsmäßige Aufteilung auf X-, Y- und Z-Anteile unterbleiben muss.

Im Gegensatz zum Isohypsenvergleich erfolgt die Abschätzung des Fehlers bei der Passpunkt- oder (als Variante davon) der Profillinienmethode über die Höhendifferenzen zwischen Test- und Vergleichsmodell. Beide Methoden sind mit einer Viel-zahl von Softwarepaketen zu realisieren und besitzen zusätzlich den Vorteil der relativ leichten Interpretierbarkeit der Ergeb-nisse. Die Nachteile der Methoden resultieren aus einem statistischen Problem: Wo bzw. wie dicht müssen die Passpunkte liegen um das Testgebiet mit all seinen orographischen Besonderheiten ausreichend genau beurteilen zu können? Mit anderen Worten: Die Anzahl der üblicherweise aus Koten oder GPS-Messungen gewonnenen Kontrollpunkte reicht selten aus um das zu untersuchende Gebiet im statistischen Sinne repräsentieren zu können (Kumar Ghosh, J. & Appa Rao 2003).

Gestützt auf diese Erkenntnisse scheint nur ein vollflächiger Vergleich von Test- und Kontroll-Modell den Ansprüchen einer qualitativen und quantitativen Beurteilung des Gesamtverhaltens bei gleichzeitiger Möglichkeit zur Lokalisierung bestehender Fehler zu genügen. Dabei stehen prinzipiell sowohl TIN- als auch GRID – Strukturen zur Verfügung. Erstere unterliegen dabei nicht der stringenten Organisation regelmäßiger Gitter und den daraus resultierenden Nachteilen, letztere besitzen den Vorzug, dass die überwiegende Mehrzahl der verfügbaren Höhendaten entweder sensorgestützt akquiriert wurden und damit nativ als Raster vorliegen oder von den jeweiligen Produzenten als GRID geliefert werden. Eine Umwandlung in TINs würde einen weiteren Konvertierungsprozess und damit eine zusätzliche Fehlerquelle bedeuten. Diese Überlegungen und die bereits in Abschnitt 3.1 angedeutete größere Flexibilität hinsichtlich der weiteren Verarbeitung und Analyse ließen das GRID – Modell für diese Untersuchung als geeignet erscheinen.

Erfahrungsgemäß erschöpft sich die Nutzung von digitalen Geländemodellen selten in der Auswertung des Attributs Höhe; in den meisten praxisnahen Analyseszenarien werden zusätzlich noch weitere aus der Höhe abgeleitete Kenngrößen (Derivative) berücksichtig (Desmet 1997). Diesem Umstand Rechnung tragend werden in dieser Studie neben der Z-Komponente mit der Hangneigung und der Exposition auch die beiden meist genutzten höhenabhängigen Attribute in die Betrachtung mit einbezogen. Dies macht insoferne auch Sinn als sich Fehler im Höhenmodell selbstverständlich auch die Güte der Derivative und damit die Analyseergebnisse beeinflussen können. Aus statistischer Sicht konzentriert sich die Studie auf drei Werkzeuge, deskriptive Methoden zur Quantifizierung von Zentraltendenz und Streuung der Abweichnung zwischen Test- und Kontrolldatensatz, die Analyse der Korrelation zwischen ausgewählten GRID - Parametern und der Feststellung von Trends innerhalb der untersuchten Gebiete.

3.3 Die Testgebiete

Die Auswahl der Testgebiete erfolgte in erster Linie unter dem Gesichtspunkt der landschaftlichen Vollständigkeit, d.h. es wurden vorzugsweise solche Gebiete ausgewählt, die sich neben der Reliefenergie auch durch eine möglichst ausgeprägte Formenwelt auszeichneten. Nicht minder wichtiges Kriterium war die Verfügbarkeit von Kontroll- und Testdatensätzen entsprechender Güte, wobei bei den ASTER-Daten auch wegen der weitaus größeren Abdeckung die Relativvariante verwendet wurde. Allfällige Probleme durch vereinzelt auftretende „Datenlöcher“ (sogennannte missing values innerhalb eines Tiles) konnten durch die geeignete Auswahl der Testgebiete ausnahmslos umgangen werden. Abb.2 zeigt die Lage der unter diesen Gesichtspunkten ausgewählten Gebiete in der slowakischen Teil der Hohen Tatra bzw. im Vorarlberger Montafon. Das dargestellte Gebiet entspricht dem Bereich von 8° E bis 21°30’ E bzw. 43°30’ N bis 51°30’ N.

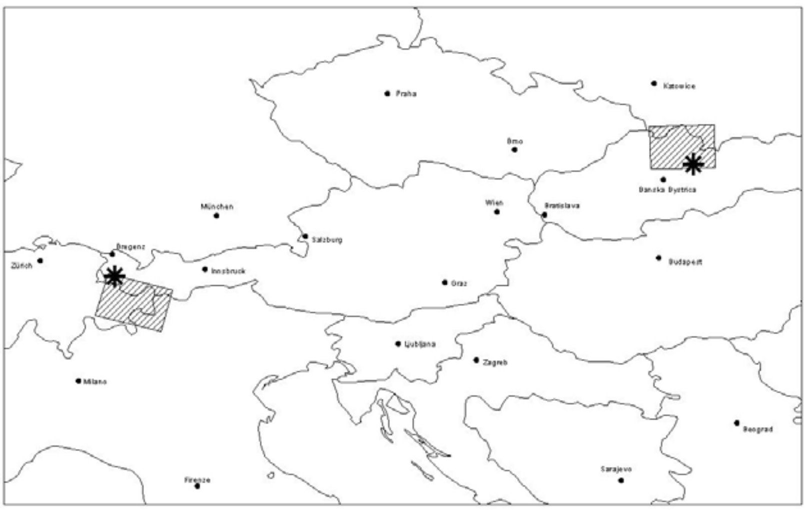

Abb.2: Die Lage der Testgebiete (ASTER-Szenen: schraffiert, Sternsymbol: Auswahlgebiete)

3.3.1 Tatra

Das für die Tatra verwendete etwa 10km mal 12,5km große Testgebiet liegt an der Südabdachung der Liptauer Tatra (westliche Hohen Tatra) etwa 5 km nordöstlich von Liptovsky Mikulas (ca. 600 m Seehöhe) bzw. südlich des Baranec (2184,0 m). Die verwendeten Korrekturdaten wurden dem Autor freundlicherweise von Tomas Cebecauer von der Firma GeoModel s.r.o. überlassen. Als Datengrundlage für dieses Modell dienen vornehmlich topographische Karten der Slowakei im Maßstab 1:50000, wobei in kritischen Bereichen zusätzliche Strukturinformationen (u.a. Terrassenkanten, Spothöhen) eingearbeitet wurden. Die Interpolation des GRIDs erfolgte über die „regularized spline with tension" – Methode von Mitasova und Mitas (Mitasova & Mitas 1993). Das daraus entstehende DTM25-SK (Projektion: S-42, Zone 34) liegt gegenwärtig in der Version 2.1 vor und erreicht bei einer Nominalauflösung von 25 Metern RMSE – Werte von 1,1 bis 1,6 bzw. in den gebirgigen Teilen Werte unter 2,3 Meter (Cebecauer 2003).

3.3.2 Montafon

Für das Testgebiet Gargellental im Vorarlberger Montafon liegen für eine Fläche von 130 km² First Pulse-Airborne-Laserscannerdaten vor. Die Daten stammen aus einem Gemeinschaftsprojekt des Landesvermessungsamtes Feldkirch (http://www.vorarlberg.at/lva) , mit der Wildbach- und Lawinenverbauung, dem Stand Montafon mit dem Institut für Photogrammetrie und Fernerkundung der TU Wien, bei dem mit Hilfe eines GPS-IMU-positionierten flugzeuggestützten Laserscanners im Mittel eine Million Punkte pro km² bestimmt wurden. Die Befliegung wurde an zwei Terminen im Herbst 2002 sowie im Sommer 2003 durchgeführt. Das Testgebiet wurde aufgrund der besonderen topographischen Rahmenbedingungen (Hochgebirge von 800 bis über 2800m Seehöhe, starke Reliefenergien, komplexe Geländeformen) sowie des inhomogenen Bewuchses ausgewählt, um eine qualifizierte Aussage über die generelle Eignung des Verfahrens für die Erfassung von Höhendaten in Hochgebirgsregionen zu erhalten. Die im WGS84-System erfassten Daten wurden auf Basis lokal bestimmter Transformationsparameter in das Landeskoordinatensystem überführt und liegen nunmehr im System GK-M28 vor. Eine unabhängige Kontrolle der Daten auf Basis von 11 terrestrisch bestimmten Flächentrippeln ergab eine Höhengenauigkeit der First-Pulse Daten von besser 1m.

Die Auswertung des Testprojekts ist noch nicht abgeschlossen, zusammenfassend kann jedoch bereits folgendes festgestellt werden:

- Airborne-Laserscanning ist ein geeignetes Verfahren zur flächenhaften Erfassung von Oberflächen mit einer Höhengenauigkeit besser 1m sowohl in offenem als auch in bewaldetem Gelände.
- Die Komplexität des Messverfahrens erfordert eine umfangreiche Vorbereitung und eine sehr präzise Durchführung der einzelnen Arbeitsschritte. Zur Qualitätssicherung müssen in nicht unerheblichem Ausmaß begleitende terrestrische Vermessungen durchgeführt werden.
- Die elementare Bedeutung der Flugpositionsbestimmung mittels GPS stellt ein militärisches Verfahren dar, dessen zivile Verfügbarkeit theoretisch jederzeit beendet werden könnte.
- Das Messverfahren ist prinzipiell nicht überbestimmt, eine Kontrolle kann direkt nur durch deutliche Überlappung der einzelnen Flugstreifen, indirekt durch terrestrische Kontrollmessungen erfolgen.
- Das Verfahren ist insbesondere im Hochgebirge extrem witterungsabhängig. Sowohl Sicherheitsaspekte (aufgrund der geringen Flughöhen über Grund) als auch Methodikaspekte (Extinktion des Laserstrahls z.B. durch Nebel) werden schlagend.
- Um eine mit den klassischen Erfassungsverfahren (Terrestrische Vermessung, Photogrammetrische Auswertung) vergleichbare Informationsdichte zu erreichen ist eine um den Faktor 100 bis 1000 höhere Punktdichte notwendig.
- Das Verfahren ist „blind", erst in der Zusammenschau mit bildgebenden Verfahren (z.B. Orthophotos) gelingt eine Zuordnung der Messpunkte zu unterschiedlichen Objekttypen.

4 DIE ANALYSEERGEBNISSE IM DETAIL

Die Fehleranalyse basiert auf dem Testgebiet „Tatra" mit 334 Spalten und 418 Zeilen (rund 140000 Testpunkte auf ca. 125km²) und dem Testgebiet „Montafon" mit 128 Spalten bei gleichzeitig 29 Zeilen (3712 Testpunkte auf einem 3,8km mal 0,87km großen Areal). Die offensichtliche Differenz der Testgebietgröße resultiert aus der geringen Überlappung zwischen Gebieten mit Laserscanning- und Asterdaten in Vorarlberg. Die dadurch zu erwartende Beeinträchtigung der Vergleichbarkeit der Analyseergebnisse musste in Ermangelung brauchbarer Alternativen in Kauf genommen werden.

Trotz der dieser Methode anhaftenden Schwächen sollen die Ergebnisse des Isolinienvergleichs zumindest für die Tatra an dieser Stelle präsentiert werden. Zum einen zeigt er die über weite Strecken gute Übereinstimmung zwischen den verglichenen Datensätzen (Korrelationskoeffizient: 0,997, für das Montafon: 0,998), zum anderen treten aber die Modellfehler der Beispielregion besonders deutlich hervor (Abb.3). Dabei handelt es sich keinesfalls um eine Folgewirkung der missing values sondern ganz offensichtlich um ein überraschend großes Artefakt innerhalb der ASTER-Daten.

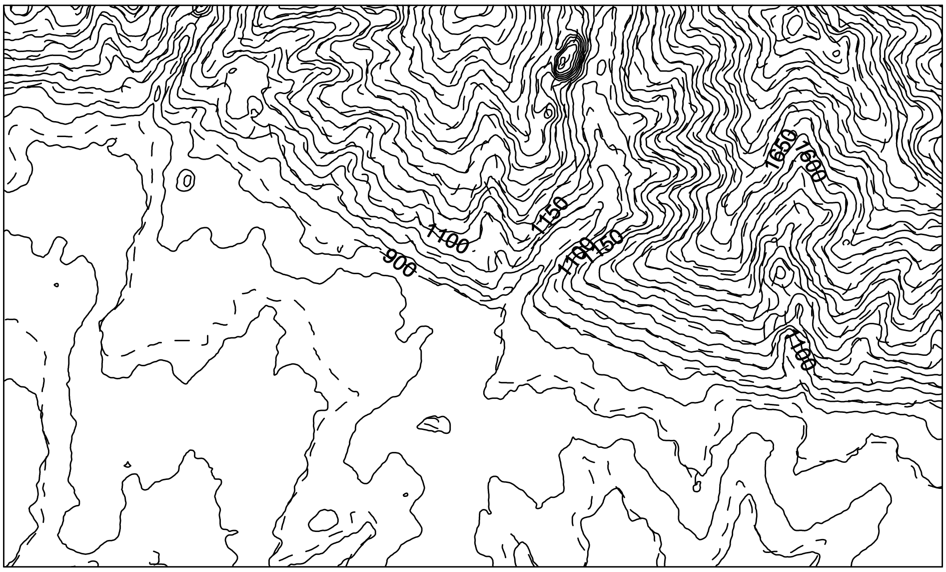

Abb.3: Isolinien - Vergleich von ASTER-DGM (durchgezogen) und Referenz-DGM (strichliert);
das Artefakt erscheint als sogen. Bullauge am oberen Abbildungsrand.

4.1 Die Höhenabweichung

Die folgenden Abbildungen geben Aufschluss über die Verteilung der Abweichung der Z-Komponente, wobei der negative Anteil jene Bereiche beschreibt, in denen die ASTER-Oberfläche tiefer liegt als die Vergleichsoberfläche; positive Werte signalisieren demnach ein „Überzeichnen" der tatsächlichen Oberfläche durch die ASTER-Daten. Zur Visualisierung des Einflusses der Ausreißer in der Tatra-Szene wurde in der Abb. 4 der vollständigen Verteilung (links) eine fehlerbereinigte Version (rechts) gegenüber gestellt. Zur Steigerung der Auflösung wurde dabei die Klassenbreite auf 2 Meter reduziert.

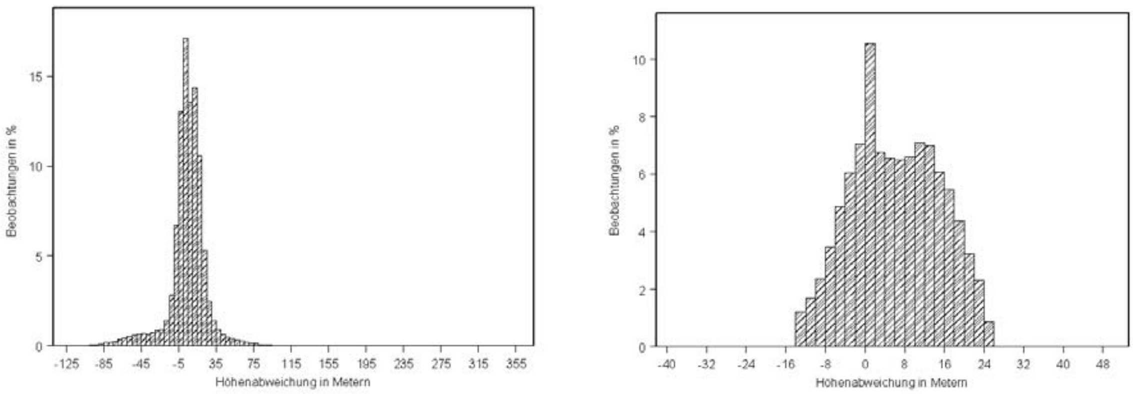

Abb. 4: Verteilung der Höhenabweichung im Testgebiet „Tatra" (links: volles Spektrum, rechts: fehlerbereinigt)

Bemerkenswert neben der deutlichen Verringerung der Streuung ist die relativ symmetrische Verteilung insgesamt mit Maxima im Bereich +2m bzw. +5m; dies und die ausgeprägte Asymmetrie der Verteilung gegen Null weisen darauf hin, dass die ASTER-Daten die Testgebietoberfläche generell leicht überhöht wiedergeben. Dabei liegen 50 Prozent der Werte im Abweichungsbereich zwischen – 1m und 13m (Tab.2).

	Tatra-volles Spektrum	Tatra - fehlerbereinigtes Spektrum	Montafon
Minimum	-125,000	-14,000	-32,430
1. Quartil	-3,000	-1,000	-7,449
Arith. Mittel	4,463	5,653	-1,668
Median	5,000	5,000	-3,238
3. Quartil	14,000	13,000	3,721
Maximum	363,000	24,000	45,339
Anzahl	139612	115870	3712
Standardabweichung	22,669	8,929	10,133
Schiefe	1,429	0,024	1,429
Kurtosis	28,417	-0,838	28,417

Tab.2: Deskriptive Kennwerte der Höhenabweichung in den Testgebieten

Eine Untersuchung des koordinatenabhängigen Trends der Höhenabweichung ergab eine Trendfläche schwach von NW nach SE einfallende Neigung was auf einen weitgehend fehlenden Zusammenhang schließen lässt. Die niedrigen Korrelationskoeffizienten von -0,326 (gegen X) bzw. 0,0 (gegen Y) scheinen dies zu belegen. Ebenfalls kaum ausgeprägt ist der Zusammenhang zwischen der Höhenabweichung und dem Höhenwert (Koeffizient: -0,241 im ASTER-Datensatz bzw. -0,312 im Vergleichsmodell), sodass eine statistisch deutliche Höhenabhängigkeit des Fehlers nicht angenommen werden kann. Immerhin würde die in der Tatra tendenziell vorhandene Übereinstimmung mit dem Höhenwert des Vergleichs-DGM weitere Untersuchungen rechtfertigen.

Die statistischen Kennwerte (Tab.2 bzw. Abb.5) weisen auch für die Höhenabweichung des Testgebiets „Montafon“ eine symmetrische Verteilungskurve aus, wobei jedoch der Negativteil der Verteilung markant umfangreicher ausfällt. Im Gegensatz zur Tatra liegen hier 50 % der Beobachtungen im Bereich zwischen 7,449 m und 3,722 m tiefer als die Oberfläche des Testgebiets, was einer generellen Absenkung um rund 4 m gleichkommt.

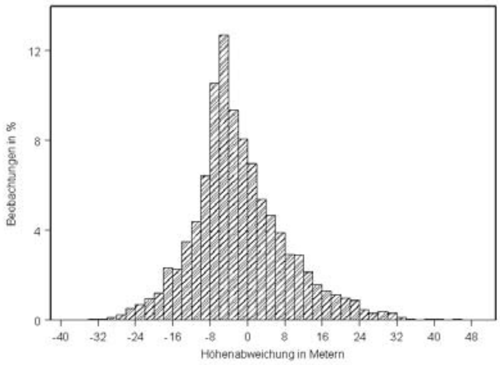

Abb. 5: Verteilung der Höhenabweichung im Testgebiet „Montafon“

Auch im Falle des Montafoner Testgebiets lässt sich im Hinblick auf die räumlichen Koordinaten kein eindeutiger Zusammenhang erkennen (Korrelationskoeffizient gegen X: 0,391 bzw. gegen Y: 0,235); der Vollständigkeit halber soll jedoch darauf hingewiesen werden, dass die berechnete lineare Trendfläche im flachen Winkel von NE gegen SW einfällt. Ähnlich wie in der Tatra findet sich allerdings auch hier keine sichtbare Übereinstimmung mit den orographischen Gegebenheiten. Dies gilt auch für die Seehöhe. Wie in der Tatra konnte auch im Montafon mit einem Koeffizienten von –0,283 kein signifikanter Zusammenhang zwischen der Seehöhe des Vergleichsmodells und der Veränderung der Hangneigung nachgewiesen werden.

4.2 Die Hangneigungsabweichung

Gefälledaten stellen vielfach die Ausgangsbasis für detailliertere Untersuchungen besonders in Bereichen der Klimatologie, des Bodenschutzes, der Hydrologie oder ähnlich gelagerter Fachschwerpunkte. Dies verleiht ihnen eine Bedeutung, die über jene eines DGM-Derivates hinaus geht. Damit wird gleichzeitig nicht nur die Frage nach der Qualität des DGM's an sich in den Mittelpunkt gerückt, sondern auch in wie weit sich Fehler in die Neigungsdaten fortpflanzen. Die vorliegende Studie konzentrierte sich auf eine Auswertung der Absolutbeträge der Abweichungen, da eine Berücksichtigung der Richtung der Gefälleänderung innerhalb des gesteckten Rahmens als nicht opportun erachtet wurde.

	Tatra	Montafon
Minimum	0,000	0,000
1. Quartil	1,032	1,169
Arith. Mittel	3,893	3,372
Median	2,463	2,630
3. Quartil	5,066	4,759
Maximum	50,450	19,193
Standardabweichung	4,475	2,883
Schiefe	2,726	1.390
Kurtosis	10,715	2.341

Tab.3: Deskriptive Kennwerte der Neigungsabweichung in den Testgebieten

Die Informationen in Tab.3 weisen darauf hin, dass sich eine durch die Verwendung eines alternativen Geländemodells verursachte Gefälleänderung in den ausgewählten Gebieten in sehr engen Grenzen hält. Rund 75% der Beobachtungen für das Tatra-Tesgebiet wies eine Neigungsdifferenz von 5° oder weniger auf. Erweitert man die Klasse auf 10°Abweichung so erfüllen etwa 98% aller Testpunkte diese Kriterien. Ähnliches ist mit marginalen Abweichungen auch für Vorarlberg gültig (Abb.6). Nach diesem Befund wirkt sich die Verwendung von ASTER-Daten bei gefällebasierten Analysen weniger negativ aus als es die simple Betrachtung der Höhenabweichung vermuten lässt. Tendenziell treten zwar in Tatra-Testgebiet im SE geringere Abweichungen auf als im NW, eine klare Abhängigkeit von einer Raumrichtung ist jedoch genauso wenig nachzuweisen wie ein Zusammenhang mit der Höhenabweichung. Im Montafon konnte der Korrelationskoeffizient in keinem Fall größere Werte als 0,144 erreichen. Für die Tatra gilt dies nur bedingt, obwohl Koeffizienten von 0,506 (gegen die Hangneigung des Kontrollmodells) und 0,405 (gegen die Seehöhe des Kontrollmodells) wahrscheinlich eher als Manifestation des Wirkungskomplexes größere Höhe – steilere Flanken – mehr Neigungsabweichung denn als Ausdruck eines direkten Zusammenhangs gewertet werden müssen.

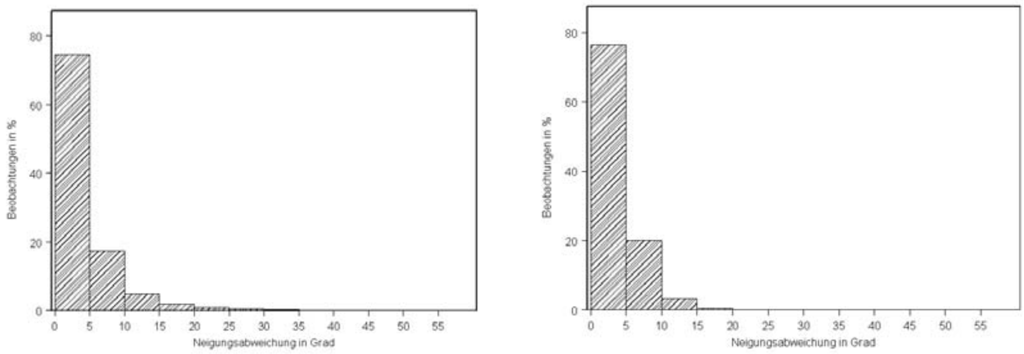

Abb.6: Verteilung der Neigungsabweichung in den Testgebieten (rechts: Tatra, links: Montafon)

4.3 Die Expositionsabweichung

Wie bereits im Falle der Neigungsabweichung zwischen ASTER-basierten und nationalen DGM's wurde auch im Falle der Exposition versucht, die Expositionsänderung als Absolutbetrag und unabhängig von der – u.U. auch stärker von lokalen Gegebenheiten abhängigen – Richtung der Ausrichtungsänderung zu beschreiben. Die deskriptiv-statistische Auswertung (Tab.4) erbrachte für die Tatra nicht nur überraschend hohe Werte sondern auch eine wesentlich breitere Streuung (nur etwa 50% der Werte haben weniger als 50° Abweichung) als für das Vorarlberger Testgebiet (Abb.7). Interessant wäre in diesem Zusammenhang eine Quantifizierung des Beitrages der tatsächlichen Exposition zu diesem Ergebnis gewesen, sie hätte allerdings den Rahmen dieses Beitrags gesprengt und musste ebenso unterbleiben wie die Untersuchung, ob bzw. wie Einzelzellen und Rasterzellverbände von dieser Änderung betroffen wurden. Besonders letzter Information wäre von entscheidender Bedeutung etwa für die Bearbeitung klimatologischer Fragestellungen (z.B. für die Sonneneinstrahlung) gewesen.

	Tatra	Montafon
Minimum	0,000	0,000
1. Quartil	9,913	3,697
Arith. Mittel	37,541	12,644
Median	23,099	7,977
3. Quartil	49,458	14,829
Maximum	180,000	177,124
Standardabweichung	39,717	17,793
Schiefe	1,647	4.712
Kurtosis	2,197	29.640

Tab. 4: Deskriptive Kennwerte der Expositionsweichung in den Testgebieten

Das Montafon-Testareal weist hinsichtlich der Expositionsabweichung ein insgesamt auffällig besseres Streuungsverhalten auf. Hier verbuchen etwa 60% der Messwerte eine Änderung der Ausrichtung unter als 10°. Die Standardabweichung von 17,793 gegenüber 39,717 scheint dieses Ergebnis zu stützen. Nicht unerwähnt bleiben sollte an dieser Stelle die Rolle des Zufalls in Gestalt der Geländebesonderheiten: Trotz des Versuchs einen möglichst repräsentativen Ausschnitt zu definieren musste der geringen Überdeckung Rechnung getragen und bezüglich der verwendeten Arealgröße Konzessionen gemacht werden. Solange dieses Phänomen also nicht auf breiterer Basis untersucht worden ist darf dieser Aspekt zumindest nicht ganz vernachlässigt werden.

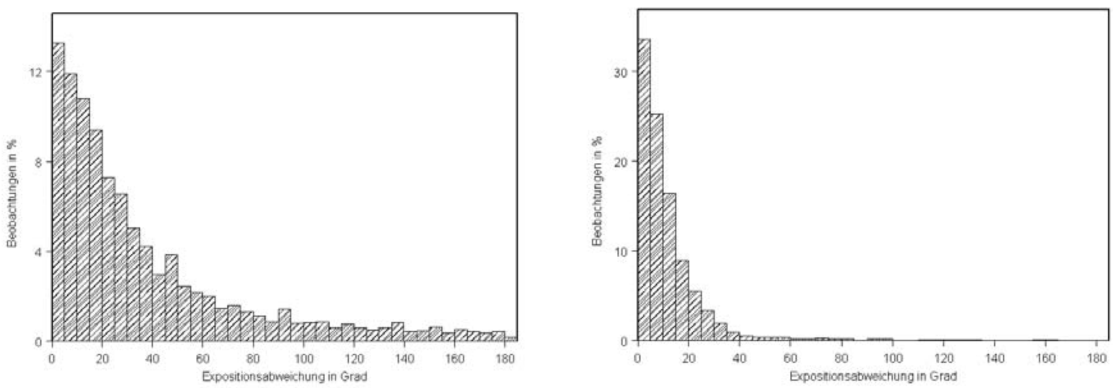

Abb. 7: Verteilung der Expositionsabweichung in den Testgebieten (rechts: Tatra, links: Montafon)

Im Rahmen der geprüften Zusammenhänge lassen sich in beiden Testgebieten mit statistischen Mitteln nur relativ schwache gegenläufige Zusammenhänge zwischen dem Ausmaß der Expositionsänderung einerseits und der Hangneigung des Test-DGM's (Tatra: -0,284; Montafon: -0,385) bzw. seiner Seehöhe (Tatra: -0,189; Montafon: -0,217) andererseits herausfinden. Neben dieser

Erkenntnis zeigte die visuelle Beurteilung, dass gleichförmig gestaltete Geländeteile (flache Hänge, ebene Rücken oder breitere Talböden) wenig bis gar nicht verfälscht wurden während beispielsweise tiefer eingeschnittene Bachläufe innerhalb dieser Verebnungen durch besonders hohe Abweichungen auffallen.

5 SCHLUSSFOLGERUNGEN UND AUSBLICK

5.1 Die abschließende Beurteilung

In der zusammenschauenden Beurteilung der Testergebnisse zur Verwertbarkeit relativer ASTER-DGM's präsentiert – möglicherweise auch infolge der geringen Anzahl von Beispielgebieten – neben dem Trennenden auch Gemeinsames:

- Auf Grund der Sensorcharakteristik existieren in den ASTER-DGM's in unterschiedlichem Ausmaß „Löcher", die als nodata values kodiert ihren Niederschlag im Datensatz finden; dies und die für manche Bereiche der Erdoberfläche noch immer recht unvollständige Abdeckung schränkt den aktuellen Nutzwert der Daten in unterschiedlichem Maße ein.

- Als wesentlich störender erweist sich das offensichtliche Vorhandensein von Artefakten in scheinbar vollständigen Datensätzen; durch das Fehlen der entsprechenden Kodierung (und geeigneter Testdaten) bleibt es dem Benutzer und seiner Sach- bzw. Ortskenntnis überlassen, diese Problemzonen aufzufinden. Dies erhöht die Gefahr der Verwendung inkorrekter Daten namentlich bei weniger auffälligen Fehlern.

- Wiedergabetreue des Geländes und Höhenabweichung liegen innerhalb der spezifizierten Grenzen, wobei die in die nominell relativ hohe Horizontalauflösung gesetzten Erwartungen nicht erfüllt werden konnten; der Versuch Zusammenhänge zwischen den Abweichungen und als potentiell erachteten Einflussgrößen (Seehöhe, Hangneigung etc.) nicht die erhofften statistisch abgesicherten Ergebnisse erbracht hat.

- Für die Testgebiete hat sich gezeigt, dass die Exposition offenbar eher bzw. in stärkerem Maß negativ von einer Substituierung nationaler Datensätze durch ASTER-Daten beeinflusst wird als die Hangneigung.

Bei Berücksichtigung dieser doch gravierenden Nachteile können relative ASTER-DGM's nationale Höhendatensätze gegenwärtig nur schwerlich ersetzen, dies gilt vor allem für den Auflösungsbereich bis 30m Maschenweite, während der Datensatz vor allem im mesoskaligen Bereich seine unbestreitbaren Vorzüge (Kostengunst, problemloser Bezug und flächendeckende Verfügbarkeit für weite Teile der Erdoberfläche) voll zur Geltung bringen kann (vgl. dazu auch Toutin & Cheng 2001).

5.2 Aktuelle und zukünftige Impulse durch Airborne-Laserscanning

5.2.1 Die Bedeutung des Airborne-Laserscanning für die Gewinnung metergenauer DHMs

Seit den späten 90er-Jahren des 20 Jahrhunderts stellt das flugzeuggestützte Laserscanning ein in der Praxis sehr effizientes Verfahren für die Erfassung von Oberflächen dar. Insbesondere für die Erfassung hochauflösender DHMs in Waldgebieten sowie auf kaum bzw. gar nicht zugänglichen Flächen (Hochgebirge, Gletscher, Fels, aber auch Dachlandschaften etc.) empfiehlt sich das Laserscanning als kosteneffizientes Verfahren. Die derzeit eingesetzten Sensoren erlauben in der Praxis mittlere Punktdichten von deutlich über einem Punkt pro m² bei Tageserfassungsleistungen von über 100 km². Probleme ergeben sich gegenwärtig aufgrund der schieren Datenmenge (ca. 1 bis 10 Mio. Einzelmessungen pro km²) sowie der noch in der Entwicklung stehenden Aggregations- sowie Filteralgorithmen (zusammenfügen der einzelnen Messstreifen, Elimination von Fehlpunkten, Filterung der Vegetation etc.). Für größerflächige Analysen praktikabel ist derzeit hautsächlich der Einsatz von interpolierten regelmäßigen Gittermodellen mit Pixelgrößen vom 25 cm x 25 cm bis 5 m x 5 m.

5.2.2 Versuch eines Ausblicks zur zukünftigen Bedeutung von Airborne-Laserscanning-Aufnahmeverfahren

Gegenwärtig können für den Bereich des flugzeuggestützten Laserscanning folgende Forschungsschwerpunkte benannt werden:

- Scanner: Erhöhung der Aufnahmerate und der möglichen Flughöhe sowie Kombination mit bildgebenden Verfahren (Digitalaufnahmen im sichtbaren sowie im nahen Infrarotspektrum). Daraus resultierend eine deutliche Kostensenkung pro Messpunkt sowie pro Flug-km².
- GPS-Positionierung / IMU: Erhöhung der Messrate von dzt. 1 Hz in Richtung 2 bis 5 Hz. Dies ermöglicht eine deutliche Verbesserung der Positions- und der Orientierungsbestimmung zu den jeweiligen Aufnahmezeitpunkten und resultiert in einer deutlichen Verbesserung der Punktlagebestimmung.
- Datenauswertung: Stetige Weiterentwicklung der eingesetzten Aggregations- und Filteralgorithmen. Kombination mit anderen Messverfahren insbesondere der klassischen Photogrammetrie sowie von terrestrischen Verfahren. Ziele sind in diesem Bereich der Forschung insbesondere die Reduktion der Datenmenge bei gleichzeitig steigender Qualität der Modelle.

5.2.3 Airborne-Laserscanning-Aufnahmeverfahren im Kontext mit bestehenden DHMs

- Auf Basis der Höhendaten aus Laserscanning-Befliegungen gelingt erstmals eine größerflächige Evaluierung der bestehenden DHMs.
- Laserscanning-Daten eignen sich besonders zur Qualitätsverbesserung von Strukturinformationen aus photogrammetrisch erfassten Oberflächenmodellen (z.B. BEV-Strukturlinienmodell). Diese sind in der Regel in der Lage sehr gut erfasst, weisen aber in der Höhe oft stark Fehler auf. Diese Höhenabweichungen können sehr effizient mit den insbesondere höhengenauen Laserscanningdaten kombiniert werden. Es entstehen sehr repräsentative 3D-Strukturlinien die bei gleichzeitig sehr geringen Datenmengen sehr hohe Signifikanzen erreichen.
- Das Verfahren kann aufgrund des gemeinsamen Koordinatensystems WGS84 problemlos in bi-/multilateralen Projekten eingesetzt werden.

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Planung des öffentlichen Raumes - der Einsatz von neuen Medien und 3D Visualisierungen am Beispiel des Entwicklungsgebietes Zürich-Leutschenbach

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1 DAS WETTBEWERBSWESEN UND DER EINSATZ VON NEUEN MEDIEN UND 3D VISUALISIERUNGEN

1.1 Wettbewerbspräsentationen

Wettbewerbe sind Bestandteil unserer Baukultur und für Auftraggeber ein wichtiges Instrument qualitativ hoch stehende Projekte zu finden. Durch die Ausrichtung von Wettbewerben und die Veröffentlichung der Ergebnisse gelangen die meisten Projekte erst an die breite Öffentlichkeit. Deren Meinung besitzt gerade in der Schweiz hohes Gewicht, da die Baurealisation von Grossprojekten der öffentlichen Hand durch die Bewilligung der Baukredite über Volksabstimmungen geregelt ist. Trotzdem muss man sich bei Wettbewerbsausstellungen oft auch heute noch in nicht ansprechenden und schwer erreichbaren Räumlichkeiten an langen Stellwänden durch Wettbewerbsbeiträge lesen. Für Laien kommt erschwerend hinzu, dass die Plangraphik und die Begleittexte nur auf die Kommunikation zwischen Fachleuten ausgerichtet sind.

In der Planung und hauptsächlich im Wettbewerbswesen sind Visualisierungen in Form von Photomontagen inzwischen Standart, aber für komplexere Visualisierungen bereitet man die notwendigen Daten meistens nicht auf. Die Planungsteams müssen sich umständlich mit selbst erstellten Modellen weiterhelfen. Dies kostet Zeit und der Aufwand wird nicht vergütet. Die öffentlichen und privaten Wettbewerbsauslober verwenden leider noch zu wenig die 3D Stadtmodelle, die es bei den Vermessungsämtern in vielen grösseren Städten gibt und die gut nutzbar für Visualisierungen wären. Aus 3 D Modellen, die während eines Wettbewerbs für die Erstellung von Einzelbildern benutzbar sind, lassen sich mit etwas Aufwand sogar Computeranimationen (‚Filme'), 360 Grad Bilder oder interaktive Modelle erstellen. Damit könnte der Auslober, nachdem ein Gewinnerprojekt ermittelt wurde, in eine effektive Kommunikation mit der Öffentlichkeit treten.

1.2 Forschungsfragen

Bislang liegt das Forschungsfeld der Kommunikation und Wahrnehmung planerischer Arbeiten weitestgehend brach (vgl. Lange 1999, Rice 2003). Das Forschungsprojekt „Planung des öffentlichen Raumes - der Einsatz von neuen Medien und 3D Visualisierungen am Beispiel des Entwicklungsgebietes Zürich-Leutschenbach", das durch die Kommission für Technologie und Innovation (KTI) des Bundesamts für Berufsbildung und Technologie, die Stadt Zürich und durch mehrere Software- und Hardwarehersteller finanziert wird, begleitete ein Wettbewerbsprojekt konsequent bezüglich des Einsatzes von 3D Visualisierung und neuen Medien (Touchscreentechnologie) von der Auslobung bis zur Veröffentlichung. Folgende Fragen sollten durch das Forschungsprojekt beantwortet werden:

- Sind 3D Modelle sinnvoll bei Wettbewerben einsetzbar?

- Wie hoch ist die Akzeptanz der neuen Medien und 3D Visualisierungen im Vergleich zu den traditionellen Mitteln (Ausstellung mit Plänen und Modellen, Broschüren, etc.), um Planungen zu kommunizieren?

- Werden die Inhalte mit neuen Medien und 3D Visualisierungen besser kommuniziert?

1.3 3D Stadtmodell

Im Rahmen der Erstellung eines Stadtmodells für den Wettbewerb und das Forschungsprojekt waren einige Koordinationsaufgaben durch das Forschungsteam zu leisten.

So erfasste Geomatik + Vermessung (GeoZ) für das Wettbewerbsgebiet ein digitales 3D Stadtmodell (Grundlagenmodell) im Landeskoordinatensystem, das gut mit den Baumkatasterdaten sowie den sonstigen Umweltdaten von Grün Stadt Zürich (GSZ) kombinierbar war. Dagegen wurden im Amt für Städtebau (AfS) die Wettbewerbsunterlagen extern aufbereitet. Der Informationsgrad der Pläne war sehr hoch, aber die digitale Information befand sich nicht im Landeskoordinatensystem. Weiterhin besassen die Pläne keine einheitliche, mit der Stadt abgestimmte Layerstruktur. Für geplante Gebäude in unmittelbarer Nähe des Wettbewerbsgeländes existierten bereits zahlreiche CAD Modelle von privaten Bauträgern und Büros. Diese uns problemlos zur Verfügung gestellten 3D Daten eignen sich sehr gut für Einzelobjektvisualisierungen, aber für den Einbau in Stadtmodelle waren sie wegen der Datenmenge nicht brauchbar. Die Gebäudehüllen mit den Texturen der Fassaden mussten nochmals modelliert werden. Besonders Gebäudetexturen sind eine wesentliche Voraussetzung für eine realitätsnahe Visualisierung (vgl. Lange 1999, Beck & Steidler 2001).

In den Sitzungen der Wettbewerbsjury bzw. im Vorbereitungsteam gab es keine Fachleute mit vertieften Kenntnissen im Bereich 2D / 3D CAD. Die Probleme mit den digitalen Daten, die normalerweise bei der eigentlichen Bearbeitung des Wettbewerbs auftreten und zu viel Zeitverlust und hohen Kosten führen (offener Wettbewerb – keine Bezahlung) wurden daher nicht angesprochen. Es wäre für zukünftige Wettbewerbe sicher von Vorteil wenn alle 2D und 3D digitalen Wettbewerbsdaten durch Geomatik + Vermessung (GeoZ) koordiniert und entsprechende Fachleute im Vorbereitungsteam integriert wären, um damit den späteren Arbeitsaufwand für die Wettbewerbsteilnehmer zu reduzieren.

1.4 Touchscreenversion des Wettbewerbs

Die Touchscreenrohversion wurde mehrere Monate vor der Ausstellung erstellt. Das Layout und die Programmierung übernahm ein externes Grafikbüro. Die Füllung der Rohfassung mit Material (Texte, Bilder, Videos) erfolgte durch die HSR. Die Benutzerfreundlichkeit der Anwendung entscheidet über den Erfolg und die Akzeptanz. Man sollte hier nicht am falschen Platz Geld sparen, und versuchen selbst das Content Design zu machen. Eine Zusammenarbeit mit Profis führt zu besseren Ergebnissen.

Die Einrichtung und Aufstellung des Infoterminals war sehr einfach, da es sich um einen normalen PC handelt der anstatt an einem normalen Monitor an einem Touchscreen angeschlossen ist. Die Hardware ist sehr robust und eignet sich gut für halböffentliche Räume. Nachdem der Wettbewerb entschieden war, erstellte das HSR Team die 3D Visualisierungen (360 Grad Einzelbilder, Animationen, Filme) des ersten und des zweiten Ranges. Das Büro, das den Wettbewerb gewann, benutzte intensiv das im Rahmen des KTI Projektes erstellte 3D Modell für die Visualisierungen. Die Daten des ersten Ranges konnten daher gut für die Animation eingesetzt werden und dies führte zu Zeiteinsparungen. Eine besondere Herausforderung bestand darin, dass der grafische Stil der Büros sich in den Animationen widerspiegelte. Nicht zu unterschätzen ist der Zeitfaktor bei der Aufbereitung der Filme (Animationen). Einerseits konnten die Animationen erst erstellt werden, nachdem die Jury die Rangierung ermittelte. Andererseits finden die Ausstellungen normalerweise relativ kurz nach der Preisgerichtssitzung statt. Für die Erstellung der animierten Filmsequenzen des ersten und zweiten Rang wurden rund 500 Stunden eingesetzt. Das ist ein neuer und hoher Kostenfaktor im Budget einer Wettbewerbsbetreuung.

2 FORSCHUNGSERGEBNISSE

2.1 Die Sicht der Planungsbüros zum Einsatz von 3D Modellen bei Wettbewerben

Nach Wettbewerbsabgabe wurden die Wettbewerbsteilnehmer bezüglich des 3D Modells, des Softwareeinsatzes und der Softwareunterstützung befragt. Von 13 Teilnehmern haben 11 an der Befragung teilgenommen. Fast alle der Befragten bemängelten am 2D Datensatz Probleme bei den Layerbezeichnungen, der Layerstruktur, der Anzahl der Layer und das Übereinanderliegen von Linien und dadurch aufwendiges Bereinigen.

Das 3D Datenmodell wurde von der Mehrheit benutzt (8 von 11). Als Formate kamen dxf / dwg/ 3ds / mcd zum Einsatz. Die Mehrzahl der Teilnehmer würde es begrüssen, wenn in Zukunft bei Wettbewerben ein 3D Modell zur Verfügung stünde. In diesem Zusammenhang räumen sie der 3D Visualisierung als Kommunikationsmittel für die Öffentlichkeitsinformation eine hohe Bedeutung ein. Auch die Fragen, ob es als sinnvoll betrachtet wird, dass die neuen Medien bei Wettbewerbspräsentationen für die Öffentlichkeitsinformation eingesetzt werden und der Jury-Bericht / Abgaben zusätzlich digital auf einer CD abgeliefert werden, wurden bejaht. Ein Bezug der Auslobungsdaten per Internet, erachtet die Mehrzahl der Teilnehmer als nützlich.

Folgendes sollte bei zukünftigen Auslobungen bezüglich der mitgelieferten digitalen Daten beachtet werden:

- Sauberer 2D Datensatz (keine übereinanderliegenden Linien).
- Nachvollziehbarkeit der Layerbezeichnung und Layerstruktur.
- Reduktion der Anzahl von Layern.
- 3D Modell als Bestandteil jeder Auslobung.
- Falls finanziell machbar digitale Aufbereitung der Ergebnisse als CD oder auf dem Internet.
- Bezug der Daten über das Internet.

2.2 Akzeptanz der neuen Medien und 3D Visualisierungen im Vergleich zu den traditionellen Medien

Die kommunikativen Aspekte der neuen Medien im Vergleich zu den traditionellen Medien wurde mit Hilfe einer Befragung im Ausstellungsraum und anschliessend in sogenannten öffentlichen Räumen (Bahnhof Oerlikon, SF DRS in Leutschenbach und Stadthaus Zürich) untersucht. Einerseits wurden Fragen gestellt, die das Siegerprojekt zum Inhalt hatten. Diese bezogen sich auf quantifizierbare Aspekte des Projekts (z.B. Schätzen der Anzahl der Bäume in der Allee) und andererseits auf qualitative, bewertende Aspekte des Projekts (z.B. Wohlfühlen im Park). Im zweiten Teil des Fragebogens wurden die Einstellungen zu neuen Präsentationsformen im Planungsbereich erhoben.

Während der Ausstellung im Hallenbad Oerlikon konnten insgesamt 67 Besucher und Besucherinnen befragt werden. Im Rahmen der Befragung wurde nur das Siegerprojekt untersucht. Eine Berücksichtigung von weiteren Projekten in der Befragung wäre sicher sehr interessant gewesen, hätte jedoch den zeitlichen und finanziellen Rahmen des Projekts gesprengt. Im Vergleich zu den sonstigen Wettbewerbsbeiträgen weist das Poster des Siegerprojekts zahlreiche 3D Visualisierungen auf. Dies ist unserer Einschätzung nach bei landschaftsarchitektonischen Wettbewerben zum jetzigen Zeitpunkt eher die Ausnahme als die Regel.

Im Rahmen der Touchscreenpräsentation wurden neben den auf dem Siegerposter enthaltenen Plänen und Bildern auch digitale Filme mit animierten Sequenzen des neuen Parks gezeigt. Fast alle Befragten geben an, dass sie sich das Projekt gut oder sogar sehr gut vorstellen können (s. Abb. 6).

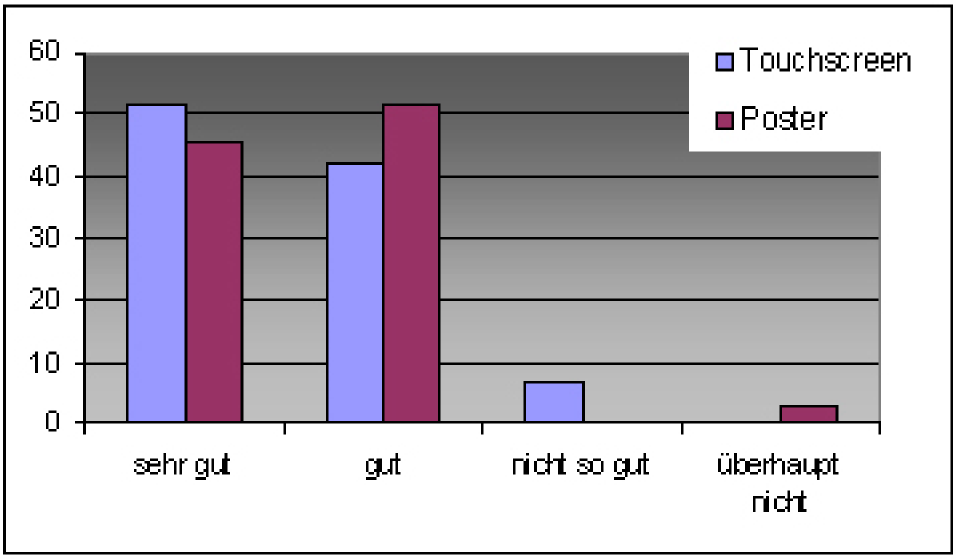

Abb. 1: Vorstellungsvermögen bezüglich des Aussehens des Projekts

Auch auf die Frage nach dem Wunsch, die Mittagspause im Park zu verbringen bzw. die Frage nach der Erholungseignung des geplanten Parks sind nur leichte Unterschiede zwischen den Gruppen (Poster bzw. Touchscreen) festzustellen. Inhaltlich sind auch bei diesen Fragen die Zustimmungsraten zum neuen Projekt sehr hoch.

Eine weiterer Schwerpunkt der Befragung, der es erlauben sollte, Aussagen über mögliche Unterschiede in der Wahrnehmung in Abhängigkeit des Mediums ableiten zu können, konzentriert sich darauf, quantitative Einschätzungen über bestimmte messbare, physische Charakteristika (z.B. prozentualer Anteil der asphaltierten Fläche) des Siegerprojekts miteinander zu vergleichen. Bis auf eine Ausnahme konnten keine signifikanten Unterschiede zwischen den beiden Gruppen nachgewiesen werden.

Als weiteres Verfahren, um Unterschiede in der Wahrnehmung feststellen zu können, wurden die Versuchspersonen gebeten, das Projekt mit Hilfe eines Polaritätsprofils zu beurteilen (vgl. Echelberger 1979, Hoisl et al. 1987, Smardon et al. 1986). Es handelt sich dabei um gegensätzliche Adjektivpaare die das Projekt charakterisieren wie z.B. natürlich-künstlich, schön-hässlich, üppig-karg, die entsprechend einer Skala von -3 bis +3 bewertet werden.

Insgesamt gesehen konnten in der ersten Phase der Untersuchung keine wesentlichen Unterschiede zwischen der Wahrnehmung der Präsentation des Siegerprojekts durch das Poster oder durch den Touchscreen gefunden werden. Wir führen dies vor allem auf die professionelle und betrachterfreundliche Aufbereitung, die in diesem Fall bei beiden Medien gegeben war, zurück.

2.3 Kommunikation der Planungsinhalte mit neuen Medien und 3D Visualisierungen

Im Anschluss an die Wettbewerbsausstellung bei der sowohl das Poster des Siegerprojekts wie auch der Touchscreen gezeigt wurden, konzentrierte sich die Untersuchung in der zweiten Phase des Projekts auf den Touchscreen allein. Für jeweils ca. zwei Wochen wurde der Touchscreen im Bahnhof Oerlikon, beim Schweizer Fernsehen SF DRS in Leutschenbach und im Stadthaus Zürich präsentiert. Dabei konnten insgesamt 133 Personen befragt werden.

Im Ergebnis ist festzuhalten, dass die Akzeptanz der Darstellungsformen (3D Visualisierungen und Computeranimationen) wie auch des Touchscreens sehr hoch ist. Zwischen 55% und 65% finden den Einsatz dieser neuen Medien im Rahmen von Planungspräsentationen sehr gut. Weitere 25% bis 35% finden einen derartigen Einsatz der neuen Medien gut.

Im direkten Vergleich der beiden Medien 3D Visualisierungen vs. Computeranimationen (gemäss der Frage, welches der beiden besser gefallen hat) gewinnt der Film jedoch eindeutig (s. Abb. 9). Über 60% der Befragten bevorzugen den Film, während 15% die Bilder bevorzugen. Über 20% finden beide Medien gleich gut. Die starke Bevorzugung der Filme ist auffallend. Offensichtlich können die Filme Qualitäten bieten, die das Poster nicht hat. Von den Befragten wurden hierfür vor allem Gründe wie ein verbessertes Raumgefühl, aber auch die Bewegung und Dynamik innerhalb der virtuellen Landschaft genannt.

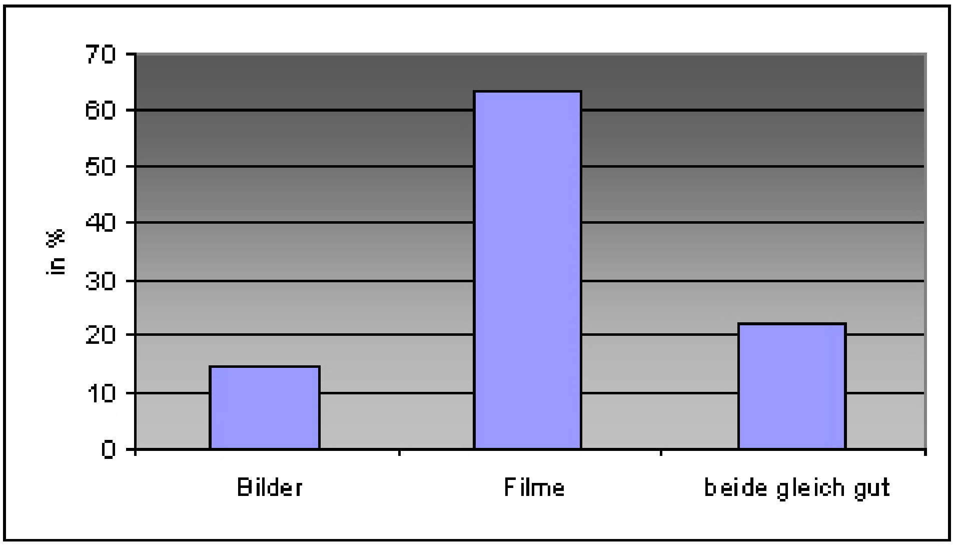

Abb. 2: Präferenz zwischen Bildern (3D Visualisierungen) und Filmen (Computeranimationen)

3 ZUSAMMENFASSUNG

Die grosse Mehrzahl der Wettbewerbsteilnehmer würde es begrüssen, wenn in Zukunft bei Wettbewerben 3D Modelle zur Verfügung stünden. Ein wichtiges Argument für die Bereitstellung von 3D Modellen bei Wettbewerben liefert das Siegerteam des Wettbewerbs Leutschenbach, indem es das hier erstmals durch den Auslober abgegebene 3D Modell intensivst für die Erstellung der Visualisierungen einsetzte.

Im Rahmen einer empirischen Untersuchung während der Wettbewerbsausstellung wurde die traditionelle Poster-Präsentation des Siegerprojekts mit der digital aufbereiteten Touchscreen-Version verglichen. Vor allem deshalb, weil auf dem Poster des Siegerprojekts zahlreiche 3D-Visualisierungen vorhanden waren konnten nur geringe Unterschiede in der Beurteilung zwischen den Gruppen Poster bzw. Touchscreen festgestellt werden.

Anschliessend wurde der Touchscreen im Bahnhof Oerlikon, beim SF DRS in Leutschenbach und im Stadthaus Zürich jeweils für ca. zwei Wochen präsentiert. Die Befragungen ergaben, dass ca. 85 – 90% der Besucher den Einsatz der neuen Medien bei Planungspräsentationen als gut bis sehr gut einstufen.

Der direkte Vergleich zwischen statischen Visualisierungen und animierten Sequenzen fällt klar zugunsten der ‚Filme' aus. Über 60% der Befragten bevorzugen den Film, während 15% die Bilder bevorzugen. Über 20% finden beide Medien gleich gut.

Es ist erfreulich, dass im Rahmen der Ausstellung für den Wettbewerb Limmatquai, die im Mai 2003 stattfand, ebenfalls Filme des ersten Preises erstellt und im Helmhaus in Zürich gezeigt wurden. Von Seiten der Stadt Zürich wurde uns bestätigt, dass das KTI Projekt der Katalysator für die publikumsnahe Aufbereitung des ersten Preises war. Darüber hinaus muss betont werden, dass durch das Forschungsprojekt generell das Interesse der lokalen Politiker geweckt wurde, Wettbewerbsergebnisse und Planungsprojekte mittels neuer Medien und Animationen verständlicher der Öffentlichkeit zu präsentieren.

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Übertragung von Geometrie und Semantik aus IFC-Gebäudemodellen in 3D-Stadtmodelle

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ABSTRACT

Heutige 3D-Stadtmodelle enthalten häufig sehr detaillierte Geometriedaten und Texturen, aber nur wenig Semantik, weil mit den verfügbaren Erfassungsmethoden (Photogrammetrie, Laserscanning) im Wesentlichen Geometriedaten erhoben werden. Dies hat zur Folge, dass sich die Anwendung von 3D-Stadtmodellen meist auf die reine Präsentation und Visualisierung beschränkt. Architektur-CA(A)D-Systeme liefern dagegen neben der Geometrie auch reichhaltige semantische Informationen über Gebäude, die aber über die vorhandenen Schnittstellen (z.B. DXF) meist nicht exportiert werden können. Deshalb wird von der „International Alliance for Interoperability“ (IAI) das Produktdatenmodell IFC (Industry Foundation Classes) entwickelt und standardisiert, das geometrische und semantische Gebäudedaten für andere Anwendungen zur Verfügung stellt. IFC wird von führenden CA(A)D-Systemen bereits unterstützt.

Im Beitrag wird ein geometrisch/semantisches Datenmodell für kleinere städtische Bereiche (Quartiere) vorgestellt und die besondere Problematik der Interoperabilität (semantische Anpassung) von GIS- und CA(A)D-Systemen beleuchtet. Das Quartier-Modell hat einen Detaillierungsgrad, der der Fußgänger-Perspektive entspricht und für den städtebaulichen Entwurf und damit im Zusammenhang stehende Problembereiche eingesetzt werden soll. Für den Gebäudeentwurf werden CA(A)D-Systeme eingesetzt, deren Ergebnisse über die IFC-Schnittstelle zur Verfügung stehen. Der Beitrag geht insbesondere auf die Schwierigkeiten ein, aus dem IFC-Modell die für ein Quartiersmodell relevanten Details (z.B. Außenwände, Anbauten, ..) zu extrahieren und in das Quartiersmodell zu transformieren, d.h. die implizite Semantik des IFC-Modells explizit zu machen.

1 EINLEITUNG

In heutigen 3D-Stadtmodellen werden die Gebäude vorwiegend durch texturierte Klötzchenmodelle mit teilweise ausgeformten Dächern repräsentiert. Die Gebäude sind als Ganzes ansprechbar und können mit zugehörigen Informationen verknüpft werden. Typische Einsatzbereiche sind die Präsentation ganzer Stadtlandschaften für den Tourismus, die Werbung oder die Simulation der Durchlüftung oder der Ausbreitung von Funkwellen. Zur Erstellung dieser Modelle werden Katasterpläne (ALKIS) und die Luftbild-Photogrammetrie eingesetzt, wodurch die erreichbare Detaillierung begrenzt wird, große Datenmengen aber relativ schnell generiert werden können.

Ein Anwendungsbereich digitaler Stadtmodelle, der zunehmend an Bedeutung gewinnt, ist die Stadtentwicklung. Sie umfasst die Bauleitplanung, den städtebaulichen Entwurf, die Bebauungsplanung, die Dokumentation des Gebäudebestandes, seine Bereitstellung für die detaillierte Gebäudekonstruktion, sowie die Immobilienwirtschaft und -Bewirtschaftung. Für diese Einsatzfelder ist der bisher verwendete Detaillierungsgrad im Allgemeinen nicht ausreichend. Daher muss ein neues Gebäudemodell entwickelt werden, das den erweiterten Anforderungen gerecht wird: Der Detaillierungsgrad sollte so hoch sein, dass ein Fußgänger aus einigen Metern Abstand einen wirklichkeitsgetreuen Eindruck bekommt, und insbesondere sollten auch Gebäudeteile im Modell identifizierbar sein, um sie mit Informationen verknüpfen und sie wahlweise ausblenden, austauschen oder in ihrer Darstellung verändern zu können. Diese Anforderungen sind nur realisierbar, wenn das Gebäudemodell auch Semantik enthält. Dafür müssen weitere Datenquellen erschlossen werden, die beispielsweise von CA(A)D-Systemen aus dem Architekturbereich bereitgestellt werden. Das Standard-Austauschformat dieser Systeme ist IFC, mit dessen Hilfe die Gebäude-Geometrie, Gebäude-Parameter und weitgehend auch die Gebäude-Semantik übertragen werden kann.

Eine weitere Datenquelle wäre ein spezielles DV-System für den städtebaulichen Entwurf, mit dem diese Gebäude-Modelle interaktiv generiert und bearbeitet werden können, und das darüber hinaus auch andere Bereiche des städtebaulichen Entwurfs wie beispielsweise die Verkehrsplanung oder die Grünplanung unterstützt. Dieses Ziel wird mit der Entwicklung des Quartierdaten-Managementsystems QUASY verfolgt. Mit diesem System sollen u. a. auch die Erstellung des Bebauungsplanes aus städtebaulichen Entwurfsalternativen und die Erteilung einer Baugenehmigung auf der Grundlage des Bebauungsplanes und eines IFC-basierten Bauantrags unterstützt werden.

In Folgenden wird nach einer kurzen Beschreibung des IFC-Gebäudemodells das neue QUASY-Gebäudemodell vorgestellt und die Gebäude-Geometrie und -Semantik erläutert. Auf dieser Basis werden dann einige Probleme der Modelltransformation von IFC nach QUASY dargestellt und prinzipielle Lösungswege aufgezeigt.

2 IFC-GEBÄUDEMODELL

Um einen problemlosen Datenaustausch zwischen allen Beteiligten am Bauprozess (z. B. Architekten, Ingenieuren, Baufirmen, Bauherren, …) über die Grenzen der Fachdisziplinen hinweg zu ermöglichen, wurde von der International Alliance for Interoperability (IAI) ein Produktmodell für das Bauwesen, das IFC-Datenmodell (Industry Foundation Classes), definiert. Die IAI wurde 1995 gegründet, die aktuelle Modell-Version ist die Ausgabe IFC-2x2 von 2003. Die IAI-Modellierungsarbeit basiert auf der EXPRESS-Sprache, einem Bestandteil des STEP-Standards (ISO 10303) für den Produktdatenaustausch. Mit dieser Entscheidung stand die umfangreiche STEP-Technologie zur Verfügung, insbesondere beispielsweise die Modellierung der Geometrie und die Arbeiten zum Kernmodell für die Bauindustrie innerhalb des STEP-Projektes.

Im Unterschied zu dem viel verwendeten Datenaustauschformat DXF, das lediglich den Austausch von Graphik und Geometrie unterstützt, erfasst das IFC-Modell die Gebäude-Semantik: Ein Gebäude wird durch anwendungstypische Objekte mit problemgerechten Attributen repräsentiert. Dem Empfänger eines Datensatzes wird also auch die Bedeutung geometrischer Informationen mitgeteilt. Die für ein Objekt, beispielsweise eine Wand, zulässige Geometrie wird informell beschränkt, syntaktisch besteht eine große Modellierungsfreiheit.

Um die komplexe Modellstruktur der IFC zu erläutern, wurde ein informelles UML-Modell (Abb. 1) erstellt, das die Grundzüge des IFC-Gebäudemodells darstellt. Dieses Modell beschränkt sich auf die in diesem Zusammenhang interessierenden Objekte. Es unterscheidet sich von dem IFC-Modell auch dadurch, dass die dort verwendeten Relationsobjekte nicht übernommen wurden.

Ein IFC-Modell wird durch ein Projekt (*IfcProject*) repräsentiert, das eine räumliche Struktur hat. Diese Raumstruktur wird durch Raumstrukturelemente (*IfcSpatialStructureElement*) gebildet: Standorte (*IfcSite*), Gebäude (*IfcBuilding*), Geschosse (*IfcBuildingStorey*) und Räume (*IfcSpace*). Da diese räumlichen Elemente IFC-Produkte (*IfcProduct*) sind, kann ihnen eine Geometrie (*IfcShapeRepresentation*) und ein Ort (*IfcLocalPlacement*) zugewiesen werden. Den Elementen der räumlichen Struktur können die eigentlichen Bauelemente (*IfcBuildingElement*) zugeordnet werden: Wände (*IfcWall*), Türen (*IfcDoor*), Fenster (*IfcWindow*), etc.. Wände können Öffnungen (*IfcOpeningElement*) haben, in die Fenster und Türen eingesetzt werden. Versorgungsanschlüsse eines Gebäudes können durch den Objekttyp *IfcFlowTerminal* modelliert werden, der einem räumlichen Strukturelement (z.B. Gebäude) zugeordnet wird.

Zur Modellierung der Objektgeometrie, die in dem UML-Diagramm durch die Klasse *IfcShapeRepresentation* repräsentiert wird, gibt es im IFC-Modell viele Möglichkeiten, die hier nicht alle vorgestellt werden können. Diese Vielfalt wird in der Praxis allerdings selten voll ausgeschöpft. Zur Modellierung von Wänden gibt es zudem eine spezielle Klasse (*IfcWallStandardCase*) mit eingeschränkten Möglichkeiten zur geometrischen Repräsentation.

Zur Modellierung der Volumengeometrie von IFC-Objekten wie Wänden oder Dächern werden die folgenden Verfahren am häufigsten eingesetzt:

- Darstellung der Volumen-Außenfläche als „Faceted Boundary Representation", d.h. als dreidimensionaler Polyeder [Eastman, 1999],
- Erzeugung des Volumens durch die Extrusion einer ebenen Fläche entlang einer vorgegebenen Extrusions-Kurve,
- Speziell für Wände: Parametrische Generierung des Wand-Volumens aus Wand-Achse (ebene Kurve), Wand-Dicke und Wand-Höhe.

Die auf diese Art und Weise erzeugten Volumina können dann mit Methoden der Constructive Solid Geometry (CSG) noch verändert werden, z.B. durch Verschnitt mit einem Halbraum. Öffnungen, z.B. für Türen oder Fenster, können ebenfalls mit CSG-Methoden aus einem Volumen herausgestanzt werden.

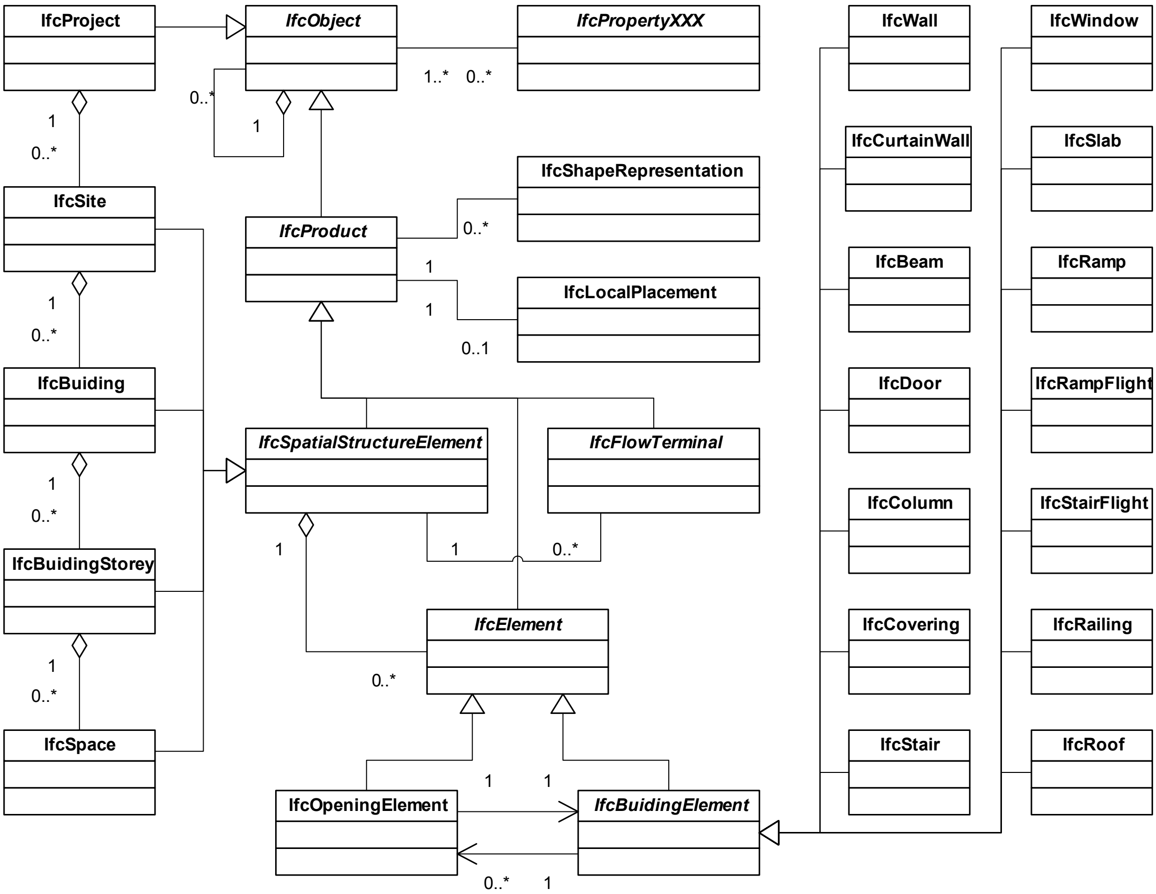

Abb. 1: Informelles IFC-Gebäudemodell in UML-Notation

3 DAS SEMANTISCHE GEBÄUDEMODELL VON QUASY

Das hier beschriebene semantische Gebäudemodell ist eine Komponente eines übergeordneten Quartier-Modells, in dem z.B. auch Straßen, Vegetationsflächen oder das Geländerelief repräsentiert sind. Für den Entwurf des Gebäudemodells waren die folgenden Kriterien maßgebend:

- Das Modell muss die Visualisierung ganzer Stadtteile (Quartiere) mit möglichst geringer Datenmenge unterstützen,
- es muss aus existierenden Datenbeständen, insbesondere aus IFC-Modellen zu erzeugen sein, und
- die semantische Strukturierung orientiert sich am Applikationsbereich „Städtebaulicher Entwurf/Stadtplanung".

Abgeleitet aus diesen Kriterien wurden die folgenden grundlegenden Design-Entscheidungen bezüglich der geometrischen und semantischen Modellierung getroffen:

- Es wird ein stark vereinfachtes Geometrie- und Topologiemodell in Anlehnung an GML verwendet, das im Wesentlichen auf polygonal berandeten Flächen aufbaut.
- Es findet keine explizite Volumen-Modellierung statt, Gebäude und ihre Teilkomponenten werden geometrisch durch die von außen sichtbare Oberfläche repräsentiert.
- Topologische Beziehungen der für das äußere Erscheinungsbild wichtigen Teilkomponenten eines Gebäudes (z.B. Gebäude → Gebäudeteil → Geschoss → Wand → Fenster) werden explizit repräsentiert.
- Alle für den Anwendungsbereich wichtigen Attribute, die nicht direkt aus der geometrischen Beschreibung abgeleitet werden können (z.B. Massen, Materialbilanzen), werden als Attributwerte aus den IFC-Daten übernommen.

Die im Weiteren näher beschriebene semantische Strukturierung erlaubt es einer Applikation auf einfache Art und Weise, unterschiedlich detaillierte, dreidimensionale Visualisierungen eines Gebäudes zu generieren, z.B. eine „photorealistische" Ansicht aus der Fußgängerperspektive, eine grobe Ansicht der Gebäudehülle ohne Fassaden-Details, oder eine noch stärker abstrahierte Darstellung einzelner Geschossflächen. Gleichzeitig stellt das semantische Modell Geometrie- und Sachdaten zur Verfügung, um für die Bebauungsplanung und Baugenehmigung wichtige Parameter (Abstandsflächen, Baulinien, Ausrichtung von Balkonen, Ausrichtung und Neigung von Dachflächen, Baumassen- und Geschossflächenzahlen) ableiten zu können. Der Datenaustausch mit entsprechenden Applikationen wird über eine XML-Schnittstelle erfolgen, ein zugehöriges, GML-konformes Austauschformat wird derzeit entwickelt.

3.1 Geometrie-Modellierung

Abb. 2 zeigt die im Quartier-Modell verwendeten Geometrieklassen. Die Modellierung benutzt ausgewählte GML-Geometrieklassen, ein ähnliches Schema wird auch in [Gröger, Kolbe 2003] verwendet. Basisklassen des geometrisch-topologischen Modells sind Knoten (*Node*, geometrisch repräsentiert durch 3D-Punkte) und Kanten (*Edge*), repräsentiert durch Anfangs- und Endknoten. Durch Mehrfach-Referenz von Knoten und Kanten können topologische Beziehungen zwischen geometrischen Objekten hergestellt werden. Ein Ring (*LinearRing*) ist eine geschlossene, sich nicht selbst überschneidende Kette (geordneter) Kanten. Das Flächenstück (*PolygonPatch*) besitzt einen Außenring und optional mehrere disjunkte Innenringe, deren Knoten alle in einer Raumebene liegen. Flächenobjekte (*Surface*) sind eine Aggregation von Flächenstücken. Die davon abgeleitete Klasse *AttrSurface* hat zusätzliche Attribute für Material und Textur, die z.B. für Visualisierungszwecke genutzt werden können. In einer weiteren Aggregationsstufe können Flächen zu Multiflächen (*MultiSurface*) zusammengefasst werden.

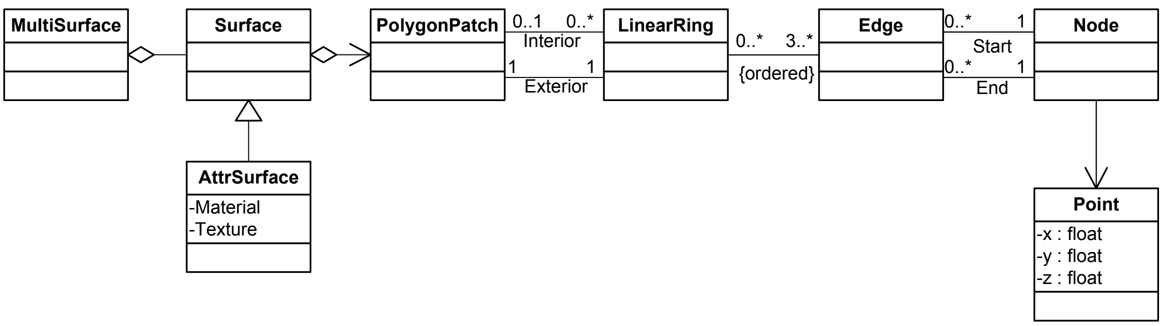

Abbildung 2: Quartierdatenmodell - Geometrische Modellierung

3.2 Semantische Modellierung

Auf der semantischen Ebene werden in QUASY Gebäudegruppen und Einzelgebäude modelliert, die wiederum in Gebäudeteile gegliedert sind. Ein Gebäude kann mehrere, geometrisch durch Punkte repräsentierte Anschlussobjekte (*QuGebAnschluss*) verwalten, die z.B. Versorgungs-Anschlüsse repräsentieren. Die detaillierte geometrische und semantische Strukturierung erfolgt dann auf der Ebene von Gebäudeteilen. Dabei gibt es die Grundelemente

- Stockwerke (*QuGeschoss*)
- Wände (*QuWand*)

- Dachflächen (*QuDach*)

Geometrisch repräsentiert eine Instanz der Klasse *QuGeschoss* den Boden eines Stockwerkes. Außerdem können über die Geschoss-Klasse einzelne Wandobjekte (*QuWand*) einem Stockwerk zugeordnet werden. Wand- und Dachobjekte werden geometrisch als Multifläche beschrieben, um unterschiedliche Material- und Oberflächen-Eigenschaften innerhalb eines semantischen Objektes modellieren zu können. Weiterhin können Wände und Dächer durch Öffnungen (*QuOeffnung*) und Kontaktflächen (*QuKontakt*) strukturiert werden.

Eine Öffnung entspricht geometrisch dem „Loch", in dem z.B. ein Fenster in einer Wand oder eine Gaube in einem Dach sitzt. Eine detaillierte geometrische Modellierung des in der Öffnung sitzenden Objektes (z.B. Fensterrahmen, Fensterleibung und Fensterscheibe) erfolgt durch die Klasse *QuOeffnungsObj*. Da diese Klasse keine weitere semantische Strukturierung ermöglicht, ist anwendungsabhängig die Ableitung spezieller Unterklassen für z.B. Fenster, Türen oder Loggien möglich.

In ähnlicher Art und Weise wird auch mit Fassaden-Anbauten wie Balkonen, Erkern oder Treppen verfahren. Die Kontaktfläche zwischen einem Anbau und einer Wand wird geometrisch als *Surface* modelliert, der Anbau selber wie das Öffnungs-Objekt als *MultiSurface*. Da Anbau-Objekte selbst wieder Anbauten oder Öffnungen besitzen können, ist prinzipiell eine beliebig komplexe Strukturierung einer Gebäudefassade möglich.

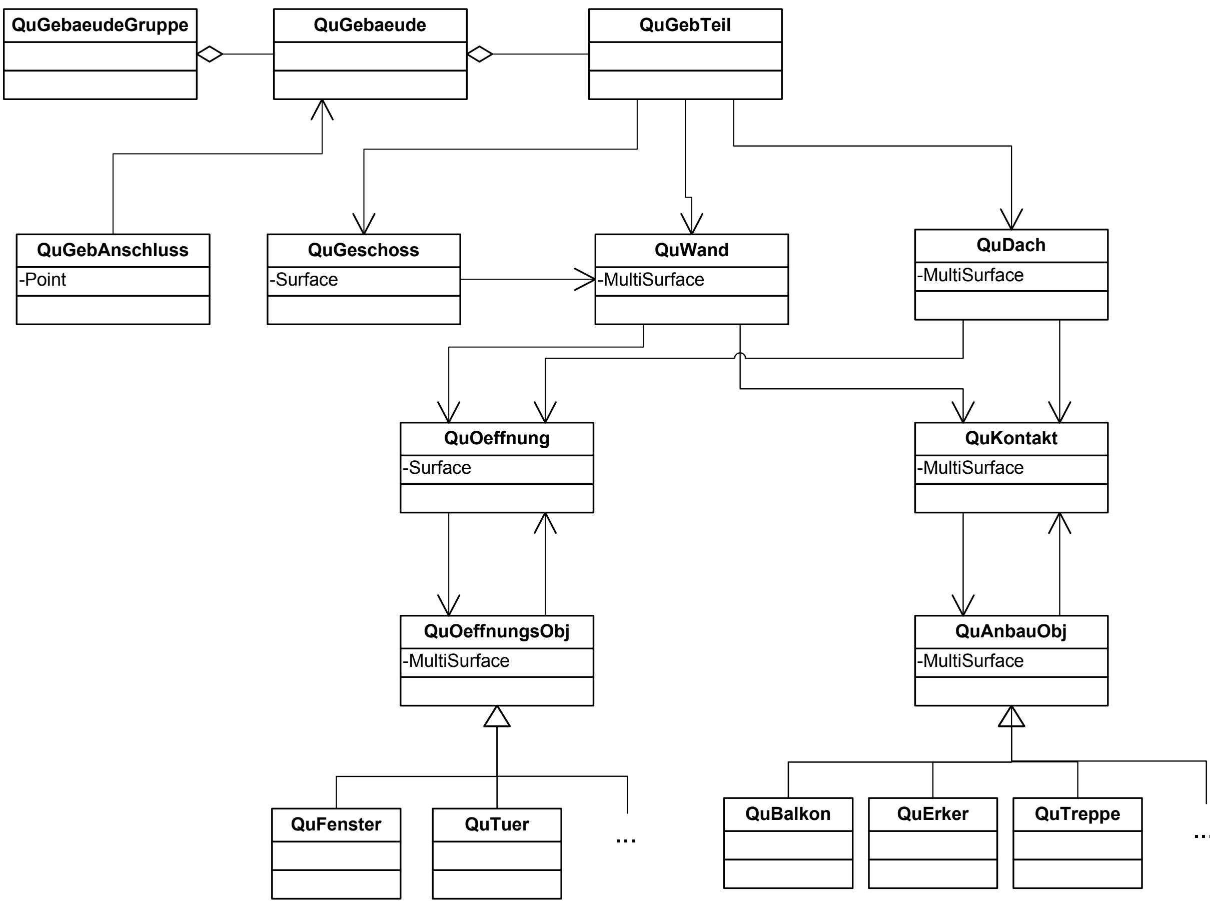

Abbildung 3: QUASY Gebäudemodell

4 ABBILDUNG DES IFC-MODELLES AUF DAS QUASY-GEBÄUDEMODELL

Aus den vorherigen Abschnitten ist zu entnehmen, dass die Gebäudemodelle von IFC und QUASY zwar Überdeckungsbereiche haben, aber bei weitem nicht deckungsgleich sind. Einerseits bietet IFC viel Information an, die in QUASY irrelevant ist; andererseits verlangt QUASY nach Informationen, die in IFC nicht oder nur implizit angeboten werden. So können z.B. in IFC Wände im Prinzip über mit ihnen verknüpfte „Properties" als Außenwände gekennzeichnet werden, aber in kaum einem realen IFC-Datensatz wird davon Gebrauch gemacht. Folglich muss diese – implizit vorhandene – Information algorithmisch oder heuristisch aus den IFC-Daten extrahiert werden.

Dies gilt noch mehr für QUASY-Objekte, die in IFC gar keine semantische Entsprechung haben. Es gibt dort etwa keine semantischen Objekte mit der Bedeutung „Erker", „Balkon" oder „Dachgaube". Sie sind nur daran zu erkennen, dass z.B. beim Erker eine Bodenplatte über den Grundriss des Gebäudekörpers hinausragt und an der Außenkante dieser Auskragung geschosshohe Wände (mit oder ohne Fenster) trägt, während an der Stelle des Gebäudekörper-Grundrisses in diesem Bereich keine Wände vorhanden sind. Für solche Fälle sind Heuristiken erforderlich, an Hand derer ermittelt werden kann, welche Teile der IFC-Daten dem jeweiligen QUASY-Objekt entsprechen.

Die extrahierten Daten werden entsprechend der Spezifikation des in Kap. 3 erwähnten GML-Austauschformates auf eine Austauschdatei geschrieben.

4.1 Die Gebäude-Außenhülle

Der erste Schritt zur Abbildung des IFC-Modells auf das QUASY-Gebäudemodell ist die Ermittlung der Außenhülle eines Gebäudes. Sie ist in einem IFC-Datensatz im Allgemeinen nur implizit definiert. Deshalb wird der folgende Algorithmus zur Extraktion eingesetzt:

1. Bestimme für jedes Stockwerk und das Gesamtgebäude den „Footprint" der zugehörigen Bodenplatten, d.h. die zweidimensionale Vereinigung ihrer Projektion auf die jeweilige Grundfläche. Bilde zum Umriss des Footprints einen Puffer, begrenzt durch eine (geglättete) innere und äußere Parallelkurve in einem Abstand, der etwas größer als die Dicke einer Außenwand ist.
2. Berechne für alle Wände im Stockwerk den Footprint auf derselben Grundfläche und prüfe, ob er innerhalb der äußeren, aber außerhalb der inneren Parallelkurve liegt. In diesem Fall wird die Wand als Außenwand erkannt und entsprechend gekennzeichnet.
3. Überprüfe den gefundenen Satz von Außenwänden auf Lücken und schließe diese entweder durch andere Bauteile, soweit vorhanden, oder durch weiter zurückliegende Wände (wenn z.B. die Bodenplatte einen Balkon oder eine Terrasse einschließt).
4. Schließe das Dachgeschoss mit der Dachplatte bzw. den Dachplatten nach oben hin ab. Diese gelten ohne weitere Prüfung als außen liegende Gebäudeteile.
5. Ermittle alle Bauteile, welche Dachplatten durchdringen und/oder nach oben aus ihnen herausragen, z.B. Schornsteine oder Dachgauben.
6. Ermittle diejenigen (Teile von) Bodenplatten, die nicht durch die Bauteile darunter liegender Stockwerke nach unten abgedeckt werden.
7. Extrahiere von allen in den Schritten 2. bis 6. als außen liegend erkannten Bauteilen die nach außen zeigenden Flächen und speichere sie zusammen mit einer Referenz auf das jeweilige Bauteil ab.

Damit ist zunächst eine Rohform der Außenhülle bestimmt. Dieser Rohform fehlen allerdings noch fast alle semantischen Zuordnungen. Auch Öffnungen, Kontaktflächen sowie Öffnungs- und Anbau-Objekte sind noch nicht explizit erfasst.

4.2 Öffnungen und Kontaktflächen, Öffnungs- und Anbau-Objekte

Die weiteren geometrischen Operationen werden nun an der gefundenen Rohform der Außenhülle vorgenommen. Durch die Referenzen auf die ursprünglichen Bauteile stehen alle im IFC-Datensatz definierten Beziehungen und Eigenschaften weiterhin zur Verfügung. Dies gilt insbesondere für alle nichtgeometrischen Eigenschaften, die später im QUASY-Modell verfügbar sein sollen; bei der Geometrie der speziellen Fassadenobjekte sind aber unterschiedliche Wege erforderlich.

4.2.1 Öffnungen und Öffnungs-Objekte

Die meisten Öffnungen und Öffnungs-Objekte sind im IFC-Modell explizit vorhanden. Ein *IfcOpeningElement* ist mit dem Bauteil verknüpft, in dem sich die Öffnung befindet, und definiert die Öffnungsgeometrie mit Hilfe eines Körpers, der durch eine boolsche Operation vom Bauteilkörper zu subtrahieren ist. Um eine Öffnung für die QUASY-Anwendung zu definieren, muss daher zunächst die Außenfläche des betroffenen Bauteils mit dem Körper der *IfcOpeningElement*-Instanz geschnitten werden; da dieser Körper sehr häufig als *IfcExtrusion* definiert ist, genügt für diese Schnittbildung oft eine geeignete Projektion. Gleichzeitig bestimmt dieser Körper auch die Leibungsflächen für das Öffnungsobjekt.

Außerdem definiert das IFC-Modell auch explizit einige Objekte mit geometrischer Repräsentation, die einem Öffnungsobjekt von QUASY entsprechen, z.B. *IfcWindow* oder *IfcDoor*. Solche Objekte sind mit einem *IfcOpeningElement* verknüpft. Ihre Außenflächen ergeben zusammen mit den Leibungsflächen die geometrische Repräsentation eines Öffnungs-Objekts in QUASY.

Allerdings haben nicht alle in QUASY definierten Öffnungs-Objekte eine direkte Entsprechung im IFC-Modell. Z.B. gibt es kein Objekt, das eine Loggia repräsentiert; sie ist nur an Hand der typischen Wandanordnungen zu erkennen (zurückgezogene Rückwand, geschosshohe Seitenwände, Öffnungen in Rückwand oder Seitenwand, die Zugang gestatten). Auch die vordere Öffnung ist nicht explizit gegeben und muss aus der Lücke der Wände an der Außenkante der Bodenplatte erkannt werden. In einem solchen Fall erfolgt die Ermittlung der Daten für die Öffnung und das Öffnungs-Objekt analog zum Vorgehen bei Kontaktflächen und Anbau-Objekten, das im folgenden Abschnitt beschrieben wird.

4.2.2 Kontaktflächen und Anbau-Objekte

Anbau-Objekte sind im IFC-Modell nicht definiert. Sie bestehen dort aus normalen Bauteilen, die nicht von den entsprechenden Bauteilen im Geschoss zu unterscheiden sind; oft teilen sie sich sogar ein Bauteil mit dem restlichen Geschoss (z.B. die Bodenplatte).

Daher kann ein Anbau-Objekt nur heuristisch aus der für den jeweiligen Objekt-Typ typischen Anordnung gewisser Bauteile, wie Bodenplatte, Wände, Verbindung zum Hausinnern usw., erkannt werden. Diese heuristische Identifikation eines Anbau-Objekts stellt den schwierigsten Teil der Konvertierung dar und kann deshalb nicht immer gelingen. Danach ist die Außenhülle des Anbau-Objekts von der Rohform der Gebäude-Außenhülle abzutrennen; das dadurch entstandene Loch in der Gebäude-Außenhülle wird durch Expansion der Nachbarflächen geschlossen. Diese neu hinzugefügten Flächen am Gebäudemodell bilden nun gleichzeitig die Kontaktflächen des Anbau-Objekts.

Dieses Vorgehen soll am Beispiel eines Erkers weiter verdeutlicht werden. Ein Erker ist zunächst daran zu erkennen, dass die Bodenplatte in einem beschränkten Bereich über den „regulären" Grundriss des Stockwerks (z.B. ein Rechteck) hinausragt. An der Außenkante der Bodenplatte im Bereich dieser Ausragung befinden sich geschosshohe Wände, von denen mindestens eine mit Fenstern versehen ist; nach oben ist der Erker entweder durch das darüberliegende Stockwerk, durch das Hausdach oder durch ein separates Dach abgeschlossen. Vom Innenraum her stellt sich der Erker als Nische an der Außenwand dar, wobei der Nischenraum ansonsten ein ununterscheidbarer Teil des Innenraums ist.

Ist ein Erker an Hand solcher Kriterien erkannt, werden die zu ihm gehörigen Flächenstücke von der Außenhülle entfernt: überragender Teil der Bodenplatte, Wandflächen über diesem Bodenplattenteil inklusive Öffnungen und Fenster, obere Abdeckung (soweit getrennt vorhanden) bilden die geometrische Repräsentation der neuen Instanz eines „Erkers". Die Schließung der nun geglätteten Gebäude-Außenhülle liefert zugleich die entsprechende Kontaktfläche.

5 ZUSAMMENFASSUNG, AUSBLICK

In diesem Beitrag wurde ein neuartiges semantisches Modell für Gebäudegruppen und Einzelgebäude vorgestellt. Es ist Teil eines umfassenden Modells für kleinräumige städtische Bereiche (Quartiere), auf dessen Basis ein DV-System QUASY zur Unterstützung der Stadtentwicklung entwickelt wird. Im vorgestellten Modell sind wichtige Teilkomponenten eines Gebäudes wie Öffnungen oder Anbauten explizit repräsentiert. Es gestattet eine sehr hohe geometrische Detaillierung der dreidimensionalen Darstellung, so dass auch aus der „Fußgängerperspektive" ein realistischer Gesamteindruck entsteht.

Geometriedaten mit einer derartig hohen Detaillierung gibt es derzeit nur in Architektur-CA(A)D-Systemen. Die für diesen Anwendungsbereich entwickelte und international normierte IFC-Schnittstelle erlaubt es im Prinzip, Daten aus beliebigen Architektur-Systemen in das neue Gebäudemodell zu integrieren. Da das IFC-Modell aber sehr viele für den Anwendungsbereich Stadtentwicklung irrelevante Informationen enthält und überdies eine andere semantische Struktur als das QUASY-Gebäudemodell aufweist, kann diese Integration nur über einen teilweise heuristischen Extraktions- und Abbildungsprozess erfolgen. Da dabei Fehlzuweisungen nie gänzlich auszuschießen sind, muss das Zielsystem über interaktive Funktionen zur Korrektur und Nachbearbeitung verfügen.

Das hier vorgestellte Gebäudemodell erfasst nur von außen sichtbare Merkmale eines Gebäudes in ihrer 3D-Geometrie. Damit können Anwendungen wie das Facility-Management oder der Katastrophenschutz, für die auch Informationen über das Gebäudeinnere wie Raumaufteilung, Zu- und Abgänge oder Treppenhäuser benötigt werden, nicht realisiert werden. Da im IFC-Modell derartige Informationen aber auch zur Verfügung stehen, muss das QUASY-Gebäudemodell und die zugehörige GML-Schnittstelle eventuell noch anwendungsabhängig erweitert werden. Außerdem ist für den Anwendungsbereich „Stadtplanung" das Gebäudemodell durch ein semantisches Modell eines Bebauungsplanes zu ergänzen.

6 LITERATUR UND LINKS

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IAI – International Alliance for Interoperability http://www.iai-international.org/iai_international/
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IFC 2.x.2 – Industry Foundation Classes: http://www.iai-ev.de/spezifikation/Ifc2x2/index.htm
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GML – Geography Markup Language: http://www.opengis.org/docs/02-023r4.pdf

Benutzerschnittstellen in der multimedialen 3D Kartografie – eine Gegenüberstellung

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1 EINLEITUNG UND MOTIVATION

Die Vermittlung permanenter Veränderungen in der städtischen und regionalen Struktur erfordert für Planer und Betroffene Werkzeuge effizienter Kommunikations- und Präsentationsmöglichkeiten, um geplante Vorhaben und vergangene Entwicklungszeitpunkte nachvollziehen zu können. Diese leicht verständliche Präsentationsart von raumbezogenen Inhalten stellt eine Schlüsselposition am Schnittpunkt von Planer und Öffentlichkeit dar.

Ein attraktives Hilfsmittel zur Darstellung raumbezogener Inhalte wird in der 3D Visualisierung gefunden. Dieses lässt sich anhand der großen Anzahl von Arbeitsschwerpunkten und angewandten Lösungen im Bereich der virtuellen Realität – oder die mit virtueller Realität vermittelt werden – feststellen. Die Rekonstruktion der „geplanten" Realität im virtuellen Raum kann aber nur der erste Schritt zu einer effizienten Darstellung der topografischen – thematischen Zusammenhänge sein. Begründet mit einer leichteren Verständlichkeit – beispielsweise durch eine Interpretationshilfe mit gezieltem Einsatz von Symbolik – sollten Konventionen für die Anwendung von multimedialen Komponenten abhängig von Benutzergruppe und deren verfügbare Schnittstellen gefunden werden. Die multimedialen Komponenten bezeichnen in diesem Zusammenhang Elemente der visuellen und auditiven Wahrnehmung, die der Interpretation und Kennzeichnung von Elementen im Raum und des Raumes selbst hilfreich sind.

Im Bereich der Multimediakartografie entwickelt sich das Themengebiet der multimedialen 3D Kartografie. Hierin wird der Versuch unternommen, Konventionen für die 3D Kartografie zu schaffen, diese möglicherweise aus der traditionellen Kartografie oder der zweidimensionalen Multimediakartografie abzuleiten und die Sinnhaftigkeit des Einsatzes von 3D für unterschiedliche Nutzergruppen zu klären. Im Zentrum der Betrachtungen stehen die menschliche Wahrnehmung, die Semiologie des virtuellen Raumes, Benutzerschnittstellen und deren Verwendung unterschiedlicher Modalitäten zur Geokommunikation.

Ein Teil der Schwierigkeiten der multimedialen 3D Kartografie liegt in der Beschreibung der Beziehungen zwischen den physikalischen Gegebenheiten der Realität und der über die Sinnesorgane wahrgenommenen und anschließend verarbeiteten räumlichen Außenwelt. Die Wahrnehmung des Raumes ist demnach kein passiver Prozess, sondern eine aktive Leistung des Gehirns, in die die persönlichen Erfahrungen eingebunden werden. [Albertz 1997] So könnte möglicherweise durch die genauere Kenntnis der Beziehungen von Realität und wahrgenommener Welt die raumbezogene Information effizienter kommuniziert werden.

Die Übertragung der Information – die Eingabe des Nutzers und damit die Navigationsmöglichkeit und die Ausgabe der aufbereiteten Information – erfolgt mit der Schnittstelle von Mensch und Computer. Diese technische Lösung sollte nach Möglichkeit den menschlichen Sinnesorganen angepasst sein, um eine umfassende Informationsübertragung zu ermöglichen. Die rasante technische Entwicklung der letzten Jahre bezüglich digitaler Präsentationsmethoden und verfügbarer Rechnerleistung ist die Grundlage für neuartige Benutzerschnittstellen und Übertragungsmöglichkeiten von raumbezogener Information.

Dieser Beitrag stellt eine Auswahl von aktuellen und zukünftigen – als Prototyp vorhandenen – Ausgabeschnittstellen gegenüber und vergleicht ihre Verwendung der Tiefenwahrnehmungsparameter. Zunächst werden diese Parameter der visuellen und auditiven Tiefenwahrnehmung erläutert und der Begriff der 3D Kartografie in groben Zügen definiert.

2 3D KARTOGRAFIE – EIN THEMA DER DEFINITION

Die 3D Kartografie ist jener Bereich der Kartografie, der – sowohl im analogen als auch im digitalen Bereich – die echt dreidimensionalen kartografischen Darstellungen, die klassischen dreidimensionalen körperlichen und die kartenverwandten Darstellungen in ihrer Gesamtheit umfasst. [Bollmann et al 2002]

Nach der geometrischen Definition entsteht eine Karte als Senkrechtprojektion auf eine horizontale Fläche – ein Grundrissbild. Die kartenverwandten Darstellungen sind demnach durch eine andere Lage – meist schief angeordnet – der Projektionsebene im Raum charakterisiert. [Hake et al 2002] Diese Erklärung der kartenverwandten Darstellungen verwendet die Projektion der realen Welt auf eine zweidimensionale Ausgabeebene. Sie kann daher nur den analogen und „Pseudo 3D" (die Erläuterung dieses Begriffes folgt in den nächsten Absätzen) Bereich zusammenfassen und für diesen eine ausreichende Abgrenzung gegenüber anderen kartografischen Präsentationsformen in der Definition liefern.

Versucht man das aktuelle Spektrum des Fachbereichs Kartografie – erweitert mit den digitalen Möglichkeiten – hinsichtlich der Ausgabeform bzw. Präsentationsform zu erklären oder zu strukturieren, findet man mit den traditionellen geometrischen Definitionen keine ausreichende Lösungsmöglichkeit. Vielmehr verlagert sich die Aufgabe der Kartografie von der geometrischen Abbildung, Dokumentation und Archivierung von raumbezogenen Inhalten zu der effektiven Vermittlung von Informationen über raumbezogene Inhalte [Gartner 2002] – die Dokumentation und Archivierung der Inhalte erfolgt nunmehr in geografischen Informationssystemen (GIS), die diese Inhalte für unterschiedliche Präsentationsformen, Maßstäbe und Benutzergruppen, ohne Anwendung einer kartografischen Generalisierung oder Symbolisierung, verwalten und zur Verfügung stellen. Somit bildet der kartografische Kommunikationsprozess, der mitunter durch den Einsatz von Multimedia unterstützt wird [Cartwright et al 1999], eine mögliche Definitionsquelle.

Der kartografische Kommunikationsprozess wird durch die menschliche Wahrnehmung über unterschiedliche Sinnesorgane und eine anschließende Verarbeitung im Gehirn geprägt. So wird in der Multimediakartografie der Versuch unternommen, mittels verschiedener Übertragungsmodalitäten die raumbezogene Information effizienter zu präsentieren. Für die multimediale 3D Kartografie scheinen sich die Wahrnehmungsparameter, die anschließenden psychologischen Prozesse und die Einwirkung des Erfahrungsstandes des Nutzers in diese Prozesse stärker auf das Ergebnis – der wahrgenommenen Realität – auszuwirken als in der zweidimensionalen Kartografie. Von besonderer Bedeutung sind hier die Parameter für die Tiefenwahrnehmung (siehe Punkt3), die für die Bildung eines wahrgenommenen Raumes zuständig sind. Je mehr dieser Komponenten von einer Benutzerschnittstelle verwendet werden können, umso besser wird der wahrgenommene Raum in unserem Kopf abgebildet. [Albertz 1997]

Die verschiedenen Darstellungsweisen der 3D Kartografie werden grundsätzlich durch die Theorie der räumlichen Perzeption – des stereoskopischen Sehens –, die physikalischen Parameter des Displays und die grafische Semiologie geprägt. Sie ermöglichen eine Klassifizierung der 3D kartografischen Präsentationsformen in drei Teile: Pseudo 3D, Parallaxen 3D und Voll 3D.

Pseudo 3D bezeichnet die perspektiv-monoskopischen Visualisierungen kartografischer 3D Darstellungen auf einem flachen Medium – Papier oder Bildschirm. Diese, überlicherweise als kartografische 3D Darstellung bezeichneten, Präsentationen verwenden nur psychologische Tiefenwahrnehmungsparameter (siehe Punkt 3.1.2).

Bei Parallaxen 3D (P3D) Darstellungen werden ausgewählte bi- und monokulare psychologische und physiologische Tiefenparameter (depth cues) ausgenützt. Im Wesentlichen umfassen P3D Bilder die Technologien der Chromostereoskopie, des Pulfrich Effekts, der Stereoskopie und der Multistereoskopie (z.B.: Lentikularlinsenverfahren auf Papierträger).

Darstellungen des Voll 3D setzen alle bi- und monokularen psychologischen und physiologischen „depth cues“ ein. Bei dieser Art von Raumbildern bestehen in allen Richtungen kontinuierliche Parallaxen Effekte. Die zwei vorrangigen Technologien der Herstellung sind „volumetric imaging“ – die volumetrische Bildherstellung mit „light emitting volume“-, „rotating helix mirror“- oder rotating matrix display“- Verfahren – und die Holografie mit echten Hologrammen. [Bollmann et al 2002]

3 DIE TIEFENWAHRNEHMUNG IN MULTIMEDIALEN PRÄSENTATIONEN

Bewirkt eine kartografische Darstellung bei einem Nutzer einen echten dreidimensionalen, also räumlichen Eindruck, wird diese Abbildung als kartografisches Raumbild bezeichnet [Bollmann et al 2002]. In diese Definition fallen auch die körperlichen kartenverwandten Darstellungen, wie Globus, Reliefkarte oder Reliefmodell. Im Weiteren werden die analogen – körperlichen – Beispiele außer Acht gelassen und nur multimediale 3D kartografische Beispiele betrachtet.

Die multimedialen Präsentationen der 3D Kartografie werden durch die Charakteristiken des Begriffs Multimedia geprägt. Diese sind vor allem die computerbasierte Datenverarbeitung, Medienkombination, Multimodalität und Interaktivität [Dransch 2001]. Sie ermöglichen, je nach den technischen Voraussetzungen der Benutzerschnittstelle, eine umfassendere Informationsübertragung und Bedienung der menschlichen Sinneskanäle.

3.1 Depth cues – die Tiefenwahrnehmungsparameter

Die visuellen Tiefenwahrnehmungsparameter werden in der Theorie des stereoskopischen Sehens festgelegt. Diese Parameter, „depth cues“ oder Anhaltepunkte für das räumliche Sehen, bestehen aus vier physiologischen und sechs psychologischen Komponenten. Die Physiologischen sind die retinale Parallaxe, Konvergenz, Akkomodation und Bewegungsparallaxe. Die Psychologischen umfassen die retinale Bildgröße, lineare Perspektive, Luftperspektive, Verdeckung, Beschattung und den Texturgradienten.

Im Sinn von Multimedia sollen die allgemeinen Parameter der Tiefenwahrnehmung um die auditiven Komponenten ergänzt werden. Diese werden für das räumliche „Sehen“ – die allgemeine Wahrnehmung des Raumes – oft nicht beachtet. Sehbehinderte Nutzergruppen zeigen jedoch die Wichtigkeit dieser Parameter und die Möglichkeit, den realen Raum nur mit dem Hörsinn zu erfahren.

3.1.1 Die physiologischen Parameter

Die physiologischen Parameter beschreiben die menschliche „Technik“ der visuellen räumlichen Wahrnehmung. So wird die dreidimensionale Welt auf die flachen Sphären unserer Augen – der Netzhaut – abgebildet und davon wiederum der dreidimensionale Raum als Wahrnehmung abgeleitet.

Die retinale Parallaxe ermöglicht grundsätzlich das räumliche Sehen. Sie wird auch als Horizontalparallaxe bezeichnet und liegt in der von der Augenbasis gebildeten Ebene. Ein räumlicher Punkt wird in den Augen auf unterschiedlichen Positionen der Netzhaut projiziert. Die Differenz der Netzhautposition – die horizontale Parallaxe – ist das Maß der Entfernung. Das Verschmelzen beider Netzhautbilder zu einem Raumbild nennt man Stereoskopie – räumliches Sehen.

Die Akkomodation ist die „Scharfstellung“ des Auges auf verschiedene Entfernungen. Sie erreicht eine scharfe Abbildung auf der Netzhaut. Eine Entfernungsableitung aus der Akkomodation ist nicht möglich.

Die Konvergenz ist eng mit der Akkomodation verknüpft. Für nahe Objekte ist der Konvergenzwinkel der Sehachsen groß, für entfernte Objekte klein. Für sehr weit entfernte Punkte wird die Konvergenz gleich Null – die Sehachsen sind parallel. [Kraus 1994]

Die Bewegung im Raum ist für die räumliche Wahrnehmung unserer Umwelt von großer Bedeutung. Während einer Bewegung verschiebt sich jeder Punkt, den wir betrachten, auf unserer Netzhaut abhängig von seiner Entfernung und unserer Blickrichtung. Diese systematische Verschiebung nennt man Bewegungsparallaxe. Sie wird besonders beim Blick aus einem fahrenden Fahrzeug normal zur Fortbewegungsrichtung auffällig. [Albertz 1997]

3.1.2 Die psychologischen Parameter

Unabhängig von der technischen Ausformung des Sehapparates unterstützen die psychologischen Parameter die Entstehung eines Raumbildes. Sie beeinflussen die Beziehungen zwischen Realität und wahrgenommenem Bild und verstärken so den räumlichen Eindruck.

Die retinale Bildgröße ist ein Maß für die Einschränkung des Sehfeldes. Das Sehfeld eines gesunden Menschen ist nur durch die Fläche der registrierenden Bildpunkte auf der Netzhaut begrenzt. Der Raum um das Individuum weist grundsätzlich keine Einschränkungen auf. Benutzerschnittstellen, die flächenmäßig begrenzt sind – vor allem bei Pseudo 3D Ansichten –, weisen diesen unterstützenden Parameter auf Grund der Sehfeldbegrenzung nicht auf.

Ein Objekt konstanter Größe wird mit abnehmender Entfernung immer größer wirken. Wegen der linearen Perspektive entsteht der Eindruck, dass weiter entfernte Objekte kleiner sind. Jedoch wird man nicht eine Größenänderung des Objektes annehmen, sondern diese durch die Entfernungsabhängigkeit mit dem perspektiven Einfluss in Zusammenhang bringen.

In einer Landschaft werden näher liegende Bereiche kontrastreicher als entferntere Bereiche wahrgenommen. Diese Eigenschaft hängt mit dem Dunstanteil der Atmosphäre zusammen. Weiters weisen die Farben aus physikalischen Gründen mit wachsender Entfernung immer mehr Blauanteile auf. Diese Effekte werden in der Wahrnehmungspsychologie als Luftperspektive zusammengefasst.

Der Effekt der Verdeckung erscheint zunächst als einer der primitivsten psychologischen Tiefenwahrnehmungsparameter. Bereits bei den Ägyptern wurde dieser Parameter für die Übertragung der Tiefeninformation eingesetzt. Objekte werden teilweise von näher liegenden verdeckt. Damit dieser Prozess wirksam werden kann, müssen Figuren für die einzelnen Objekte erkannt werden. Die Ergänzung von teilweise sichtbaren zu ganzheitlichen Objekten muss Bestandteil des Prozesses sein, um über die räumliche Verteilung Auskunft geben zu können.

Bei der Beschattung wirken die Einfallsrichtung des Lichts, die geometrische Form des schattenwerfenden Objektes und die Form der beschatteten Oberfläche zusammen. Obwohl die Wahrnehmung die einzelnen Komponenten gemeinsam verarbeitet, setzen diese enthaltene Informationen voraus. So wird ein Schlagschatten nur richtig erkannt, wenn die Einfallsrichtung des Lichts richtig interpretiert und die Form der Oberfläche richtig erkannt wird. Allgemein dient die Beschattung zur Erkennung von sonst nicht sichtbaren Objektformen.

Produziert eine Beleuchtungssituation keine Schlagschatten, sondern nur weiche Hell- Dunkel Übergänge, spricht man von einem Helligkeitsgradienten. Dieser ist eine Form des Texturgradienten, der die Wahrnehmung der Oberflächenform unterstützt. Auf der unebenen Fläche entstehen unterschiedliche Beleuchtungsstärken – je nach Einfallswinkel der Beleuchtung. Weitere Formen des Texturgradienten sind Größen- und Dichtegradienten, die durch den Vergleich gleichartiger Objekte oder gleichmäßiger Muster den räumlichen Eindruck unterstützen. [Albertz 1997]

3.1.3 Die auditiven Parameter

Ebenso wie die visuellen Parameter können die Auditiven den Raumeindruck verstärken und somit die Wirksamkeit der raumbezogenen Informationsübertragung erhöhen.

Die Lautstärke ist, ähnlich der Größe bei der visuellen Wahrnehmung, ein Indikator für die Entfernung der Tonquelle. Je näher eine konstante Tonquelle positioniert ist, umso lauter wird diese wahrgenommen.

Die Bewegungsparallaxe (Punkt 3.1.1) wird von der frequenzabhängigen Tonhöhe unterstützt. Den physikalischen Gesetzen des Dopplereffektes folgend, ist bei herannahenden Objekten eine Frequenzzunahme – eine Erhöhung des Tons – , bei sich entfernenden Objekten eine Frequenzabnahme – Vertiefung des Tons – wahrnehmbar.

Das Timbre eines Klangs beschreibt die Klarheit des Hörbaren. Dies kann kombiniert mit der Lautstärke ein Indikator für die Entfernung sein oder als selbstständige Größe die Ver- bzw. Abdeckung der Tonquelle signalisieren.

Abhängig von der Ausprägung der Benutzerschnittstelle im auditiven Bereich – „Sourround“- oder Stereo- „Sound“ – kann ergänzend die Position und Richtung der Tonquelle abgeschätzt werden.

Die aufgezählten Parameter der Tiefenwahrnehmung beschreiben nicht alle Möglichkeiten der räumlichen Erfassung. Tast- und Geruchsinn sind ebenso Bestandteil des Wahrnehmungsprozesses, können jedoch bisher aus technischer Sicht sehr schwer oder gar nicht nachgebildet und in eine Schnittstelle eingebaut werden. Hinsichtlich der ausgewählten Benutzerschnittstellen sollen die genannten Komponenten eine Differenzierung und Bewertung ermöglichen.

4 AUSGEWÄHLTE BENUTZERSCHNITTSTELLEN IM VERGLEICH

Die betrachteten Schnittstellen wurden nach ihrer möglichen Verwendung für eine multimediale 3D kartografische Anwendung ausgewählt. Sie unterscheiden sich durch die Möglichkeit, die verschiedenen Tiefenwahrnehmungsparameter für eine Informationsübertragung gezielt einzusetzen.

Neben weit verbreiteten Visualisierungstechniken, wie dem Computerbildschrim, wurden auch zukünftige – als Prototypen oder in Entwicklung befindliche – Technologien in den Vergleich eingebunden. Die Intention mancher dieser neuen Entwürfe ist, den virtuellen Raum greifbar und erlebbar zu machen. Andere versuchen erst gar nicht die Realität nachzubilden, sondern ergänzen diese mit virtuellen Objekten, Symbolen und Interpretationen.

Im Folgenden werden die fünf verschiedenen Ausgabeschnittstellen beschrieben, ihre Funktionsweise kurz erläutert und die Verwendung der Tiefenwahrnehmungsparameter zugeordnet.

4.1 Bildschirm mit Pseudo 3D

Die weit verbreitetste Benutzerschnittstelle zwischen Mensch und Computer ist das Computerdisplay. Hierbei werden die üblicherweise als kartografische 3D Darstellung oder 3D Anwendung bezeichneten, mit einer Anzahl von kommerziellen Software

Programmen herstellbaren, Visualisierungen auf einem flachen Display Medium realisiert. Die eingebundene Interaktivität wird nach der Visualisierung mit üblichen Eingabegeräten – Maus, Keyboard o.ä. – erwidert.

Abbildung 14: Cave (Quelle: Cruz-Neira et al 1993), Humphrey (Quelle: www.aec.at), Sichtfeld einer Augmented Reality Anwendung (Quelle: www.ims.tuwien.ac.at)

Die dreidimensionalen Anwendungen des Pseudo 3D erfordern eine hohe Rechenleistung der Grafikkarte, da die Darstellung des Bildschirmes „rahmenweise" berechnet werden muss. Um einen fließenden, realen Eindruck zu vermitteln, müssen mindestens 15 Rahmen pro Sekunde des gewünschten Abbildes der virtuellen Welt dargestellt werden.

Grundsätzlich wird hier die physiologische Wahrnehmung und deren Parameter nicht für die Wahrnehmung des virtuellen Raumes verwendet. Der Raumeindruck wird hauptsächlich mit den psychologischen depth cues gebildet. Ein zusätzlicher Einsatz von Lautsprechersystemen ergänzt diese Technologie mit der auditiven Wahrnehmung.

4.2 Bildschirm mit Stereoskopie

Die Erweiterung von handelsüblichen Computerdisplays für stereoskopische Verfahren kann mit Software- und Hardwarelösungen erfolgen. Ziel ist die Erstellung von Parallaxen 3D Raumbildern, die mittels Autostereoskopie einen verbesserten Raumeindruck ermöglichen.

Beim Anaglyphenverfahren werden zwei Stereopartner simultan betrachtet. Die Aufspaltung der zur gleichen Zeit präsentierten Bilder erfolgt mit dem Einsatz von Filtern. Ein Stereopartner wird in Grün, der andere in Rot dargestellt. Durch das Vorsetzen entsprechend eingefärbter Filter vor die Augen erreicht man den stereoskopischen Effekt. Farbige Visualisierungen sind wegen der Filterung in diesem Verfahren nicht möglich.

In einer Variation werden an Stelle der Filter „Shutterglasses" eingesetzt. Die Visualisierung am Bildschirm wird polarisiert. Eine, in der gleichen Taktfrequenz laufende, Polarisationsbrille lässt abwechselnd die Stereopartner für das jeweilige Auge hindurch und ermöglicht somit Autostereoskopie.

Die stereoskopischen Verfahren am Bildschirm bedienen sich der retinalen Parallaxe. Sie verwenden daher gegenüber den Pseudo 3D Darstellungen ausgewählte physiologische depth cues. Der Raumeindruck kann in diesem Fall durch die Verwendung der menschlichen Physiologie besser vermittelt werden. [Deering 1992]

4.3 CAVE

Die „CAVE" wurde mit dem Ziel, ein brauchbares Werkzeug der wissenschaftlichen Visualisierung zu schaffen, entworfen. CAVE ist die Abkürzung für Computerbased Automatic Virtual Environment (computerbasierte automatische virtuelle Umgebung). Sie besteht aus einem Würfel mit einem Ausmaß von 3x3x3 Metern, der auf einer Seite zur Begehung offen ist. Die Wände des Würfels werden als Projektionsflächen mittels Rückprojektion benutzt, d.h. sie werden von außen angestrahlt. Durch das Ausmaß können mehrere Menschen gleichzeitig in die virtuelle Realität eintauchen.

Die Projektion des CAVE erfolgt mit stereoskopischen Verfahren. Der räumliche Eindruck wird über LCD Shutterglasses (Brillen mit Flüssigkristalldisplay) hergestellt. Mit einem Magnetfeldsensor kann die Position des Betrachters im Raum und seine Blickrichtung erfasst werden. Rechenstarke Computer erstellen dann 96 Mal pro Sekunde abwechselnd für das linke und rechte Auge eine immer perspektivisch richtige Darstellung der Computergrafik. Zusätzlich ist der Würfel mit einem Surround Sound System ausgestattet und unterstützt mit diesem die räumliche Wahrnehmung. [www.aec.at 2004]

Der Einsatz der Stereoskopie bewirkt die Verwendung einiger physiologischer Parameter für die Tiefenwahrnehmung. Die Projektion auf mehreren Flächen um den Benutzer verursacht keine Einschränkung der retinalen Bildgröße. Das komplette Sehfeld wird für die Informationsübertragung ausgenutzt. [Cruz-Neira et al 1993]

4.4 Humphrey

Humphrey ist ein speziell konstruiertes Gerüst mit Force-Feedback-Apparaturen. Damit können physikalische Kräfte der virtuellen Welten mechanisch simuliert werden. Das Ziel ist, durch die Kombination von Virtual-Reality- und Force-Feedback-Technologien ein möglichst realistisches Gefühl von Schwerelosigkeit und der durch Flugbewegungen aufkommenden Fliehkräfte zu vermitteln.

Der Benutzer wird mit einem Pilotenoverall an einem Seilsystem befestigt, das mit pneumatischen Muskeln als Membran-Kontraktions-System auf dessen Bewegung reagieren kann. Ein „head mounted display" – ein Datenhelm – mit stereografischer Visualisierung versorgt die visuellen, ein Kopfhörersystem die auditiven Sinne. Mittels intuitiver Bewegung der Arme wird die Fortbewegung durch die künstlich geschaffene Welt ermöglicht.

Die stereografische Berechnung der Darstellung im Datenhelm versorgt den Benutzer mit ausgewählten physiologischen Parametern. Die psychologischen Raumanhaltepunkte werden durch die entsprechende Programmierung der virtuellen Welt – wie bei den vorangegangenen Beispielen – berücksichtigt. Mit dem Tonsystem des Datenhelmes können auch die auditiven Parameter auf die Wahrnehmung Einfluss nehmen. [www.aec.at 2004]

4.5 Augmented Reality

In der „augmented reality" wird die Realität mit virtuellen Objekten ergänzt. Es wird nicht der Versuch unternommen, eine künstliche Welt zu schaffen. Die Problematik der hohen Rechenleistung für die Berechnung einer detailgetreuen Nachbildung der Natur entfällt bei dieser technischen Lösung. Die Probleme entstehen hier bei der genauen Positionierung des Benutzers und der virtuellen Objekte in seinem Display.

Auch hier wird der Benutzer mit einem „head mounted display" versehen. Dieses kann auch eine halbdurchlässige Brille sein, in dessen Glas die Informationen eingeblendet werden.

Eine Besonderheit des „augmented reality"- Verfahrens ist die Ortsgebundenheit, da die Realität nur ergänzt werden kann. Befindet sich der Benutzer nicht in dem gewünschten Gebiet, kann auch keine kartografische Interpretation und Symbolisierung – eine augmentierte Anwendung – erfolgen.

Nachdem die Realität direkt verwendet wird, unterstützt diese Technologie alle Parameter der menschlichen Raumerfassung. [www.ims.tuwien.ac.at 2004]

4.6 Gegenüberstellung der Schnittstellen

	Phys. 1	Phys. 2	Phys. 3	Phys. 4	Psych .1	Psych .2	Psych .3	Psych .4	Psych .5	Psych .6	Audit. 1	Audit. 2	Audit. 3
Bildschirm (Pseudo 3D)				ja		ja	ja	ja	ja	ja	ja*	ja*	ja*
Bildschrim (Stereoskopie)	ja			ja		ja	ja	ja	ja	ja	ja*	ja*	ja*
CAVE	ja	ja		ja	ja	ja	ja	ja	ja	ja	ja	ja	ja
Humphrey	ja			ja	ja**	ja	ja	ja	ja	ja	ja*	ja*	ja*
Augmented Reality	ja	ja	ja	ja	ja**	ja	ja	ja	ja	ja	ja*	ja*	ja*

Erklärung der Tabelle – Die Schnittstelle kann zur Informationsübertragung folgende Parameter verwenden:

Phys.1...die retinale Parallaxe, Phys.2...Konvergenz, Phys.3...Akkomodation, Phys.4...Bewegungsparallaxe,

Psych.1...keine Einschränkung der Bildgröße, Psych.2...lineare Perspektive, Psych.3...Luftperspektive, Psych.4...Verdeckung, Psych.5...Beschattung, Psych.6...Texturgradienten,

Audit.1...Lautstärke, Audit.2...frequenzabhängige Tonhöhe, Audit.3...Timbre des Klangs

*...mögliche Verwendung der Parameter bei entsprechender technischer Ausrüstung (Surround oder Stereo Sound), **...je nach Art des Displays (Sehfeldeinschränkung).

5 RESÜMEE

Die aktuellen technischen Lösungen der Mensch-Computer-Interaktion zeigen die Notwendigkeit, die Beziehungen des realen Raumes mit dem wahrgenommenen Abbild im Kopf des Menschen genauer zu durchleuchten und in die technische Konzeption einfließen zu lassen. Der Wahrnehmungsprozess mit seiner Komplexität bestimmt einen Großteil des räumlichen Sehens und Verstehens. Die Kommunikationsmöglichkeit von raumbezogenen Inhalten sowie die Veranschaulichung von räumlich und zeitlich situierten Prozessen kann möglicherweise durch die Verwendung dieser Beziehungen gefördert werden.

Darüber hinaus macht sich über den Bereich der multimedialen 3D Kartografie ein Wechsel der wissenschaftlichen Grundauffassung in der Kartografie bemerkbar – von den traditionellen Definitionen der Geometrie und Abbildungslehre zu den Grundsätzen des Kommunikationsprozesses und der Wahrnehmungspsychologie.

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Effiziente Erzeugung von 3D Stadtmodellen aus vorhandenen Vermessungsdaten

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ZUSAMMENFASSUNG

Der Beitrag bietet eine Übersicht über das System City**GRID** mit dem 3D Stadtmodelle generiert, verwaltet und genutzt werden können. Das System besteht aus mehreren Modulen die mit Hilfe genormter Schnittstellen auch unabhängig voneinander einsetzbar sind. Die Entwicklung erfolgte durch die Firmen No Limits IT GmbH (Graz, Wien) und GeoData (Leoben) in Zusammenarbeit mit Christian Doppler Forschungslabors an den Technischen Universtäten Graz und Wien Graz und dem K+ Zentrum VrVIS (Graz, Wien).

1 CITYGRID

1.1 CITYGRID Scanner

Der CityGRID Scanner, dient zur effizienten multidimensionalen Abbildung der Stadt vom Strassenraum aus. Das auf einem Fahrzeug montierte, hybride Meßsystem besteht aus einem GPS Empfänger, einem Laserscanner und mehreren Digitalkameras. Alle Sensoren sind zueinander kalibriert und liefern Zeit-synchronisierte Aufnahmen.

Zur Aufnahme von Fassaden fährt der CityGRID Scanner im „dynamischen" Modus mit maximal 5 km/h entlang der Strasse. Mit Hilfe des fahrzeugeigenen Odometers werden die Kameras so ausgelöst, dass jeder Fassadenteil in mindestens 5 Aufnahmen abgebildet ist. Gleichzeitig mit jeder photographischen Aufnahme wird vom Laserscanner eine horizontal liegende Zeile entlang der Fassade gescannt.

Der GPS- Empfänger ermöglicht eine grobe Verortung für die Verwaltung der Aufnahmen in einem GIS. Für die Auswertung der Aufnahmen wurde am VrVIS ein Matching Verfahren entwickelt, das die horizontalen und vertikalen Fassadenstrukturen für die automatische Sensororientierung nutzt. Das Ergebnis dieses Prozesses ist ein absolut verzerrungsfreies „True" Orthophoto der Fassaden für die Texturierung des Stadtmodells.

Abb.1 City**GRID** Scanner

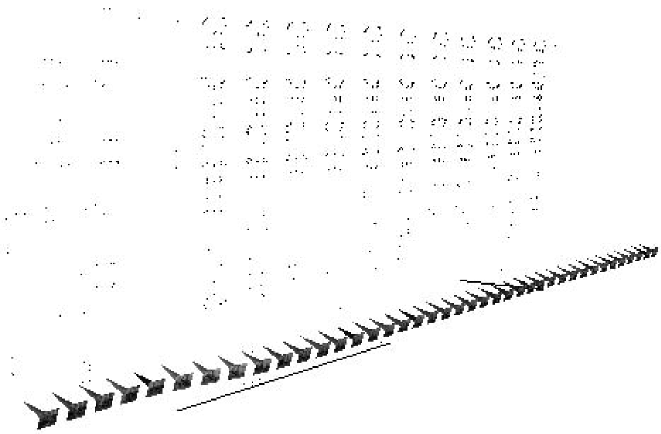


Abb.2 Orientierung der Bildsequenz aus dem dynamischen Mode

Abb.3 Bildsequenz

Abb.4 True Orthophoto

Im „Stop and Go“ Betrieb nimmt der City**GRID** Scanner Daten für die Naturbestandsaufnahme auf. Der Laserscanner erfasst eine ganze “Rundumszene“ entsprechend den Bildausschnitten der Digitalkameras. Aus diesen Daten können im Wege des Post-Processing Objekte des Strassenraumes erkannt und verortet werden. Geeignete Algorithmen werden im Rahmen eines CD-Labors vom Institut für Photogrammetrie und Fernerkundung der TU-Wien gemeinsam mit der Firma No Limits IT GmbH entwickelt.

Abb.5 Bildsequenz und Flächenscan

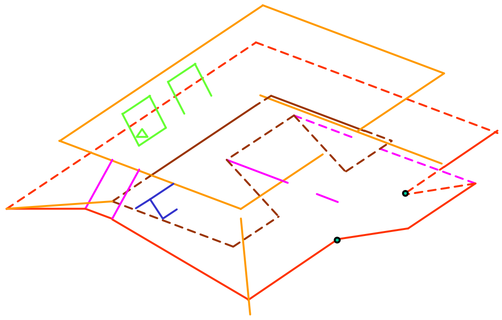
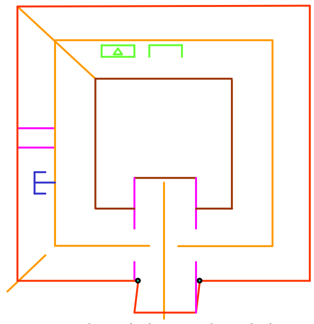
1.2 CITYGRID Modeler

Die 3D Modellierung der Gebäude erfolgt mit dem City**GRID** Modeler, entwickelt von No Limits IT GmbH auf der Basis von 3D Studio. Den Bedürfnissen der Stadtverwaltung Rechnung tragend, wird die Gebäudeform aus Linien abgeleitet: aus der Baukörperumfahrung und, falls vorhanden, aus Dachlinien. Die Baukörperumfahrung ergibt sich durch Verschieben des Gebäudegrundrisses auf die geschätzte bzw. die gemessene Gebäudehöhe. Die Dachlinien werden entweder aus einer Luftbild Stereoauswertung oder mit Hilfe von Airborne Laserscanning gewonnen.

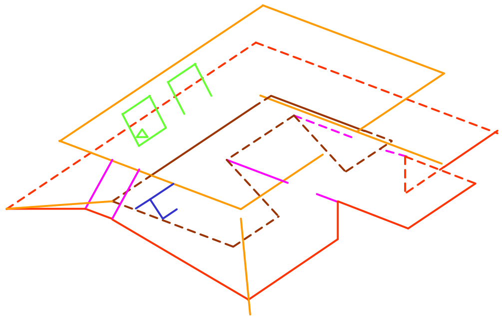
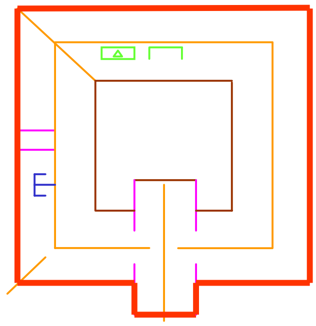
Der City**GRID** Modeler trianguliert automatisch die aus diesen Linien vorgegebene Dachform. Etwaige Fehler in den gemessenen Linien können im Linien-Editiermodus bereinigt werden, auf den hier im Detail eingegangen werden soll:

Als Ausgangsdaten für die Dachmodellierung bieten sich stereophotogrammetrisch aus Luftbildern gemessene Dachlinien an. Optimalerweise unterscheidet man schon bei der Auswertung in Traufenlinien (rot), Ausschnitte (grün), Extrusionen (blau), Bruchkanten (lila) und sonstige Dachlinien (gelb).

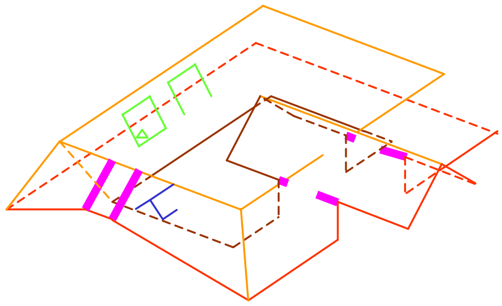
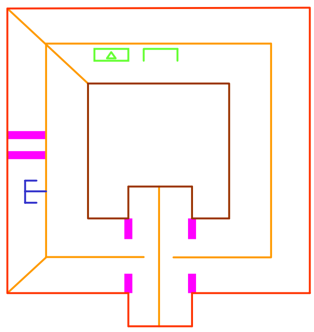
Zu beachten ist jedoch, dass der Stereoauswerter absichtlich gewisse „Fehler“ machen muss, um effizient arbeiten zu können. So ist es z.B. bei vertikalen Kanten der Traufenlinie einfacher, den evtl. verdeckten unteren Knickpunkt auszulassen und die Linie schräg zum oberen Knickpunkt zu ziehen.

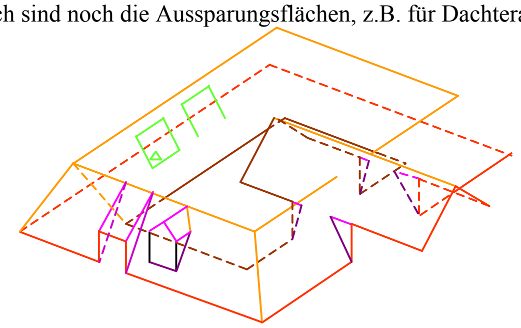
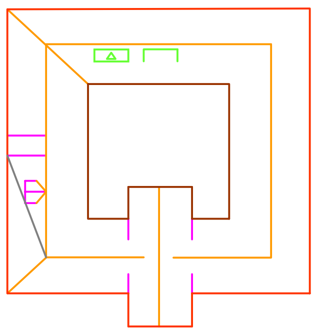
Die typischen Fehler der Luftbildauswertung können in einer regelbasierten automatischen Datenbereinigung korrigiert werden. Ein wichtiger Zwischenschritt ist dabei die Generierung einer geschlossenen äußeren Traufenlinie, die das Dach abgrenzt. Darüber hinausstehende Linien können nun automatisch „gestutzt“ werden.

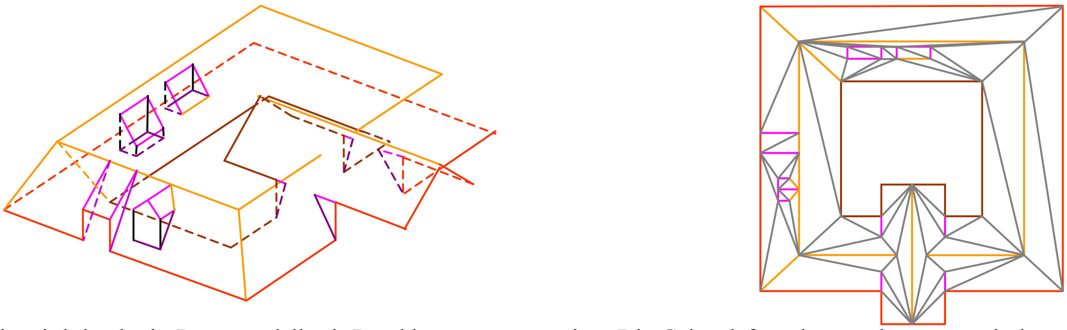
Nun können die senkrechten „Bruch“-Flächen im Dach, deren Unterkanten i.d.R. im Luftbild verdeckt sind und nicht gemessen werden können, wiederhergestellt werden. Dabei geht man von den gemessenen oberen Bruchkanten aus.

Schließlich sind noch die Aussparungsflächen, z.B. für Dachterassen, zu berücksichtigen.

Das Ergebnis sind die aus den gemessenen Dachlinien automatisch abgeleiteten bereinigten Dachlinien. Aus diesen lässt sich durch Triangulation das Oberflächenmodell des Daches ableiten. Das Dachmodell ist demnach eine aus den gemessenen Dachlinien automatische ableitbare Darstellungsform. Es reicht daher aus, nur die gemessenen und evtl. auch die bereinigten Dachlinien zu speichern. Diese Linieninformation kann für etwaige spätere Nachmessungen in das Stereoauswertegerät eingeblendet werden. Im Gegensatz zur direkten Verspeicherung der Dachflächen ist so die Aktualisierbarkeit des Dachmodells gewährleistet.



Das Gelände wird durch ein Rastermodell mit Bruchkanten repräsentiert. Die Gebäudefassaden werden automatisch vom Dach bis zum Gelände extrudiert. Auch Dachvorsprünge werden berücksichtigt, sofern sowohl die Lage des aufstrebenden Mauerwerkes als auch die Traufenlinien bekannt sind.

Unabhängig von der Textur wird die Gebäudegeometrie durch vier LOD („Level Of Detail") Stufen beschrieben:

1. Baukörperumfahrung,
2. Blockmodell mit flachem Dach,
3. Formmodell mit der Dachformen
4. Detailmodell mit detaillierten Dachelementen (Gauben, Kaminen) und Fassaden.

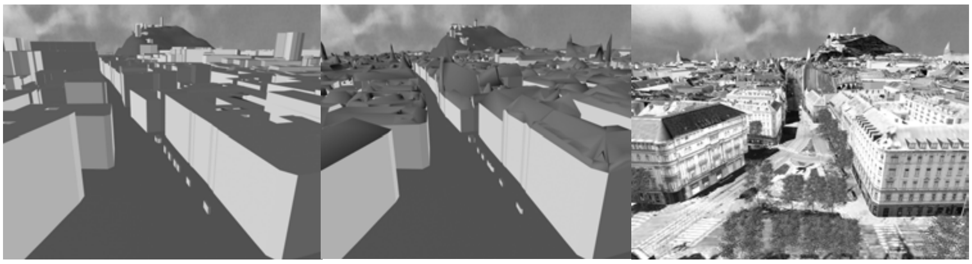


Abb.6-8 Blockmodell Formmodell texturiertes Modell

Die photorealistische Texturierung der Dächer und des Geländes erfolgt mit Hilfe digitaler Luftbilder. Fassadentextur gewinnt man, wie oben beschrieben, aus den Aufnahmen des City**GRID** Scanners.

1.3 CITYGRID Manager

Zur Verwaltung der modellierten Gebäude dient der City**GRID** Manager, entwickelt von No Limits IT GmbH auf der Basis von Oracle. Im Sinne der relationalen Datenbank ist jedes einzelne Gebäudemodell eine „Unit" die unter einer eindeutigen Nummer verspeichert wird. Diese Unitnummer, zum Beispiel der von der Stadtverwaltung vorgegebene Gebäudecode, ermöglicht die Kombination mit gebäudebezogenen Sachdaten im GIS. Der Anwender kann für den einfacheren Zugriff mehrere „Modelle" von verschiedenen Stadtbereichen definieren, zum Beispiel „gesamt", „Hauptplatz" oder „Innenstadt". Falls Strassennamen vorhanden sind, können diese über die Strassenachse den jeweiligen Gebäudemodellen zugeordnet werden. Dann kann der Anwender die Gebäude auch strassenweise aus der Datenbank abrufen. Über eine genormte XML Schnittstelle kann der City**GRID** Manager die Gebäudemodelle verschiedenen Anwendersystemen zur Verfügung stellen.

1.4 CITYGRID Planner

So können mit dem Modul City**GRID** Planner die Gebäudemodelle eines beliebigen lokalen Bereiches geladen und mit dem digitalen Architekturmodell eines Bauprojektes kombiniert werden. Auf diese Art lassen sich verschiedene Planungsvarianten in Bezug zur bestehenden Umgebung dreidimensional visualisieren und aus der Sicht der Stadtplanung beurteilen.

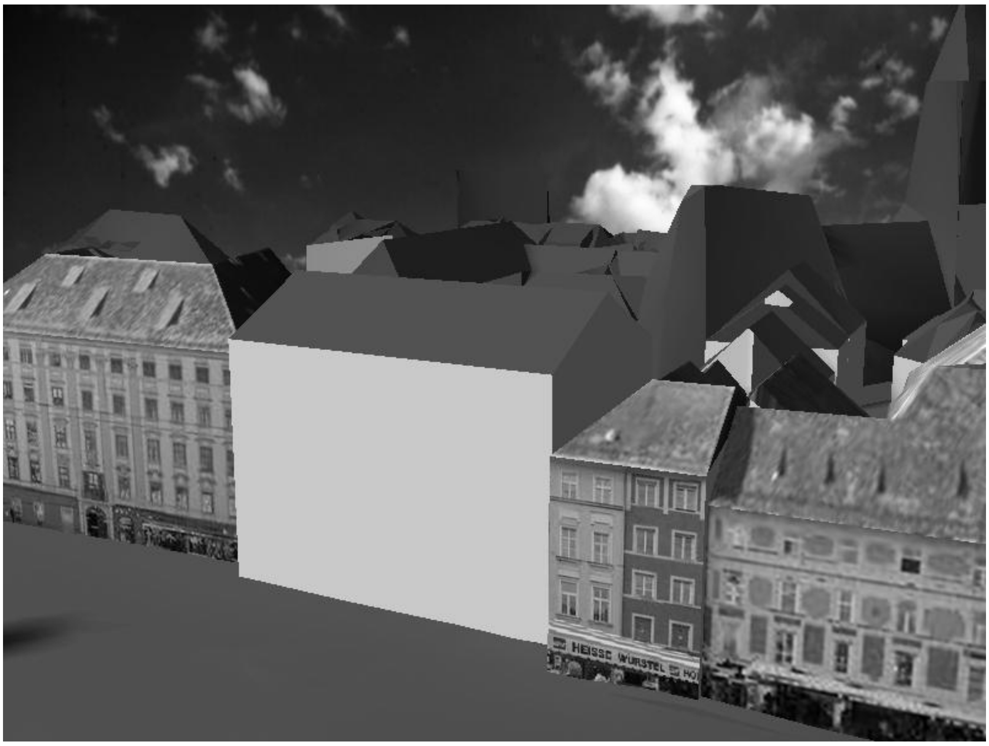


Abb.9 City**GRID** Planer

Für 3D Internet Anwendungen wurde vom VrVIS der City**GRID** Explorer entwickelt. Dieser Viewer ist für die flüssige Navigation in sehr großen Stadtmodellen optimiert und basiert auf der automatischen Vorselektion der im Sichtfeld liegenden Gebäude.

Mit dem System City**GRID** wurde im Auftrag des Grazer Stadtvermessungsamtes im Jahr 2002 ein Modell des inneren Stadtgebietes bestehend aus mehreren 1000 Gebäuden erstellt. 2003 folgen Teile der Wiener Innenstadt im Auftrag der MA 41 (Stadtvermessung) der Stadt Wien. Darüber hinaus sind Pilotprojekte in Deutschland in Vorbereitung.

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GIS-Einsatz im Rahmen eines Monitorings bergbaubedingter Umwelteinwirkungen

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1 EINLEITUNG

Die Entnahme großer Mengen Steinkohle in Teufen von über 1000 m führt zu unterirdischen Hohlräumen, die sich unter dem Gebirgsdruck wieder schließen. Dies leitet einen Senkungsvorgang der nächst höheren Gesteinsschichten ein, der sich bis an die Erdoberfläche fortsetzt und aufgrund von Senkungen, Schieflagen und Verschiebungen Veränderungen an der Tagesoberfläche hervorrufen kann [Kratzsch, 1997].

Abbauvorhaben die Senkungen der Erdoberfläche von 3 m und mehr verursachen, bedürfen in Deutschland gem. § 1 UVP-V Bergbau einer Umweltverträglichkeitsprüfung (UVP). Nach § 52 Abs. 2a des Bundesberggesetzes (BBergG) ist für deren Zulassung ein obligatorischer Rahmenbetriebsplan aufzustellen und ein Planfeststellungsverfahren nach Maßgabe der §§ 57a und 57b BBergG durchzuführen.

[Hansel, 2000] stellt die Sonderform der integrierten UVP bei Rahmenbetriebsplanverfahren mit Planfeststellung für bergbauliche Vorhaben heraus. Für die Erstellung und Zulassung des Rahmenbetriebsplans und den zu genehmigenden Abbau muss ein Zeitraum von ungefähr 25 Jahren angesetzt werden. Angaben zur Lagerstätte (z.B. die geologische Situation), wie auch zum Abbau (z.B. die zeitliche Folge oder die Abbaugeschwindigkeit), liegen nicht so detailliert vor, dass eine Darstellung des Vorhabens und der hiervon ausgehenden Auswirkungen, wie sie in der UVP gefordert werden, für einen solch langen Zeitraum geliefert werden können. Dies betrifft insbesondere die senkungsbedingten Auswirkungen auf das Grundwasser, die Oberflächengewässer sowie die Arten und Lebensgemeinschaften. Da zum Zeitpunkt der Planfeststellung somit Entscheidungen insbesondere im Bereich des Wasser- und Naturschutzrechtes nicht abschließend getroffen werden können, wird der untertägige Steinkohlenabbau im Land Nordrhein-Westfalen durch ein System der räumlichen Beobachtung, Kontrolle und Steuerung der Umweltauswirkungen (Monitoring) begleitet.

In Kapitel 2 wird das Konzept für ein Monitoring bergbaulicher Umwelteinwirkungen vorgestellt. Wesentlich bei der Bearbeitung dieses Monitorings ist die EDV-technische Unterstützung, speziell durch Geoinformationssysteme (GIS). Das Kapitel 3 stellt die Anforderungen an ein GIS dar. Bis heute integrieren kommerzielle GIS die Zeit als weitere Dimension gar nicht oder nur unzureichend. [Couclelis, 1999] weist in diesem Zusammenhang daraufhin, dass das Akronym GIS momentan eher für Geometrische als für Geographische Informationssysteme steht. Das Kapitel 3 beschäftigt sich mit dem Aufbau eines GIS zur Unterstützung des Monitorings. Der Schwerpunkt liegt hierbei auf der Verwaltung räumlicher, zeitlicher und raumzeitlicher Daten.

2 KONZEPT FÜR EIN MONITORING BERGBAUBEDINGTER UMWELTEINWIRKUNGEN

Der Begriff Monitoring wird häufig mit dem Begriff der Dauerbeobachtung gleichgesetzt, beinhaltet aber im Rahmen eines Monitorings bergbaulicher Umweltveränderungen weit mehr als die Messung und Beobachtung ausgewählter Umweltparameter.

Das Monitoring bergbaulicher Umwelteinwirkungen beinhaltet laut Monitoringkonzept für den Bereich „Kirchheller Heide / Hünxer Wald“ [Bezirksregierung Arnsberg, 2002] insbesondere

die Überprüfung der Auswirkungsprognose anhand der tatsächlich beobachtbaren Veränderungen,

die Verifizierung und Entscheidung der Notwendigkeit vorgeschlagener Maßnahmen und

die Erfolgskontrolle durchgeführter gegensteuernder und kompensatorischer Maßnahmen.

Die im Land Nordrhein-Westfalen hierzu entstandene Organisationsstruktur besteht derzeit im Wesentlichen aus einer Entscheidungsgruppe, der alle vom Abbauvorhaben betroffenen Stellen gleichberechtigt angehören und weiteren Arbeitsgruppen, welche die erforderlichen Fachbeiträge zu bestimmten thematischen Arbeitsfeldern (siehe Abb. 1) erbringen. Die Deutsche Steinkohle AG als Träger des Vorhabens wurde auf der Grundlage verschiedener Genehmigungsvorbehalte (§ 74 Abs. 3 Satz 1 VwVfG) in diesem Rahmen verpflichtet die notwendigen Entscheidungsgrundlagen zu erarbeiten (z. B. Erstellung des jährlichen wasserwirtschaftlicher Bericht mit Integration eines gewässerökologischem Berichtes, alle zwei Jahre, sowie dem sog. „Fachbeitrag Abbaueinwirkungen auf Natur und Landschaft“, ebenfalls alle zwei Jahre). Die erforderlichen Rechtsfolgen (z.B. Kompensationsmaßnahmen) werden als Nachtragsbeschlüsse zur Rahmenbetriebsplanzulassung angeordnet.

Aufgrund der inhaltlichen Schwerpunktsetzung des Monitorings auf die senkungsbedingten Umwelteinwirkungen ergeben sich am Beispiel des Monitorings Kirchheller Heide / Hünxer Wald (Bergwerk Prosper-Haniel) die in Abb. 1 dargestellten thematische Arbeitsfelder und Bearbeitungsschritte.

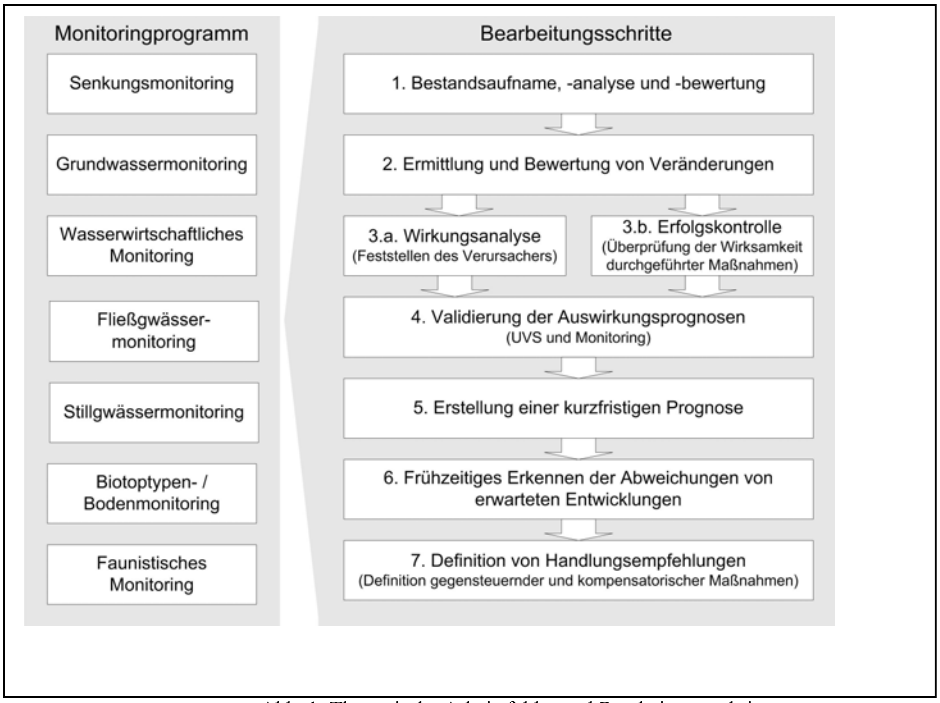

Abb. 1: Thematische Arbeitsfelder und Bearbeitungsschritte

Die Methodik zur Erfassung, Beschreibung und Bewertung des Zustandes der Umwelt orientiert sich eng am Untersuchungsrahmen der UVP. In Abhängigkeit von der Dynamik der Umweltveränderungen wurden i. d. R. ein- bis zweijährliche Untersuchungen festgelegt. Die Dauer der Untersuchungsprogramme beträgt analog zu den Laufzeiten der Rahmenbetriebspläne ca. 20 Jahre. Darüber hinaus ist neben der Ermittlung, Beschreibung und Bewertung der Umweltveränderungen, eine Validierung der Prognosen anhand der festgestellten Zustände und Veränderungen, sowie eine frühzeitige Detektion von Zielabweichungen vorgesehen.

Am Beispiel des „Biotoptypen- / Bodenmonitoring“ für den Bereich „Kirchheller Heide / Hünxer Wald“ bedeutet dies alle zwei Jahre die Durchführung folgender Arbeiten:

Erfassung von Beobachtungsdaten (Bodenfeuchte, Nährstoffversorgung, Basenversorgung, Sauerstoffversorgung) durch Bodenuntersuchungen und Vegetationsaufnahmen an:

- ca. 75 Dauerbeobachtungsflächen,
- ca. 6 Kontrollflächen, die keinesfalls von Senkungsauswirkungen betroffen sind und
- ca. 4 Vergleichsflächen, die heute schon von Senkungsauswirkungen betroffen sind,

Erfassung der Standorteinheiten und Bildung der integrierten Ökoschlüssel [Dahmen, 1994],

Erfassung und Bewertung der Biotoptypen in 22 prognostizierten Auswirkungsbereichen nach [ARGE Eingriffsregelung, 1995],

Ermittlung der Veränderungen der integrierten Ökoschlüssel und des Biotoptypenbestandes,

Bewertung der Biotoptypenveränderungen, d.h. der Beeinträchtigungen und Verbesserungen von Natur und Landschaft,

Erfolgskontrolle, d.h. die Überprüfung der Wirksamkeit durchgeführter Vermeidungs-, Ausgleichs- und Ersatzmaßnahmen,

Prognose der Standorteinheiten, Biotoptypen bzw. Betroffenheitsgrade [Keltschebach & Nesselhauf, 1998],

Validierung der Biotoptypenprognose anhand festgestellter Ist-Zustände und

Aufzeigen von Handlungsempfehlungen für gegensteuernde und kompensatorische Maßnahmen.

Aufgrund der Untersuchungshäufigkeiten, der erforderlichen Bearbeitungszeiten und der Vorgaben zur Veränderungsanalyse sind zeitliche Verschiebungen der Betrachtungszeiträume notwendig, wobei insbesondere auf die zwei bis vier Jahre zurückblickende Bilanzierung der festgestellten Auswirkungen und damit die sehr späte Festsetzung der erforderlichen Kompensationsmaßnahmen hinzuweisen ist (vgl. Abb. 2).

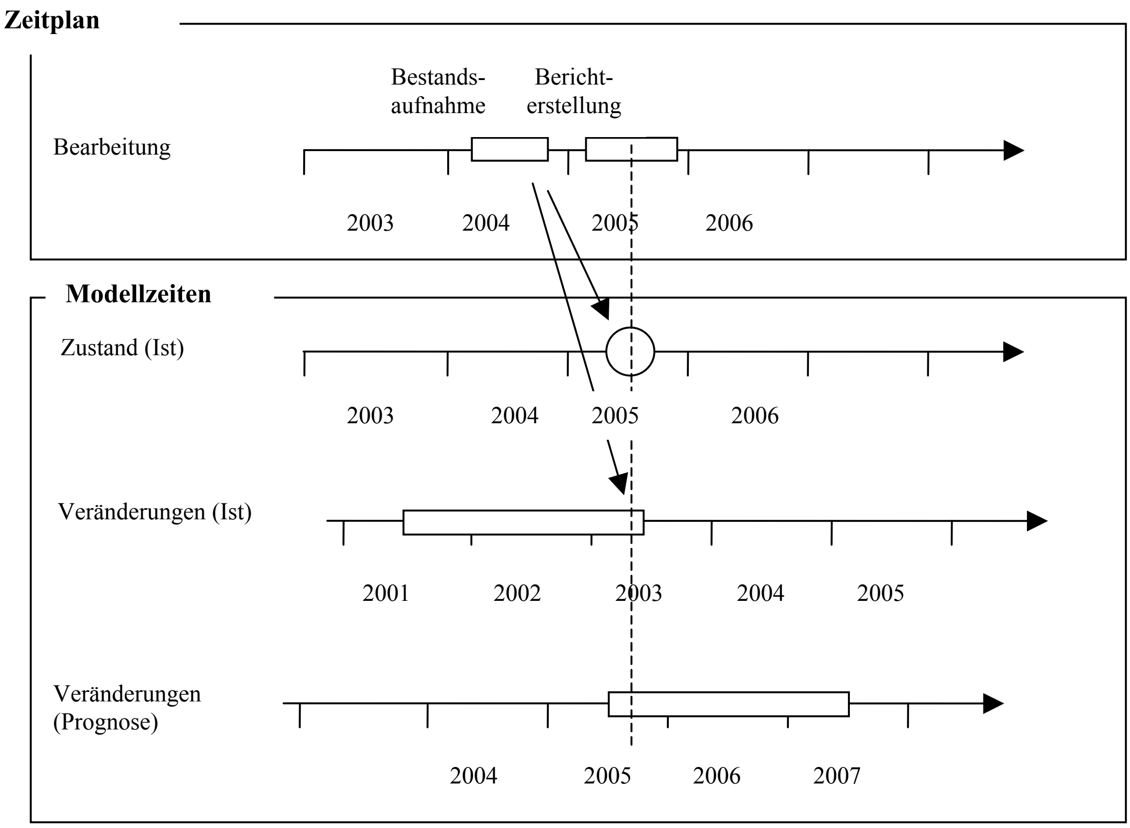

Abb.2: Zeitliche Verschiebung zwischen Prognose und Bilanzierung von Auswirkun-gen dargestellt für den Monitoringzeitschnitt 2005 (aus: ILS 2003, verändert)

3 FACHSPEZIFISCHE ANFORDERUNGEN AN EIN GIS

Aufgrund der Komplexität der Aufgabenstellung und der enormen Datenmengen kann das dargestellte Monitoring bergbaubedingter Umwelteinwirkungen nicht ohne EDV-Unterstützung durchgeführt werden. Der erfolgreiche Einsatz von Geoinformationssystemen (GIS) für räumliche Anwendungen und speziell für ein Umweltmonitoring konnte in den letzten Jahren in verschiedenen Projekten nachgewiesen werden.

Die konkreten Anforderungen an ein GIS wurden in diesem speziellen Fall auf der Grundlage einer durchgeführten Anforderungsanalyse ermittelt. Die wesentlichen Anforderungen ergeben sich aus der Speicherung der anfallenden Daten, sowie den räumlichen, zeitlichen und raumzeitlichen Analysen der Objekte.

Beispielhaft werden einige Fallgruppen im Rahmen einer Veränderungsanalyse im Monitoring bergbaulicher Umwelteinwirkungen dargestellt, die durch GIS-Analysen unterstützt werden:

Ermittlung und Bewertung von Veränderungen der bergbaulichen Einwirkungen und der Umwelt durch den Vergleich von eingetretenen Zuständen mit früheren eingetretenen Zuständen,

Frühzeitiges Erkennen der Abweichungen von erwarteten Entwicklungen durch

- Vergleich von Zustandsprognosen,
- Vergleich von Veränderungsprognosen,
- Vergleich von Zuständen mit Zustandsprognosen zukünftiger Zeitpunkte,
- Vergleich von Veränderungen mit Veränderungsprognosen zukünftiger Zeiträume,

Validierung von Prognosen durch

- Vergleich von Zuständen mit Zustandsprognosen derselben Zeitpunkte,
- Vergleich von Veränderungen mit Veränderungsprognosen desselben Zeitraumes.

4 AUFBAU EINES GIS ZUR UNTERSTÜTZUNG DES MONITORINGS

Ein Schwerpunkt beim Einsatz eines GIS zur Unterstützung des Monitorings bergbaulicher Umwelteinwirkungen ist die Integration der Zeit als zusätzliche Dimension. Weitere Schwerpunkte ergeben sich aus den fachspezifischen Anforderungen zur Bewertung, Analyse und Prognose von Zuständen und Veränderungen.

4.1 Persistente Speicherung räumlicher, zeitlicher und raumzeitlicher Objekte

Fragestellungen der Astronomie und der Quantenphysik benötigen unter Umständen integrierte Raum-Zeit-Modelle. Im Gegensatz dazu ist die Aufspaltung von Raum und Zeit für Fragestellungen, wie sie in diesem Beitrag behandelt werden, sinnvoll und notwendig.

Ist die Modellierung des Raumes, als Grundlage für eine Unterstützung menschlicher Planungen und Handlungen, wie auch die Integration raumbezogener Objekte in Informationssysteme, hinreichend in der Fachliteratur beschrieben (z.B. [Bartelme, 2000], [Worboys, 1995]), so wird die Zeit als weitere Dimension häufig vernachlässigt. Die Integration temporaler Konzepte ist für ein Monitoring allerdings als elementar anzusehen. Im Folgenden sollen kurz bekannte Ansätze zur Integration von Zeit in Informationssystemen dargestellt werden.

Zeit in Temporalen Datenbanken

Mit der Integration temporaler Konzepte in relationale, objektrelationale oder objektorientierte Datenbanken beschäftigen sich seit nunmehr knapp 20 Jahren verschiedene Forschungsprojekte. Eine umfangreiche Integration dieser Konzepte in kommerzielle Standard-Datenbanksysteme lässt aber weiter auf sich warten.

Der Zeitaspekt kann sich auf die Weltzeit, die Datenbankzeit oder eine andere benutzerdefinierte Zeit beziehen. Die Weltzeit beschreibt das Auftreten eines Ereignisses oder die Gültigkeit eines Zustandes im Modell der Realität, während die Datenbankzeit Bezug nimmt auf die Zeit, wann ein Objekt in der Datenbank gespeichert, verändert oder entfernt wurde. Weltzeit und Datenbankzeit können als orthogonal zueinander modelliert werden.

Eine Klassifizierung temporaler Datenbanksysteme über die Implementierung der Weltzeit und / oder Datenbankzeit ergibt sich nach [Ott, 2000] wie folgt:

- Statische Datenbanken berücksichtigen keine Weltzeit und keine Datenbankzeit,
- Historische Datenbanken berücksichtigen die Weltzeit,
- Rollback Datenbanken berücksichtigen die Datenbankzeit und
- Bitemporale Datenbanken berücksichtigen sowohl die Weltzeit, als auch die Datenbankzeit.

Um den Bezug zwischen den Objekten und der Zeitdimension herstellen zu können, werden Zeitstempel verwendet. Ein Zeitstempel kann aus einem Zeitpunkt oder einem Zeitintervall bestehen und der Weltzeit, Datenbankzeit oder einer nutzerdefinierten Zeit zugeordnet sein.

Die Integration temporaler Konzepte erfordert allerdings weit mehr, als die Implementierung temporaler Datentypen. Zusätzlich muss die Semantik der Datenbank- und Weltzeit dem Datenbanksystem bekannt gemacht werden. Zur Implementierung der Datenbankzeit wird das zugrunde liegende Datenmodell dahingehend erweitert, dass „alte“ Objektversionen nicht durch „neue“ Zustände überschrieben, sondern weiter vorgehalten werden und dem Nutzer weiterhin zur Verfügung stehen.

Zeit in Engineering Datenbanken

[Katz, 1990] stellt fest, dass für konstruktive Tätigkeiten wie z.B. im Bereich der Planung oder auch des Softwareengineerings [Westfechtel, ??], die dargestellten Konzepte temporaler Datenbanken zu kurz greifen. Versionen sind weit mehr als Daten, die sich im Laufe der Zeit ändern und über Zeitstempel strukturiert werden können.

Versionsmodelle werden eingesetzt, die eine Erweiterung der Datenmodelle, wie z. B. des relationalen Datenmodells, darstellen und es ermöglichen, komplexe Vorgehensmodelle zu integrieren.

Grundelement der Versionsmodelle ist das komplexe Objekte, das sich aus verschiedenen anderen komplexen und / oder simplen Objekten zusammensetzt (=> Aggregation oder is-part-of-Beziehung). Am Beispiel des Monitorings (siehe Abb. 3) könnte ein komplexes Objekt Monitoring definiert werden, dass wiederum die komplexen Objekte Erdoberfläche, Grundwasser usw. aggregiert. Es besteht die Möglichkeit sehr umfangreiche Hierarchien festzulegen (=> Komponenten-Hierarchie). Die Komponenten-Hierarchie berücksichtigt u. a., dass komplexe Aufgaben in immer kleinere Aufgaben unterteilt und zu verschiedenen Zeitpunkten bearbeitet werden können, letztendlich aber doch im Zusammenhang gesehen werden müssen.

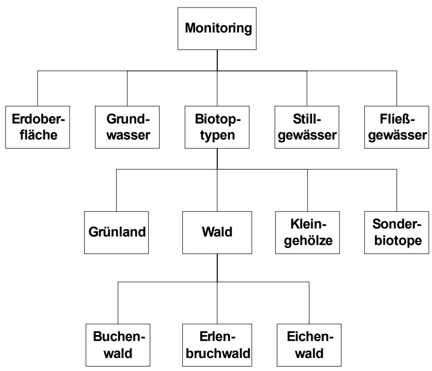

Abb. 3: Komponenten Hierarchie eines komplexen Objekts

Eine Version im Sinne der Versionsmodelle ist demnach eine Zustandsbeschreibung eines komplexen oder simplen Objektes zu einem bestimmten Zeitpunkt. Der Zeitpunkt zur Erzeugung einer Version kann, anders als bei den temporalen Datenbanken, vom

Anwender explizit gewählt werden. Eine Version wird über den Versionsnamen direkt angesprochen und es besteht die Möglichkeit, jeder Version einen Bearbeitungsstatus und entsprechende Zugriffsrechte zuzuordnen.

Ein weiterer Grundgedanke der Versionsmodelle ist die Integration der Versions-Historie. Die Zeit wird hierbei über eine Versionsnummer oder über einen Zeitstempel berücksichtigt.

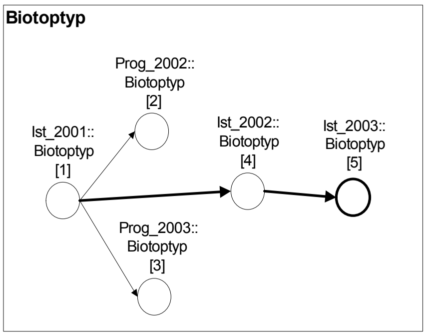

Abb. 4: Versionshistorie eines komplexen Objektes

In der Abb. X existiert ein Ausgangszustand Ist_2001::Biotoptyp[1] (Ist_2001 = Versionsnamen; Biotoptyp = Objektklasse; [1] = Versionsnummer). Prog_2002::Biotoptyp[2], Prog_2003::Biotoptyp[3] und Ist_2002::Biotoptyp[4] haben jeweils als Vorgänger Ist_2001::Biotoptyp[1] und der Vorgänger ist dem Nachfolger bekannt. Zur Erzeugung eines Nachfolgers können Regeln definiert werden, z.B. ob der Versionszustand des Vorgängers an den Nachfolger vererbt werden soll (=> Vererbung).

Prog_2002::Biotoptyp[2] stellt in diesem Beispiel eine Prognose und somit eine Alternative zu Ist_2002::Biotoptyp[4] dar. Dies ist aus der Versions-Historie auch direkt herzuleiten, da diese beiden Versionen nicht auf der gleichen Verbindungslinie zum Ausgangszustand liegen.

Wird das Konzept der Komponenten-Hierarchie mit dem Konzept der Versionshistorie kombiniert, erhält man die so genannten Konfigurationen. Eine Konfiguration legt den Versionszustand eines komplexen Objektes auf der Grundlage bestimmter Versionen der aggregierten Komponenten fest. Hierbei sind die statische und dynamische Erzeugung dieser Konfigurationen zu unterscheiden. Bei der statischen Konfiguration werden die beteiligten Versionen der Komponenten explizit vom Nutzer festgelegt. Die dynamischen Konfigurationen werden im Gegensatz dazu jedes Mal neu berechnet, sobald sich eine Version einer Komponente ändert (z.B. kann jeweils die aktuellste Version einer Komponente in die Konfiguration übernommen werden).

Das Versionsmanagement stellt u. a. sicher, dass:

- Versionen erzeugt, redigiert und gelöscht werden können,
- die Versionshistorie gespeichert wird und Regeln zur Vererbung eingehalten werden,
- die Konfiguration erzeugt werden kann (statisch oder dynamisch),

Ansatz einer bitemporalen Versionsverwaltung durch Erweiterung der ESRI Geodatabase

Dieser Ansatz versucht die Konzepte bitemporaler Datenbanken mit den Konzepten der Versionsverwaltung zu kombinieren. Die Welt-, Datenbank- und benutzerdefinierte Zeit spielen bei den Engineering Datenbanken keine wesentliche oder zumindest eine eher untergeordnete Rolle. Zeit wird in den meisten vorgeschlagenen Ansätzen zur Versionsmodellierung über die Versionsnummer integriert.

ESRI integriert in der Geodatabase ein Versionsmodell, das hierzu erweitert werden soll. Die Geodatabase unterstützt folgende Konzepte der temporalen Datenbanken und der Versionsmodelle:

- die Datenbankzeit wird berücksichtigt und eingesetzt um Datenmanipulationen zu dokumentieren. Zur Speicherung der Historie der Objektzustände werden ADD- und DELETE-Tabellen eingeführt. Die Zeit der Datenmanipulation (INSERT, UPDATE, DELETE) wird in der STATE-Tabelle gespeichert. Die Weltzeit wird nicht explizit berücksichtigt.
- Es existiert ein komplexes Objekt und das ist die Geodatabase an sich. Es ist nicht möglich eigene komplexe Objekte im Sinne der Versionsmodellierung zu erstellen und zu verwalten.
- Es existiert eine Komponenten-Hierarchie, diese ist allerdings statisch, nicht veränderbar und ergibt sich aus der Geodatabase als einzigem komplexen Objekt und sämtlichen FeatureDatasets, FeatureClasses und ObjectClasses als simplen Objekten (siehe Abb. 5).

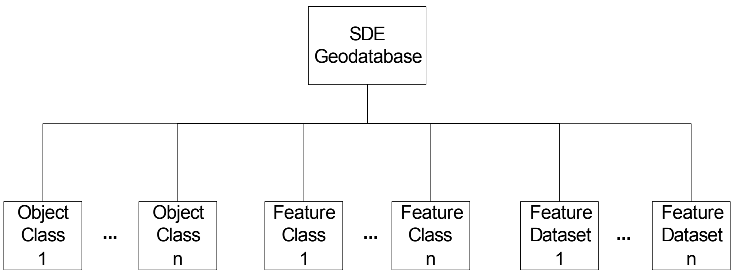

Abb. 5: Komponeten-Hierarchie der ESRI Geodatabase

- Versionen des komplexen Objektes können explizit erstellt und benannt werden. Das komplexe Objekt aggregiert automatisch alle in der Geodatabase vorhandenen simplen Objekte.
- Zugriffsrechte können einer Version zugeordnet werden (public, protected, private),
- Wird eine neue Version erstellt, wird die Beziehung zur Vorgänger-Version gespeichert. Die neue Version erbt den aktuellsten Zustand der Vorgänger-Version. Somit werden die Konzepte Versions-Historie und Vererbung unterstützt.
- Alternativen, wie sie in der Versionsmodellierung vorgesehen sind können mit der Geodatabase realisiert werden.

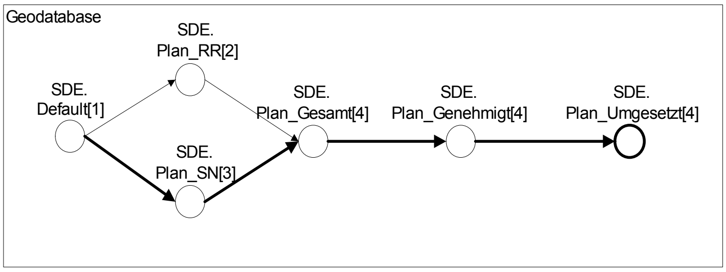

Abb. 6: Versionshistorie der ESRI-Geodatabase

Versionen der simplen Objekte (FeatureDataset, FeatureClass und ObjectClass) werden einer Version des komplexen Objektes (Geodatabase) zugeordnet. Die Version des komplexen Objektes ergibt sich immer aus den aktuellen Zuständen der simplen Objekte, was der automatischen Erstellung einer dynamischen Konfiguration entspricht.

Zur optimalen Unterstützung eines Monitorings bergbaubedingter Umwelteinwirkungen muss das Versionsmodell der Geodatabase erweitert werden. Komplexe und simple Objekte im Sinne der Versionsmodellierung werden um Attribute zur Beschreibung der Gültigkeit dieser Version in der Welt- und Datenbankzeit sowie zur Zuordnung einer konkreten Aufgabe erweitert. Es ist somit sichergestellt, dass eine Version nicht nur über den Namen, sondern auch über die Gültigkeitszeit und über eine Aufgabe selektiert werden kann.

Die Komponenten-Hierarchie des Versionsmodells der Geodatabase wird dynamisch erzeugt. Jedes simple Objekt dass der Datenbank hinzugefügt wird, wird automatisch vom komplexen Objekt aggregiert. Im Monitoring bergbaulicher Umwelteinwirkungen kann es durchaus die Einschränkungen geben, dass bestimmte simple Objekte innerhalb bestimmter Versionen der Geodatabase nicht verändert werden dürfen. Aus diesem Grund, wird eine explizite Erzeugung einer Komponenten-Hierarchie dem ESRI-Versionsmodell hinzugefügt.

Die Konfiguration wird dynamisch berechnet und weist einer Version der Geodatabase immer den aktuellsten Zustand der Versionen der simplen Objekte zu, die in dieser Version bearbeitet wurden. Das ESRI-Versionsmodell wird so erweitert, dass die Zuweisung einer statischen Konfiguration möglich ist. D. h. einer Version der Geodatabase können explizit bestimmte Zustände der simplen Objekte zugeordnet werden, die auch durch weitere Bearbeitungen des Objektes nicht aufgehoben werden. Zur Vererbung eines Zustandes eines komplexen Objektes an den Nachfolger wird allerdings immer der letzte vorhandene Zustand weitergeben.

4.2 Unterstützung räumlicher, zeitlicher und raumzeitlicher Analyse

Die Integration der Zeit als weitere Dimension in ein GIS ermöglicht grundsätzlich die Durchführung räumlicher, thematischer, zeitlicher und raumzeitlicher Analysen. Grundlagen für diese Analysen sind geometrische, topologische, statistische und Mengenmethoden. Zeitliche wie auch raumzeitliche Analysen werden von kommerziellen GIS größtenteils nicht unterstützt. Zur Integration dieser Analysen wurde die Funktionalität von ArcGIS erweitert.

Raumzeitliche Analysen spielen speziell bei der Durchführung der Veränderungsanalyse im Rahmen des Monitorings bergbaulicher Umwelteinwirkungen eine große Rolle. Eine Grundlage weiterführender Bewertungen und komplexerer Analysen sind selektive Abfragen über bestimmte räumliche und zeitliche Ausdehnung, wie z.B.: Selektiere alle Objekte innerhalb einer bestimmten Region zum Zeitpunkt 10.06.2002.

Zur Unterstützung der Veränderungsanalysen ist u. a. wesentlich die Veränderungen eines oder mehrerer Objekte in einem bestimmten Zeitraum zu betrachten.

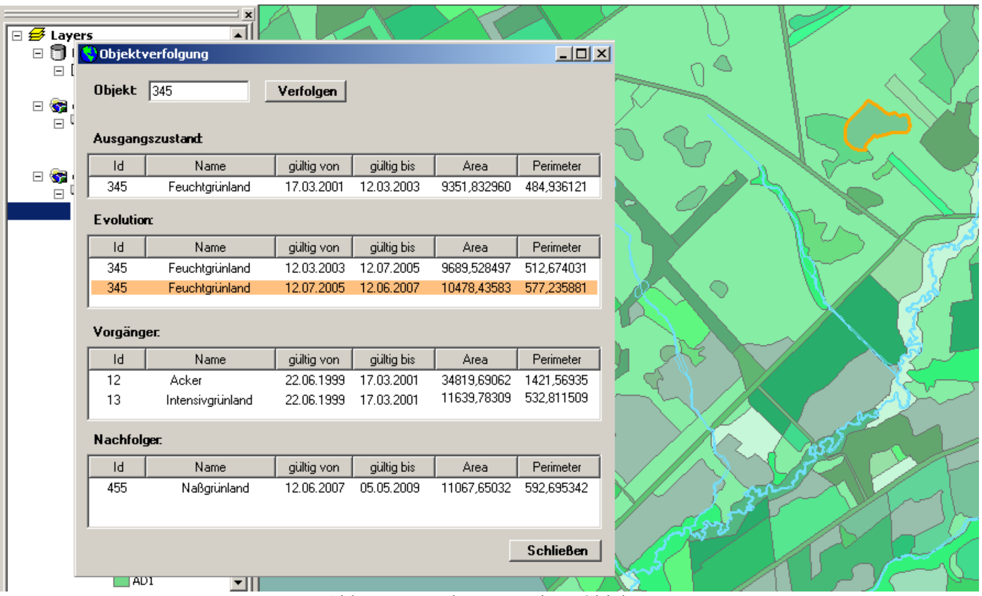

Abb. 7: Veränderungen eines Objektes

Die Interpolation sowohl räumlicher als auch thematischer Eigenschaften zwischen zwei Erfassungszeitpunkten ist im Monitoring bergbaubedingter Umwelteinwirkungen nicht von Interesse. Die Zustände der Objekte werden zwischen den Erfassungen als zustandsstabil modelliert.

Prozessanalysen wie auch Simulationen können eingesetzt werden zur Analyse geplanter Maßnahmen zur Vermeidung bzw. Verminderung von Beeinträchtigungen durch das Vorhaben. Diese Analysen dienen zur Definition von Handlungsempfehlungen für gegensteuernde Maßnahmen.

5 ZUSAMMENFASSUNG UND FAZIT

In diesem Bericht werden die Ziele des Monitorings bergbaulicher Umwelteinwirkungen kurz vorgestellt. Aufbauend auf diesen Zielen werden Bearbeitungsschritte bei der Durchführung einzelner thematischer Arbeitsfelder im Rahmen des Monitorings durch den Vorhabensträgers definiert und beispielhaft für das Boden- / Biotoptypenmonitoring „Kirchheller Heide / Hünxer Wald" dargstellt.

Aufgrund der enormen Datenmengen und der komplexen durchzuführenden fachspezifischen Analysen kann das Monitoring bergbaubedingter Umwelteinwirkungen nicht ohne EDV-Unterstützung durchgeführt werden. Fachspezifische Anforderungen bezogen auf die Veränderungsanalyse als einer wesentlichen Aufgabe des Monitorings werden beispielhaft genannt.

Temporale Aspekte spielen bei jedem Monitoring eine entscheidende Rolle. Zeit als zusätzliche Dimension ist trotz vielfältiger erfolgreicher Forschungsprojekte jedoch weder in kommerzielle Datenbanksysteme noch in Geoinformationssysteme ausreichend integriert. Es werden die Konzepte der temporalen Datenbanken und der Versionsmodelle erläutert und die Kombination dieser Ansätze als Grundlage für die Verwaltung räumlicher, zeitlicher und raumzeitlicher Daten vorgeschlagen. Zur Umsetzung dieses Ansatzes wird das Versionsmodell zur Geodatabase der Firma ESRI erweitert. Die erweiterte Geodatabase wurde im Rahmen eines von der Deutschen Steinkohle AG geförderten Forschungs- und Entwicklungsprojektes entwickelt. Der Test dieses Ansatzes wird Aufgabe der nächsten Monate sein.

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Darstellung von Zeitreihen räumlicher Daten mittels WebMapping

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1 EINLEITUNG

WebMapping-Anwendungen zur Darstellung räumlicher oder räumlich-zeitlicher Informationen, die über das Medium Internet potenziellen Nutzern zur weiteren Bestimmung zur Verfügung gestellt werden können, sind durch Größe und Auflösung des Visualisierungsmediums (Bildschirm o.ä.) eingeschränkt. Daher setzt WebMapping verstärkt bildhafte, interaktive, animierte und verlinkte Elemente ein. In der folgenden Abhandlung wird untersucht, inwieweit WebMapping die Anforderungen einer verständlichen Vermittlung räumlich-zeitlicher Informationen erfüllen kann. Dazu werden zuerst die technischen Voraussetzungen und Standards, aktuelle Forschungsprojekte und konkrete Anwendungsmöglichkeiten von WebMapping in der Raumplanung dargestellt. Anschließend wird die am Institut für Stadt- und Regionalforschung der TU Wien erstellte Beispielapplikation AniMap, die vorwiegend auf freier Software basiert, anhand zweier Beispiele vorgestellt.

2 WEBMAPPING

Die Visualisierung von Daten mittels Kartenwerken ist eine bedeutende Möglichkeit, räumliche Phänomene kognitiv zu erfassen. In Geographischen Informationssystemen (GIS) können räumliche Gebietseinheiten und Attributinformationen nach räumlicher Ausbreitung, Verknüpfungen und Trends analysiert und veranschaulicht werden. Die explosionsartige Entwicklung von Internettechnologien in den letzten Jahren hat erweiterte Möglichkeiten für die GIS-Applikationen, u.a. WebMapping geschaffen.

Im wesentlichen basiert WebMapping auf drei Komponenten: der Information, der Geographie und dem Web:

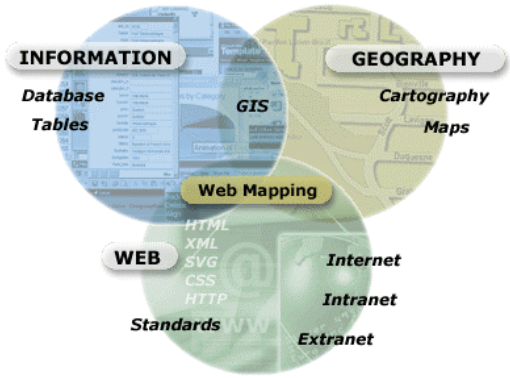

Abb.1: Schematische Darstellung der WebMapping Elemente (Quelle: DBx GEOMATICS, 2003)

In einem GIS werden geographische Daten effizient erfasst, sofort am Bildschirm visualisiert und in Form von gedruckten Karten ausgegeben. Dies kann mit kombinierbaren Inhalten für gewünschte Ausschnitte in unterschiedlichen Maßstäben erfolgen. Bei der Veröffentlichung von Karten aus einem GIS im Internet entstehen unter Umständen schlecht les- bzw. interpretierbare Karten, wenn Inhalt und Symbolik nicht an die Besonderheiten der Bildschirmdarstellung (geringere Auflösung, beschränkte Darstellungsfläche) angepasst werden.

Die Outputs eines GIS (Kartenwerke) können für den WebMapping-Einsatz über einen Mapserver verwaltet werden. Dieser erzeugt Images (für gewöhnlich in einem gängigen Grafikformat, z.B. gif oder jpeg) für einen gewählten Ausschnitt in einem bestimmten Maßstab. Diese Images werden sodann an einen Webbrowser gesendet, wo der Benutzer etwa einen vergrößerten Ausschnitt der Karte durch Anwählen der Schaltfläche „zoom in“ erhalten kann. Dies führt dazu, dass der Befehl „Neu zeichnen“ des entsprechenden Kartenausschnittes im entsprechenden Maßstab [„redraw“] am Server ausgeführt und ein neues Image an den Webbrowser geschickt wird. Eine Alternative dazu sind Appliktionen, für die der Benutzer Applikationen, PlugIns oder Java-Applets am Browser installieren muss. So kann ein Teil der interaktiven Funktionalität (z.B. Zoom-Funktionen) direkt am Client, also im Browser, ausgeführt werden. Damit verringert sich der Datenstrom zwischen Server und Client und die Ladezeiten werden verkürzt. Mit solchen Lösungen sind der kartographischen Interaktivität fast keine Grenzen mehr gesetzt.

Folgende Faktoren beeinflussen die Attraktivität einer WebMap hinsichtlich Multimedia positiv (nach SPIESS, 1996):

- Interaktion in Bezug auf Navigation, Attributabfragen von Objekten, Suchfunktionen, Wahl des thematischen Inhalts, Symbolisierung
- Animation
- Leicht erkennmare Links mit thematisch korrekter Verknüpfung
- Schneller Download und schneller Bildaufbau

2.1 Kommerzielle Lösungen und Forschungsprojekte

WebMapping hat in den letzten Jahren in der Kartographie und zur Darstellung raumbezogener Daten und Informationen stark Einzug genommen. In der Folge werden ein paar Beispiele von aktuellen Projekten aufgezeigt.

2.1.1 Rastergrafik vs. Vektorgrafik

Bislang dominierten Mapserver-basierte Applikationen mit Rastergrafik-Formaten das WebMapping. Im Gegensatz dazu besteht eine Vektorgrafik aus mathematischen Operationen, die eine Karte definieren. Als Grundelemente dienen dabei Punkte, Linien und Flächen. Dies ist die Basis zur Skalierung der Darstellungen ohne Qualitätsverluste – eine Voraussetzung für Echtzeit-Zoom-Funktionen und Animationen.

Die Grenzen der kartographischen Aufbereitung bei Rasterkarten werden schnell erreicht, denn mehr Alternativen als eine Rasterung der Karte und eine Ausstattung der angezeigten Images mit anklickbaren Bereichen (sog. ImageMaps) sind nicht umsetzbar. Das Beispiel "Stationen österreichischer Juden in Wien" (CARTO:NET, 2003a), welches den UMN Mapserver (http://mapserver.gis.umn.edu/) verwendet, zeigt Adressen in einem Stadtplan an. In einer Übersichtskarte wird ein Ausschnitt gewählt und die Hauptkarte auf diesen zentriert, wobei die einzelnen Raster dabei rastergrafikbedingt immer die selbe Zoomstufe haben. Zusätzlich sind ein Drop-Down-Menü zur Auswahl der Adressen und ein Textbereich für Zusatzinformation angeordnet.

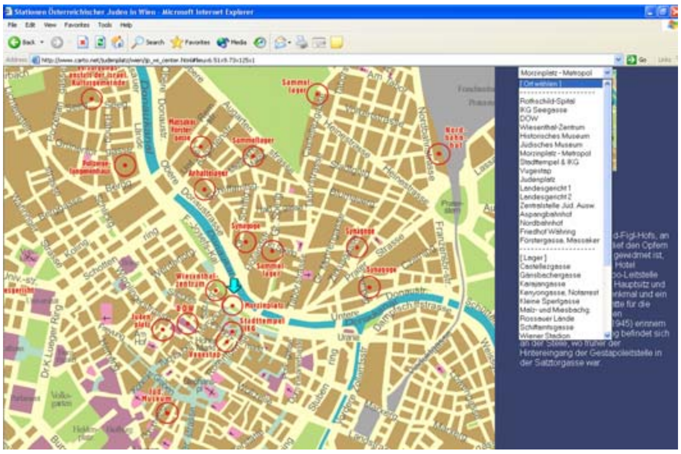

Abb. 2: Stationen österreichischer Juden in Wien (Quelle: CARTO:NET, 2003a)

Folgendes Beispiel zur Migration zwischen den europäischen Staaten und der Schweiz (Joray, 2001) ist vektorbasiert und benötigt am Client den SVG-Viewer von Adobe (http://www.adobe.com/svg). Zu dem Karteninhalt der internationalen Wanderung können Variablen, Klassen und Optionen definiert werden, um die Darstellung den Wünschen des Benutzers anzupassen. Demnach kann zwischen Immigration und Emigration sowie Männern und Frauen unterschieden, variable Klasseneinteilung vorgenommen und eine animierte Darstellung der Informationen zu definierten Zeiträumen gewählt werden. Durch die Auswahl einer Schweizer Teilregion (in der Hauptkarte) oder eines europäischen Staates (in der Übersichtskarte) wird in beiden Karten die Information gemäß dieser Benutzer-Auswahl angezeigt.

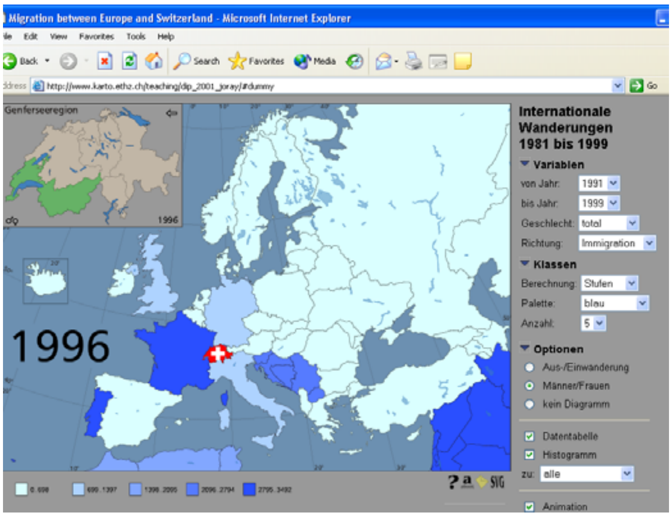

Abb. 3: Migration zwischen Europa und der Schweiz (Quelle: Joray, 2001)

2.1.2 Kartodiagramme

Im OECD-Atlas Europa (CARTO:NET, 2003b) kann der Benutzer die Darstellungsart der Europakarte angeben – zur Auswahl stehen Landesgrenzen, Fließgewässer und Relief. Die landesspezifischen Kreissektorendiagramme zu wirtschaftlichen (z.B.

Beschäftigte, BIP), demographischen (z.B. Bevölkerung) oder geographischen (z.B. Länderinformationen) Themen werden SVG-basiert mittels JavaScript direkt aus den Ursprungsdaten dynamisch generiert.

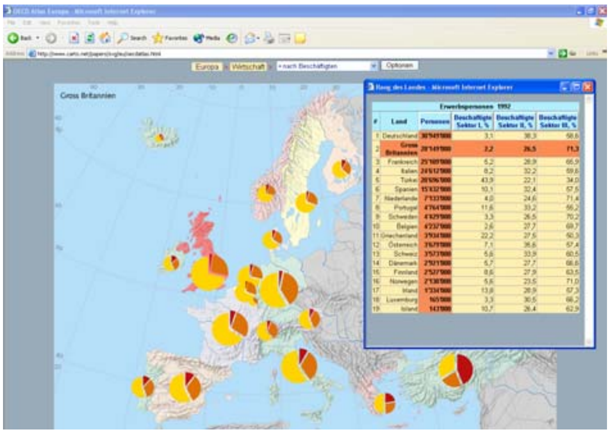

Abb. 4: OECD Atlas Europa, Beschäftigte nach Sektoren (Quelle: CARTO:NET, 2003b)

2.1.3 Animierte Darstellung

Der AirportMonitor des John Wayne Flughafens in Los Angeles (PASSUR, 2003) wurde von der Firma Passur zur Visualisierung des Flugverkehrs (abgehende und ankommende Flugzeuge) entwickelt. Der Benutzer hat jedoch nur die Möglichkeit, Einstellungen wie Datum, Uhrzeit, diverse Fluginformationen und v.a. den Maßstab vorzunehmen.

Abb.5: Airport Monitor des John Wayne Airports in Los Angeles (Quelle: PASSUR, 2003)

2.2 OpenSource und offene Standards

Hoch qualitative Web-Kartographie wird durch standardisierte Vektorgrafik-Formate stark begünstigt. Mit deren Hilfe können Interaktionen, Analysen und grafische Outputs strukturiert und integriert werden. Die Qualität der grafischen Wiedergabe wird gegenüber rasterbasierten Darstellungen wesentlich erhöht. SVG – Scalable Vector Graphics – ist der derzeit für WebMapping am häufigsten eingesetzte Standard, der die Integration von Vektorgrafiken in Websites ermöglicht. SVG wird seit 1999 als vollständig offener Standard vom W3C (World Wide Web Consortium) entwickelt und für WebMapping empfohlen (W3C, 2003). SVG ist eine standardisierte, in XML formulierte Sprache zur Beschreibung von 2D-Grafik mittels Vektoren, Text und Raster-Images.

XML – Extensible Markup Language – ist der universelle Standard für netzwerktransparente und plattformunabhängige, strukturierte Dokumente für das Internet und darüber hinaus für den Austausch von Daten zwischen Applikationen aller Art. Als Metasprache ist XML die Basis für konkrete Andwendungen, wie z.B. SVG. SVG bietet zur Interaktivität mehrere Events (Erkennen von durch den Benutzer verursachten Ereignissen wie onMouseOver, onClick oder onKeypress) an, die analog der traditionellen HTML Elemente implementiert werden können. (A. NEUMANN, A. M. WINTER, 2003)

Weitere verbreitete Standards, die auch weiterentwickelt werden, sind Macromedia Flash, WebCGM und VRML.

Flash ist der de-facto Standard für Vektordarstellung und hat sich über die Verbreitung in der Werbe- und Multimediabranche durchgesetzt. Flash bietet eine breite Palette von Funktionen zur Animation, Einbindung audio-visueller Effekte, sowie von Filmen an. Da es sich dabei jedoch um ein proprietäres, binäres Format handelt, steht es im Konflikt zur OpenSource-Idee.

WebCGM ist eine webbasierte Version des ISO Standards Computer Graphic Metafile (CGM), eine W3C Empfehlung und ist primär für die Darstellung von technischen und wissenschaftlichen Zeichnungen anzuwenden.

VRML – Virtual Reality Modeling Language – kann sowohl für 3D als auch für 2D Darstellungen eingesetzt werden. Dieser Standard wird zur Zeit umstrukturiert.

3 TEMPORAL GIS UND GIS-ANIMATION

Von Attributdaten spricht man, wenn Entitäten durch Beschreibung ihrer Eigenschaften charakterisiert werden. Wenn Entitäten raumbezogene Eigenschaften (z.B. Koordinaten, Fläche, Abstände) besitzen, ist der Einsatz eines GIS zur Analyse und Darstellung sinnvoll. So weit der klassische GIS-Ansatz. Was aber, wenn sich raumbezogene Eigenschaften über die Zeit verändern? Auf jeden Fall ergeben sich neue Erfordernisse an die Datenstruktur, aber auch an die Darstellung.

Temporal GIS ist ein Begriff, mit dem vor allem Anforderungen an die Datenstruktur eines GIS mit zeitlicher Dimension Rechnung getragen werden soll.

GIS-Animation kommt dann zum Einsatz, wenn die Darstellung räumlicher Gegebenheiten eine Zeitdimension erfordert. Im Fall von Temporal GIS ist damit also die Darstellung von Zeitreihen räumlicher Daten gemeint. GIS-Animation ist nicht nur für die Raumplanung, sondern auch für andere Themenbereiche, wie z.B. Archäologie und GPS-Tracking von Bedeutung. Daher haben die für diesen Zweck verfügbaren Software-Werkzeuge auch unterschiedliche Schwerpunkte.

3.1 Kommerzielle Lösungen und Forschungsprojekte

Die Idee des Temporal GIS scheint bei den großen GIS-Herstellern noch nicht allzu weit verbreitet zu sein. Eine Ausnahme bilden hier Tracking-Module, die oft lediglich der Visualisierung, nicht aber der Speicherung von Zeitreihendaten dienen. In welche Richtungen die Lösungen gehen, soll die folgende exemplarische Aufzählung kurz erläutern.

3.1.1 STEMgis

Das unseren Recherchen nach einzige universelle GIS-Werkzeug für GIS-Animation ist die eigenständige Software *STEMgis* (Discovery Software, 2003). Damit kann man Animationen in verschiedenen Formaten erzeugen, unter anderem auch als einfache Web-Applikationen im Scalable Vector Graphics Format (SVG). Weiters ist *STEMgis* voll 3D-fähig. Dieses Produkt ist für den gebotenen Funktionsumfang mit ca. 640 € auch erstaunlich preiswert.

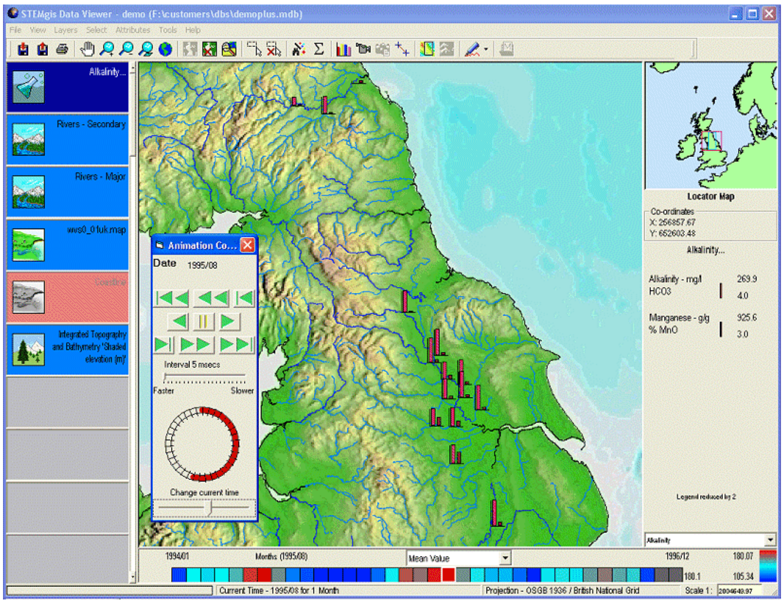

Abb.6: Oberfläche von STEMgis mit Animation Tool (Quelle: Discovery Software, 2003)

3.1.2 ArcView/ArcGIS Tracking Analyst Extension

Primär für diverse Tracking-Anwendungen (z.B. GPS-Flottenmanagement) entwickelt, bietet der *Tracking Analyst* (ESRI, 2000) auch Möglichkeiten der Analyse und Darstellung von Zeitreihen. Animationen sind ebenfalls möglich, jedoch bedarf es zahlreicher Tricks einschließlich Skript-Programmierung, um ähnliche Ergebnisse wie mit STEMgis zu erzielen. WebMapping wird nicht unterstützt. Der Schwerpunkt dieser Extension liegt im Management räumlicher Daten mit Zeitbezug in Echtzeit und nicht in der animierten Darstellung vergangener Zeitreihen.

3.1.3 TimeMap

Das TimeMap-Projekt (TimeMap, 2003) des Archaeological Computing Laboratory der University of Sydney bietet Software-Werkzeuge, die auf ESRI MapObjects aufsetzen und für die Verarbeitung und Darstellung archäologischer Daten konzipiert wurden. Animationen können im Shockwave Flash Format (SWF) exportiert werden. Die Software aus dem TimeMap-Projekt ist für private und universitäre Nutzung kostenlos.

3.2 OpenSource und offene Standards

Im Zuge unserer Recherchen konnten wir keine Software finden, die im Quellcode verfügbar ist und keine kommerziellen GIS-Tools benötigt, um GIS-Animationen zu erstellen.

Was die Speicherung räumlicher Daten mit Zeitbezug betrifft, so gibt es sowohl vom OpenGIS-Konsortium (OGC), als auch in der ISO-Norm ISO/TC211 (ISO 19108) Spezifikationen (Skjellaug und Berre, 1997). Für die Entwicklung eigener Applikationen kann also auf offene Standards zurückgegriffen werden, sofern dies erwünscht ist.

4 ANIMAP – PROOF OF CONCEPT EINER OPEN-SOURCE WEBMAPPING-SOFTWARE

Als Spin-Off der Forschungs- und Lehrtätigkeit des Institutes für Stadt- und Regionalforschung (Kalasek et al., 2002 und Riedl & Hocevar, 2003) entstand das Projekt AniMap (http://www.srf.tuwien.ac.at/animap/), in dem Möglichkeiten der animierten Darstellung räumlich-zeitlicher Informationen mit Hilfe von Open-Source Software und offenenen Standards untersucht werden sollen.

AniMap ist eine Client/Server-Webapplikation mit einem Frontend für die Visualisierung räumlich-zeitlicher Daten und einem Backend für das Einpflegen dieser Daten in das System.

4.1 Aufbau von AniMap

4.1.1 Verwendete Software

Serverseitig wird ein Webserver (z.B. Apache oder Microsoft IIS), die Skriptsparche PHP sowie die Datenbank MySQL verwendet. Am Client wird ein Webbrowser mit dem SVG-Plugin von Adobe in der Version 3.01 (Adobe, 2003) sowie JavaScript benötigt. Zum Aufbau der XML-Struktur der SVG-Dokumente wird am Server die PHP/PEAR-Erweiterung XML_SVG (PEAR, 2003) verwendet. Der Einfachheit halber wird auf eine OGC-konforme Implementierung verzichtet. Das Zusammsnspiel der genannten Komponenten für das Frontend ist in Abbildung 7 dargestellt.

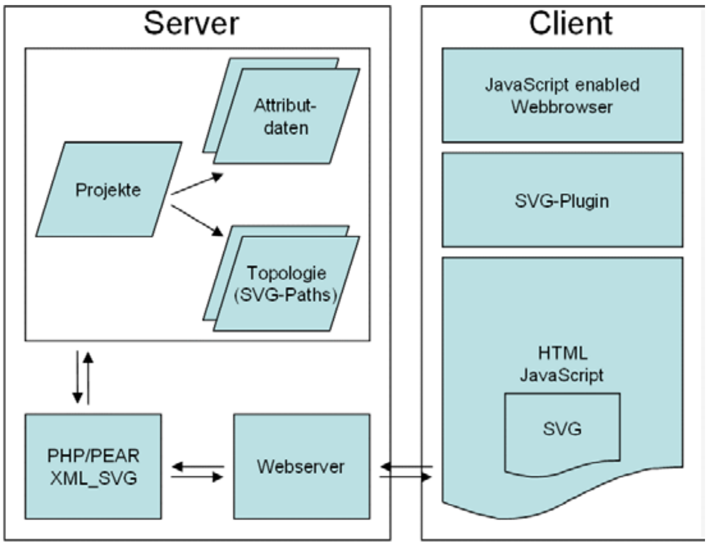

Abb.7: Struktur des AniMap-Frontends

4.1.2 Funktionsweise von AniMap

Das Konzept des AniMap-Frontends besteht darin, aufgrund von Requests der Clients (Web-Browser) on demand animierte Karten zu erzeugen. Dazu werden zur Laufzeit am Server in einer MySQL-Datenbank gespeicherte Topologie- und Attributdaten zu HTML-Seiten mit eingebetteten SVG-Dokumenten verarbeitet. Die Attributdaten werden dabei zu JavaScript-Arrays im HTML-Code. Die Topographiedaten werden um Animationsinformationen ergänzt und in ein SVG-Dokument gepackt. SVG verwendet eine XML-Struktur, deren Erstellung durch die PHP/PEAR-Erweiterung XML_SVG unterstützt wird.

Da die Attributdaten unterschiedlich strukturiert vorliegen können, ist eine Projektdatenbank notwendig, welche Metainformationen zu den Attributen sowie die Layerstruktur der animierten Inhalte enthält. Teil der Metadaten sind SQL-Befehle, die die unterschiedlich vorliegenden Attributdaten zur Laufzeit in eine einheitliche Struktur bringen. Außerdem ist es dadurch möglich, über ein Web-Interface neue Karten in AniMap einzubinden.

Das AniMap-Backend ermöglicht es dem Kartenautor, Kartenprojekte in der Projektdatenbank anzulegen sowie Topographie- und Attributdaten auf den Server zu laden. Die topographischen Informationen (räumliche Gebietseinheiten mit ihren Mittelpunkten) müssen in ein bestimmtes tabellarisches Format (mit eindeutiger ID, SVG-Pfad und X/Y-Mittelpunktkoordinate für jede Gebietseinheit) gebracht werden und können dann über das Backend auf den Server geladen werden. Die räumlich-zeitlichen Attributdaten müssen ebenfalls als Tabellen vorliegen und für jede Gebietseinheit die selbe ID wie die Topographiedaten enthalten. Weiters muss der Kartenautor im Backend die SQL-Befehle angeben, mit denen die Attributtabellen in das von der AniMap-Engine verwendete Format umgewandelt werden. Bei diesem Format handelt es sich um eine Tabelle, die wir „AniMap-Agenda“ nennen. Diese Tabelle entählt die Spalten Gebietseinheits-ID, Zeitpunkt, Attribut und Wert. Somit gibt es für jede Gebietseinheit, jeden Zeitpunkt und jedes Attribut eine Zeile mit dem Wert des Attributes zu diesem Zeitpunkt.

In der folgenden Beschreibung von AniMap wird die Funktionalität des Frontends beschrieben. Ein typischer Aufruf einer AniMap-Animation hat den in Abbildung 8 dargestellten Ablauf:

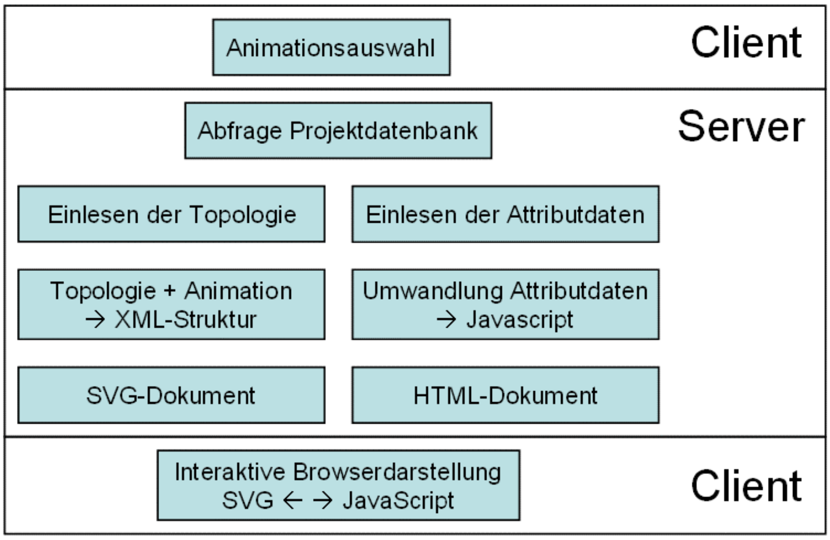

Abb.8: Prozesse beim Aufruf einer AniMap-Animation

4.2 Benützung von AniMap anhand zweier Beispieldatensätze

Im folgenden Abschnitt werden die Features von AniMap anhand einer Benützungsanleitung für zwei Beispieldatensätze erläutert:

- Reale Ausdehnung der Stadt Wien in den letzten 100 Jahren
- Bevölkerungsentwicklung der Stadt Wien in den letzten 40 Jahren.

Nach Einstieg in die Applikation kann der Benutzer ein Kartenthema und eine Darstellungsart auswählen. Diese Seite (siehe Abb. 9).wird dynamsich aus der Projektdatenbank generiert und bietet eine Auswahl der vorhandenen Kartenthemen und ihrer unterschiedlichen Darstellungsarten.

Abb.9: AniMap Kartenauswahl

Zur Visualisierung der Datensätze gelangt man über die Themenauswahl. Wenn es für ein Thema (z.B. die reale Ausdehnung der Stadt Wien) nur eine einzige Darstellungsmöglichkeit gibt, wird das Beispiel sofort angezeigt. Kann der Benutzer jedoch aus verschiedenen Darstellungsarten wählen (z.B. für das Thema - Bevölkerungsentwicklung der Stadt Wien), ist die anzuzeigende Darstellung (Variable) in einem zweiten Schritt aus einem Drop-Down Menü zu selektieren.

Die Art der Animation (Geschwindigkeit des Animationsablaufes und Dauer der Animationsübergänge) wird über die AniMap Navigation (siehe Abb. 10) eingestellt. Eine Übergangsdauer von 0 bewirkt einen sprunghaften, nicht fließenden Übergang zwischen zwei aufeinander folgenden diskreten Zuständen. Mit den Buttons Reset, ◂ (Animation rückwärts), ▸ (Animation vorwärts) und ■ (Animation anhalten) wird die Animation gesteuert. In einer Zeitleiste ist der Zeitpunkt der aktuellen Darstellung ersichtlich.

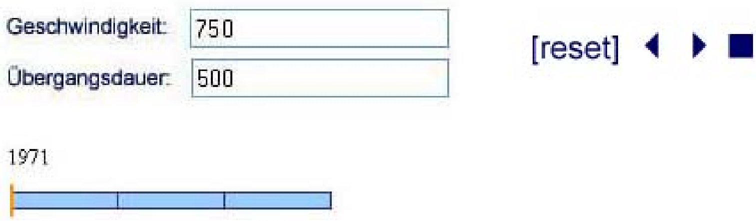

Abb.10: AniMap Navigation

4.2.1 Reale Ausdehnung der Stadt Wien in den letzten 100 Jahren

Für die reale Ausdehnung der Stadt Wien wird als Datengrundlage die nachgewiesene Bautätigkeit an technischen Infrastruktursystemen (Kanalausbau) in den Zählbezirken der Stadt herangezogen. Um die Veränderung der Ausdehnung animiert darzustellen, wird eine flächige Animation verwendet (siehe Abb. 11): rote Flächen visualisieren die nachgewiesene Bautätigkeit, weiße Flächen stellen die Gebietseinheiten von Wien dar, für die bis zum entsprechenden Zeitpunkt noch keine Bautätigkeit nachgewiesen werden konnte.

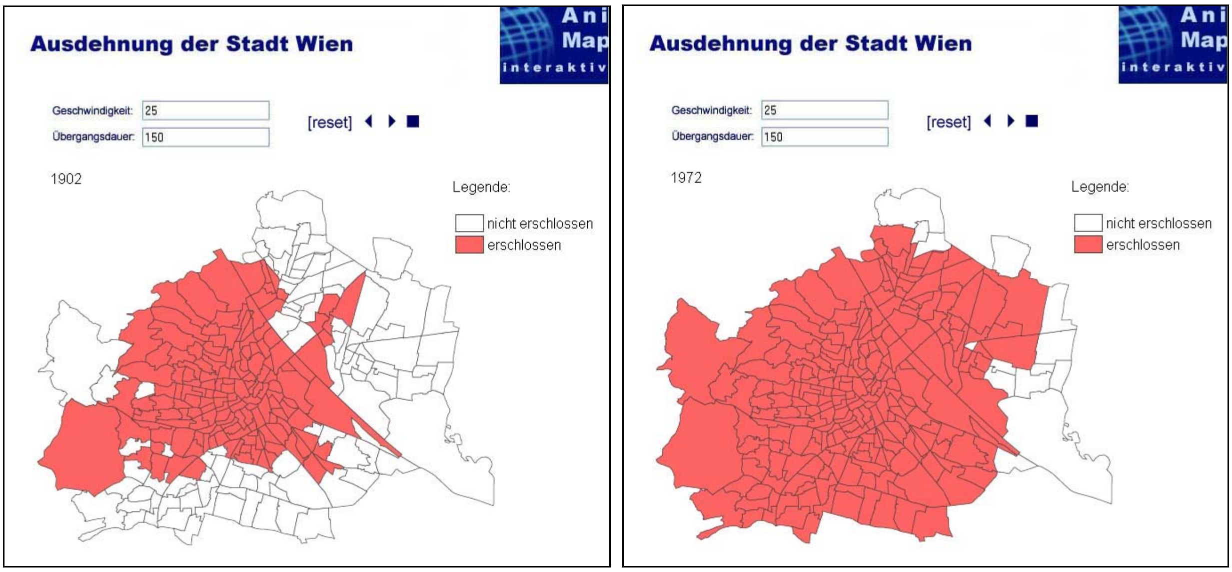

Abb.11: Ausdehnung der Stadt Wien in den Jahren 1902 und 1972 (Animationsübergänge sind erkennbar).

4.2.2 Bevölkerungsentwicklung der Stadt Wien in den letzten 40 Jahren

Die Bevölkerungsentwicklung der Stadt Wien in den letzten 40 Jahren wird anhand der demographischen Daten (Einwohner gegliedert nach den Altersklassen „Kinder“ [0-15 Jahre], „Erwachsene“ [15-60 Jahre] und „Pensionisten“ [über 60 Jährige]) dargestellt. Die Abbildung 12 zeigt zwei Darstellungen zur Altersstruktur Wiens, wobei in der rechten Abbildung auch das Attributabfrage-Feature zu erkennen ist: wenn mit der Maus auf eine Gebietseinheit (hier: 22. Bezirk) geklickt wird, werden die Attributdaten dazu tabellarisch angezeigt.

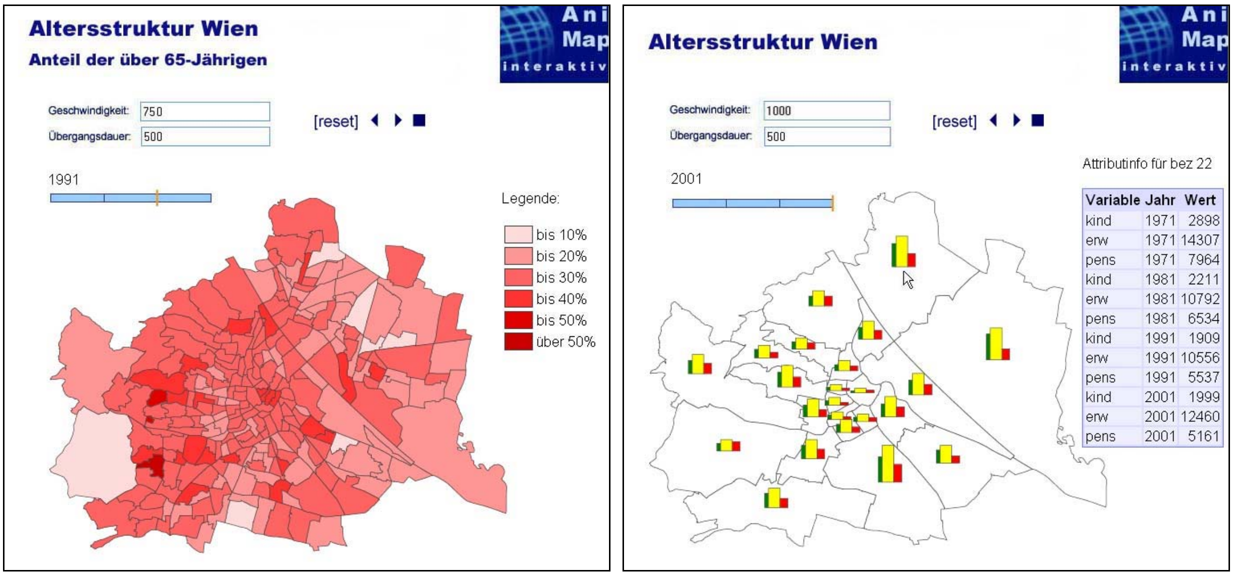

Abb.12: Zwei verschiedene Darstellungen zum Thema « Altersstruktur ».
Links: Choropletendarstellung einer einzelnen Altersklasse. Rechts: Kartodiagramm nach Altersklassen sowie Attribut-Info.

4.3 Stärken und Schwächen der gewählten Lösung

Generell liegt der große Vorteil von interaktiven, animierten Karten und WebMapping-Darstellungen im Verknüpfen von Datensätzen und in der vernetzten Analyse und Interpretation von räumlichen Daten. Karteninhalte können beliebig verknüpft oder überlagert werden, sodass die Karten- und Attributinformation den Benutzern sehr gut verständlich gemacht werden. Dem gegenüber steht der Nachteil, dass der im Vergleich zu großflächigen Papierkarten kleine und niedrig auflösende Darstellungsbereich des Bildschirms oder mobiler Devices den Kartenersteller dazu zwingt, platzsparende und gut erkennbare Kartenelemente einzusetzen.

Die Animation von Veränderungen über die Zeit kann komplizierte kartographische Elemente ersetzen und ist leicht zu verstehen, für eine detaillierte Interpretation ist sie jedoch weniger geeignet.

Mit AniMap können räumlich-zeitliche Daten schnell ins Web gestellt und auf gängige vordefinierte Arten animiert dargestellt werden. Ein Nachteil dabei ist, dass SVG derzeit nur mit dem Internet Explorer richtig funktioniert. Anhand der gewählten Beispiele hat sich gezeigt, dass AniMap zwar ein zweckmäßiges Werkzeug zur webbasierten Bereitstellung und Steuerung kartographischer Animationen ist, eine Animation von räumlich-zeitlichen Daten aber nicht per se der beste Weg ist, um dem Betrachter bestimmte Entwicklungen verständlich zu machen. Dies wurde vor allem bei der Darstellung der Altersklassen als Balkendiagramme deutlich.

Die Frage ist also, wo und wann animierte Karten besser geeignet sind als statische Karten, in denen zeitliche Informationen als Kartensymbole umgesetzt sind (etwa als Balkendiagramme, wo jeder Balken einen Zeitpunkt repräsentiert). Eine Karte mit synchroner Animation zahlreicher Elemente übersteigt rasch die kognitiven Fähigkeiten des Betrachters. Um die Aufmerksamkeit des Betrachters während der Animation auf bestimmte Veränderungen zu lenken, könnten Hervorhebungen und textliche Anmerkungen oder ähnliche Interpretationshilfen verwendet werden. Die Animation wird dadurch aber schnell quasi zu einem Lehrfilm und lässt dem Betrachter nur noch wenig Freiraum für eine eigenständige Interpretation. Am exaktesten, aber auch unübersichtlich, sind räumlich-zeitliche Veränderungen den tabellarischen Grunddaten zu einer Karte zu entnehmen. Die Abfrage von Attributdaten während der Animation bzw. während Animationspausen mittels Mausklick, wie es in AniMap in einfacher Form möglich ist, ist daher eine wichtige Ergänzung zur rein grafischen Animation. Insgesamt kann davon ausgegangen werden, dass durch weitere Tests und Experimente mit AniMap und anderen Applikationen Wege gefunden werden, um animierte Web-Karten zu einem sinnvollen Analysewerkzeug für räumlich-zeitliche Daten zu machen.

5 ZUSAMMENFASSUNG

Die neuen technischen Methoden zur kartographischen Darstellung von Inhalten mittels webbasierten Applikationen (WebMapping) eröffnen zusätzliche Möglichkeiten für die Illustration, Analyse und Interpretation. Aktuelle Anwendungen und Forschungsprojekte zu den Themenbereichen WebMapping, Temporal GIS und GIS Animation sind clientseitig mittels SVG (Scalable Vector Graphics Format) und JavaScript programmiert. Interaktive Features, wie z.B. die Generierung von Tabellen oder Diagrammen zu räumlichen Detailabfragen kommen dabei ebenso zum Einsatz wie die animierte, kartographische Illustration im Verlauf der Zeit. AniMap ist ein Projekt des Instituts für Stadt- und Regionalforschung, das räumliche-zeitliche Informationen mittels Open-Source Software und offenenen Standards (Webserver, PHP, MySQL, Webbrowser, XML_SVG) animiert darstellt. Die Handhabung dieses Produktes wird anhand der konkreten Beispiele – reale Ausdehnung der Stadt Wien in den letzten 100 Jahren und Bevölkerungsentwicklung der Stadt Wien in den letzten 40 Jahren – veranschaulicht.

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Neue Perspektiven in der Fotogrammetrie durch eine innovative großformatige digitale Luftbildkamera

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1 EINLEITUNG

Seit Jahrzehnten sind großformatige Senkrecht-Luftbilder die wichtigste Informationsquelle für die detaillierte Erfassung von Siedlungsgebieten und Landschaftsräumen. Mit den geometrischen Methoden der Fotogrammetrie und einschlägigem thematischen Fachwissen können daraus Karten und Pläne bzw. GIS-Datensätze für die verschiedensten Aufgabenstellungen erstellt werden. Der detaillierte Bildinhalt kann in maßstabsgerechte Orthofotos umgebildet und zu dreidimensionalen Modellen ergänzt werden. Voraussetzung dafür ist die Digitalisierung des analogen Bildmaterials in speziellen Scannern, die das großformatige (23x23 cm) Filmmaterial geometrische exakt mit hoher Auflösung (bis zu 10 µm) erfassen.

Da das Scannen relativ zeit- und kostenintensiv ist besteht aus operationellen Gründen schon lange der Wunsch diesen Arbeitsschritt durch die digitale Aufnahmetechnik zu ersetzen, die bis vor kurzem auf dem zivilen Sektor jedoch nur in Satelliten eingesetzt wurde. Deren Auflösung ist inzwischen zwar bis auf beachtliche 60cm gesteigert worden ist, was aber – abgesehen von der Frage der Verfügbarkeit und der Kosten der Daten – für viele Anwendungen nicht ausreicht. Daher war die Entwicklung von digitalen optischen Sensoren für photogrammetrische Anwendungen durch die bekannten Firmen Leica (ehemals Wild) und Z/I Imaging (Zeiss/Intergraph) eine logische Entwicklung; die Markteinführung dieser Systeme ist aber noch immer in den Anfängen.

Während die Zeilenkamera ADS-40 von Leica einerseits sowie die Kombination von 4 Frame-Kameras in der DMC von Z/I Imaging sehr unterschiedlichen Konzepte mit speziellen Abbildungseigenschaften sind, wurde von Vexcel Imaging Austria das bewährte geometrische Konzept der klassischen Fotogrammetrie weiterentwickelt. Die neue UltraCam$_D$ verspricht als „Digitalkamera der 2.Generation“ den Durchbruch zur operationellen Anwendung der digitalen Aufnahmetechnik zu schaffen - was nicht nur für die Fotogrammetrie sondern auch alle ihre Anwender große Vorteile verspricht.

In diesem Artikel werden das technische Grundkonzept der Kamera und seine Leistungsfähigkeit, die damit verbundenen Verarbeitungsmethoden, sowie mögliche neue Anwendungen vorgestellt.

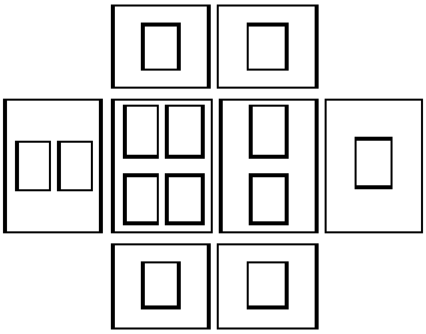
2 CHARAKTERISTIK DER ULTRACAM*D*

2.1 Das technische Konzept

Derzeit – und aus verschiedenen Gründen sicher auch nicht in absehbarer Zukunft – gibt es keine digitale Flächensensoren die auch nur annähernd das 23x23cm große Bildformat der „klassischen“ Luftbildkameras in einer mit Filmmaterial vergleichbaren Auflösung abdecken. Daher arbeitet das System von Leica mit Zeilensensoren, die das Bild im Zuge des Fluges aufbauen. Dieses Konzept erfordert allerdings eine genaue Registrierung aller Bewegungen des Flugzeuges und eine entsprechende nachträgliche Entzerrung. Z/I hingegen verwendet die größten auf dem Markt verfügbaren Flächensensoren, wobei aber 4 divergent ausgerichtete Kameras in einem Block zusammengefaßt werden, um gemeinsam eine mit dem klassichen Luftbild vergleichbare Auflösung zu erzielen.

Abb. 1: Digitale Luftbildkamera UltraCam$_D$. Zur Funktion der 8 Objektiv-Koni: Siehe Abb.2. (Vexcel Imaging Austria, 2003)

Von Vexcel Imaging Austia wird hingegen ein ganz anderer Weg beschritten: Die UltraCam$_D$ verwendet CCDs nach dem neuesten Stand der Sensortechnik, welche für die allgemeine professionelle Digitalphotographie in relativ großen Serien produziert werden. Im Gegensatz zu den kleineren „Chips" in den Consumer-Kameras sind diese Sensoren entsprechend dem klassichen Kleinbildformat 24 x 36mm dimensioniert und liefern bei 9µm Pixelgröße digitale Bilder mit 4008 x 2672 Pixel (also ca.10 Mpixel). In der UltraCam werden für den panchromatische (Schwrazweiß-)Kanal 9 dieser CCDs zu einem hochauflösenden Bild kombiniert.



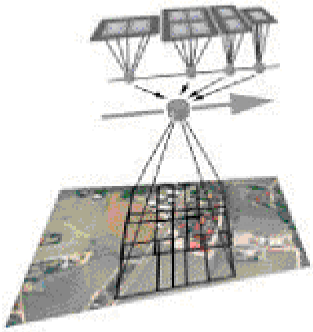


Abb. 2: Sensoranordnung (schematisch) in der UltraCam. Links: 9 Panchromatische (mittlere Reihe) und 4 Farb-CCDs (oben und unten); Rechts: Geländeüberdeckung mit den 9 panchromatischen Sensoren (Vexcel Imaging Austria, 2003)

Da CCDs naturgemäß nicht lückenlos aneinandergesetzt werden können müssen die 9 Chips auf 4 verschiedene Kamera-Koni aufgeteilt werden. Diese sind parallel senkrecht zur Erdoberfläche ausgerichtet und mit demselben Objektivtyp (5,6/100mm) bestückt, sodaß alle Aufnahmen dieselben Abbildungeigenschaften haben. Der in Flugrichtug gesehen zweite Konus, welcher 4 CCDs in den Bildecken enthält, dient als „Master Konus" und definiert somit die Geometrie des Bildes. Die geringfügig überlappenden Aufnahmen der CCDs der anderen Koni werden darauf eingepaßt, sodaß auf synthetischem Weg ein 11500 x 7500 Pixel großes Bild entsteht, das dieselbe geometrischen Eigenschaften aufweist wie ein (fiktiver) 85 Megapixel-Sensor.

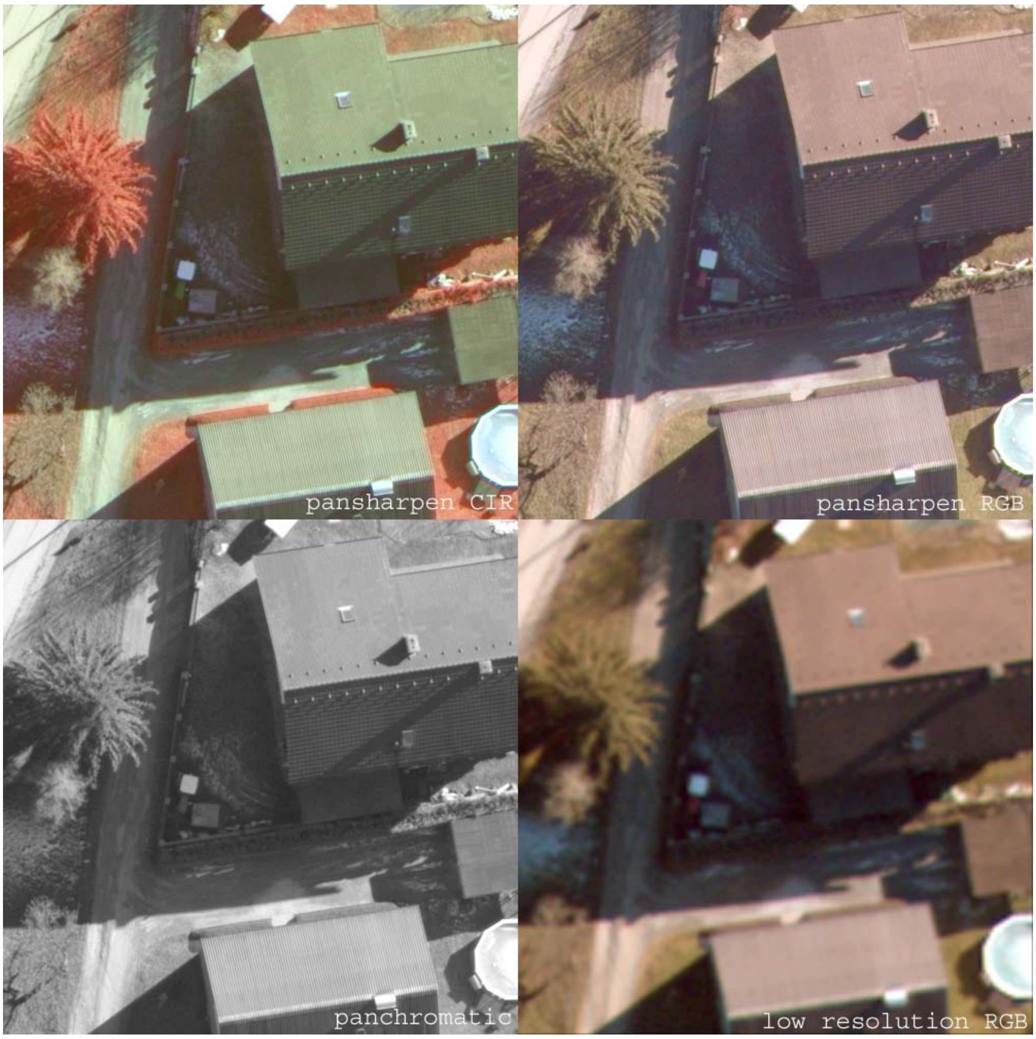


Abb.3: Gegenüberstellung eines Bildausschnittes (500x500 Pixel in der hohen Auflösung) von „gemergten" Falsch- und Echtfarben (li u. re. oben) mit dem originalen hochauflösenden Pan-Kanal (li unten) und dem Echtfarbenbild in der tatsächlichen Auflösing der R/G/B-Sensoren

Die Farbinformation stammt von 4 weiteren Kamera-Koni mit 28mm-Objektiven und je einem CCD für Rot (R), Grün (G), Blau (B) und das nahe Infrarot (NIR). Diese Sensoren decken – mit einer gegenüber dem hochauflösenden panchromatischen Sensorblock etwa um den Faktor 3 verminderten Auflösung – dasselbe Gebiet ab. Durch digitale Überlagerung („Merging") mit dem panchromatischen Daten können daraus hochauflösende Bilder in Echtfarben (RGB) oder „Falsch"-Farben („Color Infrared" CIR) erstellt werden. Diese Möglichkeit 4 Spektrakanäle und ein hochauflösendes panchromatisches Bild beliebig zu kombinieren gab es bisher nur bei satellitengestützten Sensoren, die allerdings eine um mindestens den Faktor 20 schlechtere Auflösung haben.

Neben der hohen geometrischen (Pixelgröße) und spektralen (Anzahl der Kanäle) Auflösung der UltraCam stellt die weitgehende Rauschfreiheit und große radiometrische Bandbreite der CCD-Sensoren einen entscheidenden Vorteil dar. Abb.4 zeigt deutlich die Kornfreiheit der Digitalaufnahme im Vergleich mit herkömmlichen Filmmaterial.

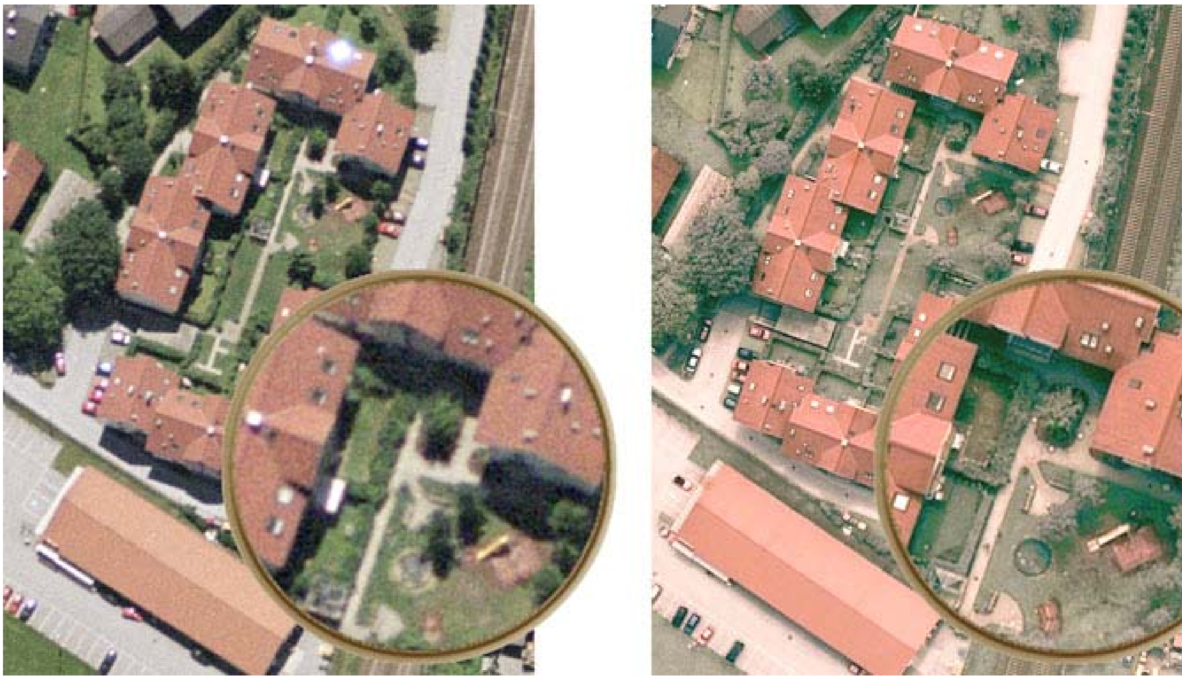


Abb. 4: Auf Filmmaterial (links) bzw. mit der UltraCam$_D$ (rechts) aufgenommene Echtfarben-Bilder (Vexcel Imaging Austria)

Die hohe radiometrische Bandbreite, welche die Kodierung der von den Pixel-Sensoren aufgezeichneten Grauwerte mit 12 bis 14 Bit erfordern, bedeutet einen deutlich größeren Belichtungsspielraum als bei Filmmaterial möglich ist. Dadurch kann ein wesentlich breiterer Kontrastbereich abgebildet werden und es ist die Durchzeichnung sowohl der hellsten Flächen wie auch der Schattenpartien auf einer Aufnahme möglich. Das ergibt wesentlich bessere Voraussetzungen zur Bildwiedergabe und Auswertung in Stadtgebieten, wo sowohl helle Dachlandschaften als auch im Schatten liegende Straßenschluchten und Innenhöfe nebeneinander vorkommen.

Technische Daten

In Tab.1 sind die wichtigsten technischen Daten der UltraCam$_D$ zusammengefaßt. Das gesamte System (Kamera und Datenregistriereinheit) benötigt eine Stromversorgung von 850 Watt.

Sensor Einheit SU	
Panchromatisches Bildformat	11500 x 7500 Pixel @ 9µm, 103,5 x 67,5 mm
Objektivbrennweite und Apertur	100 mm, f 1/5,6
Gesichtsfeld in / quer zur Flugrichtung	55° / 37°
Multi-Spektral (R/G/B/NIR)	4008 x 2672 Pixel @ 9µm
Verschlußzeiten	1/500 – 1/60 Sek.
Bewegungskompensation	TDI Steuerung
Bildwiederholrate	bis 1,3 Bilder pro Sekunde
Radiometrische Auflösung	12 – 14 bit (mt 16 bit registriert)
Dimensionen	45 cm x 45 cm x 60 cm
Gewicht	ca. 30 kg
Speicher- und Recheneinheit (Storage & Computing Unit, SCU)	
Speichervolumen	> 1 TB
Bildkapazität (alle Kanäle)	> 2775 Bilder
Dimensionen	55 cm x 40 cm x 65 cm
Gewicht	ca. 35 kg

Tab.1: Die wichtigsten technische Daten der UltraCam$_D$ (nach Gruber et.al., 2003)

Unter den vielen innovativen technischen Lösungen in der UltraCam soll besonders auf zwei Merkmale hingewiesen werden:

Die softwaremäßige Bildwanderungskompensation, die durch Verschiebung der Adressen beim Auslesen der Pixelzeilen während der Belichtung erfolgt. Auf diese Weise kann eine lineare Bewegung von bis zu 50 Pixelzeilen vollständig kompensiert werden (was allen denkbaren Befliegungssituationen genügt)

Die potentiell hohe Bildwiederholfrequenz von unter 1 Sekunde, welche eine extrem hohe Überdeckung von bis zu 96% erlaubt. Das ergibt besonders hohe Redundanzen für die Stereo-Auswertung und eröffnet völlig neue Perspektiven für die Automatisierung von Matching-Verfahren und Methoden der Objekt-Erkennung (siehe 4.1.)

3 AUFNAHMEN MIT DER ULTRACAM$_D$

3.1. Operationelle Rahmenbedingungen

Für die Aufnahmepraxis gestaltet sich die Flugplanung mit der UltraCamD wie bei einer „klassischen" Luftbildkamera mit 21cm Brennweite und 23x23cm Bildformat. Der einzige Unterschied ist das rechteckige Format im Seitenverhältnis 3:2, welches im Prinzip für eine 60%-Überdeckung um die Hälfte mehr Aufnahmen innerhalb jedes Streifens erforderlich macht. Da jedoch bei der UltraCam$_D$ in der Regel ohnedies mit einer Überdeckungen von mehr als 80% geflogen wird spielt das in der Praxis keine Rolle.

Flughöhe über Grund	Pixelgröße am Boden	Breite des Flugstreifens	Aufgenommene Fläche pro Bild	Aufnahmeabstand bei 85% Überd.	Aufnahmeintervall bei 85% Überd.	Bilder pro 30km-Streifen	Daten für 30km-Streifen
5500 m	50 cm	5750 m	22,0 km²	560 m	5,6 sek.	54	~ 14 GB
3700 m	33 cm	3800 m	9,6 km²	370 m	3,7 sek.	81	~ 21 GB
1100 m	10 cm	1150 m	0,9 km²	110 m	1,1 sek.	273	~ 71 GB

Tab.2: Kenndaten typischer Varianten für die Befliegung eines 30 km langen Streifens

Aus Tab.2 sind die wichtigsten Parameter für einen 30 km langen Streifen bei einer Befliegung mit 360 km/h (100m/sek.) und 85% Längsüberdeckung in unterschiedlichen Flughöhen ersichtlich. Die Datenmenge für den gesamten 30km-Streifen ergibt sich aus der Anzahl der Bilder mal den 265 MB (13 CCDs mit je 4008 * 2672 Pixel * 16 Bit/Pixel) die für jedes Bild an Rohdaten anfallen. (Wobei in der Realität aus Sicherheitsgründen an Bord die doppelte Datenmenge auf unabhängigen Festplatten aufgezeichnet wird !). Da heutzutage 1 GB Speicherplatz auf einer Festplatte weniger als 1 € kostet stellen die hier ausgewiesenen Datenmengen kein Problem dar; vor allem sind die Kosten im Vergleich zu den mindestens 20 € die man pro Luftbild für Film, Entwicklung und Scannen veranschlagen muß vernachlässigbar.

3.2. Praktische Beispiele

Ein Beispiel für 6 aufeinanderfolgende Aufnahmen eines Flugstreifens der am 14.1.2004 im Stadtgebiet von Graz geflogen wurde ist in Abb. 5 ersichtlich. Die Aufnahmen erfolgten um die Mittagszeit mit der Cessna 206 von Bildflug Fischer (Klagenfurt) mit einer Geschwindigkeit von 120 kn (215 km/h bzw. 60m/sek) aus 850 m über Grund bei einem Aunfnahmeintervall von 1,5 sek.

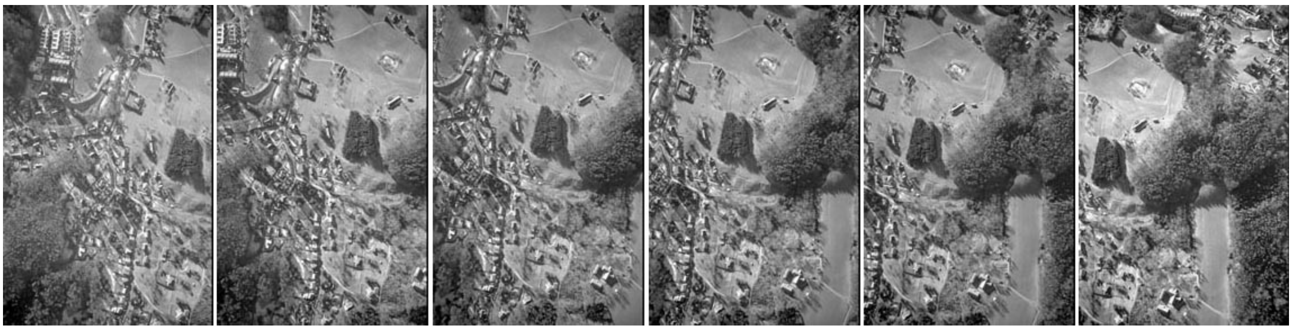


Abb. 5: „Quick-Views" der Aufnahmen 247 bis 252 aus dem Flug „Graz 14.1.2004" (Bildgröße am Boden je ca. 860 x 560 m)

Wie der Ausschnitt in Abb.6 zeigt ist die Qualität der 7,5cm Bodenauflösung aufweisenden panchromatischen Daten hervorragend. Da bei der Befliegung böiger Wind herrschte sind allerdings einige wenige der mit 1/250 sek Belichtungszeit und Kamera-interner Bewegungskompensation (die den konstanten Anteil der Flugbewegung kompensiert) aufgenommenen Bilder leicht verwackelt. Im konkreten Fall ist dies wegen der hohen Überdeckung kein Problem und es liegen mehr als ausreichend viele sehr gute Bilder vor.

Für die beste Bildqualität in jeder Situation empfiehlt sich jedoch der Einsatz einer kreiselstabilisierten Platform wie z.B. CCNS4 von IGI, welche auch alle irregulären Rollbewegungen des Flugzeuges kompensiert. Durch die integriete Navigation mittels GPS/IMU kann dieses System überdies den Piloten entsprechend einer vorgegebenen Flugplanung führen, die Kameraauslösung steueren sowie exakte Aufnahmeorte und –Richtungen registrieren und für die Auswertung der Daten zur Verfügung stellen. All diese Funktionen unterstützen wesentlich die Bedienungssicherheit der Kamera und den Automatisierungsgrad der Verarbeitung der Aufnahmen.

Abb. 6: Ausschnitt (900 x 700 Pixel) aus dem Flug „Graz 14.1.2004" (Pixelgröße am Boden 7,5 cm)

Beim vorliegenden Flug, von dem es selbverständlich auch sehr schöne Farb- und Farbinfrarotbilder gibt (siehe die Beispiele in Abb.3) wurde in einem Bereich von zwei einander zu mehr als 60% quer-überlappender Streifen eine Aerotriangulation vorgenommen. In insgesamt 11 Bildern wurden automatisationsgestützt mehr als 800 Punkte gemessen. Der auf die Sensorebene bezogene interne mittlere Fehler der Messungen war +/- 1,8 µm (also 20% der Pixelgröße). Die Restfehler an den Geländepunkten beliefen sich auf bis zu +/- 4 cm in der Lage bzw. +/- 11 cm in Höhe.

4. EINSATZMÖGLICHKEITEN DES SYSTEMS

Hoch-redundante Stereoskopie und „True" Orthofoto

Die hervorragenden radiometrischen Eigenschaften der Kamera liefern auch in schwierigen beleuchtungstechnischen Situationen rauschfreie Bilder. Auch bei Flächen mit wenig Detailinhalt (versiegelte Flächen, abgeerntete Äcker etc.), wo bei Filmmaterial nur mehr die Körnung zu sehen ist, findet sich ausreichend Textur um einem Stereo-Operator (oder aber auch einem automatischen Matching-Programm !) die Korrelation der Bildpaare und somit die dreidimensionale Auswertung der Daten zu ermöglichen.

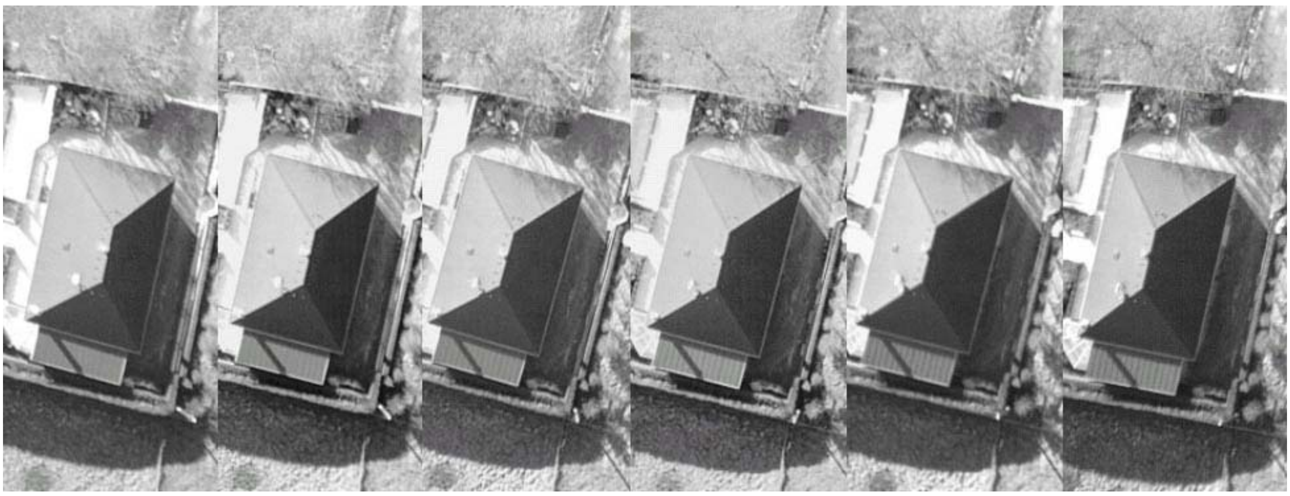


Abb. 7: „Hoch-redundanter“ Stereo-Ausschnitt (je 160 x 370 Pixel) aus 6 aufeinanderfolgenden Bildern

Der hohe Überdeckungsgrad den die UltraCamD ohne nennenswerten Mehraufwand liefern kann und durch den jedes Objekt am Boden typischerweise 5-8 mal abgebildet ist, ermöglicht hoch-redundante und somit sehr robuste Stereo-Verfahren für die detaillierte Erfassung von Oberflächen und 3D-Modellierung von Objekten. Abb.7 zeigt die bei einem niedrigen Haus ziemlich subtilen Änderungen der stereoskopischen Perspektive zwischen aufeinanderfolgenden Aufnahmen. Das bietet sehr günstige Voraussetzung für die Bildkorrelation zwischen den benachbarten (recht ähnlichen) Bildern, während die Höheninformation mit optimaler Genauigkeit aus den am extremsten auseinanderliegenden Aufnahmen abgeleitet werden kann.

Die hervorragenden Eigenschaften der UltraCam zur Erfassung der Höhe von Objekten bieten optimale Voraussetzungen für die Erstellung von genauen Oberflächen- und 3D-Modellen; insbesondere von Stadtlandschaften. Wegen des hohen Detaillierungsgrades der Abbildung sind die Daten insbesondere für „True“ Orthophotos, in denen der Bildsturz von Gebäuden vollständig kompensiert und sichttote Räume durch entsprechende Mosaikierung aus benachbarten Bildern abgedeckt werden, ausgezeichnet geeignet.

Weitere Anwendungsgebiete

Wegen ihrer mit herkömmlichen analogen Luftbildern identen geometrischen Eigenschaften (einheitliche Zentralperspektive über das gesamte Bild) kann die UltraCam$_D$ für alle „klassischen“ Anwendungen der Fotogrammetrie und unter Verwendung derselben Arbeitsabläufe bzw. Programme eingesetzt werden. Typische Einsatzgebiete (bzw. die speziellen Vorteile der UltraCam$_D$) sind:

Erstellung von präzisen Gelände- bzw. Geländeoberflächenmodellen (mittels hoch-redundantenter Stereoverfahren)

Herstellung von hochauflösenden Orthofotos (wahlweise in Scharzweiß; Echtfarbe oder Farb-Infrarot)

Erstellung von 3D-Stadt- und Siedlungsmodellen (mit optimaler Bildqualität und guten Möglichkeiten zur Mosaikierung)

Erfassung umfangreicher Basisdaten für Ingenieurprojekte (Detaillierungsgrad der Auswertung je nach den Erfordernissen)

Fototriangulationen zur präzisen Punktbestimmung (mit Sub-Pixel-Genauigkeit)

Naturraumdokumentation und –Kartierung (unter speziellerr Verwendung des Infrarot-Kanals)

Winter-Aufnahmen (Bewältigung der extremen Licht-Schatten-Verhältnisse mittels großer Bandbreite der Sensoren)

Forstwirtschaft (hohe Detaillierungsgrad zur Erfassung der Kronenstrukturen; gute Einsicht in Schattenhänge)

Planung, Management und Kontrolle in der Landwirtschaft (kostengünstige Herstellung von multitemporalen Aufnahmen)

Erfassung von Naturkatastrophen (Flug auch bei Schlechtwetter bzw. schlechten Beleuchtungsverhältnissen möglich)

Befliegungen für reine Dokumentationszwecke (ohne Anfall von Filmkosten; rascher Zugriff auf digitale Archive)

Die neue großformatige digitale Luftbildkamera UltraCam$_D$ wird ab dem Jahr 2004 von Meixner Vermessung Wien betrieben und steht für die beschriebenen Anwendungen wie auch für weitere vom Auftraggeber definierte Aufgaben zur Verfügung. Die Autoren erwarten sich durch die mit dieser Kamera erstmals mögliche voll-digitale Produktionskette eine wesentliche Steigerungen bezüglich Qualität und Wirtschaftlichkeit der Fotogrammetrie, was allen beteiligten Projektpartnern zugute kommen wird.

5. REFERENZEN

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Der Einsatz von Laserscanning und Photogrammetrie zur Dokumentation des urbanen Straßenraumes

Gerald FORKERT

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1 DER CITYGRII SCANNER ALS UNIVERSELLE MULTISENSOR AUFNAHMEPLATTFORM

Die Technologie des 3D Laserscanning stellt eine ideale Ergänzung zu den bewährten photogrammetrischen Aufnahmeverfahren dar. Besonders die seit dem letzten Jahr verfügbaren Laserscanner, die mit geodätischer Genauigkeit arbeiten, lassen eine signifikante Effizienzsteigerung bei der Nahbereichsvermessung erwarten. Um die erhofften Rationalisierungseffekte zu erreichen, bedarf es neuer Aufnahme- und Auswerteverfahren die der räumlichen bildhaften Datenerfassung gerecht werden.

Abb. 1: City**GRID** Scanner und Detail der Sensorik

Speziell für die Erfassung des urbanen Straßenraumes entwickeln die Firmen No Limits und Geodata das fahrzeuggestützte Multi Sensor System „City**GRID** Scanner". Dieses System vereinigt einen 3D Laserscanner, mehrere hochauflösende Digitalkameras und einen GPS Empfänger auf einer kalibrierten drehbaren Plattform.

Der CityGrid Scanner wird in zwei Modi betrieben, im dynamischen zur Erfassung der Fassaden und im Stop&Go zur Erfassung der Elemente des Straßenraumes.

2 DER DYNAMISCH MODUS ZUR FASSADENERFASSUNG

Bei einer typischen Aufnahmefahrt im dynamischen Modus wird mit dem City**GRID** Scanner an Ecken und Kreuzungen angehalten und die Fassadengeometrie durch einen Flächenscan erfasst. Die Fassaden dazwischen werden aus der Fahrt durch Photos so aufgenommen, dass sich eine fünffache Überlappung ergibt. Der Scanner arbeitet während der Fahrt im Zeilenmodus

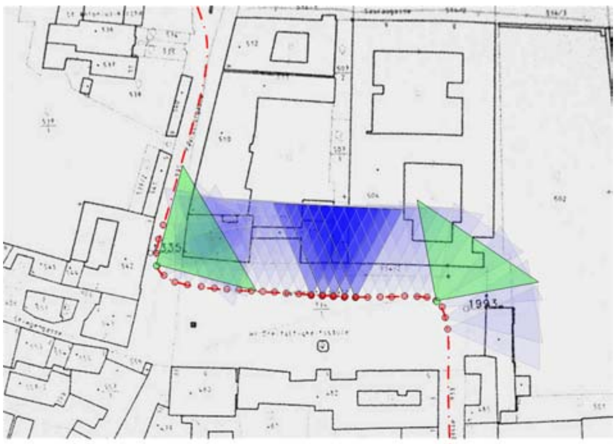

Abb 2: Beispiel für eine Aufnahmefahrt des City**GRID** Scanners:
Blau – Stereophotos, Grün – Flächenscans, Rot – Trajektorie

Abb. 3 Serie von Bildaufnahmen aus dem dynamischen Mode

Für die automatisierte Orientierung können Satelliten gestützte Navigationssysteme nicht genutzt werden, da GPS in engen Gassen nicht mehr zuverlässig arbeitet. Es ist daher notwendig, die Orientierung mittels Passlinien und –punkten durchzuführen. Diese Passinformationen werden in den Photos mit Hilfe teilautomatischer Matching-Routinen bestimmt. Um die Aufnahmezeit des Laserscanners kurz zu halten, können die Scans auf jeweils eine Zeile beschränkt werden („Zeilenscan" im Gegensatz zum sonst üblichen Flächenscan) . Bei liegend eingebautem Scanner werden so quasi laufend die Gebäudegrundrisse erfaßt – diese Information kann zur „Abstützung" der automatisierten Bildorientierung verwendet werden.

Das von der No Limits IT GmbH in Kooperation mit dem VRVIS entwickelte automatische Orientierungsverfahren beruht auf Verknüpfungspunkten die sich durch den Schnitt von horizontalen und vertikalen Kanten ergeben, und nutzt die Information über identische Fluchtpunkte für die automatische korrekte Zuordnung der Punkte zwischen den Photos. Voraussetzung für dieses Verfahren ist die Aufnahmeanordnung im „Bildflug" Stil.

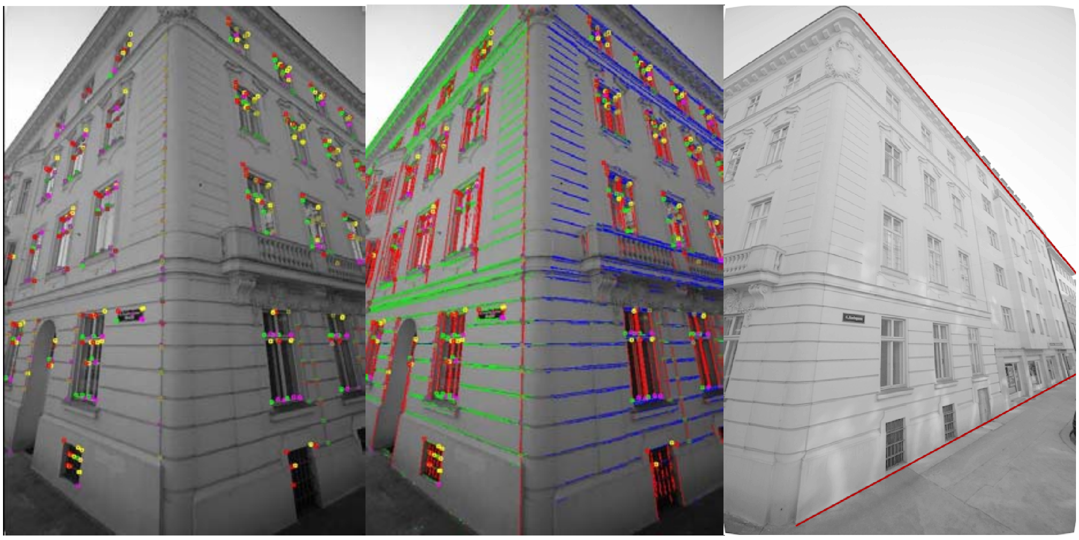

Abb. 4 Bildorientierung: automatische Detektion der Points of Interest und Fluchpunkterkennung anhand paralleler Linien

Abb. 5 Hochauflösende Imagesensoren ermöglichen die detailreiche Fassadenerfassung

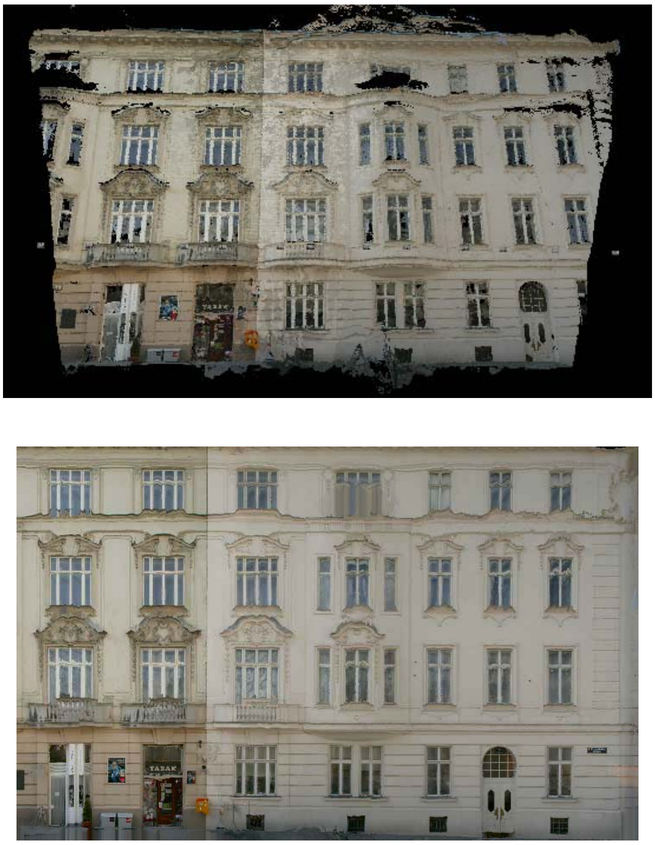

Abb. 6 3D Fassadenmodell und Orthophoto aus dynamischer Aufnahmefahrt des City**GRID** Scanner

3 DER STOP AND GO BETRIEB ZUR STRAßENRAUMERFASSUNG

Im Stop&Go Betrieb, erfasst das System von einem Standpunkt aus die gesamte sichtbare Umgebung. Zur Reduktion der durch parkende PKW verursachten Sichtbehinderung erfolgt die Aufnahme aus einer Arbeitshöhe von 4m über Grund. Die effektive Aufnahmeentfernung liegt bei maximal 100m, in der Praxis ist eine Aufstellung alle 20 bis 50m erforderlich, um eine typische urbane Straßenszene lückenlos zu dokumentieren.

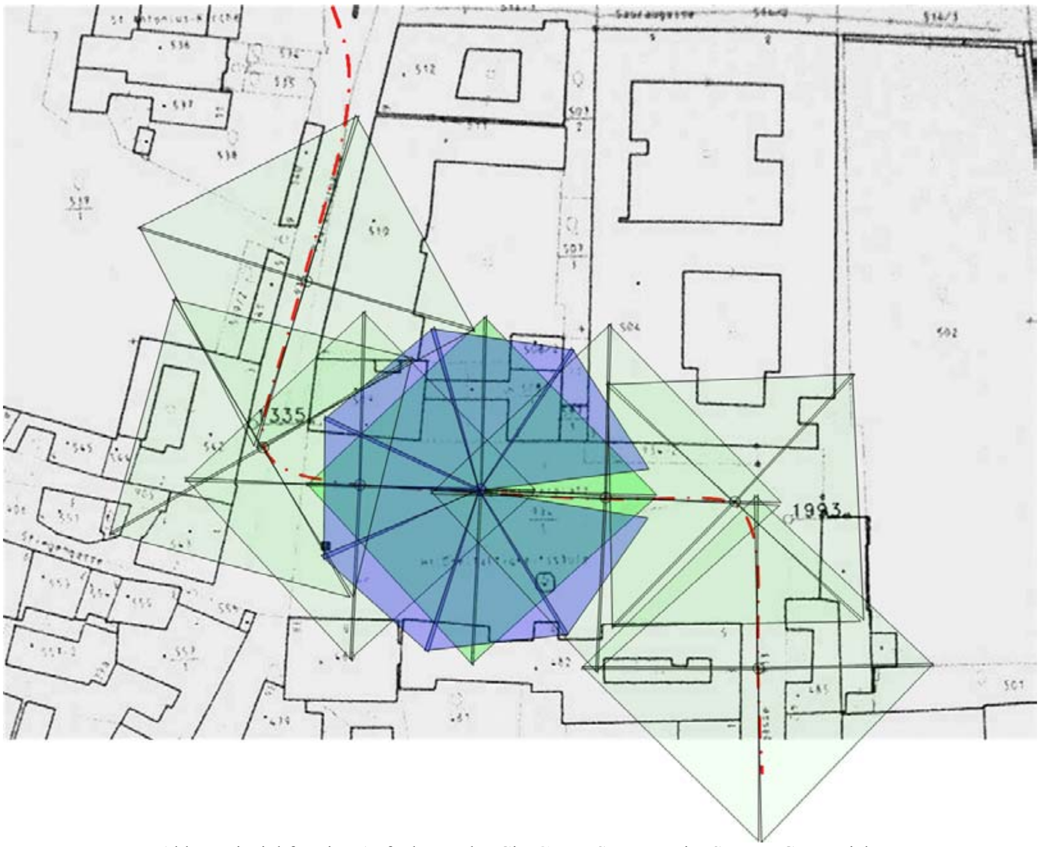

Abb : Beispiel für eine Aufnahmen des City**GRID** Scanners: im Stop an Go Betrieb:
Durch die spezielle Anordnung der Sensorik erfolgt die Aufnahme der gesamten Hemishäre.

Von jedem Aufnahmestandpunkt liegt nun ein photographisch und zugleich räumliches Abbild der realen Umgebung vor, das aus 5 sektoralen Laserscans und 10 hochauflösenden digitalen Photographien besteht. Zur Auswertung dieser Daten wurde der „City**GRID** Analyser“ entwickelt. Dieses CAD gestützte System ermöglicht die Interpretation von Elementen im Photo, die aufgrund der vom Laserscanner stammenden räumlichen Information sofort georeferenziert werden. Spezielle Algorithmen ermöglichen die automatisierte Auswertung von linienhaften Elementen der Straßenoberfläche und von Freileitungen über dem Straßenraum.

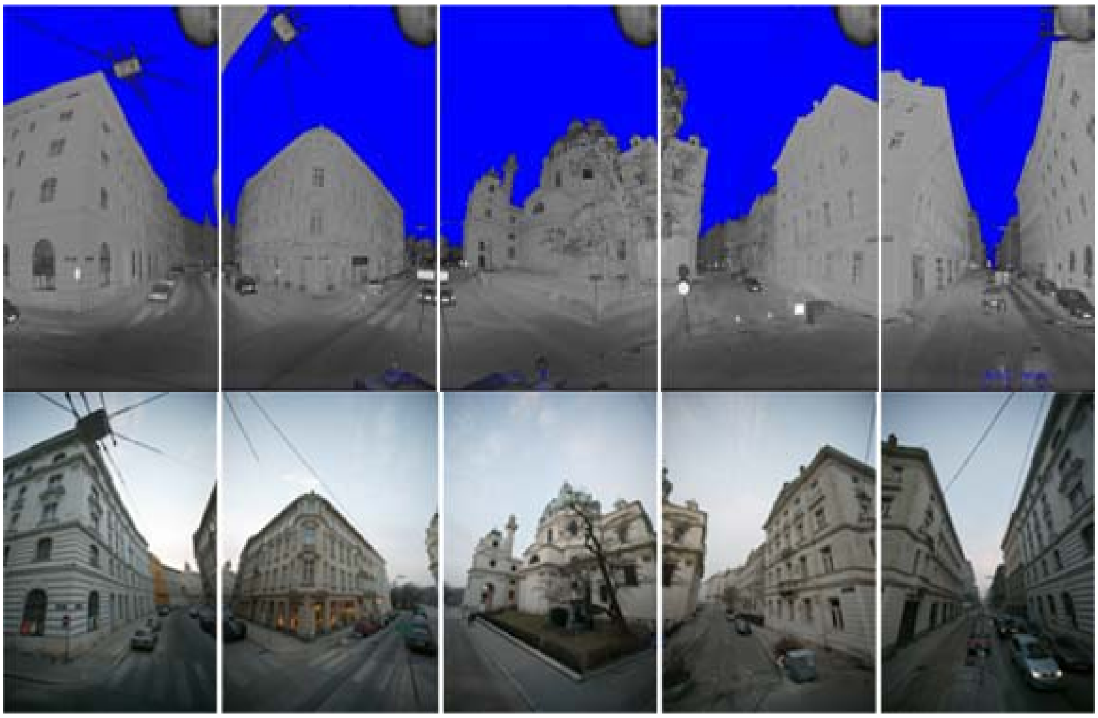

Abb. 7 Bildaufnahmen und korrespondierende Laserscans einer Rundum Aufnahme

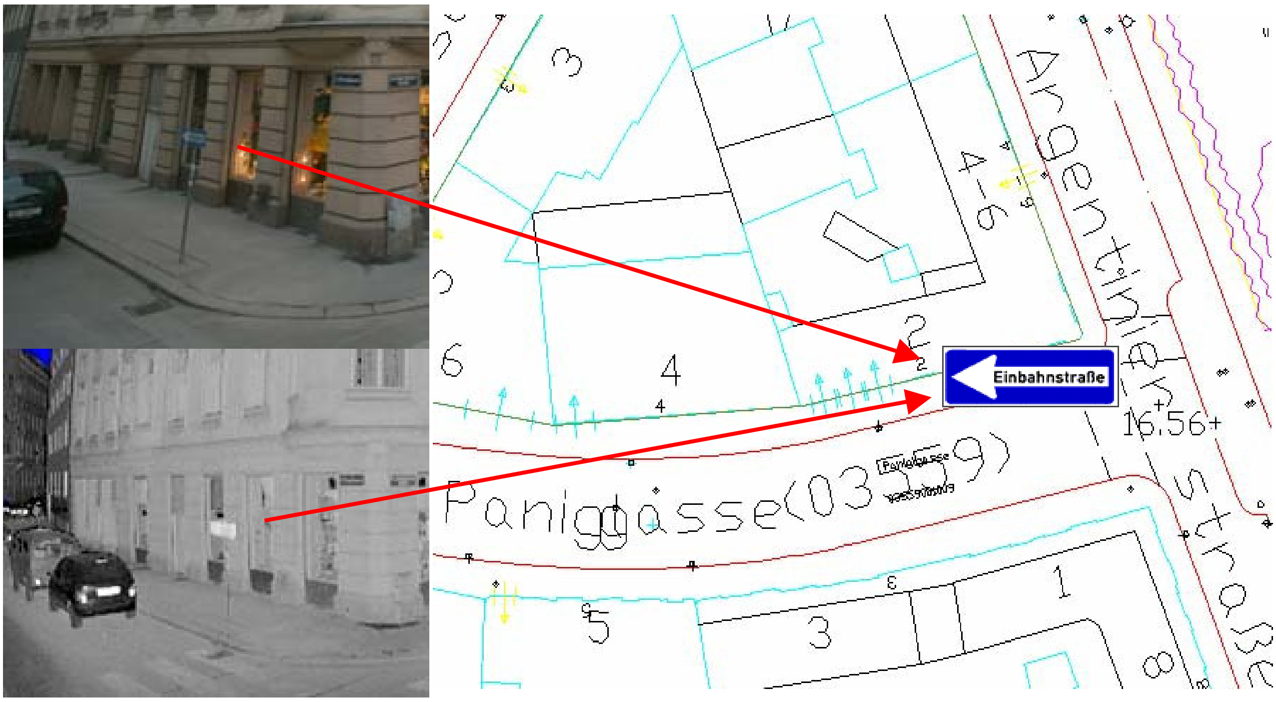

Abb 8 Erfassung und Positionierung von Verkehrszeichen aus der Rundum Aufnahme

Neben den Elementen des Straßenraumes können relevante Gebäudelinien, z.B. das aufstrebende Mauerwerk, Fassadenoberkanten, Traufenlinien, Balkonkanten, etc. ausgewertet werden. Dabei ist aufgrund der Regelmäßigkeit von Gebäuden ein hoher Automatisierungsgrad erzielbar, wenn Gebäudegrundrisse aus dem kommunalen GIS übernommenwerden können. Die ausgewerteten Strukturlinien der Gebäude ermöglichen die automatische Generierung von Fassdenmodellen im City**GRID** Modeler.

Abb 9 Bild und Geometrieinformation einer einzelnen Rundumaufnahme

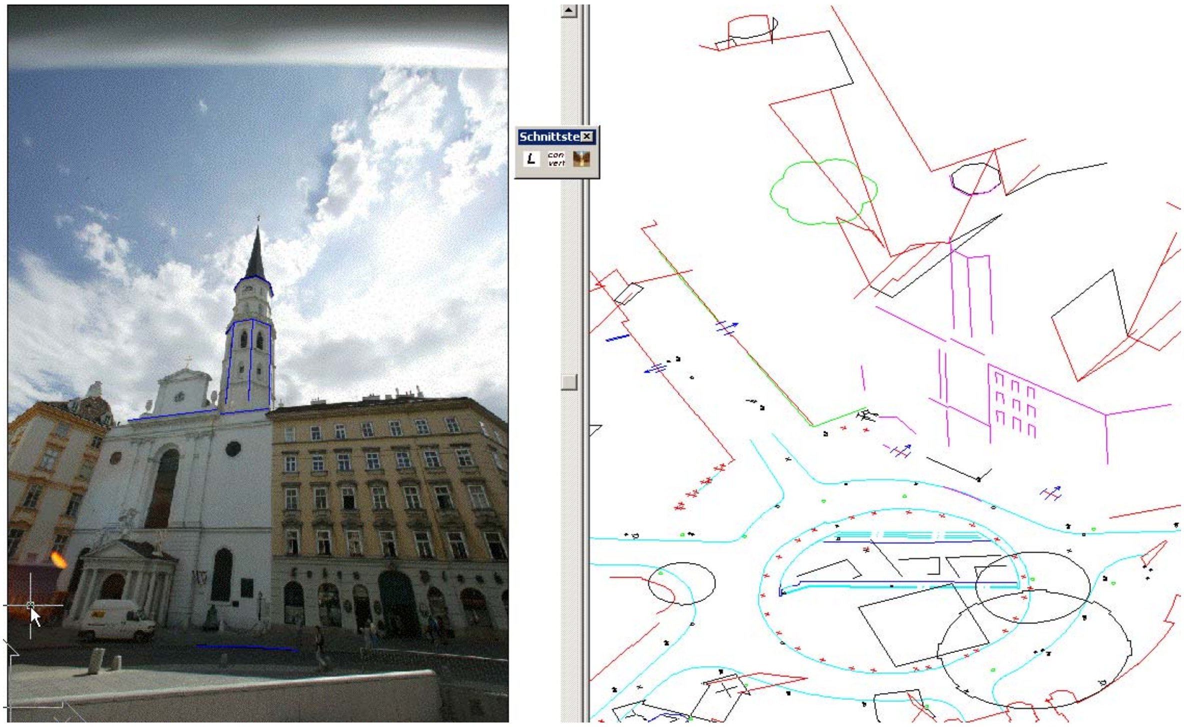

Abb. 10: 3D Linienauswertung im Photo einer City**GRID** Scanner-Aufnahme (links), georeferenziertes 3D Ergebnis (rechts)

4 DER CITYGRID SCANNER ZUR ARCHITEKTURDOKUMENTATION.

Für die schnelle Auswertung paralleler rechtwinkeliger Fassadenelemente eignet sich die Methode des „Z-codierten True Orthophotos“. Zur Berechnung des „True Orthophoto“ wird aus den Daten des Laserscanners ein Relief generiert. Mit diesem Relief können allerdings, auf die Ansicht bezogen, keine „Überhänge“ dargestellt werden – die Reliefdarstellung wird daher als nur „2,5D“ bezeichnet.

Das Relief kann auch als „Tiefenbild“, mit denselben Bilddimensionen wie das „True Orthophoto“, dargestellt werden und speichert solcherart den Z-Wert für jeden Bildpunkt.

Mit Hilfe einfacher Zusatz-Routinen kann das „Z-coded True Orthophoto“ („ZOP“) in das CAD geladen und räumlich ausgewertet werden. Das im Hintergrund befindliche Tiefenbild ermöglicht es, durch Mausklick an einer beliebigen Stelle des True Orthophotos den zugehörigen Tiefenwert einzustellen.

4.1 Beispiel Rathaus Wien

Bei der der Aufnahme der Westfassade des Wiener Rathauses wurde aus den Scanner- und Photodaten nach deren Orientierung Z-kodierte True Orthophotos berechnet.

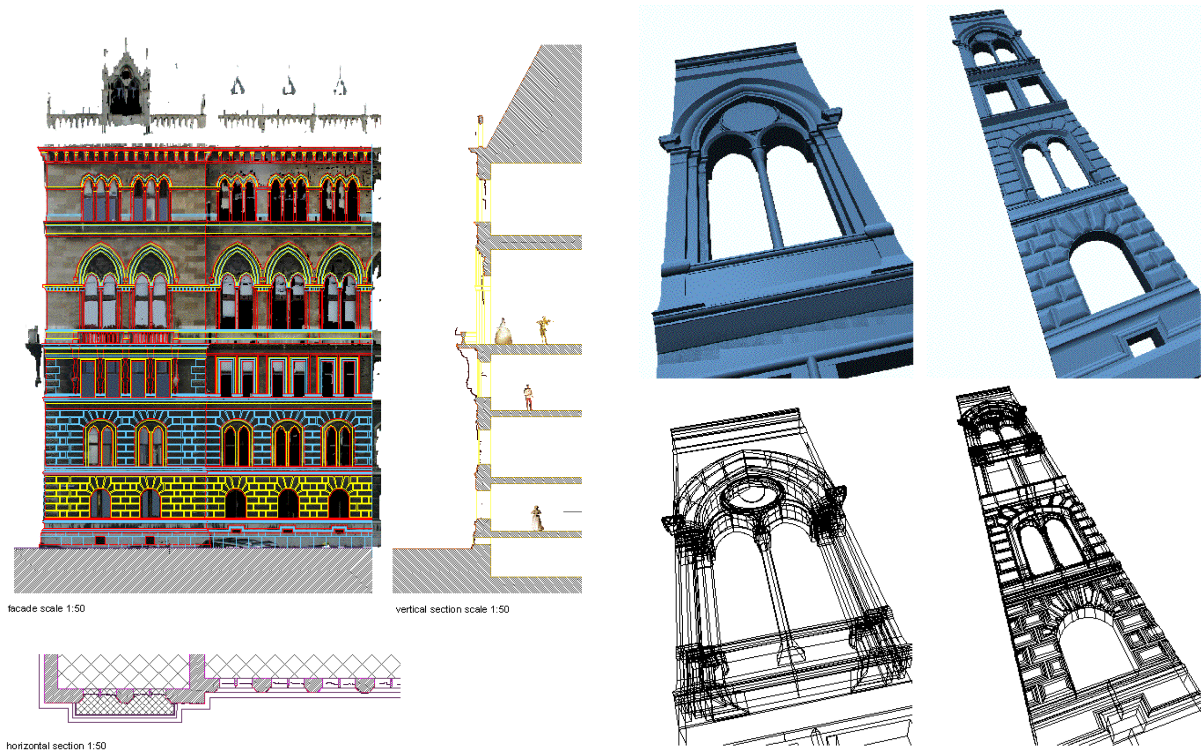

Abb. 11 3D Strichauswertung der Fassade und Detailauswertung einzelner Fassadenelemente

Auf Basis der ZOP erfolgte im CAD die Kartierung der Ansicht. An typischen Stellen wurden zusätzlich Profile aus den Scannerdaten (in Form eines Tiefenbildes vorliegend) extrahiert und interaktiv überarbeitet.

Schließlich wurde anhand dieser Profile exemplarisch die Möglichkeit von Schnittdarstellungen angedeutet, wobei die Mauerstärken vorerst aus Annahmen stammen.

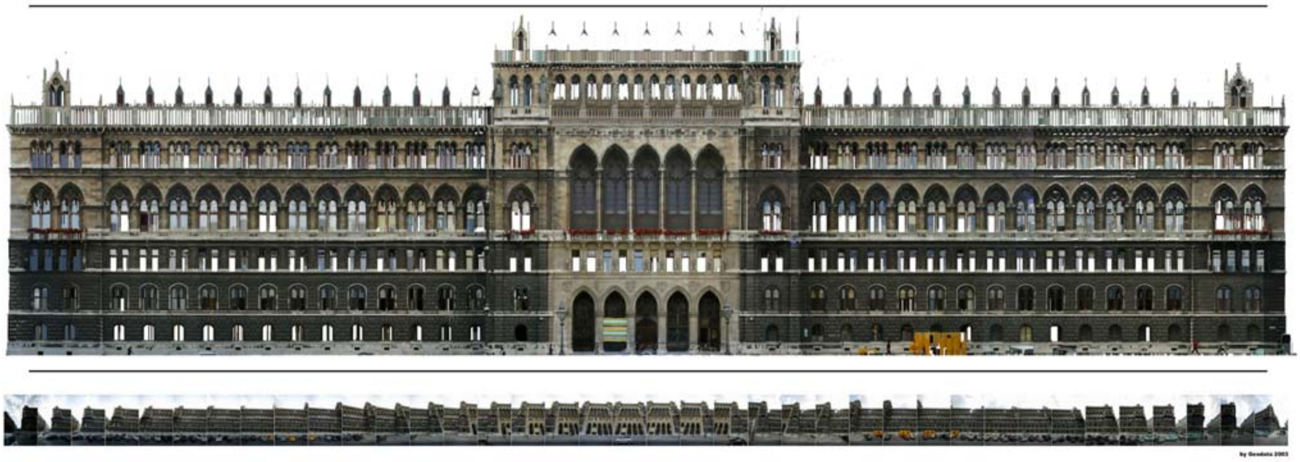

Abb. 12 Westfassade des Wiener Rathauses; Die Auflösung der Aufnahme beträgt 2cm x 2cm, damit ist eine Planausgabe im Maßstab 1:100 möglich.

5 LITERATUR:

G. Forkert, T. Gaisecker 2002: 3D Rekonstruktion von Kulturgütern mit Laserscanning und Photogrammetrie Vortrag im Rahmen der CultH 2002, vom 13.-15.1. 2002

H. Holzer, G.Forkert, 2003: Die Erstellung, Verwaltung und Nutzung von 3D-Stadtmodellen mit dem System City**GRID**. Vortrag im Rahmen der AGIT 2003, Universität Salzburg vom 2.7. bis 4.7. 2003

K. Karner, A. Klaus, J. Bauer, C. Zach, 2003: *MetropoGIS: A City Modeling System* Vortrag im Rahmen der CORP 2003, TU-Wien, 25.2. bis 1.3. 2003. (http://www.corp.at)

Online Prüfprogramm für Geodaten: abc-geodata.com

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1 EINFÜHRUNG

Geodaten unterliegen im allgemeinen bestimmten Regeln, nach denen sie erzeugt werden. Solche Regeln werden als „Richtlinie", „Schnittstelle", „Datenmodell", „Planzeichenverordnung", „Standard", engl. „Application Schema" bezeichnet.

abc-geodata.com bietet als besondere Innovation die Möglichkeit, Geodaten darauf zu prüfen, ob sie der Richtlinie entsprechen, nach der sie erstellt wurden.

Unter abc-geodata.com finden Sie auch eine Bibliothek von anderen Richtlinien zum Nachlesen.

Nach einer einheitlichen Methode werden zum Beispiel nachstehende Kriterien geprüft:

Allgemein:

- Dateiorganisation: Namen, Zusammengehörigkeit, usw.
- Datenformat, Version
- Regionaler Ausschnitt, Koordinatensystem, Koordinatenbereich

Inhaltlich:

- Klassifikation, topologische Typen
- Attribute: Name, Wertebereiche, Vorhandensein usw.
- Geometrische Eigenschaften
- Visualisierungsvorschriften
- Zusammenhänge von Objekten verschiedener Klassen untereinander (Kontext)
- Sonstiges

Die Vorteile dieses Prüfdienstes liegen auf der Hand: Auftraggeber sind oft aus Mangel an Personal oder entsprechenden Werkzeugen nicht in der Lage, gelieferte Geodaten auf Regelentsprechung zu prüfen. Daher wurden die Geodaten in der Vergangenheit oft ungeprüft in den Unternehmensdatenbestand übernommen.

Mit der Verlagerung des Prüfaufwandes vom Auftraggeber zum Auftragnehmer wird auch die Beweislast für die Richtigkeit der Geodaten übertragen. Der Auftraggeber soll vom Auftragnehmer den Nachweis der Fehlerfreiheit fordern und der Auftragnehmer kann diesen durch Anwendung des vorliegenden Dienstes erbringen.

Anlass für die Einrichtung dieses Dienstes war der Bedarf der ASFINAG (Autobahnen- und Schnellstraßen FinanzierungsAG), Datenbestände des Autobahnen- und Schnellstraßennetzes (1:1000) auf ihre Enstprechung mit der Dokumentationsrichtlinie ("PLaDOK") zu prüfen.

Die Architektur der Softwarelösung, die hinter diesem Prüfdienst steht, erlaubt ein Hinzuschalten von Prüfungen für zusätzliche Richtlinien und beliebige Datenformate mit relativ geringem Aufwand.

2 FUNKTIONSWEISE

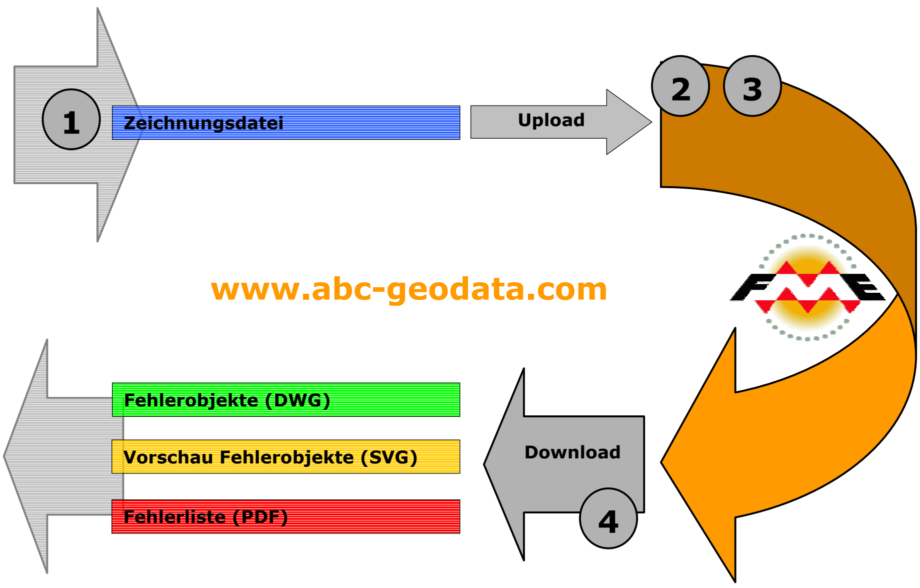


Abb.1: Funktionsskizze abc-geodata.com

Die zu prüfenden Dateien werden upgeloadet und online geprüft. Als Ergebnis kann ein ZIP-Archive mit den Fehlerobjekten in einer DWG-Datei, eine Vorschau der Fehlerobjekte als SVG-Datei sowie eine Fehlerliste mit detaillierter Beschreibung als PDF-Datei downgeloadet werden.

2.1 Auswahl der Richtlinie

In der Richtlinien-Bibliothek kann der volle Text der Richtlinie eingesehen werden. Weiters gibt es Tipps und Hinweise zur Richtlinie als auch einen Link zur Homepage des Herausgebers.

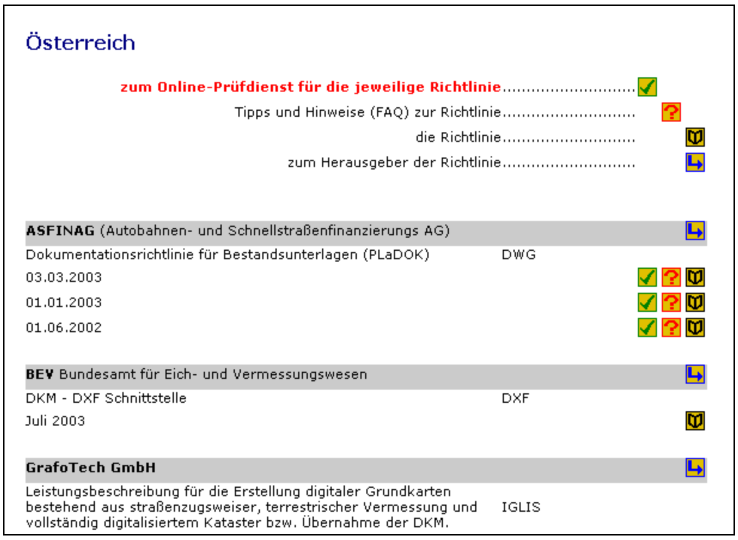


Abb 2: Richtlinien-Bibliothek

2.2 Datei Upload, Parametereingabe und -kontrolle

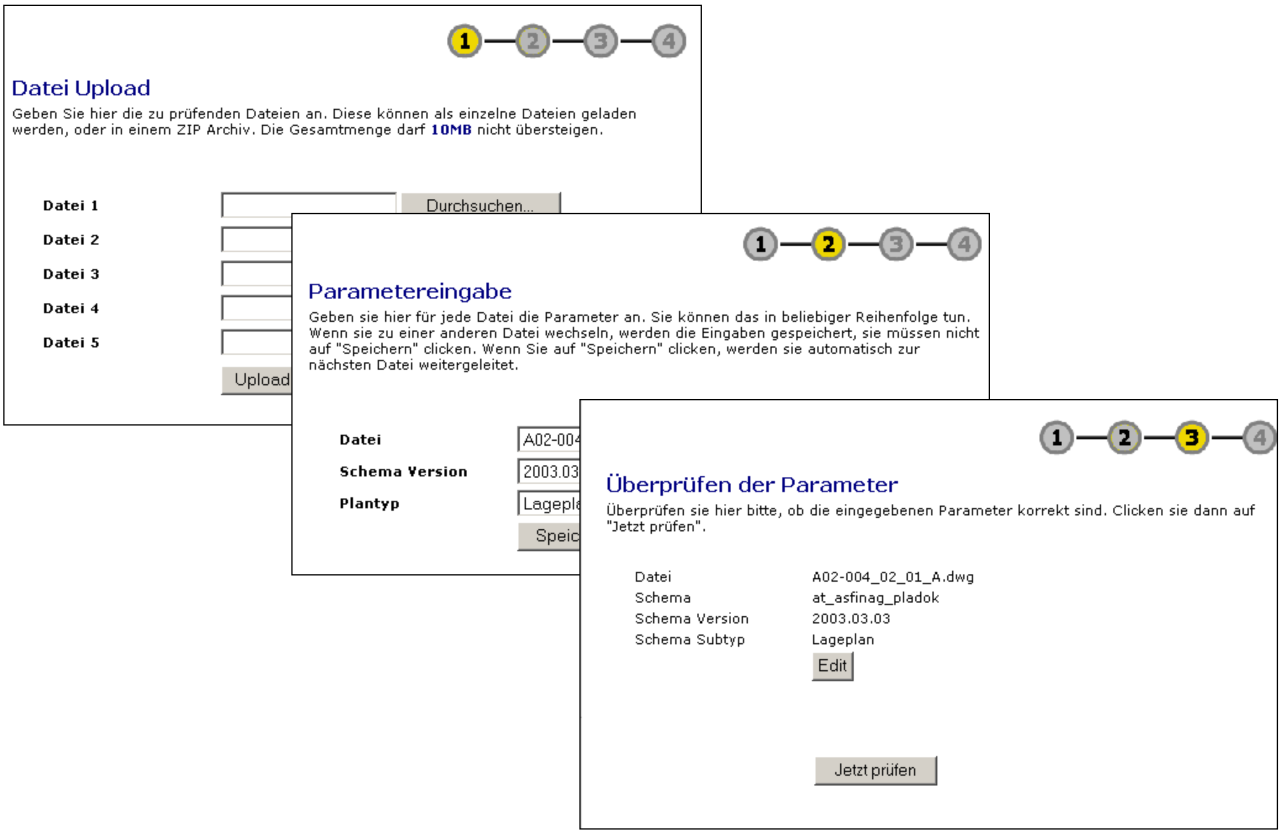


Abb. 3: Datei-Upload, Parametereingabe und -kontrolle

2.3 Prüfergebnis

Nach erfolgter Prüfung erhält man eine Zusammenfassung der Ergebnisse. Es wird die Anzahl der Fehler im jeweiligen Fehlerlevel aufgelistet. Im Prüfprotokoll (PDF-Datei) befindet sich eine deatallierte Fehlerliste samt Erläuterung. Das ZIP-Archiv enthält die Zeichnung mit den Fehlersymbolen sowie das Prüfprotokoll, und kann zur weiteren Verwendung downgeloadet werden.

- Error-Code: Alphanumerisches Kürzel für die Fehlerart
- Error-Level: Schweregrad des Regelverletzung (1 = Warnung, 2 = tolerierbarer Fehler, 3 = schwerer Fehler). Der Schweregrad kann in Abhängigkeit vom zu prüfenden Schema unterschiedlich sein.
- Error-Text: Text, der im Prüfergebnis (tabellarischer Prüfbericht, graphische Fehlerdatei) verwendet wird. Der Fehlertext kann in Abhängigkeit vom zu prüfenden Schema unterschiedlich sein.
- Bei den einzelnen Anwendungsfällen (Richtlinien) werden unterschiedliche Error-Levels und Error-Texte verwendet. Die Error-Codes und die zugehörigen Prüfkriterien sind nicht veränderlich.

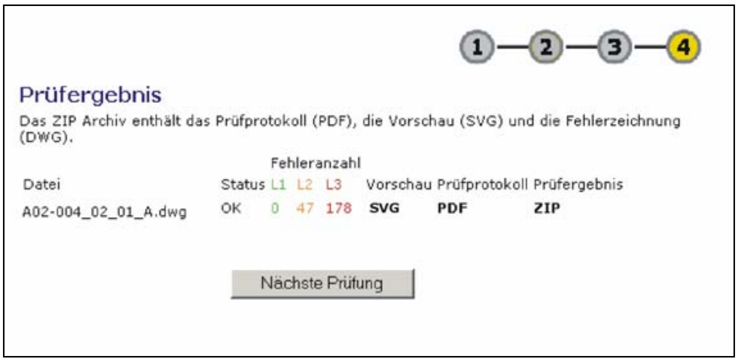


Abb.4: Prüfergebnis

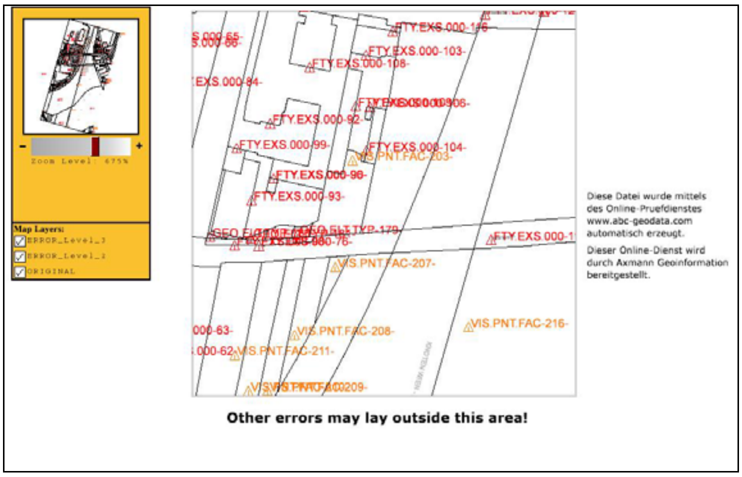
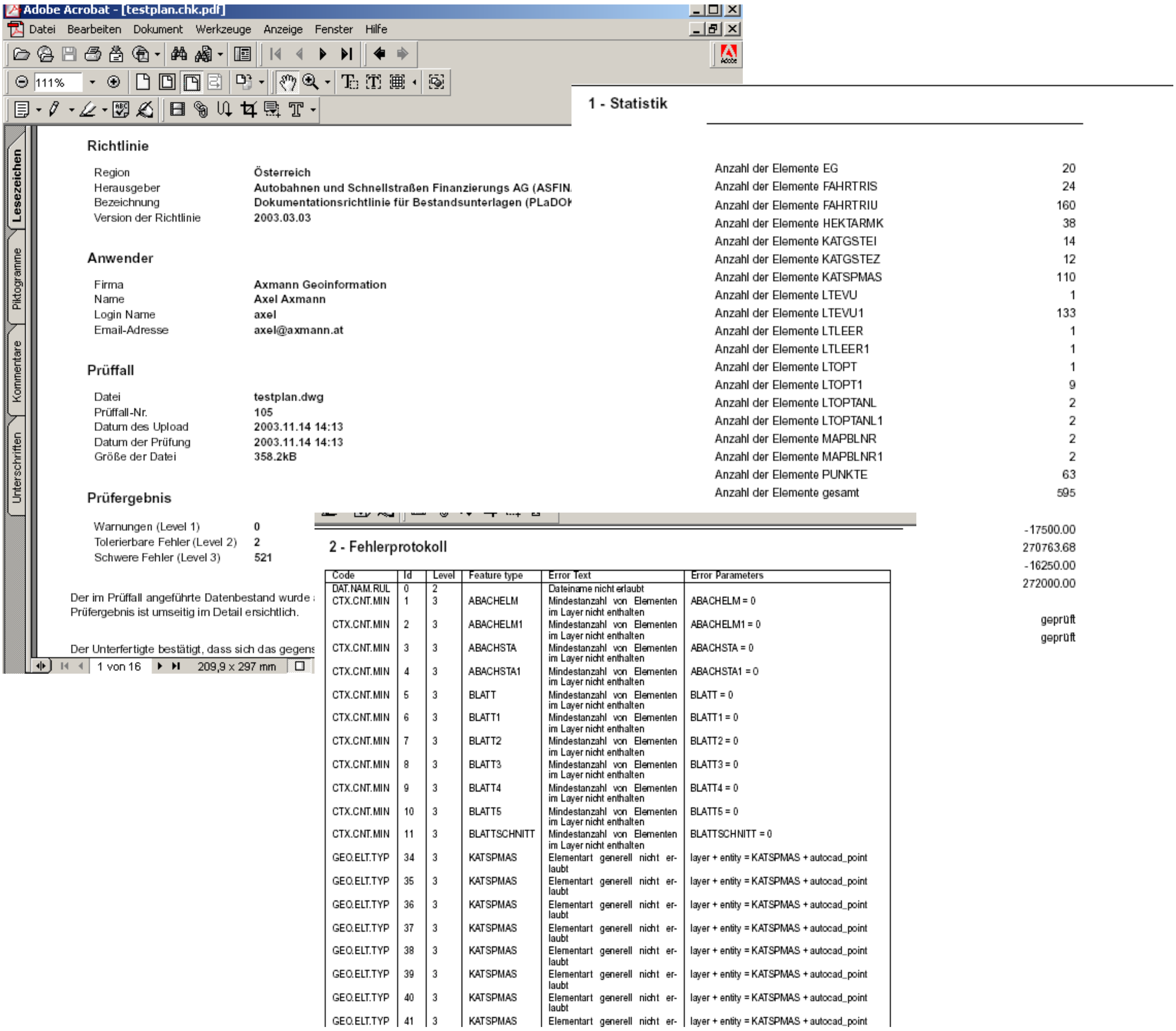


Abb.5: Online-Vorschau des Prüfergebnisses als SVG-Datei

Die Vorschau erlaubt das Ein- und Ausschalten der nach Layern organisierten Fehlerarten.



Adobe Acrobat - [testplan.chk.pdf]

Datei Bearbeiten Dokument Werkzeuge Anzeige Fenster Hilfe

Richtlinie

Region	Österreich
Herausgeber	Autobahnen und Schnellstraßen Finanzierungs AG (ASFIN
Bezeichnung	Dokumentationsrichtlinie für Bestandsunterlagen (PLaDOK
Version der Richtlinie	2003.03.03

Anwender

Firma	Axmann Geoinformation
Name	Axel Axmann
Login Name	axel
Email-Adresse	axel@axmann.at

Prüffall

Datei	testplan.dwg
Prüffall-Nr.	105
Datum des Upload	2003.11.14 14:13
Datum der Prüfung	2003.11.14 14:13
Größe der Datei	358.2kB

Prüfergebnis

Warnungen (Level 1)	0
Tolerierbare Fehler (Level 2)	2
Schwere Fehler (Level 3)	521

Der im Prüffall angeführte Datenbestand wurde
Prüfergebnis ist umseitig im Detail ersichtlich.

Der Unterfertigte bestätigt, dass sich das gegens

1 von 16 209,9 x 297 mm

1 - Statistik

Anzahl der Elemente EG	20
Anzahl der Elemente FAHRTRIS	24
Anzahl der Elemente FAHRTRIU	160
Anzahl der Elemente HEKTARMK	38
Anzahl der Elemente KATGSTEI	14
Anzahl der Elemente KATGSTEZ	12
Anzahl der Elemente KATSPMAS	110
Anzahl der Elemente LTEVU	1
Anzahl der Elemente LTEVU1	133
Anzahl der Elemente LTLEER	1
Anzahl der Elemente LTLEER1	1
Anzahl der Elemente LTOPT	1
Anzahl der Elemente LTOPT1	9
Anzahl der Elemente LTOPTANL	2
Anzahl der Elemente LTOPTANL1	2
Anzahl der Elemente MAPBLNR	2
Anzahl der Elemente MAPBLNR1	2
Anzahl der Elemente PUNKTE	63
Anzahl der Elemente gesamt	595

-17500.00
270763.68
-16250.00
272000.00

geprüft
geprüft

2 - Fehlerprotokoll

Code	Id	Level	Feature type	Error Text	Error Parameters
DAT.NAM.RUL	0	2		Dateiname nicht erlaubt	
CTX.CNT.MIN	1	3	ABACHELM	Mindestanzahl von Elementen im Layer nicht enthalten	ABACHELM = 0
CTX.CNT.MIN	2	3	ABACHELM1	Mindestanzahl von Elementen im Layer nicht enthalten	ABACHELM1 = 0
CTX.CNT.MIN	3	3	ABACHSTA	Mindestanzahl von Elementen im Layer nicht enthalten	ABACHSTA = 0
CTX.CNT.MIN	4	3	ABACHSTA1	Mindestanzahl von Elementen im Layer nicht enthalten	ABACHSTA1 = 0
CTX.CNT.MIN	5	3	BLATT	Mindestanzahl von Elementen im Layer nicht enthalten	BLATT = 0
CTX.CNT.MIN	6	3	BLATT1	Mindestanzahl von Elementen im Layer nicht enthalten	BLATT1 = 0
CTX.CNT.MIN	7	3	BLATT2	Mindestanzahl von Elementen im Layer nicht enthalten	BLATT2 = 0
CTX.CNT.MIN	8	3	BLATT3	Mindestanzahl von Elementen im Layer nicht enthalten	BLATT3 = 0
CTX.CNT.MIN	9	3	BLATT4	Mindestanzahl von Elementen im Layer nicht enthalten	BLATT4 = 0
CTX.CNT.MIN	10	3	BLATT5	Mindestanzahl von Elementen im Layer nicht enthalten	BLATT5 = 0
CTX.CNT.MIN	11	3	BLATTSCHNITT	Mindestanzahl von Elementen im Layer nicht enthalten	BLATTSCHNITT = 0
GEO.ELT.TYP	34	3	KATSPMAS	Elementart generell nicht erlaubt	layer + entity = KATSPMAS + autocad_point
GEO.ELT.TYP	35	3	KATSPMAS	Elementart generell nicht erlaubt	layer + entity = KATSPMAS + autocad_point
GEO.ELT.TYP	36	3	KATSPMAS	Elementart generell nicht erlaubt	layer + entity = KATSPMAS + autocad_point
GEO.ELT.TYP	37	3	KATSPMAS	Elementart generell nicht erlaubt	layer + entity = KATSPMAS + autocad_point
GEO.ELT.TYP	38	3	KATSPMAS	Elementart generell nicht erlaubt	layer + entity = KATSPMAS + autocad_point
GEO.ELT.TYP	39	3	KATSPMAS	Elementart generell nicht erlaubt	layer + entity = KATSPMAS + autocad_point
GEO.ELT.TYP	40	3	KATSPMAS	Elementart generell nicht erlaubt	layer + entity = KATSPMAS + autocad_point
GEO.ELT.TYP	41	3	KATSPMAS	Elementart generell nicht er-	layer + entity = KATSPMAS + autocad_point

Abb.6: Auszüge aus dem Prüfprotokoll

3 KOSTEN

Die Entwicklung eines Prüfdienstes für eine Richtlinie erfolgt im Auftrag und in enger Abstimmung mit dem Herausgeber der Richtlinie und wird auch durch diesen finanziert.

Das Online-Prüfen von Geodaten ist für den Benutzer kostenfrei.

4 ZUSAMMENFASSUNG

Der Online-Prüdienst für Geodaten abc-geodata.com ist eine völlig neuartige Form der Qualitätssicherung an Geodaten, wobei die richtliniengetreue Erstellung der Daten bereits vor Übernahme gewährleistet wird.

Der Auftraggeber kann bei der Übernahme von Plänen das entsprechende - von dem oben beschriebenen Prüdfienst erstellte - Prüfprotokoll verlangen, und anhand dessen die Qualität der Daten rasch beurteilen.

Laserscanning in der Raumplanung

Heinz BUSCH & Jürg LÜTHY

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Dipl. Ing. Jürg Lüthy, Swissphoto AG, Abt. GeoSolutions, Dorfstrasse 53, CH-8105 Regensdorf, juerg.luethy@swissphoto.ch

1 DIGITALE GELÄNDEMODELLE FÜR DIE SCHWEIZERISCHE KATASTERVERMESSUNG

1.1 Informationen zum Projekt

Im Zusammenhang mit der Bereinigung der landwirtschaftlichen Nutzflächen entstehen mit Lasertechnologie im Auftrag des Bundesamtes für Landestopographie und im Rahmen der Katastervermessung ein digitales Terrainmodell („DTM-AV"), ein digitales Oberflächenmodell („DOM"), ein digitales Orthophoto (DOP „Swissimage") sowie automatisch generierte Waldgrenzen (AWG). Das DTM ist das Abbild des Grund und Bodens. Das DOM stellt die obere umhüllende Fläche aller auf dem Boden stehenden Objekte wie Gebäude, Bäume, Wälder etc. dar. Die Geländemodelle werden bis auf eine Höhe von 2000 m.ü.M. erstellt und erstrecken sich beinahe über die ganze Schweiz. In Kantonen, in denen bereits eigene, zum Teil photogrammetrisch erhobene Höhenmodelle aufgebaut wurden, wird eine Integration dieser vorhandenen Modelle in die neuen Geobasisdaten angestrebt. Ziel ist ein landesweites homogenes Terrainmodell für die Katastervermessung.

Die Daten von DOM und DTM wurden mit Laserscanning-Technologie erfasst und weisen folgende Charakteristiken auf: die Höhengenauigkeit (einfache Standardabweichung) an einer beliebigen Stelle des DTM bzw. von Strukturelementen im DOM (Gebäude, Brücken) ist ca. ± 0.3 m, der mittlere Punktabstand beträgt im DOM 1.1 m, im DTM 1.3 m. Die Befliegung fand in den laubfreien Monaten statt, so dass das DTM auch in den Wäldern eine hohe Punktdichte aufweist.

Nachdem nun Datensätze aus verschiedenen Regionen produziert, verifiziert und für die Nutzung freigegeben worden sind, konnten in den vergangenen Monaten erste Erfahrungen mit den neuen Modellen gesammelt werden. Dabei hat sich gezeigt, dass von diesen qualitativ hochstehenden Geobasisdaten verschiedenste Anwendungen, insbesondere in der Raumplanung, profitieren können. Das Papier soll deshalb Beispiele zu verschiedensten Anwendungen präsentieren, die dank den neuen Geobasisdaten effizienter, umfassender und vielfach auch kostengünstiger betrieben werden können.

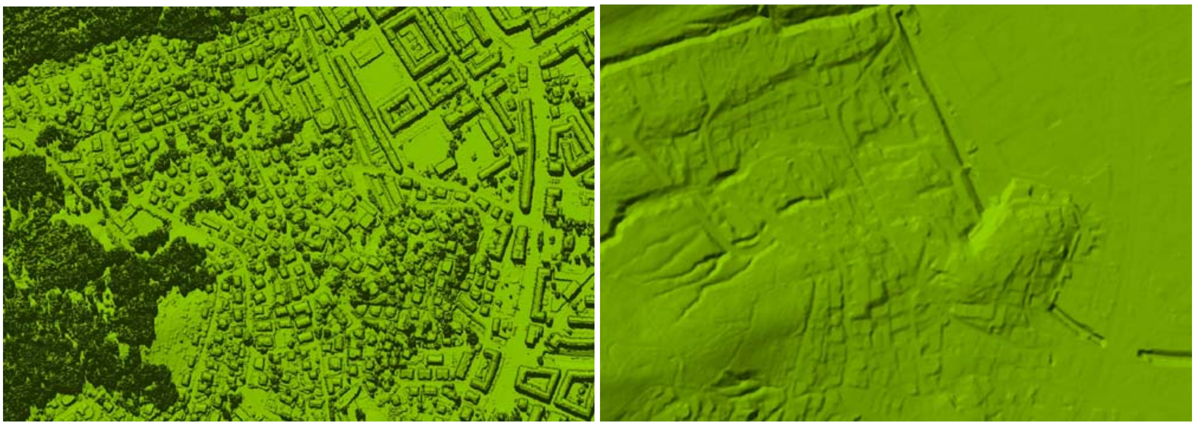

Abbildung 15: Beispiele von DOM bzw. DTM

1.2 Übersicht abgeleiteter Datensätze

Die folgende Abbildung gibt einen Überblick welche Produkte aus den neuen Geobasisdaten abgeleitet werden können:

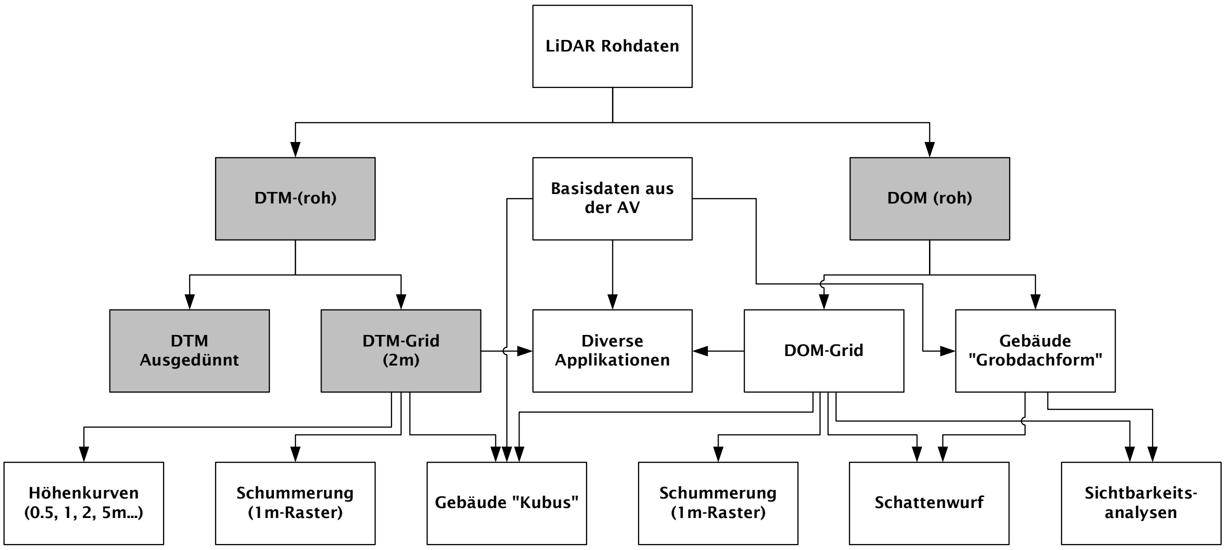

Abbildung 16: Geobasisdaten und daraus abgeleitete Produkte

Die grau hinterlegten Boxen zeigen die Höhenmodelle, welche vom Bundesamtes für Landestopographie im Rahmen des Projekts Landwirtschaftliche Nutzflächen (LWN) offiziell verkauft werden. Die wichtigsten aus dem DTM abgeleiteten Datensätze sind Höhenkurven und Geländeschummerungen. Für verschiedene Arten von Gebäudemodellen werden die DTM Daten gebraucht, um den Gebäudefusspunkt festzustellen. Aus dem DOM lassen sich folgende wichtige Daten ableiten: hochauflösender Raterdatensatz, Gebäudemodelle (tlw. in Kombination mit Situationsdaten der AV), Geländeschummerungen, Sichtbarkeiten.

2 DIE ANWENDUNGSGEBIETE

Grundsätzlich erfüllen die nun vorhandenen Geobasisdaten die Anforderungen vieler Anwendungen hinsichtlich Genauigkeit, Auflösung, Homogenität und Aktualität. Die Applikationen, welche am stärksten von dieser Datenqualität profitieren können, sollen im folgenden kurz dargestellt werden:

- Katastervermessung:
  Basisdaten Ebene Höhe, 3D-Gebäude und Kunstbauten, Höhenlinien, Schummerung des Übersichtsplanes
- Landwirtschaft:
  Hangneigung, Exposition, Sonneneinstrahlung
- Emissionsausbreitung:
  Lärm, Elektrosmog, Luftschadstoffe
- Naturgefahren:
  Überflutungs- und Erosionsanalyse, Simulation von Murgängen etc.
- Bodenkunde, Geologie:
  Analyse der topographischen Kleinstrukturen
- Raumplanung:
  Städte- und Ortsplanung, Denkmalpflege, Planen und Beurteilen von Bauprojekten, Architektur, Beschattungsanalysen, Landschaftsmodelle, 3D-Visualisierungen
- Planung/Projektierung:
  Strassen, Bahnen, Überbauungen (keine Detailprojektierungen)
- Immobilienwesen:
  Lagebeurteilung, Sichtbarkeiten, 3D-Visualisierungen
- Geomarketing:
  Standortmarketing, Wirtschaftsförderung, Location Based Services
- Tourismus:
  Sichtbarkeiten, Visualisierungen, 3D-Routen/-Visualisierungen
- Simulationssysteme:
  Flug- und Fahrsimulationen, 3D-Visualisierungen

2.1 Katastervermessung

Im Datenmodell der schweizerischen Katastervermessung ist das Thema Geländemodell in der Ebene „Höhe“ eingegliedert. Aktuell wird die Ebene in den meisten Kantonen mit reduzierter Priorität behandelt. Der Höhendatensatz besteht aus DHM25-Daten (digitales Höhenmodell mit 25m Maschenweite), welches punktuell verbessert wurde. Auch wenn die neuen Geobasisdaten die geforderten Genauigkeiten nicht in allen Toleranzstufen (insbesondere innerstädtische Bereich) erfüllen, kann nun die Ebene „Höhe“ mit einem flächendeckenden, homogenen und aktuellen Datensatz abgedeck werden.

Künftig werden immer mehr Forderungen über 3D-Daten an die Katastervermessung herangetragen, sei es für Zusatzinformationen über Gebäude (Baukubatur, Dachlandschaften, Stockwerke etc), aber auch Informationen über den Aufbau des Untergrundes (Lage von Leitungen, vertikale Ausdehnung von Bauwerke/Tiefgaragen). In diesem Bereich kann sich die Vermessung mit dem Aufbau und der Nachführung von Gebäudemodellen und den zugehörigen Adressen als Partner für die kommende 3D-GIS-Generation positionieren.

Die Katastervermessung ist aber nicht nur eine „disziplinbezogene Datensammlung“, sondern soll und muss die Basis für verschiedenste Applikationen mit Raumbezug bilden. Die neuen Höhendaten können insbesondere in die Übersichtspläne einfliessen. Die neue Generation „Übersichtspläne“ in den Massstabsreihen 1:5'000 – 1:10'000 wird aus den Katasterdaten abgeleitet und mit den Höheninfomationen aus dem DTM ergänzt: Höhenkurven und Geländeschummerung. Bei der Schummerung ist allerdings darauf zu achten, dass die kartographische Qualität (Lesbarkeit, Detaillierungsgrad) nicht leidet.

Abbildung 17: Übersichtsplan kombiniert mit Schummerung aus DTM (Reproduziert mit Bewilligung des Vermessungsamtes Kanton Zug)

2.2 Lärmschutz und Lärmbekämpfung

1987 ist in der Schweiz die Lärmschutzverordnung (LSV) in Kraft getreten. Seither haben die kantonalen Lärmschutzfachstellen begonnen, die Lärmausbreitung bzw. die -einwirkung mittels Simulationen zu berechnen. Dabei stand jedoch die fehlende Genauigkeit des Terrainmodells sowie Angaben zu Höhen von Bauwerken der Genauigkeit der Simulation und damit der Akzeptanz der Resultate entgegen. Die Simulationen mussten deshalb durch aufwändige Messungen im Feld kalibriert werden. Die höhere Genauigkeit des DTM und die Skalierbarkeit der Äquidistanz kombiniert mit Gebäudehöhen aus dem DOM verbessern die Qualität der Simulation so stark, dass nur noch punktuelle Feldmessungen zur Verifikation der Modellannahmen notwendig sind.

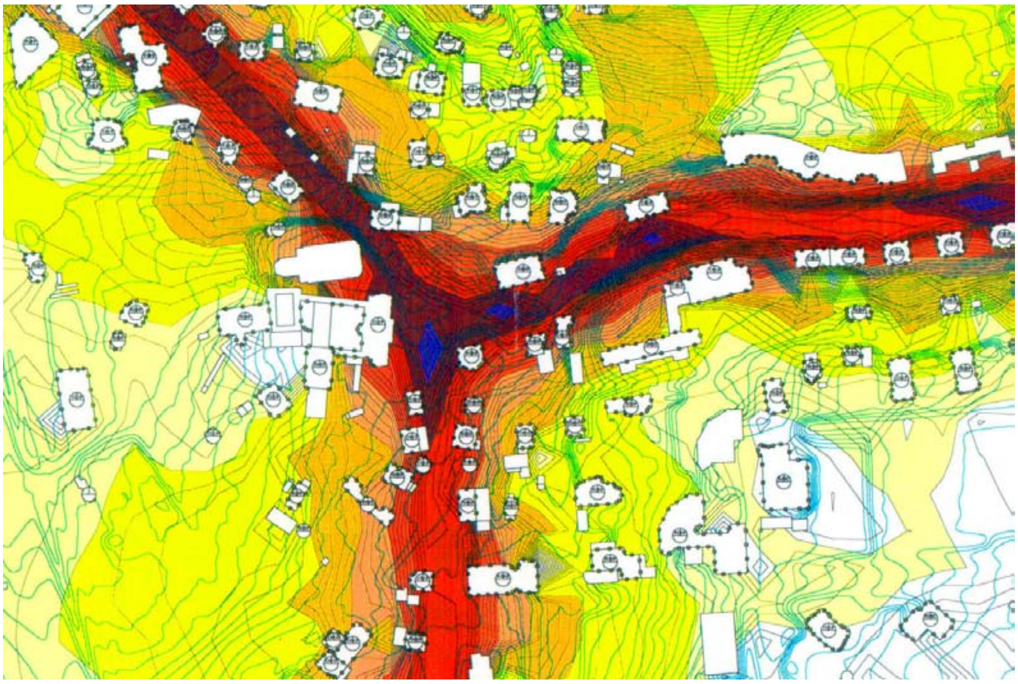

Abbildung 3: Plan der Lärmbelastung, aus einem 3D-Modell berechnet: die Abschattung durch die Gebäude ist gut ersichtlich (Reproduziert mit Bewilligung der Kantonalen Lärmschutzfachstelle Luzern)

2.3 Besonnungsanalyse

In der Raumplanung stellt sich immer wieder die Frage, welche Flächen für welche Nutzung auszuscheiden sind. Wie bereits im vorangehenden Kapitel ersichtlich ist Verkehr und Lärm ein Kriterium. Ein weiterer Punkt bei der Beurteilung eines Standortes ist die Besonnung. Während für industrielle und gewerbliche Nutzung auf sonnige Standorte verzichtet werden kann, sind Wohnzonen viel sensibler. Die Besonnung lässt sich mit dem DOM für einen beliebigen Ort und für jeden beliebigen Zeitpunkt rechnen und kann damit die Nutzungsplanung optimieren.

Durch die hohe Auflösung des DOM kann aber auch die Besonnung eines einzelnen Gebäudes analysiert werden: bei Neu- und Umbauten ist die Energiebilanz dank „Energie 2000“ und viel Forschung im Bereich Minergie ein wichtiges Thema. Für die Berechnung der externen Wärmezufuhr liefern Informationen über die potentielle Sonneneinstrahldauer einen wichtigen Beitrag.

Weiter kann die Besonnungsanalyse natürlich auch die Bewertung einer Liegenschaft beeinflussen. Bei einer Feldbesichtigung im Sommer ist für ein potentieller Käufer nicht einfach zu beurteilen, wie hoch die Sonne im Winter steigt und ob dass Nachbarhaus damit ein „Hindernis“ darstellt oder eben nicht.

Abbildung 4: Schattenwurf im Sommer – grün, bzw. Winter –grau. (Reproduziert mit Bewilligung des Kantonalen Vermessungsamtes Luzern)

2.4 Sichtbarkeitsanalyse

Die dichte Besiedlung der Schweiz erschwert das Baubewilligungsverfahren insbesondere bei Grossprojekten massiv, da bei fast jedem Standort ein oder mehrere Nachbarn das Gefühl haben, vom Projekt tangiert zu werden. Im Gegensatz zu Ausbreitungen von Luftschadstoffen, welche durch schwankende Wetterlagen nicht präzis modelliert werden müssen/können, spielt sich die visuelle Einwirkung mehr als schwarz/weiss-Abfolge. Entweder kann der Bau gesehen werden oder eben nicht. Damit einher geht bei Bauten mit Lärmemissionen auch eine tendenziell höhere Belastung, falls die Sicht zum Objekt nicht verdeckt ist. Die Höhenmodelle können in verschiedenen Kombinationen eingesetzt werden, um die Sichtbarkeit eines Objektes aus jeder Lage zu analysieren. Umgekehrt kann natürlich auch berechnet werden, von wo ein Point of Interest gesehen werden kann, also wo sehe ich das Feuerwerk am besten, von welchem Standpunkt kann ich am meisten Sehenswürdigkeiten einer Stadt sehen?

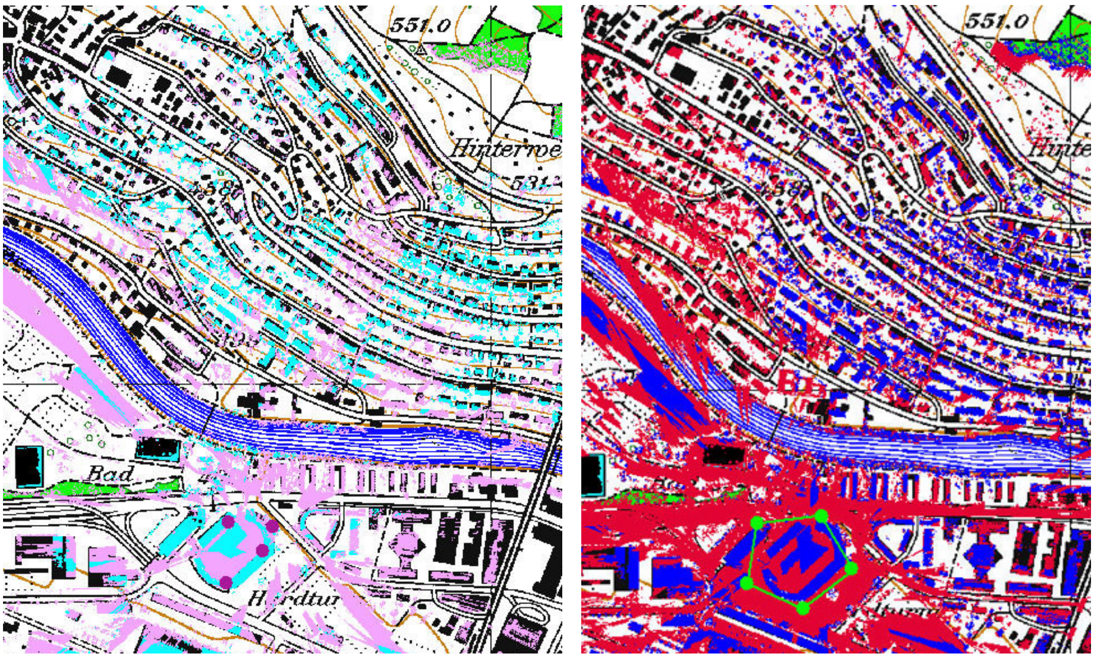

Abbildung 5: Sichtbarkeit alter (links) bzw. neuer Bau. rot teilweise, blau: vollständig sichtbar (Reproduziert mit Bewilligung der swisstopo, BA035772)

2.5 Siedlungsmodelle und Stadtplanung

Aus der Kombination von zweidimensionalen Situationsdaten der Katastervermessung mit den neuen digitalen Geobasisdaten DOM und DTM können kostengünstig hochgenaue, dreidimensionale Gebäudemodelle erzeugt werden. Dabei können verschiedene Detaillierungsstufen unterschieden werden:

- Kubus: Hoher Automationsgrad bei der Erstellung, d.h. kostengünstig, aber wegen der mangelnden Dachformen wenig realitätsnah.
- Grobdachform: bei der Erstellung manuelle Bearbeitung erforderlich, realitätsnah
- Detaildachform: Die Dachdetails können entweder photogrammetrisch, terrestrisch oder durch eine zusätzliche Laserbefliegung mit höherer Punktdichte ergänzt werden.

Die Detaillierungsstufen können beliebig kombiniert werden. Das heisst, werden in einer Initialphase Kuben erstellt, kann ihr Detaillierungsgrad später verfeinert werden. Oder anders ausgedrückt, die anfängliche Investition in ein einfaches Modell wird geschützt durch die weitere Verwendung und Verfeinerung des Modells.

Die Gebäudemodelle können in Kombination mit dem DTM und einem Orthophoto (Textur) für Visualisierungen verwendet werden. Bereits günstige Tools bieten die Möglichkeit, beliebige Szenerien zu generieren, so dass Standort, Sichtwinkel und Wetter/Licht der Realität möglichst nahe kommt. Daraus lassen sich Einzelbilder oder aber ein Überflug über ein Gebiet von hohem raumplanerischem Interesse berechnen.

Abbildung 6: Kombination von Gebäudemodellen aus DOM, True Orthophoto und DTM

Neben dieser rein visuellen Anwendung können aus den Gebäudemodellen auch die Volumen gerechnet werden. Dazu sind die Wände mit dem Gelände zu verschneiden und der Gebäudefusspunkt ist zu berechnen. Für den Grundriss des Körpers werden die Daten aus der Katastervermessung verwendet. Je nach Detaillierungsstufe kann eine Abschätzung über das Gebäudevolumen einer ganzen Stadt gerechnet oder eben genauere Angaben pro Einzelgebäude bestimmt werden. Mit den Volumeninformationen wird parzellenscharf oder über eine ganze Zone die Baumassenziffer gebildet. Dabei kann auch zwischen Flach- und Schrägdächern unterschieden werden.

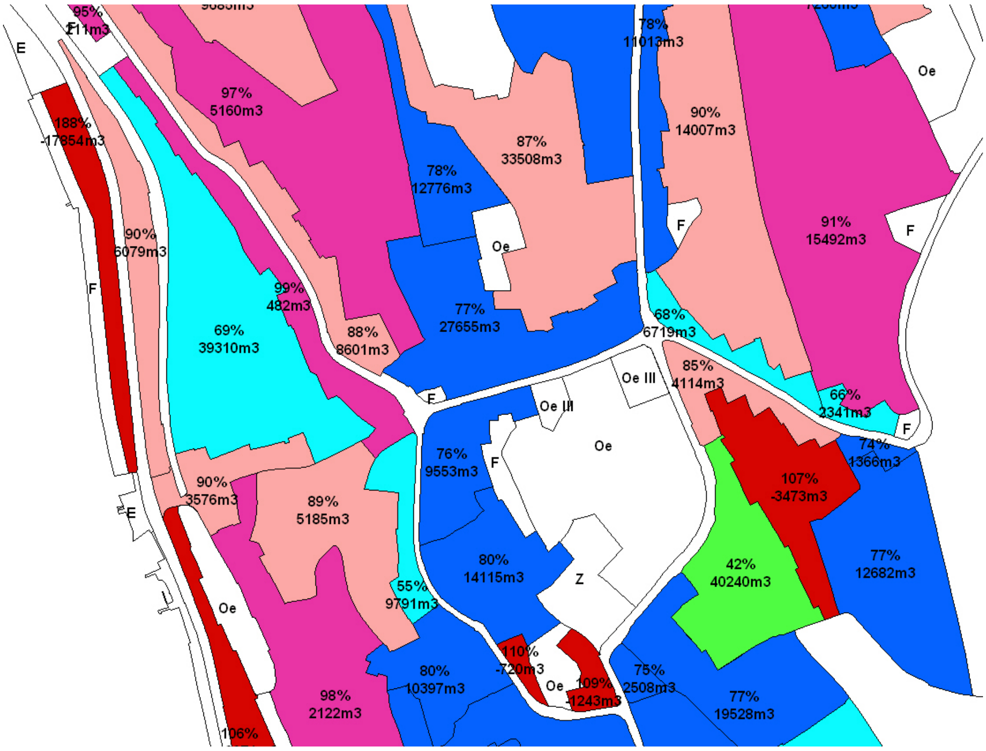

Abbildung 7: Aktueller Bebauungsgrad als Verhältnis von effektiver zu erlaubter Baumassziffer, berechnet aus Gebäudemodellen (DOM-AV) und Zonenplan. Auf der zweiten Zeile ist das noch verfügbare Volumen pro Zone angeschrieben. (Reproduziert mit Bewilligung der Gemeinde Zollikon)

3 NUTZEN DER NEUEN GEOBASISDATEN

Die neuen Geobasisdaten DTM und DOM, welche dreidimensional und digital vorliegen, erlauben es, bestehende Aufgaben besser, kostengünstiger und in kürzerer Zeit zu lösen als es die herkömmlichen Möglichkeiten erlaubten. In der Regel liefern genauere Modelle auch realitätsnähere Ergebnisse im Zusammenhang mit Untersuchungen, Simulationen und Darstellungen. Digitale Modelle, welche der Realität nahe kommen, erfordern weniger Feldarbeiten und helfen somit Kosten sparen. Die Verfügbarkeit digitaler Daten ist in der Regel höher als Ergebnisse konventioneller Methoden und hilft dadurch, Arbeitsprozesse zu beschleunigen. Die DTM und DOM sind genau, aktuell, homogen und zuverlässig. Dank dem Umstand, dass sie der Amtlichen Vermessung gehören, ist mittelfristig auch ihre laufende bzw. periodische Nachführung gewährleistet.

Gleichzeitig sind die Kosten für Hardware gesunken und die Kapazitäten und Möglichkeiten der Rechnersysteme (Prozessoren, Arbeitsspeicher und Grafikkarten) massiv gestiegen, so dass die Simulation auf Standard-PCs durchgeführt werden können. Diese Kombination von Hardware und verfügbaren Daten bieten ein grosses Potential für die Planung der Siedlungs- und Landschaftsentwicklung.

Das Systemkonzept zum Verkehrsdatenverbund Wien im Rahmen des Wiener Verkehrsmanagements

Rainer HASELBERGER

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Rathausstrasse 1, 1082 Wien, har@adv.magwien.gv.at

1 AUSGANGSLAGE

Es ist zu erwarten, dass die weitere Zunahme der Motorisierung, das wirtschaftliche Wachstum, die weitere Ansiedlung von Betrieben in den Stadtrandgemeinden, die Osterweiterung der EU, die weitere Zersiedelung des Umlands und nicht zuletzt Verhaltensänderungen, die sich aus der Entwicklung und Verbreitung neuer Kommunikationstechnologien ergeben, die Nachfrage nach Verkehrsleistungen weiter erhöhen wird. Dies trifft sowohl auf den Personen-, als auch auf den Güterverkehr zu. Eine Trendumkehr ist nicht in Sicht.

Gleichzeitig ist eine Ausweitung der Verkehrsinfrastruktur in einem dieser Zunahme entsprechenden Ausmass nicht möglich, das heisst die Schere zwischen Angebot und Nachfrage geht immer weiter auf. Infrastruktur ist teuer und das Angebot muss optimal genutzt werden. Folglich ist danach zu trachten, durch Einsatz der neuerdings verfügbaren Technologien zur Telekommunikation und Informationsverarbeitung eine möglichst effiziente Nutzung des bestehenden Kapitals zu erreichen.

In Wien sind seit 40 Jahren umfangreiche Einrichtungen zur Betriebsabwicklung der verkehrsbetreibenden Organisationen entstanden, so die Verkehrsleitzentrale der Stadt Wien und der Polizei, das Rechnergestützte Betriebsleitsystem der Wiener Linien, die Elektronische Fahrplanauskunft des Verkehrsverbundes Ostregion usw. Diese Einrichtungen haben sich bewährt, eine übergreifende Managementebene fehlt jedoch.

1.1 Der Masterplan Verkehr 2003 der Stadt Wien

Im Jahr 2003 hat die Wiener Stadtplanung über Auftrag des Herrn StR Dipl.-Ing. Schicker im Dialog mit den Bürgern einen Masterplan Verkehr erarbeitet, der die Anpassung des Verkehrskonzepts 1994 an die geänderten Rahmenbedingungen darstellt und die Entwicklungsrichtung für die nächsten zwanzig Jahre vorgibt.

Als zentrale Grundsätze wurden die folgenden Begriffe eingestuft, die unter dem Motto „Intelligente Mobilität – G'scheit unterwegs", die Richtung der Verkehrsentwicklung in der Region bestimmen sollen:

- Nachhaltigkeit, vor allem durch Beeinflussung des Modal Split[1],
- Innovation,
- Kooperation,
- Akzeptanz und
- Effektivität.

Im Sinne dieser Grundsätze wurden Handlungsschwerpunkte definiert, die neben U- und S-Bahnausbau, Verbesserung der Sicherheit, Logistik-Kompetenz, Radverkehrsförderung usw. auch die „Mobilität mit System" umfasst, nämlich den Aufbau eines umfassenden Verkehrs- und Mobilitätsmanagements in der Region.

Der Schwerpunkt „Mobilitätsmanagement" zielt darauf ab, dass Wien in 10 Jahren über ein modernes, intermodales und regionales Verkehrsinformationssystem verfügt. Einerseits soll damit eine intermodale Steuerung des Verkehrssystems auf der Makroebene durchgeführt werden, andererseits eine Mobilitätsberatung angeboten werden. Beide Massnahmen sollen nicht an den Grenzen der Verkehrsunternehmungen und den territorialen Grenzen enden.

2 DAS PROJEKT VEMA – VERKEHRSMANAGEMENT FÜR DIE REGION WIEN

Bereits im Jahre 2000 wurde die Magistratsabteilung 46 (MA 46 –technische Verkehrsangelegenheiten) durch die Baudirektion (MD BD) mit der Durchführung des Projekts Vema (Verkehrsmanagement) beauftragt.

Als Zweck desselben wurde die „Intelligente, umwelt- und sozialverträgliche Regelung (Steuerung) des Verkehrsverhaltens in Wien als Lebensraum und Wirtschaftsstandort nach den Vorgaben des STEP (Verkehrskonzeptes)[2]" vorgesehen, und zwar „durch Verstärkung des positiven Trends des Modal Split in den Innenbezirken und zumindest Stabilisierung in den Aussenbezirken".

Daraus wurden folgende strategischen VEMA-Ziele abgeleitet:

- **Information und Bürgerservice**: Ein gemeinsames Verkehrslagebild soll zu einer optimalen Nutzung der teuren Infrastruktur führen
- **Optimale Steuerung auf Makroebene**: Das Verkehrssystem ist ein vernetztes System, in dem die einzelnen Teile optimal aufeinander abgestimmt werden müssen, ohne die dezentrale Steuerungshoheit und -verantwortung der beteiligten Verkehrsunternehmen zu durchbrechen,

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[1] Anteil des Öffentlichen Personenverkehrs (ÖPNV) an allen Wegen im Personenverkehr in %. Angestrebt wird ein Anteil des Umweltverbundes (Fuß-, Rad-, ÖPNV) von 75% bis 2020.

[2] und des Masterplans Verkehr 2003, der zum Zeitpunkt der Zielfestlegung noch nicht in Bearbeitung war.

- **Umweltschutz und Nachhaltigkeit**: können nur durch Monitoring des Verkehrssytems sicher gestellt werden.
- Störfallmanagement und Erhöhung der **Sicherheit**
- **Regional – intermodal**: Die schlummernden Reserven des Verkehrssystems können nur durch Überschreiten der modalen und regionalen Grenzen nutzbar gemacht werden. Während bei den einzelnen Verkehrsträgern die laufende Verbesserung von Betrieb und Kundenservice umgesetzt werden, gibt es intermodal und regional weder die institutionelle noch die technische Basis für die Optimierung des Betriebs des Gesamtsystems „Mobilität in der Region".

3 WAS IST VERKEHRSMANAGEMENT?

Verkehrsmanagement ist der **Einsatz der Informations- und Kommunikationstechnologien zur Optimierung des Betriebs des Verkehrssystems** und die Schaffung der organisatorischen Voraussetzungen hiefür. Es handelt sich dabei um eine neue Aufgabe der Öffentlichen Verwaltung, bei der nicht Profite als Effektivitätsmassstab heran zu ziehen, sondern die gesellschaftlichen und wirtschaftspolitischen Zielsetzungen durch optimale Nutzung der Potentiale des Verkehrssystems umzusetzen sind.

3.1 Begriffe

Folgende Begriffe sind im Umfeld des Verkehrsmanagements von Relevanz und werden im Folgenden mit der folgenden Bedeutung verwendet:

Verkehrslage: Zustand des Verkehrssystems zu einem bestimmten Zeitpunkt/in einem Zeitraum

Verkehrslagebild: Abbildung und Bewertung der Verkehrslage aus Sicht verkehrspolitischer Ziele für die Verkehrsmanagementorgane und Verkehrsteilnehmer.

Verkehrsprognose: Extrapolation der Verkehrslage in die nahe Zukunft unter Zugrundelegung von Trends, historischen Daten und Modellen und Abbildung in einem Verkehrslagebild - Prognose.

Verkehrsmodell: Generierung von makroskopischen netzbezogenen Verkehrsplanungskenngrössen (JDTV) durch Modellierung von charakteristischen Verhaltensmustern im Personenverkehr. Aufgrund der Unschärfen für kurzfristige Prognosen zu ungenau.

Verkehrsdatenverbund: Ein Systemverbund zum Betrieb eines virtuellen, digitalen Abbildes aller in den beteiligten Verkehrnetzen gemessenen bzw. errechneten (prognostizierten), auf das Verkehrsbezugssystem bezogenen, aktuellen Verkehrskenngrössen. Stellt die für die Erzeugung, Kommunikation und Darstellung des Verkehrslagebildes erforderlichen Ressourccen, Daten und Funktionen bereit.

Verkehrsbezugssystem: Das intermodale Referenznetz für alle verkehrsflussrelevanten Ereignisse und Maßnahmen Es bildet das gesamte Verkehrsnetz (ÖV, IV, Radverkehr, Fusswege soweit zweckmässig) der Region ab und stellt die zentrale Lokalisierungs-Referenz aller im Verkehrsnetz stattfindenden Ereignisse und Massnahmen dar. Jedes relevante Infrastrukturobjekt muss in diesem System eindeutig und unveränderlich identifiziert werden können, damit ihm in den Datenbanken verkehrstechnische Eigenschaften (Fachinhalte, Sachdaten) zugeordnet werden können, und es mit anderen Objekten in Beziehung gesetzt werden kann.

Störungs- und Massnahmenkataster: Der Störungskataster ist eine auf dem Verkehrsbezugssystem Wien aufsetzende Datenbank, in der alle vorhersehbaren bzw. bekannten, verkehrsrelevanten Störungen im Verkehrsnetz zentral erfasst, verwaltet und abgestimmt werden können. Er beinhaltet die Werkzeuge zur raum-zeitbezogenen Erfassung, Auswertung und Darstellung durch den Genehmiger, Verursacher, Überwacher.

3.2 Prozess des Verkehrsmanagements

Ein erfolgreiches Verkehrsmanagement setzt zumindest folgende Schritte voraus:

Erstellung eines aktuellen **Verkehrslagebildes** auf der Grundlage eines intermodalen Verkehrsbezugssystems

Ableitung einer **Verkehrslageprognose** daraus.

Bewertung bezüglich der angestrebten Qualitätsvorgaben (LOS, Verspätungen, Energieverbrauch, Sicherheit, ...).

Ableitung von **Strategien und Massnahmen**-Szenarien

Simulation von deren Umsetzung

Erarbeitung von **Steuerungsvorschlägen** an die Verkehrsträger, die diese im Rahmen ihrer dezentralen Steuerungsverantwortung umsetzen, oder deren Ablehnung diese begründen müssen.

Kontrolle des Steuerungserfolges durch Analyse der Verkehrslageentwicklung.

Im Endausbau muss die Organisation und Technik des Verkehrsmanagements alle diese Schritte unterstützen. Der Ausbau erfolgt sukzessive.

3.3 Arten von Verkehrsdaten

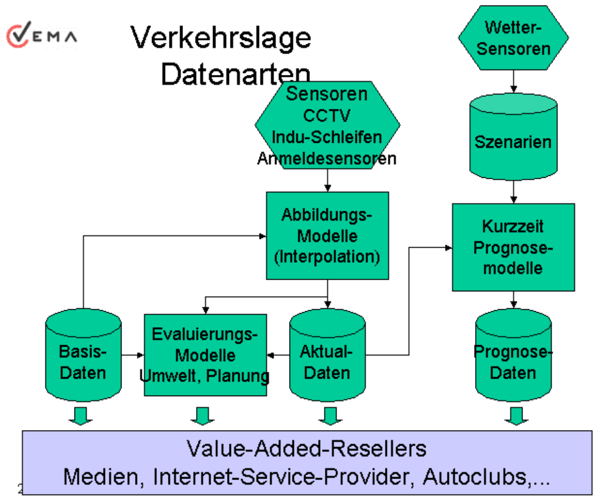

Abb.1: Datenarten Verkehrslagebild

3.4 Vema-Teilprojekte

Als erster Schritt zum Verkehrsmanagement werden in der laufenden Analyse- und Konzeptphase folgende Projektteile bearbeitet:

1. Organisationskonzept
2. Verkehrsleitzentrale Wien
3. Systemkonzept zum Verkehrsdatenverbund

Daneben werden einige Unterprojekte (Parkleitsystem, Ausbau der Dauerzählstellen, Floating Car Data,...) betrieben, auf die nicht näher eingegangen werden soll.

3.4.1 Organisationskonzept

Integratives Verkehrsmanagement ist aus unserer Sicht vor allem anderen ein neues Instrument der Verkehrspolitik. Es bezweckt durch den Einsatz von Information, Preis und Zwang Verhaltensänderungen bei den Mobilitätsakteuren.

Neben dem staatlichen Verkehrsmanagement entwickeln sich unter dem Titel Verkehrstelematik rasant Märkte für Informationsleistungen und Verkehrsleistungen, die zum Teil in Konkurrenz/Widerspruch zu den politischen Zielvorgaben stehen. Dieser Wettbewerb zwischen individuellem Vorteil und gesellschaftlicher Zielsetzung muss erst ins Gleichgewicht kommen und ist momentan Gegenstand umfassender Diskussionen:

- Wer hat Zugang zu welchen Informationen?
- Wer trägt die Verantwortung für die Informationsnutzung (der Markt - die Politik)?
- Wer verteilt zu welchen Konditionen die Information?
- Welche Institutionen und welche Modelle kommen zur Anwendung (staatlich – halbstaatlich – privat) und
- Welche Ressourcen sind erforderlich, um die Informationen zu sammeln und zu verwalten und welche vertraglichen Festlegungen sind in welcher Form zu treffen?
- Welche Kosten, Nutzen und Erträge entstehen im Verkehrsmanagement/in der Verkehrstelematik und wer sind die Nutzniesser und Kostenträger (Grundversorgung – Value Added Resellers)?
- Was sind die Kriterien zur Messung von Effektivität und Effizienz des Verkehrsmanagements?

Um diese Fragen zu klären, wird ein Organisationskonzept entwickelt, das die Basis für eine umfassende Verkehrsmanagementorganisation bilden soll und die Organisations- und Kommunikationsstrukturen formal absichert.

Im Rahmen des Organisationskonzepts ist geplant, dass sich die folgenden Projektpartner in nächster Zeit auf die gemeinsame Erarbeitung eines Verkehrsmanagement-Konzepts zum Aufbau eines gemeinsamen Verkehrslagebildes und einer gemeinsamen Arbeitsgruppe zur Erarbeitungen von Koordinierungsstrategien festlegen:

- Länder Wien, Niederösterreich und Burgenland
- Polizei (Bundesministerium für Inneres - BMI, Bundespolizeidirektion Wien)
- Bundesministerium für Verkehr, Innovation und Technologie (BMVIT)
- Österreichische Bundesbahnen (ÖBB – Netzinfrastruktur)
- Autobahnen- und Schnellstrassen-Finanzierungs AG (ASFINAG)
- Wiener Linien

- Verkehrsverbund Ostregion (VOR)

3.4.2 Verkehrsleitzentrale Wien

Nach vierzig Jahren Dauerbetrieb und dem Anschluss von mehr als 1000 Lichtsignalanlagen ist die Hard- und Software der Wiener Verkehrsleitzentrale den neuen Technologien und Schnittstellen anzupassen. Hierzu wird zur Zeit die Neugestaltung ausgeschrieben, die in den kommenden Jahren umgesetzt werden wird.

Der bisher bereits konsequent verfolgte Weg der Bevorrangung des Öffentlichen Verkehrs soll fortgesetzt werden.

Ein wesentlicher Teil der Neuerungen wird die Darstellung des Verkehrslagebildes in der Verkehrsleitzentrale betreffen.

3.4.3 Verkehrsdatenverbund

Erste operative Massnahme des Verkehrsmanagements ist der Aufbau eines intermodalen und regionalen Verkehrsdatenverbunds, der dazu dienen soll, alle verkehrsrelevanten Informationen in allen Modus verorten und kommunizieren zu können.

Der Verkehrsdatenverbund ist ein wesentlicher Baustein des Verkehrsmanagements für die Region Wien und Voraussetzung für die volle Inbetriebnahme der Wiener Verkehrsleitzentrale.

4 DAS SYSTEMKONZEPT FÜR DEN VERKEHRSDATENVERBUND DER REGION WIEN

Das „Systemkonzept für den Verkehrsdatenverbund (1. Ausbaustufe)“ soll aufbauend auf den Ergebnissen der Erhebung des für das Verkehrsmanagement erforderlichen Verkehrsdatenbedarfs und -angebots in der Studie „Tiefenerhebung der verkehrsrelevanten Datenbestände für Wien 2002“ die Architektur einer ersten Ausbaustufe des Verkehrsdatenverbundes Wien (Vienna Region) und die zu seiner Erstellung und Fortführung erforderlichen Schritte spezifizieren. Das Systemkonzept soll folgende Fragen beantworten:

- Wie soll der Verkehrsdatenverbund aufgebaut sein und wie sollen die Daten verwaltet werden?
- In welchen Prozessen werden die Daten erfasst, übergeleitet, gepflegt, weitergegeben und genutzt?
- Wie kann/soll die organisatorische und wirtschaftliche Struktur des Verkehrsdatenverbunds (am Ende der 1. Ausbaustufe) aussehen und in welcher Form kann der Datenverbund zweckmässig und wirtschaftlich betrieben werden, und welche Ressourcen sind für Erstellung und Betrieb erforderlich?
- Wie sind die Projektpartner zu beteiligen?
- Welche Produkte und Leistungen werden durch den Verkehrsdatenverbund dem Magistrat, den Projektpartnern und externen Kunden zu welchen Kosten zur Verfüghung gestellt?

Nicht zuletzt sollen die Ergebnisse des Systemkonzepts Grundlage für das Vergabeverfahren der ersten Realisierungsstufe sein.

4.1 Zweck des Verkehrsdatenverbundes

Er bezweckt die Vorhaltung eines modale und territoriale Grenzen überschreitenden, aktuellen, dynamischen, vollständigen **Integrierten Verkehrslagebildes** für den Raum Wien zum Zwecke der Verkehrsinformation, des Verkehrsmanagements und der Verkehrsplanung innerhalb der für die jeweilige Ausbaustufe festgelegten räumlichen Grenzen.

Er schafft die notwendige Voraussetzung, dass Daten für mobilitätsrelevante Informationen zukünftig in einem einheitlichen Format erhoben, referenziert und gespeichert werden.

Bei der Konzeption des Verkehrsdatenverbundes ist zu beachten, dass neben der Verkehrsinformation und dem Verkehrsmanagement auch Aufgaben der

- Verkehrsorganisation und Abwicklung von verkehrsrelevanten Verfahren (Verordnung definitiver Maßnahmen im Straßenbereich, Genehmigungen von Baustellen, Veranstaltungen,...),
- Stadtplanung und Regionalplanung, Infrastrukturplanung,
- Optimierung der Disposition von straßengebundenen Diensten (Straßenreinigung, Rettung, Feuerwehr,...)
- Vertretung der Wiener Interessen bei übergeordneten Organisationseinheiten (Bund, EU, PGO, VOR)
- Umweltschutz und Umweltmonitoring (Lärm, CO_2, O_3)
- Prüfung von politischen Zielvorgaben (StEP, Verkehrskonzept, Bezirkskonzepte,...)
- Vergleich im internationalen Rahmen (Best Practice evaluation)
- Katastrophenvorsorge
- u.a.m.

unterstützt werden können, wobei jedoch das Verkehrsmanagement bei der Konzeption im Vordergrund steht.

4.2 Teilsysteme

Das Systemkonzept hat folgende Teilsysteme zu behandeln:

1. Verkehrsbezugssystem in der o.a. Definition
2. Verkehrslagebild auf der Basis von 1.

3. Störungs- und Massnahmenkataster auf der Basis von 1.

Das Systemkonzept hat für jedes dieser Teilsysteme zu analysieren und zu planen, ohne jedoch die Implementierung vorwegzunehmen:

- **Anforderungsanalyse** und Abgrenzung der Ausbaustufe 1.
- **Prozessanalyse**: Analyse der zur Führung und Nutzung der Ausbaustufe 1 erforderlichen massgeblichen IST-Prozesse und die daraus abgeleiteten SOLL-Prozesse.
- vollständige Logische **Objekt- und Datenmodelle** für die in der Ausbaustufe 1 erforderlichen Objekte und Attribute, die auch die Abbildung von Geometrie und Topologie beinhalten, sowie die Definitionen und Regelsätze.
- **Funktionalität** für Erfassung, Wartung und Nutzung.
- **Datenschnittstellen**, deren Protokolle und Formate
- **Leistungen und Produkte**, Schnittstellen
- **Abgrenzung von Arbeitspaketen** und Terminplan für die stufenweise Realisierung

4.3 Das Verkehrsbezugssytem Wien (VBW)

In seiner technischen Ausprägung ist das Verkehrsbezugssystem ein topologisch vollständiger, gerichteter und mit grundlegenden Attributen der Befahrbarkeit und Begehbarkeit bewerteter Netzgraph, der alle linearen Einrichtungen und Knoten aller Verkehrsmodi mit Bedeutung für die Verkehrsabwicklung beinhaltet. Zur Darstellung der Eigenschaften des Graphen, zur Plausibilitätsprüfung und vor allem zu Navigationszwecken ist es erforderlich, nicht nur die Topologie, sondern auch die Geometrie des Netzes mit Mindestgenauigkeit abzubilden.

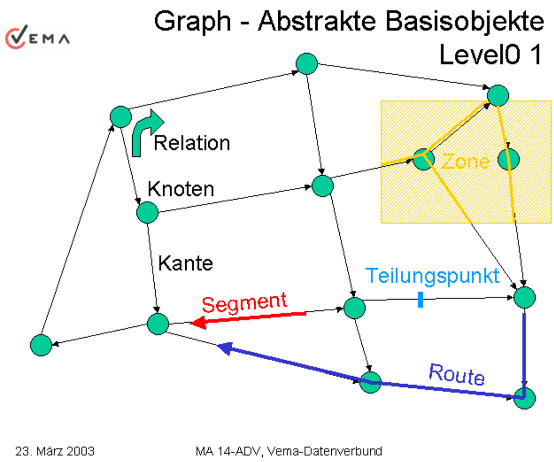

Abb. 2: Basisobjekte des VBW

Das Verkehrsbezugssystem soll als Referenzsystem für die Daten der folgenden Aufgabenstellungen dienen (demonstrative Aufzählung):

- Abbildung des Verkehrsnetzes
  - nach verkehrstechnischer Bedeutung bewertetes (Hauptstrassennetz, ÖV-Strecken im MIV),
  - vollständiges, aktuelles topologisches Abbild der modalen Netze und deren Übergangs- und Konfliktpunkte,
  - mit allen verkehrsfluss- und –steuerungsrelevanten Parametern der Netzinfrastruktur,
    - bautechnische Parameter (Fahrstreifenanzahl, Weichen, Umkehrschleifen,...)
    - signaltechnische Ausstattung (Signalanlagen und Verkehrszeichen,...)
    - betriebliche Parameter (Fahrplan, Umlaufzeiten bei VLSA,...).
  - muss in mehreren Generalisierungs-(Massstabs-)ebenen vorliegen, die einfach in einander übergeführt werden können, um das Netz sowohl für die Navigation und die Verortung von Baustellen, als auch für die strategische Verkehrsplanung einsetzen zu können,.
  - Schnittstellen zu regionalen Systemen (NÖ, VOR).
  - Datenhistorisierung
  - Modellierung in Abstimmung mit
    - bestehenden Normen, Industriestandards (OGC, GDF, ÖN A2260)
    - und den bei den Projektpartnern bestehenden Systemen
- Verortung von Messungen
- Kommunikation
- provisorische und definitive Massnahmen
- Verkehrsprognosen
- Verkehrslagebild

- Verkehrsmanagement
- strategische Verkehrsmodelle
- Navigation und Disposition
- Verkehrssicherheit
- Visualisierung

in Abstimmung und Verbindung zu folgenden Datenbeständen

- Räumliches Bezugssystem Wien – RBW (amtlicher Strassennamens- und Adressdatenbestand der Stadt Wien)
- Radwegenetz Wien der Magistratsabteilung 46
- VOR-Netz (auf Basis NavTexch) und elektronischer Fahrplan
- räumlich-verkehrliches Bezugssystem der Länder NÖ (Teleatlas) und Burgenland:
- räumliches Bezugssystem des Bundes-Verkehrswegenetzes (ÖBB, BMVIT-Bundesverkehrswegeplan, BEV-ÖK, Statistik Austria Gebäudeschlüssel,...)
- TEN-Netz der EU
- ASFINAG-Netz (Teleatlas)

4.4 Das Verkehrslagebild

Auf Basis des Verkehrsbezugssystems Wien ist für den Betrieb der Verkehrsleitzentrale und die Zusammenarbeit mit den Projektpartnern ein Verkehrslagebild zu definieren und die zu seiner Realisierung und seinem Betreb erforderlichen Institutionen, Prozesse, Funktionen und Datenstrukturen zu planen.

Zweck ist die Zusammenstellung und Einbindung aller jener Daten in einer gemeinsamen Datenbank und der zugehörigen Funktionen, die für den Betrieb der Verkehrsleitzentrale essentiell sind, oder in der VLZ anfallen und anderen Organisationen zur Verfügung gestellt werden können.

Darüber hinaus soll das Verkehrslagebild allen Projektpartnern die Möglichkeit geben, gegenseitig Daten über den aktuellen Netzzustand zur Verfügung zu stellen und abzurufen.

4.5 Der Störungs- und Massnahmenkataster

Über alle Erhebungslevel hinweg ist es für das Verkehrsmanagement unabdingbar, möglichst frühzeitig über alle erwarteten und eingetretenen Störungen Bescheid zu wissen. Hierzu ist ein Störungskataster zu führen, der von den zuständigen Behörden, aber auch von Privaten mit den erforderlichen Daten zu speisen ist.

Den datenerfassenden Stellen sind einfache Erfassungs- und Wartungsfunktionen zur Verfügung zu stellen, die auch in die behördlichen Standardabläufe integriert werden können.

Den genehmigenden und überwachenden Organen sind Funktionen zur Verfügung zu stellen, die ihnen die einfache Bewertung von Genehmigungen und Massnahmen erlauben.

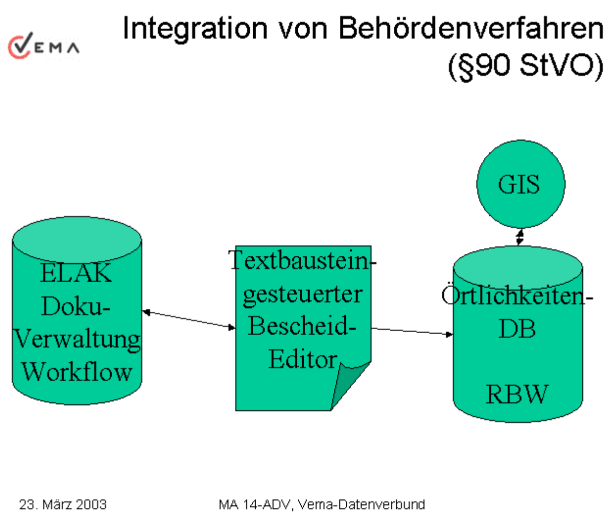

Abb. 4: Integration von Behördenverfahren

4.6 Businessplan

Alle geplanten Massnahmen sind in Varianten im Hinblick auf ihre wirtschaftlichen Wirkungen, die Finanzierung und Refinanzierung zu evaluieren. Hierzu ist auf Basis plausibler Annahmen ein Businesplan für den Verkehrsdatenverbund zu kalkulieren, dessen Ziel es ist, für die Periode von 4 Jahren die Aufwände und Ertragsaussichten für die Produkte und Leistungen abzuschätzen.

Der Businessplan hat zu beinhalten

- Organisationsmodelle und alternative Organisationsformen
- Aufwandsschätzung der Alternativen
- Produkte und Leistungen: Zielgruppen, Markt, Mengen
- Preisbildung
- Kostenumlegungsverfahren
- Finanzierungsmodelle

5 DIE HERAUSFORDERUNGEN

Die besondere Herausforderung bei den oben genannten Aufgabenstellungen besteht einerseits darin, dass der Verkehrsdatenverbund die Datenquellen aller Modi so zusammen führen soll, dass die bestehende Funktionalität erhalten bleibt, jedoch gleichzeitig überschaubar und wirtschaftlich wartbar bleiben soll. Durch die Zusammenführung der modalen Netze potenziert sich die Anzahl der Konfliktpunkte und die Mächtigkeit der Relationenmatrizen.

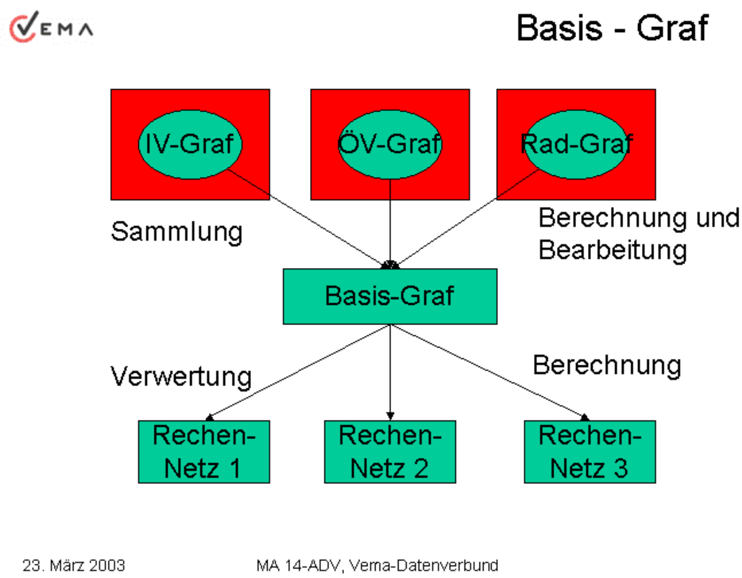

Abb. 3:Datenfluss

Die folgenden Probleme werden zur Zeit in den Arbeitsgruppen zum Systemkonzept intensiv diskutiert.

5.1 Problem Integration

Die Sammlung und Bearbeitung der Daten kann nur dann wirtschaftlich erfolgen, wenn die Daten möglichst frühzeitig - am Ort ihrer Entstehung - erfasst werden und der Weg von den Ursprungsdaten in den Verkehrsdatenverbund weitestgehend automatisiert werden kann. Für das Verkehrsbezugssystem heisst das, dass zumindest das RBW der Stadt Wien, der TeleAtlas-Graf, der Graf des VOR und der Radwegegraf der Stadt Wien integriert werden müssen. Diese Grafen unterscheiden sich zumindest in Bezug auf

- Topologie
- Geometrie
- Granularität (Massstab)
- Objektdefinitionen
- Objekt-Identitäten (Historie).

5.2 Problem Massstab

Die unterschiedlichen modalen Grafenbetreiber haben unterschiedliche Anforderungen an die Daten und sammeln ihre Daten dementsprechend in unterschiedlichen Datenmodellen und mit verschiedenen Auflösungen. Auch wenn die Topologie in der Theorie eine massstabsfreie Netzabbildung ist, ist der Aufnahmemassstab ein guter Indikator für die Granularität des Netzes (die Anzahl der Knoten je Flächeneinheit). Ein Basisgraf hat zwar in Bezug auf die Auflösung möglichst flexibel zu sein, jedoch ist aus wirtschaftlichen und zur Sicherung der erforderlichen Mindestqualität ein „Massstab“ festzulegen.

5.3 Problem Organisation und Wirtschaftlichkeit

Die neue Aufgabe „Verkehrsdatenverbund“ bedarf entsprechender organisatorischer und institutioneller Vorsorgen. Die Herausforderung besteht darin, Entscheidungsstrukturen zu schaffen, in denen alle Beteiligten gerecht beteiligt werden können und trotzdem die Produktivität nicht erlahmt.

Ein weiteres kritisches Erfolgskriterium besteht darin, die Architektur des Datenverbunds so zu entwerfen, dass seine Erstellung und Wartung möglichst mit Standardwerkzeugen erfolgen kann, da jede Spezialentwicklung und Anpassung hohe Kosten verursacht.

Schliesslich ist die Verwertbarkeit der Daten im Auge zu behalten, die erfordert, dass einheitliche Qualitätsmassstäbe an alle Teile des Datenverbunds gelegt werden können und der Benutzer eine über alle Modi gleichbleibende Auflösung und Qualität der Daten erhält. Auch ist fest zu legen, wie die Beiträge der beteiligten Organisationen bewertet werden und „gerecht“ abgegolten werden können.

Es ist davon auszugehen, dass der Basisgraf nicht in allen Fällen in der Lage sein wird, die Anforderungen an die Ursprungsgrafen zu erfüllen und diese somit vollständig ersetzen kann.

5.4 Aufruf zur Zusammenarbeit

Wir gehen davon aus, dass sich die Aufgabe der Einrichtung eines Verkehrsdatenverbundes mehreren österreichischen Städten in ähnlicher Weise mit den gleichen Problemen stellt. Weiters denken wir, dass gleichzeitig ähnliche Lösungen angedacht und realisiert werden, die die selben Fragen mit ähnlichen Definitionen und Funktionen beantworten und ähnliche Datenmodelle mit den fast gleichen Objekten erfinden. Aus diesem Grund würden wir es begrüssen, wenn sich im Rahmen der CORP 2004 die betroffenen Städte und die Vertreter der Wissenschaft und Wirtschaft zusammenfinden könnten, um einen gemeinsamen Rahmen für die Entwicklung einer gemeinsamen Strategie zum Aufbau einer umfassenden österreichischen Lösung aufzubauen.

6 QUELLEN UND LINKS

Stadt Wien, MA 46: Verkehrsmanagement Wien (VEMA)
Stadtentwicklung Wien, Magistratsabteilung 18 (Hg): Masterplan Verkehr Wien 2003,
TeleAtlas: MultiNet™, Shapefile 4.1 Format Specifications
Verkehrsverbund Ost-Region (VOR): Fahrplanauskunft [Literaturverzeichnis]

GABIS – Gemeindestrassenanalyse und Bewertung im GIS
Demonstration der Machbarkeit einer GIS-basierten Bewertung der Gemeindestraßen in den fünf Testgemeinden Hollenegg, Schwanberg, Semriach, Stanz im Mürztal und Wagna

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1 AUFGABENSTELLUNG

In der Verkehrsplanung hat das ländliche Straßennetz – Gemeindestraßen im ländlichen Raum, Erschließungswege, Güterwege – bislang wenig Beachtung gefunden. Die Bedeutung für den ländlichen Raum ist evident, stellt das Netz doch für Bevölkerung und Wirtschaft die Anbindung her; das ländliche Straßennetz der Steiermark umfasst 25.400 km, bedeutend mehr als das Landesstraßennetz (3.400 km).

Angesichts der budgetären Engpässe wird das ländliche Straßennetz in den kommenden Jahren mit geringeren Finanzmitteln als bisher auskommen müssen. Erhaltung und Ausbau des ländlichen Straßennetzes werden daher künftig eine klare, von den Gemeinden akzeptierte Einstufung erfordern, aus der Prioritäten abzuleiten sind oder Zuständigkeiten neu geregelt werden können.

Das ÖIR hat daher für die Fachabteilung 18D des Landes Steiermark ein Werkzeug entwickelt, mit dem das ländliche Straßennetz in der Steiermark wissenschaftlich objektiviert und landesweit einheitlich geplant werden kann. Die Untersuchung ging dahin, ob eine weitgehend automatisierte GIS-basierte Bewertung machbar ist, die den folgenden Zielen genügt:

- Bewertung des gesamten Gemeindestraßennetzes hinsichtlich funktionaler Bedeutung und Typisierung der Nutzer
- weitgehend automatisiert und daher kostengünstig
- nach objektiven Kriterien nachvollziehbar
- regional einheitliches, auf alle Gemeinden der Steiermark anwendbares Modell unter Einsatz von GIS
- Ermöglichung der Vergabe der Mittel für Straßenbau, Erhaltung und Unterhalt auf Basis von objektivierten Entscheidungsgrundlagen

Anhand einer Bearbeitung von fünf Testgemeinden konnte die Machbarkeit des Modells **G**emeindestraßen - **A**nalyse und **B**ewertung im **GIS** gezeigt werden. Die Demonstration fand als Desk Research in fünf Testgemeinden statt, die vor Ort auf Plausiblität kontrolliert wurden.

Die Testgemeinden repräsentieren unterschiedliche Raum- und Siedlungsstrukturen (Tabelle 1):

Gemeinde	**Kataster-fläche** km²	**Einwohner** 2001 (vorl.)	**Siedlungs-dichte (DSF)** EW/km²	**Arbeitsplätze** 1991	**Anteil Land- und Forstwi.** %	**Gästenächti-gungen** 2000
Hollenegg	17,56	2273	245,9	388	32,5	0
Semriach	60,36	3179	111,6	644	**53,4**	**19132**
Stanz im Mürztal	**76,91**	2052	96,8	319	**70,2**	4182
Schwanberg	12,00	2102	**404,5**	666	7,1	**17377**
Wagna	12,99	**5101**	**551,1**	**1285**	6,5	3374
Alle 5 Gemeinden	334,66	22211	167,3	4653	32,6	61061

Tab. 1: Testgemeinden und Strukturdaten (**Maximalwerte fett)**

Das ländliche Straßennetz in diesen Testgemeinden umfaßt 410,8 km. Auf einen Kilometer ländliches Straßennetz kommen zwischen 19 und 95 EW, das für die Erschließung der Einwohner erforderliche Straßennetz ist daher recht unterschiedlich groß und aufwändig.

2 MODELLAUFBAU

GABIS generiert Indikatoren zur Bewertung des ländlichen Straßennetzes, wobei soweit wie möglich mit Daten aus bestehenden Datenbanken das Auslangen gefunden werden konnte. Da keine einzelne Datenbank alle notwendigen Indikatoren zur Bewertung liefern kann, war eine Verknüpfung der unterschiedlichen Datensätze erforderlich (Tab. 2):

Datenquelle	Inhalte
Digitale Katastralmappe (DKM)	Grundstücksgrenzen, Gebäude, Häuser bewohnt/unbewohnt
Straßennetzgraph GIS-Stmk, FAbt. 18D	Netzgraph Bundesstraßen, Landesstraßen, ländliches Straßennetz
Straßendatenbank FAbt. 18D	Zuordnungen, Distanzen, Einstufungen
Erreichbarkeitsmodell Individualverkehr (ÖIR)	Kanten, Knoten österreichweit
Nutzung (DKM)	flächendeckend verbautes Gebiet (Polygone) sehr detaillierte Angaben zur landwirtschaftlichen Nutzung (*aber nicht innerhalb des Baulands)*
Flächenwidmung	Bauland: Gewerbliche Nutzung – Wohnnutzung Rohstoffvorrangzonen – naturräumliche Festlegungen wichtige öffentliche Einrichtungen: Feuerwehrrüsthäuser, Gendarmeriedienststellen, Gemeindeämter
Geocodierte Adressen (STATISTIK AUSTRIA und BEV)	Adressen mit Koordinatenzuordnung zu den Grundstücken/Gebäuden, Schnittstelle zu Volkszählungsdaten
Volkszählung 2001 (STATISTIK AUSTRIA)	Wohnbevölkerung nach Adressen
Digitales Geländemodell (BEV)	hoher Datenaufwand (derzeit nicht genutzt)

Tab. 2: Datengrundlagen

Um die Daten in Hinblick auf die Ziele verknüpfen zu können, mußten Teilmodelle neu entwickelt bzw. vorhandene weiter entwickelt werden:

- Modell Netzattributierung
- Modell Adresszuordnung
- Modell Bewertung

3 ATTRIBUTIERUNG STRASSENNETZ

Im Teilmodell NETZATTRIBUTIERUNG wird das Straßennetz attributiert, um mit einem kürzesten-Wege-Algorithmus die von Bevölkerung und Wirtschaft üblicherweise zurückgelegten Wege im Straßennetz im Modell simulieren zu können. Dazu werden die durchschnittlichen Fahrgeschwindigkeiten im Netz bestimmt. Das Wesentliche des Ansatzes ist die kostensparende automatische Berechnung, die auf vorhandene Datensätze zurückgreifen kann. Die Idee ist, die Geometrie des Netzes und die Flächenwidmung für die Attributierung der Fahrgeschwindigkeit zu verwenden.

In einem ersten Schritt werden in Abhängigkeit von der Straßenklasse Ausgangsgeschwindigkeiten definiert, diese in den folgenden Schritten mittels Kurvenradien und Anbaufreiheit reduziert. Die Kurvenradien der Straßen werden mittels eines Umwegfaktors berechnet, die durch Segmentierung der Straßenabschnitte automatisch aus der Netzgeometrie abgeleitet wird. Die Anbaufreiheit der Straßen wird über einen Puffer durch Verschneidung mit Nutzungsdaten ermittelt. Aus der getrennten Erfassung und Zuständigkeiten resultieren topologische Widersprüche, die in Einzelfällen eliminiert werden mußten (Harmonisierung der Datenbestände). Ergebnis des Teilmodells ist ein gerichteter Netzgraph, der das ländliche Straßennetz einer Gemeinde, eingebettet in einen landesweiten regionalen / überregionalen Netzgraph, abbildet.

4 ADRESSZUORDNUNG

Ein weiterer wesentlicher Schritt ist die GIS-basierte, automatisierte Zuordnung der Adressen zum Straßennetz. Im Modell ADRESSZUORDNUNG werden die Adressen des BEV zum Straßennetz automatisiert zugeordnet. Dabei wird von den Koordinaten der Adresse die kürzeste Distanz zum nächstgelegenen Straßenpunkt ermittelt; Weitere Kriterien (Maximaldistanz, Hierarchie der Straßen, Hindernisse im Gelände sowie Plausibilitätskontrollen sichern eine realistische Zuordnung). Am Beispiel der Gemeinde Semriach wird die realistische Zuordnung durch automatische Generierung der Kanten dargestellt:

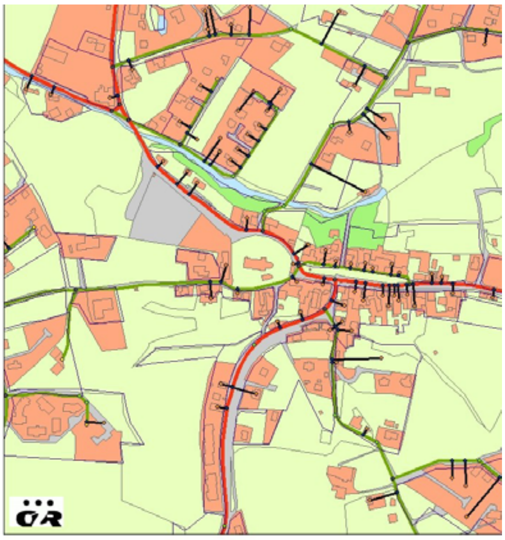

Abb. 1: Automatisierte Adresszuordnung zum Netz, Beispiel Ortszentrum Semriach

Die Bearbeitungen haben gezeigt, dass die Adresszuordnung und die Netzattributierung im kleinräumigen Bereich automatisch möglich ist, aber feine Meßgrößen – viele Straßenabschnitte und damit eine hohe Anzahl von Knoten und Kanten – erfordert.

Auch die Verfügbarkeit der Daten war zufrieden stellend. Auch wenn noch nicht alle Daten verfügbar waren, ist in absehbarer Zeit mit kompletten Datensätzen zu rechnen.

5 BEWERTUNG

Zur Bewertung des ländlichen Straßennetzes ist es notwendig, raumbezogene Indikatoren zu verwenden, wobei auf Vorarbeiten zurück gegriffen werden konnte[1]. Die Indikatoren stellen eine Weiterentwicklung einer älteren Untersuchung zur Funktionalen Bewertung des ländlichen Straßennetzes der Steiermark dar.

Die Indikatoren gehen von einem zentralörtlichen Ansatz aus, in dem einerseits auf die Daseinsgrundfunktionen der Bevölkerung (Arbeiten, Bildung, Versorgen) aufgebaut wird. So geht die Erreichbarkeit der Zentralen Orte von den Wohnorten der Bevölkerung maßgeblich ein[2]. Die Ansprüche der Wirtschaft werden über die Erreichbarkeit von Schnittstellen des hochrangigen Verkehrsnetzes dargestellt.

Nach Klärung der Verfügbarkeit der Indikatoren wurde ein Set von Indikatoren definiert. Die Standorte von Bevölkerung und Wirtschaft wurden lokalisiert, Zielpunkte (Points of Interest) identifiziert und in das Umlegungsmodell und im GIS implementiert. Die Verortung der Betriebe erfolgte über die Flächenwidmung, Zusatzinformationen wurden aus dem Internet sowie die ÖK 25.000; Ergänzend waren bei lediglich zwei Betrieben Telefonanrufe erforderlich, um ihren Standort zu lokalisieren. Es gelang, die Betriebs-standorte punktgenau zu verorten und im Modell zu berücksichtigen.

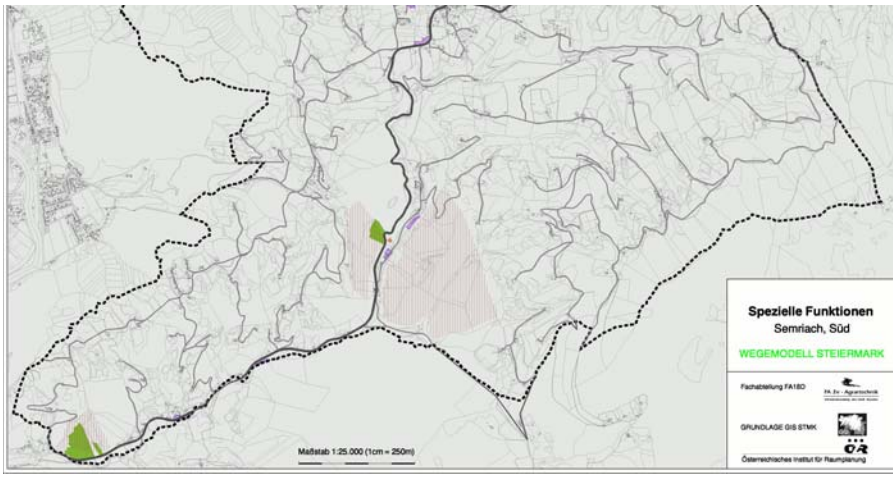

Abb. 2: Beitrag der Flächenwidmung am Beispiel Semriach, Südteil.
Betriebliche Widmungen (violett), Abbauflächen (grün), Rohstoffvorsorgegebiet (rot schraffiert)

[1] ÖIR, 1995. Funktionelle Einstufung des Steiermärkischen Straßennetzes.

[2] vgl. ÖROK, 200. Erreichbarkeitsverhältnisse im öffwentlichen Verkehr und im Individualverkehr. Schriftenreihe Nr. 155.

Funktionale Beziehungen werden zu Zielpunkten hergestellt. Zielpunkte oder Points of Interest sind Orte, die für die Erledigung grundlegender Bedürfnisse der Menschen und der Wirtschaft dienen. Mit ihrer Hilfe können modellhaft funktionale Beziehungen hergestellt werden, die über das Straßennetz laufen. Zielpunkte der Bevölkerung sind

- Zentrale Orte (Landeshauptstadt, Bezirkshauptort, Gemeindezentrum)
- Naturräumliche Zielpunkte
- Hotels, Pensionen
- (Ausflugs-)gaststätten

Zielpunkte der Betriebe sind:

- die nächste Autobahn- oder Schnellstraßen-Anschlußstelle, die in der Regel für die Gewerbe- und Industriebetriebe oder Rohstoffgewinnung die Anbindung an ihre Bezugs- und Ansatzmärkte herstellt,
- die nächste Güterverladestellen der Eisenbahn stellen für die Gewerbe- und Industriebetriebe oder Rohstoffgewinnung eine wichtige Anbindung an ihre Bezugs- und Absatzmärkte her.
- diese Auswahl ist nach Anforderungen und Datenlage auf straßennetzrelevante Zielpunkte erweiterbar (z.B. landwirtschaftliche Großbetriebe, Deponien, militärische Einrichtungen etc.).

Weiters wurden unmittelbar dem ländlichen Straßennetz zuzuordnende Indikatoren im Modell nicht berücksichtigt, könnten aber aufgrund der Datenlage in der Steiermark bereits berücksichtigt werden. So sind die Fahrtrouten der Schulbusse, der Müllsammelfahrzeuge und der Milchsammeltransporte in einer Straßendatenbank erfasst.

Kern des BEWERTUNGSMODELLS ist, dass die Bewertung der Abschnitte des ländlichen Straßennetzes durch Umlegung der Indikatoren auf das Netz erfolgt. Umgelegt werden Gewichte, die pro Wohnadresse und Betrieb vergeben werden. Um die zentralörtlichen Funktionen zu beschreiben, werden pro Wohnadresse 30 Punkte vergeben, je 10 pro Indikator:

	Funktion		**Indikator**	**Ermittlung**	**Gewicht**
1	Zentralörtliche Funktion	10	Landeshauptstadt	Erreichbarkeit der Wohnbevölkerung	10/EW
		1R	Regionales Zentrum (Bezirkshauptort)	Erreichbarkeit der Wohnbevölkerung	10/EW
		1G	Gemeindezentrum (Gemeindeamt)	Erreichbarkeit der Wohnbevölkerung	10/EW
2	Öffentlicher Verkehr	2F	Feuerwehrrüsthäuser	Erreichbarkeit der Wohnbevölkerung	10/EW
		2P	Park-and-Ride	Erreichbarkeit der nächsten Park-and-Ride-Anlage	10/EW
3	Wirtschafts-verkehr	3I	Industriebetriebe	Erreichbarkeit der nächsten ASt und Güterverladestelle	2000/Betrieb
		3G	wichtige Gewerbebetriebe	Erreichbarkeit der nächsten ASt und Güterverladestelle	1000/Betrieb
		3R	Rohstoffgewinnung	Erreichbarkeit der nächsten ASt und Güterverladestelle	2000/Betrieb
4	Tourismus und Freizeit	4A	Ausflugsziele	Erreichbarkeit der nächsten Bundesstraße	1000/PoI
		4B	Tourismusbetriebe (Hotels, wichtige Gasthäuser)	Erreichbarkeit der nächsten Bundesstraße	2000/PoI
		4N	Naturräumliche Anziehungspunkte	Erreichbarkeit der nächsten Bundesstraße	1000/PoI

Tab. 3: Indikatorengruppen und Indikatoren

Es wird davon ausgegangen, dass die Anzahl der Funktionen, die über einen Straßenabschnitt laufen, dessen Bedeutung repräsentieren. Dazu werden im Umlegungsmodell NETSIM die zeitkürzesten Wege zwischen Bevölkerung / Wirtschaft und den Zielpunkten berechnet. Ergebnis ist eine Zuordnung von Funktionen zum gesamten Straßennetz der Gemeinde:

Mit Hilfe eines Gewichtungsmodells wird die Größe der Gemeinde (Anzahl Einwohner, Betriebe) berücksichtigt. Durch Aufsummieren der Gewichte der einzelnen Indikatoren pro Straßenabschnitt wird das funktionale Gesamtgewicht errechnet.

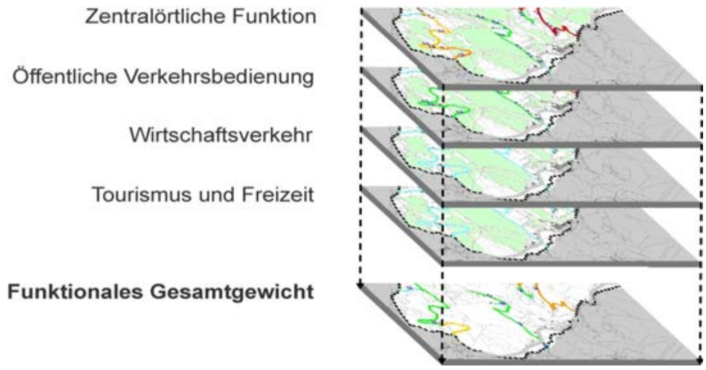

Abb. 3: Schema Funktionales Gesamtgewicht

Es kann daher – im Vergleich der Gemeinden standardisiert - die absolute Bedeutung eines Straßenabschnittes bestimmt werden. Um die deutlich höhere Belastung des Straßennetzes durch den Schwerverkehr zu berücksichtigen, wurde das Verhältnis der Funktionen von Bevölkerung und Betrieben wurde mit 1:100 festgelegt. Als Alternative wäre auch eine Gewichtung in Abhängigkeit von der Anzahl der Lkw-Fahrten oder der Beschäftigten der Betriebe denkbar.

	Indikatorengruppe	**Stanz**	**Semriach**	**Hollenegg**	**Schwanberg**	**Wagna**
1	Zentralörtliche Funktion	8.790	13.560	16.680	16.200	30.900
2	Öffentliche Verkehrsbedienung	5.860	4.520	11.120	6.300	15.450
3	Wirtschaftsverkehr	6.000	12.000	15.000	12.000	30.000
4	Tourismus und Freizeit	4.000	12.000	2.000	2.000	2.000
	Insgesamt	24.650	42.080	44.800	36.500	78.350

Tab. 4: Gesamtgewichtung des Straßennetzes der Gemeinden

Im ersten Schritt wird die vorherrschende Funktion eines Straßenabschnittes berechnet (Typisierung der Straßenabschnitte). Mittels Analyse der Anteile der Funktionen werden funktionale Typen der Straßenabschnitte gebildet und dargestellt. Das Funktionale Gewicht der Straße kann somit der Einstufung für eine Prioritätenreihung dienen.

Die Umlegung der Gewichte auf das Netz und ihre Zusammensetzung zeigt die folgende Darstellung:

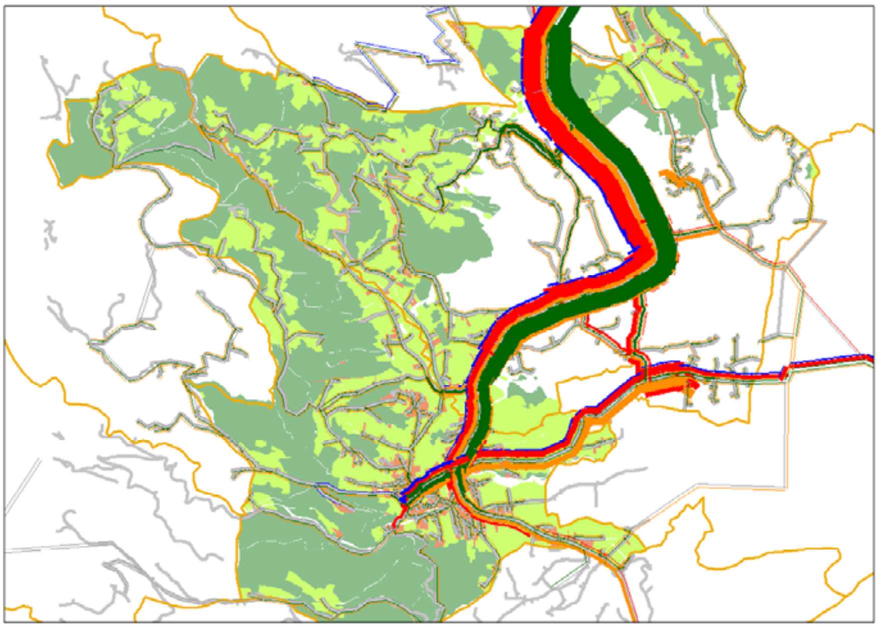

Abb. 4: Funktionales Gesamtgewicht: Gemeinde Hollenegg und Schwanberg

6 SCHLUSSFOLGERUNG

Die Arbeiten zeigten, dass ein umfassendes Modell, das Straßenzustand und Dringlichkeit sowie Raumbedeutung und Auswirkungen sowie Budgetsituation berücksichtigt und praktisch anwendbar ist, machbar ist. Die Ausgangsdaten sind quantitativ und qualitativ ausreichend. Nachbearbeitungen – vor allem die Harmonisierung der Datenquellen - sind erforderlich, der Aufwand hält sich gegenüber einer manuellen Bewertung jedoch in vertretbaren Grenzen.

7 ZUSAMMENFASSUNG

Die Erhaltung des ländlichen Straßennetzes (Gemeindestraßen, Güterwege) wird in Zukunft vor der Herausforderung stehen, mit geringeren Finanzmitteln als bisher auszukommen, um Bevölkerung und Wirtschaft ausgewogen erschließen zu können. Gefragt ist daher eine einheitliche, objektivierte und für alle Gemeinden akzeptable Bewertung des ländlichen Straßennetzes.

Das ÖIR hat im Auftrag des Landes Steiermark anhand von fünf Testgemeinden das GIS-basierte Modell GABIS zur Gemeindestraßenbewertung entwickelt.

Grundidee von GABIS ist, die Funktion der Straßen durch ein Umlegungsprogramm zu ermitteln, das die kürzesten Wege von Bevölkerung und Wirtschaft zu den points of interest bestimmt. Points of interest können zentrale Orte, Straßenanschlüsse, Bahnhöfe, touristische Zielpunkte u.a.m. sein.

Ein wesentliches Element von GABIS ist die automatisierte Bestimmung der Netzparameter, wofür

- die in der Landesverwaltung vorliegenden GIS-Daten (Widmungen, Nutzungen)
- die Straßendatenbank des Landes
- Adressdaten und
- das Erreichbarkeitsmodell des ÖIR verknüpft wurden.

Der Ausgabemaßstab kann entsprechend fein gewählt werden, die Ergebnisse können genau den Grundstücken bzw. Straßenabschnitten zugeordnet werden. GABIS könnte erstmals große Straßennetze mit vertretbarem Aufwand einheitlich funktional bewerten und damit eine wichtige Planungsgrundlage bilden.

8 ABSTRACT

The maintenance of the Rural municipal system (local roads, Rural and agricultural roads) will increasingly be confronted with the challenge to cope with less funding as previous to secure its function of providing access to the population and to the economy. Therefore the call for an evaluation is obvious, which evaluates the Rural road system in a standardised, objective way and secures the acceptance by the communities.

The Austrian Institute for Regional Studies and Spatial Planning (OIR) has developed GIS-based model GABIS for the Styrian Government, which evaluates the municipal road system in five test communities.

The underlying basic idea of GABIS determines the function of the roads by an assignment program, which identifies the shortest paths of population and economy to points of interest. Points of interest may be Central Places, road junctions, railway stations, tourist points and others.

Am essential element of GABIS is the automated determination of net parameters by linking

- GIS data available by the Land Government (zoning, land use)
- the road databank of the Land Government
- address data
- the OIR accessibility model.

A detailed scale may be chosen which allows the assignment of results to individual properties and to short road sections. GABIS could, in first time, evaluate the functions of large road networks in a standardised way and with justifiable cost.

Konsens durch Kommunikation
Chancen und Strategien für nachhaltige Lösungen bei Veränderungsprozessen in der Stadt- und Regionalentwicklung

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ABSTRACT

Jede Verhandlung, jede Zielvereinbarung ist im Kern konfliktär. Veränderungsprozesse, Fusionen, Restrukturierungen und dergleichen lassen die Konfliktpotentiale anschwellen. Im Zuge der Stadt- und Regionalentwicklung stellen sich der Realisierung von technologischen Großprojekten und größeren Bauvorhaben immer größere Widerstände entgegen.

Projektbetreiber, Politiker, BürgerInnen – alle wollen ihre Interessen durchsetzen.

Verschiedenste Interessensgruppen schließen sich gegenüber der Anonymität der planenden Instanzen zusammen. Die Folge dieser blockierenden Kommunikationsmuster sind langwierige oft jahrelange Berufungsverfahren und Zivilrechtsprozesse, sowie letztendlich zerstörte Beziehungen im sozialen Umfeld. Versuche entweder durch besonders diskretes Vorgehen oder umgekehrt durch umfangreiche bloße PR-Aktivität die Öffentlichkeit entweder zu umgehen beziehungsweise zu gewinnen, sind zum Scheitern verurteilt. Die beste Planung bleibt oft wirkungslos, wenn sie nicht erfolgreich kommuniziert wird. Je gegensätzlicher, schneller und komplexer die Planungs- und Entwicklungsaufgaben im Wettbewerb werden, um so notwendiger wird Konfliktregelungskompetenz. Die Kraft, die in derartigen Veränderungsprozessen steckt, bietet die Chance diese Energie zu kanalisieren und nachhaltige Lösungen zu erzielen.

Mediationsverfahren, mediationsähnliche Verfahren bzw. Verfahren mit mediativen Elementen können hier als Instrument der demokratischen Partizipation und des Konfliktmanagements in Gemeinden, Städten und Ländern – regional und überregional – eingesetzt werden. Die Lösungsfindung wird auf alle verteilt und die konsensualen Entscheidungen somit tragbarer gemacht. Konflikte in öffentlichen Bereichen sind meist hochkomplex. Eine Vielzahl von Beteiligten ist über ebenso viele Themenbereiche miteinander verbunden. Bei einer Vielzahl von Beteiligten gibt es ebensoviele Themenbereiche, die sich überschneiden. MediatorInnen, die sich besonders durch ihre Fachkompetenz auszeichnen, können die Sach- und Beziehungskonflikten erkennen und setzen dabei ihr Fachwissen zur Erfassung und Strukturierung der Konfliktthemen gezielt ein. Diese strukturierte Kommunikation ermöglicht zukunftsorientierte Lösungen, bei der die Interessen aller Projektbeteiligten gewahrt und die Energie auf konsensuale Ergebnisse im Gesamtprojekt fokussiert wird. Ein qualitätsvoller Auftritt auf dieser Ebene gewährleistet letztlich die effiziente und wirkungsvolle Umsetzung nachhaltiger Stadt- und Regionalplanung.

1 NACHHALTIGE ENTWICKLUNG AUF REGIONALER UND STÄDTEBAULICHER EBENE

Der Begriff der „Nachhaltigen Entwicklung“ bezeichnet eine Entwicklung, die den Bedürfnissen der heutigen Generation entspricht, ohne die Entwicklungsmöglichkeit künftiger Generationen zu gefährden. Nachhaltige Entwicklung ist somit ein an Langfristigkeit orientiertes Entwicklungsleitbild der Umwelt-, Wirtschafts-, Kultur,- Beschäftigungs- und Sozialpolitik. Die Umsetzung von Nachhaltigkeitsstrategien spielt sich bis dato vorwiegend auf drei Ebenen ab:

1. Politischer Ebene
2. Regionaler Ebene
3. Betrieblicher Ebene

Wir wollen uns hier mit der Umsetzung von Nachhaltigkeitsstrategien in der regionalen Ebene beschäftigen. Unter dem Schlagwort „think global – act local“ ist das Bestreben von Regionen und Gemeinden eine nachhaltige Entwicklung durch unterschiedliche Initiativen zu fördern. Zielsetzung dieser Projekte ist dabei unter anderem eine möglichst breite Partizipation der Bevölkerung bei der Entwicklung und Abwicklung von Projekten zu ermöglichen:

- Klimabündnisgemeinden
- Lokale Agenda 21
- Ökoprofit
- Öko-Business Plan
- Zukunft für alle, NÖ Bürgerbeteiligungsaktion, etc.

Die Standortsuche für Kraftwerke, Abfalldeponien, Müllverbrennungsanlagen und Gewerbeanlagen, der Bau von Straßen- und Bahnanlagen, das Aufstellen von GSM-Sendemasten bis hin zu regionalen Kleinprojekten führen immer wieder zu Interessenskonflikten. Das sind Vorhaben, die aufgrund ihrer Dimensionen im öffentlichen Interesse stehen, über die jedoch Politik oder Verwaltung zu entscheiden haben. Durch den öffentlichen Druck kann die Realisierung solcher Projektvorhaben, die nicht erfolgreich kommuniziert werden jedoch häufig verzögert, wenn nicht sogar verhindert werden.

Die Art, wie eine Gesellschaft mit Konflikten umgeht, spiegelt ihre demokratische Qualität wider.

In Österreich wurden Umweltkonflikte (Konflikte im öffentlichen Bereich) bis vor wenigen Jahren nahezu ausschließlich durch behördliche Genehmigungsverfahren (Verwaltungsverfahren) bzw. durch Gerichtsverfahren entschieden. Auf Grund des negativen Eindrucks dieser Lösungspraxis entstand das Bedürfnis nach konsensorientierten informellen Lösungswegen. In den neunziger Jahren begannen EntscheidungsträgerInnen in der Politik, Verwaltung und Wirtschaft den Einbezug anderer Meinungen vermehrt als Mittel zu schätzen, ihre Projekte in der Öffentlichkeit abzustützen und damit letztendlich die Realisierung schneller voranzubringen. Veränderungsprozesse und Projekte im öffentlichen Bereich sind von einem hohen Grad an Komplexität geprägt. Aber nicht nur die zu berücksichtigende Informationsmenge nimmt zu, sondern auch die Zahl der Beteiligten, die nicht bereit sind, einseitig gefällte Planungsentscheidungen ohne Mitsprache zu akzeptieren und sich daher aktiv in den regionalen und städtebaulichen Planungsprozeß einbringen wollen. Die Auffassung, dass Planung eine rein technische Tätigkeit ist, ändert sich zunehmend dahin, dass Planung als ein kommunikativer Prozeß verstanden wird, den es zu gestalten gilt.

Voraussetzungen für eine erfolgreiche Umsetzung von Nachhaltigkeit:

- Nachhaltige Entwicklung bezieht sich nicht auf punktuelle Verbesserungen, sondern erfordert zusammenhängende Ergebnisse ökologischer, ökonomischer und sozialer Bestrebungen.
- Für die Erreichung des Entwicklungszieles ist die Beteiligung aller Bevölkerungsgruppen gewünscht. Eine aktive Kooperation zwischen BürgerInnen, Wirtschaft, Politik und Verwaltung ist notwendig.
- Nachhaltigkeit setzt Interesse,Verständnis und Akzeptanz aller gesellschaftlichen Gruppierungen voraus und muss kommuniziert werden.

2 FORMALE UND INFORMELLE VERFAHREN

2.1 formale Verfahren

Im Rahmen von Genehmigungsverfahren wird die Entscheidung durch die Verwaltung getroffen. Diese ist an Gesetze und politische Vorgaben gebunden.

- Behördliche Genehmigungsverfahren (Verwaltungsverfahren)
- Gerichtliche Verfahren
- Schiedsverfahren
- Schlichtungsverfahren

In den genannten Verfahren wird die Entscheidung von Dritten gefällt. Berufung kann sowohl gegen einen Bescheid im Genehmigungsverfahren als auch gegen das Urteil eines Gerichtes eingelegt werden.

2.2 informelle Verfahren

Unter informellen bzw. kooperativen Beteiligungsverfahren werden freiwillige Kommunikations- und Entscheidungsfindungsprozesse verstanden, deren Ablauf gesetzlich nicht vorgeschrieben oder geregelt ist. Bei den meisten der folgenden Formen von informellen BürgerInnenbeteiligungsmöglichkeiten stehen Information und Befragung der BürgerInnen, sowie der Austausch von Interessen und Standpunkten im Vordergrund.

Information allein ist aber zu wenig.

Die informellen, kooperativen Verfahren, wie z.B. Mediation, zeichnet die Besonderheit der konsensorientierten Lösungssuche und des Konfliktmanagements im öffentlichen Bereich aus.

- Informationsveranstaltungen
- Open Space
- Begleitender BürgerInnenbeirat
- Befragungen der BürgerInnen
- Diskussionsveranstaltungen
- Zukunftswerkstätte
- Konsensus-Konferenz
- Diskurs
- Planungszelle/BürgerInnengutachten
- Workshop
- Runder Tisch (engl. „Negotiation“, „Round Table“)
- Schlichtung (engl. „Arbitration“)
- Conciliation
- Moderation
- Mediation

2.2.1 Mediation

Der Begriff Mediation kommt aus dem lateinischen und bedeutet "Vermittlung" oder "vermittelndes Dazwischentreten". Mediation ist ein strukturiertes aussergerichtliches Konfliktlösungsverfahren, welches die Interessen aller Betroffenen berücksichtigt. Alle beteiligten Parteien verhandeln eigenverantwortlich, mit der Unterstützung eines allparteilichen Vermittlungsteams - den MediatorInnen. Mediation ist bestrebt eine win-win Situation der Konfliktparteien und somit eine nachhaltige Lösung zu erarbeiten. Die gemeinsame Entwicklung von Lösungen erhöht deren Tragfähigkeit und vermeidet Folgekonflikte. Den Abschluss des Verfahrens bildet im Regelfall eine verbindliche, schriftliche Vereinbarung zwischen den Parteien.

Bereiche in denen Mediation angewandt wird:

- Familie
- Scheidung
- Wirtschaft
- Politik
- Umwelt bzw. öffentlicher Bereich
- Bau- und Planungsbereich

2.2.2 Beispiele von informellen Verfahren in Österreich

Die praktischen Erfahrungen mit Mediation, mediationsähnlichen Verfahren und Verfahren mit mediativen Elementen bei Konflikten im öffentlichen Bereich beschränken sich in Österreich derzeit noch auf einige wenige Beispiele:

- Mediations- und Interessensbeteiligungsverfahren S10 – Mühlviertler Schnellstraße, 2002-

  Art des Verfahrens: Mediationsverfahren

  Themenbereich: Verkehrsplanung

- Strategische Umweltprüfung Entwicklungsraum Nordosten Wiens (SUPer NOW), Okt. 2001- Frühjahr 2003

  Art des Verfahrens: SUP am runden Tisch

  Themenbereich: Stadtentwicklungs- und Verkehrsplanung

- Mediationsverfahren Flughafen Wien, Jan. 2001-

  Art des Verfahrens: Mediationsverfahren

  Themenbereich: Verkehr

- Strategische Umweltprüfung zum Wiener Abfallwirtschaftsplan (SUP Wr. AWP), Juni 1999-Okt. 2001

  Art des Verfahrens: SUP am runden Tisch

  Themenbereich: Abfallwirtschaft

- U-Bahn Ausbau in Wien, Juni 1999 - 2000

  Art des Verfahrens: BürgerInnenbeteiligungsverfahren

  Themenbereich: Verkehrsplanung

- URIS - Umfeld-Rückkoppelungs- und Informationssystem zum Flughafen Linz - Blue Danube Airport, 1999 -

  Art des Verfahrens: Dialogforum

  Themenbereich: Infrastrukturentwicklung, Verkehr/Transport

- Yppenplatz Wien, März 1997 – Jan. 1998

  Art des Verfahrens: BürgerInnenbeteiligungsverfahren,

  Themenbereich: Stadtentwicklungs- und Verkehrsplanung

- Mediations- und BürgerInnenbeteiligungsverfahren zum Wasserkraftwerk Lambach, 1996-2000

  Art des Verfahrens: Mediationsverfahren

  Themenbereich: Energiewirtschaft

- Umweltkommission der Welser Abfallverwertung (WAV), 1991/92 -

  Art des Verfahrens: Mediationsverfahren; Dialogforum

  Themenbereich: Abfallwirtschaft

Der Erfolg kooperativer Verfahren im öffentlichen Bereich ist um so wahrscheinlicher - je konkreter und/oder kleinräumiger das Thema - je klarer das Ziel - je mehr alle Beteiligten von einer Lösung profitieren können und - je besser die Einbettung in herkömmliche Entscheidungsverfahren ist.

3 MEDIATION IM ÖFFENTLICHEN BEREICH

In der Fachliteratur wird der Begriff Umweltmediation im Zusammenhang mit den Themen Umwelt, öffentlicher Bereich und manchmal auch den Bau- und Planungsbereich verwendet. Dies kann jedoch den Eindruck erwecken, dass es sich um reine naturschutzrelevante Konflikte handelt. In der Folge benutzen wir den Begriff „Mediation im öffentlichen Bereich“ für die vorgenannten Themen. Oft lassen sich die Konfliktbereiche nicht genau abgrenzen, da es zu zahlreichen Überschneidungen von Interessen kommen kann, wie zum Beispiel bei der Planung von Infrastrukturprojekten, oder bei Anlagen in Naturschutzgebieten. Mediationsverfahren können hier als Instrument der demokratischen Partizipation und des Konfliktmanagements in Gemeinden, Städten und Ländern – regional und überregional – eingesetzt werden.

3.1 Wesentliche Merkmale der Mediation im öffentlichen Bereich

3.1.1 Vielparteien und grosse Gruppen als Beteiligte

Je direkter und stärker jemand betroffen ist, desto mehr wird sie oder er sich einsetzen. Mitwirkungsmöglichkeiten in der Gemeinde stärken aber nicht nur die Bindung zum Ort, sie sind auch für die Region, selbst wenn der Aufwand auf den ersten Blick groß erscheint, von Vorteil. Das Potential der BewohnerInnen, ihre Kreativität und die Vielfalt an Ideen und Wissen wird genutzt. Die Akzeptanz für Vorhaben der Stadt- und Regionalentwicklung steigt.

Bezeichnend für die Mediation im öffentlichen Bereich ist, dass alle Betroffenen – nicht nur die Parteien im Sinne von Gesetzen – von Beginn an eingeladen werden, sich am Verfahren zu beteiligen. So wird ein Dialog zwischen den Entscheidern (Verwaltung), den Projektwerbern (Investoren) und den Betroffenen (BürgerInnen) ermöglicht.

- Anrainer / BürgerInnen bzw. Bürgerinitiativen
- ProjektbetreiberInnen
- PlanerInnen
- PolitikerInnen
- Verwaltung
- Interessensverbände
- Umwelt- und Naturschutzverbände
- Umweltanwaltschaften
- Vermittlungspersonen (MediatorInnen)

Jede Gruppe ist durch Repräsentanten vertreten, die dafür Sorge zu tragen haben, dass ihre Gruppe (Bürgerinitiative, Gemeinderat, Interessensverband, etc.) über den Fortgang der Verhandlungen informiert wird, ohne dabei die Vertraulichkeit des Mediationsprozesses zu verletzen. Von ihrer Gruppe sind sie mit einem Verhandlungsmandat ausgestattet. Die Einbeziehung der Repräsentanten geschieht in Form einer Beteiligung in Arbeitsgremien, in denen sie ihre Interessen vertreten können. Je nach Konflikt werden zu einzelnen Fragen externe Gutachter hinzugezogen.

3.1.2 Interessensausgleich schaffen

Die frühzeitige Kooperation der Beteiligten beginnt bereits bei der Problemdefinition bzw. Lösungsentwicklung und nicht erst in der Phase der Umsetzung einer politisch oder administrativ vorgegebenen Entscheidung. Nicht nur verwenden die Beteiligten ein unterschiedliches Vokabular, es geht auch um unterschiedliche Anliegen und Interessen, die verschieden kommuniziert werden. Hier sind die MediatorInnen gefordert einen Macht- und Interessensausgleich herzustellen.

3.1.3 Wille zur Verhandlungslösung

Je besser sich aus einzelnen Lösungen ein Gesamtpaket schnüren lässt, desto eher wird für Einzelne die Akzeptanz für die Gesamtlösung entstehen, sodass sie der Vereinbarung zustimmen können. Sie tun dies, weil sie mehr gewinnen als mit einer Ablehnung. Diese, deutlich von einer Kompromiß-Lösung zu unterscheidende, sogenannte win-win Lösung zu finden, ist die primäre Aufgabe einer Mediation.

In der Mediationssprache heisst: Das BATNA (Best Alternative To Negotiated Agreement) ist für die Betroffenen schlechter als die vereinbarte Lösung. Die Entfernung zwischen BATNA und WATNA (Worst Alternative To Negociated Agreement) bildet den Verhandlungsspielraum einer Partei ab, die ZOPA (Zone Of Possible Agreement). Je weiter bei allen beteiligten Parteien BATNA und WATNA auseinander liegen, desto grösser ist die Chance einer Vereinbarung in einem alternativen Konfliktlösungsverfahren und desto mehr Kreativität kann beim Schnüren der Pakete zum Zug kommen.

3.1.4 Informalität und Verbindlichkeit

Eine wichtige Grundlage stellt die Informalität des Verfahrens dar. Mediationsverfahren ersetzen Verwaltungsverfahren nicht, sondern ergänzen diese. Auf Grund des informellen Charakters bieten Mediationsverfahren flexible Wege bei der Regelung von Konflikten an und mehr Kreativität kann eingesetzt werden.

Den Abschluss bildet in der Regel eine verbindliche, schriftliche Vereinbarung zwischen den Parteien. Diesen zivilrechtlichen Vereinbarungen, die das Mediationsverfahren abschließen, sind lediglich die Grenzen des Zivilrechtes gesetzt. So dürfte etwa nichts vereinbart werden, was gegen die gesetzlichen Rahmenbedingungen verstösst oder sittenwidrig ist. Eine Bindung an diese Vereinbarung ist zwar gesetzlich nicht verankert, jedoch sollten die Ergebnisse des Konfliktlösungsverfahrens im anschließenden Genehmigungsverfahren bzw. bei der darauf folgenden Projektplanung berücksichtigt werden.

Abschließend ist festzuhalten, dass auch bei der Durchführung eines Mediationsverfahrens im öffentlichen Bereich die Letztverantwortung für die Entscheidung über ein Projektvorhaben bei Politik und Verwaltung bleibt.

3.1.5 Politik und Öffentlichkeit

Wer will denn schon von seiner Entscheidungsmacht freiwillig abgeben, noch dazu wo das Resultat nicht vorhersehbar ist?

Da die alternative Konfliktbearbeitung unter öffentlicher Aufmerksamkeit agiert, sind die Anforderungen besonders hoch. Dies und die Grösse des Verfahrens machen eine breite Abstützung in der betroffenen Öffentlichkeit ebenso nötig, wie eine sorgfältige Klärung des Verfahrensziels. Gerade PolitikerInnen werden ihre Beschlussfassung eher nach den Resultaten des kooperativen Prozesses ausrichten oder sich gar selber darin einbringen, wenn sie dafür einerseits öffentliche Aufmerksamkeit finden und wenn anderseits durch die Öffentlichkeit Druck dazu entsteht. Das legitime Bedürfnis der PolitikerInnen nach Öffentlichkeit kann jedoch für die – als eine der Grundvoraussetzungen der Mediation bezeichnete – Vertraulichkeit zum Problem werden. Dieses ist aber nicht überzubewerten, weil in Grossgruppen und Vielparteienkonflikten, um die es sich hier handelt, Vertraulichkeit ohnehin schwieriger einzuhalten ist als bei geringer TeilnehmerInnenzahl. Mediation im öffentlichen Bereich steht im Interesse der Öffentlichkeit. Dies bedeutet, dass eine sorgfältige Informationsarbeit eine erforderliche Begleitmaßnahme im Rahmen dieser Verfahren darstellt.

Wahltermine beachten! In den letzten Wochen oder Monaten vor den Wahlen wird der Wahlkampf oft dermassen dominant, dass das Verfahren manchmal ausgesetzt werden muss. Nach den Wahlen hat man es teilweise mit neuen Personen zu tun. Es empfiehlt sich daher, Verfahren so anzusetzen, dass sie vor den Wahlen einen passenden Abschluss finden können.

3.1.6 Aufwand (Zeit und Kosten)

Mediations- oder mediationsähnliche Verfahren bedeuten einen hohen Zeitaufwand für die Beteiligten. Die Teilnahme der BürgerInnen erfolgt fast ausschließlich auf ehrenamtlicher Basis. Über die Dauer der Verfahren lässt sich sagen, dass die meisten binnen eines Jahres abgeschlossen werden können. Grundsätzlich ist festzustellen, dass sich ein Verfahrensbeginn zu einem möglichst frühen Zeitpunkt positiv auf die Dauer der behördlichen Genehmigungsverfahren auswirkt.

Die Finanzierung der Verfahren folgt bisher im Wesentlichen dem Verursacherprinzip. In der Mehrzahl der Fälle wird der Aufwand vom Projektwerber getragen, aber auch die öffentliche Hand beteiligt sich vermehrt an den Kosten. Eine Aufteilung der Kosten auf mehrere beteiligte Gruppen könnte die Befürchtungen hinsichtlich der Abhängigkeit zwischen MediatorInnen und zahlenden Auftraggebern entschärfen. Laut Befragung wurde als Richtgröße für die Höhe der Kosten eines Mediationsverfahrens, sowohl von den Projektwerbern als auch von den Vermittlungspersonen ein Betrag im Promillebereich der Projektsumme angegeben. Bei kleineren Projektvorhaben (Industrie- und Gewerbeprojekten) werden die Kosten im einstelligen Prozentbereich der Projektsumme zu finden sein. Es lohnt sich, gerade bei grossen Verfahren im öffentlichen Bereich den Posten Öffentlichkeitsarbeit grosszügig zu budgetieren.

3.1.7 Allparteiliche MediatorInnen

Mediation im öffentlichen Bereich erfordert ein Arbeiten mit großen Gruppen und wird daher vorzugsweise durch MediatorInnenteams durchgeführt. Die gegenseitige Kontrolle und Reflexion zur Wahrung eines neutralen Standpunktes und der Allparteilichkeit kann so gewährleistet werden. Das ist vorteilhaft, damit einerseits auf die Inhalte und andererseits auf die Interessen geachtet wird und das zum Teil bestehende erhebliche Macht- und Ressourcenungleichgewicht, ausgeglichen wird. Die Allparteilichkeit setzt voraus, dass die MediatorInnen nicht auf Grund ihrer Funktion oder Tätigkeit eine Parteistellung in dem Verfahren haben könnten. Die Vermittlungspersonen müssen das Vertrauen und die Akzeptanz aller Beteiligten haben. Sie haben keine Schiedsrichterfunktion.

Über die fachliche Qualifikation von MediatorInnen gibt es in der Diskussion unterschiedliche Auffassungen, insbesondere darüber, ob diese auch inhaltliche Sachverständige sein sollen. MediatorInnen fungieren als ExpertInnen für den Sozialprozess, welche zur Objektivierung des Prozesses beitragen, die Parteien im Entscheidungsfindungsprozess unterstützen, jedoch nicht deren Konflikte lösen sollen. Um Autorität bewahren oder erlangen zu können, sollte die Verfahrensleitung ein grosses Mass an Feldkompetenz mitbringen. Interdisziplinäre MediatorInnenteams können ihre spezifischen Fachkompetenzen, die entscheidend für die Erfassung und Strukturierung der Konfliktthemen sind, und die Kompetenz in den psychologischen und sozialen Bereichen verknüpfen.

Eine der Aufgaben ist es, den kontinuierlichen Dialog zu fördern, auf die Einhaltung der Vereinbarungen zu achten und alle Gruppen gleichwertig zu behandeln. Die MediatorInnen haben das Verfahren zu strukturieren und auf die Bedürfnisse der Beteiligten abzustimmen, Lösungsmöglichkeiten zu prüfen, Verhandlungen zu organisieren und zu leiten. Sie bieten grundsätzlich keine Projektlösungsvorschläge an, über die die Beteiligten nur noch zu beraten haben. Die inhaltlichen Lösungsvorschläge werden von den Beteiligten weitgehend selbst erarbeitet.

3.1.8 Verfahrensstruktur

Der Auftrag muss von den verantwortlichen Entscheidungsträgern und den Organisatoren der Verfahren vor Beginn der Beratungen deutlich und möglichst schriftlich geklärt werden. Dazu gehört eine Beschreibung des Verfahrens, des Stellenwertes der Ergebnisse und wie mit diesen im weiteren Entscheidungsprozess umgegangen werden soll. Die Entscheidungen kommen nicht auf Grund von Mehrheitsbeschlüssen oder durch Dritte zustande. Bei inhaltlichen Entscheidungen gilt das Prinzip der Einvernehmlichkeit. Der norwegische Friedensforscher Johan Galtung erklärt, dass in einer Demokratie Dialog und Konsens wichtiger als Abstimmung und Mehrheit ist.

Am Ende des Mediationsverfahrens werden die Verhandlungsergebnisse schriftlich festgehalten. Eine verbindliche Vereinbarung sollte von den Beteiligten als Ergebnis angestrebt werden.

3.2 Grenzen von Mediation

Mediation im öffentlichen Bereich ist nicht das Allheilmittel für alle Auseinandersetzungen über Projektvorhaben oder gesellschaftliche Fragestellungen. Die Anwendung wird nicht für jeden Konflikt geeignet sein, vor allem dann nicht, wenn dieVoraussetzungen für eine konsensuale Lösung nicht bei allen Betroffenen in hohem Ausmaß gegeben ist. Es wird nicht möglich sein, bei jedem anstehenden Projektvorhaben Mediation zur Herbeiführung einer Lösung anzuwenden, grundsätzliche politische Entscheidungen (Standort-, Verkehrs-, Energieversorgungspolitik, etc.) können damit nicht ersetzt werden.

3.3 Einsatzgebiete von Mediation im öffentlichen Bereich

- Verkehr (Bau von Strassen, Autobahnen und Bahntrassen, Flugverkehr, Großraumlösungen für Städte und Umlandgemeinden)
- Energie, Telekommunikation (Leitungsbau für Strom, Gas, neue Technologien, etc.)
- Raumplanung und Flächenwidmung
- Standortfragen für Betriebsansiedelungen sowie Betriebsanlagenerweiterungen
- Privatisierung öffentlicher Versorgungsdienstleistungen (z.B. Wasser); Stichwort „GATS“
- Abfallbereich (Standortfragen für Abfallbehandlungsanlagen)
- Klimaschutz
- Gesundheitsbereich
- Emissionen
- Naturschutz
- Gestaltungspläne für private oder öffentliche Bauten
- Denkmalschutzentscheide
- Baubewilligungen

4 MEDIATION (- MODERATION) IM INTERNET

Die Online-Mediation befindet sich noch in den Kinderschuhen, wie sich in einem österreichischen Projekt zeigte. Ziel der "Ersten österreichischen Mediations-Wochen 2002 in Graz und Wolfsberg" war es, unter anderem den tatsächlichen Anwendungsbereich von Mediation zu untersuchen. Gerade der geringe Bekanntheitsgrad von Mediation ist derzeit ihre größte Schwachstelle. Erst in den letzten Jahren sind MediatorInnen vornehmlich in den USA auf die Idee gekommen, dass Internet zu Zwecken der Mediation zu Nutzen. Noch liegen daher verhältnismäßig wenig Erfahrungen und Ergebnisse vor, auf die sich sichere Aussagen stützen ließen, inwieweit das Internet in der Mediation den persönlichen Kontakt ersetzen kann. Die traditionelle Mediation setzt voraus, dass die Konfliktparteien an einem Ort zusammenkommen und in körperlich greifbaren Räumlichkeiten an den Lösungen des Problems arbeiten. Bei der Online-Mediation wird der reale Raum durch die virtuelle Welt des Internet ausgetauscht. Die Voraussetzung für die Kommunikation zwischen einzelnen Teilnehmern ist, technisch betrachtet, lediglich ein ausreichend leistungsfähiger Computer mit Internetzugang. Das Mediationssystem selbst befindet sich auf einem von unbefugten Zugriffen geschützten Server und wird von den MediatorInnen zur Verfügung gestellt. Die Online-Mediation-Teilnehmer können über große räumliche Distanzen auf dem Bildschirm verhandeln. Kommunikation findet via E-Mail statt oder in virtuellen Verhandlungsräumen, die von MediatorInnen verwaltet werden. Alle Online-Mediation-Mitwirkenden haben die Gelegenheit sich in solch einem virtuellen Konferenzraum zusammenzufinden, wobei für die MediatorInnen die Möglichkeit besteht, sich in einem durch ein Passwort geschützten „Verhandlungsraum“ ausschließlich mit einer Partei zu unterhalten, während die andere online in einem anderen Raum warten. Es können auch Videokonferenzen zur Erleichterung der Verständigung durchgeführt werden, und einen Face-to-face-Diskurs ermöglichen, der die klassische Mediation auszeichnet. Dieser Einsatz von Informations- und Kommunikationstechnologie unterstützt die Partizipationschancen erheblich bei allen Kommunikationsprozessen.

Online-Mediation ist ein wichtiger Bestandteil internetgestützter Konfliktmanagementsysteme. Ihre Anwendungsgebiete können Konflikte im E-Commerce-Bereich, also zwischen Unternehmen, deren Transaktionen per Internet abgewickelt werden (business to business: B2B), und zwischen Internetanbietern und unzufriedenen Kunden (business to customer: B2C) sein. In diesen Fällen kennen sich die Konfliktbeteiligten nicht, erwarten in der Regel auch keine zukünftige Beziehung und können sich nicht treffen, weil sie über den ganzen Globus verteilt sind. Internationale Organisationen, wie z.B. die EU-Kommission betrachtet Online-Mediation als ein kostengünstiges und schnelles Instrument zur Verbesserung des Vertrauens in Internet-Transaktionen. Im internationalen Handel fehlen gerichtliche Instanzen, da diese grenzüberschreitend sind. Auch weltweit operierende Unternehmen, deren interne Kommunikation weitgehend netzbasiert ist, haben im Prinzip ein ähnliches Problem: Das Internet schafft viele Kommunikations- und Interaktionsoptionen.

4.1 Prozessschritte

Die Online-Mediation durchläuft im Prinzip dieselben Prozessschritte wie die herkömmliche, traditionelle Face-to-face-Mediation. Wesentliche Unterschiede finden sich zu Beginn des Online-Mediationverfahrens.

- Vorstellung der MediatorInnen und Klärung von deren Aufgabe.
- Einführung in den Mediationsprozess im allgemeinen, sodass die Online-Mediation-Teilnehmer über die einzelnen Schritte des Verfahrens informiert sind.
- Detaillierte „Spielregeln“ für die Mediation vorstellen. Verfahrens- und Verhaltensgrundsätze werden den Parteien erläutert. Diese Regeln sollten auf der Homepage ersichtlich sein.
- Die Mediationssoftware, wie auch Ihre Funktionen werden vorgestellt.

Die weiteren Verlaufsschritte der Online-Mediation entsprechen so ziemlich der traditionellen Face-to-face-Mediation.

4.2 Einsatzgebiete von Online-Mediation

Die Einsatzgebiete der Online-Mediation (Moderation) finden besonders dort Anwendung, wo sich die Konfliktparteien nicht begegnen können oder wollen.

- Mediation im öffentlichern Bereich (z.B. Bürgerbeteiligungsverfahren)
- Wirtschaftsmediation (E-Commerce, Firmen mit verschieden internationalen Standorte)
- Trennungs- und Scheidungsmediation
- Täter-Opfer-Ausgleich

4.3 Die Vorteile der Online-Mediation gegenüber der traditionellen Face-to-face-Mediation:

- Einsparung von Wegzeit und Fahrtkosten
- Zeitversetzte Kommunikation per E-Mail oder in den Passwort geschützten „Verhandlungsräumen“
- Parallele, gleichzeitige Einzelsitzungen zwischen den MediatorInnen und den Online-Mediation-Teilnehmern
- Nachvollziehbarkeit durch die Archivierung des Mediationsverlaufs
- Anonymität

Der Einsatz der Online-Mediation mit Hilfe von Computern kann die Prozesse verändern, ohne dass dies den Teilnehmern bewusst wird, diese mögliche Veränderung ist zu bedenken und vielleicht auch mittels spezieller technischer Mittel auszugleichen.

5 CHANCEN UND RISKEN VON ONLINE-MEDIATION-VERFAHREN

5.1 Datenschutz

In der traditionellen Face-to-face-Mediation, die in realen Raum stattfindet, wird den Konfliktparteien abverlangt und versichert, dass sämtliche Informationen und Geschehnisse vertraulich behandelt werden. Gespräche unter Anwesenden werden für gewöhnlich nicht aufgezeichnet, Schriftstücke können nach dem Ende der Mediation von den MediatorInnen auf Wunsch vernichtet werden. Die Möglichkeit, sowie Gefahr der Online-Kommunikation hingegen liegt darin, dass die Kommunikation über Netzwerke unausweichlich das Kopieren von Daten einschließt, und es ungewiß ist, wie viele Kopien wo auf welchem Server auf dem Weg zum Empfänger der Information angefertigt werden können. Besonders in sensiblen Bereichen, in denen die Parteien höchste Vertraulichkeit erwarten, gewährt dies keinen ausreichenden Schutz davor, dass Dritte kopierte Informationen zu ihrem Vorteil verwenden. Einziger wirksamer Schutz und damit Garantie für vertraulichen Umgang mit übermittelten Informationen ist die Verschlüsselung (Encryption). Die Verwendung solcher Verschlüsselungsmethoden ist somit unumgänglich, um auch für die Online-Mediation Vertraulichkeit garantieren zu können, und eine große Arbeitserleichterung für die MediatorInnen darstellt.

5.2 Vertrauen

In der traditionellen Face-to-face-Mediation stehen den MediatorInnen eine Vielzahl von Techniken zur Verfügung, mit denen sie zwischen sich und den Teilnehmern das nötige Vertrauen erreichen können. Fehlt das Vertrauen in die MediatorInnen, kann dies zum Scheitern der Mediation führen. Eine essentielle Frage ist somit, ob die körperliche Abwesenheit aller Online-Mediation-Teilnehmer die Entwicklung von Vertrauen behindert und damit den Erfolg der Mediation gefährdet. Wie ersetzt man Kommunikation, die durch Körpersprache, Mimik und Gestik der Teilnehmer, wie auch tonale stimmliche Veränderungen und Sprechpausen verstärkt werden kann. Nonverbale Kommunikation fehlt hier naturgemäß. Sollten die technischen Mittel zur Verfügung stehen, kann eine Videokonferenz hilfreich sein.

5.3 Sensibilität und Vorsicht

Um mögliche Missverständnisse zu erkennen und um Vertrauen aufzubauen können die MediatorInnen mit Hilfe der „Pendel-Verhandlungskunst“, sowie einer höheren Sensibilität und Vorsicht bei der Wortwahl, einen Ausgleich schaffen. Es mag auch von Vorteil sein, zu Beginn der Mediation die Online-Mediation-Teilnehmern besonders auf diese Problematik hinzuweisen, damit auch sie sensibilisiert sind und besser mit daraus auftretenden Irrtümern umgehen können.

5.4 Identität

Die Identität des anderen Teilnehmers kann in vielen Konfliktsituationen völlig unklar sein, wobei die Distanz zwischen den Teilnehmern, das Anonyme hinter dem eigenen Bildschirm auch Sicherheit bietet. Ist ein gewisses Maß an Vertrauen zwischen MediatorInnen und Teilnehmer erreicht, fühlt dieser sich durch diese relative Anonymität gegebenenfalls sogar verstärkt zur Wahrheit ermuntert, um seine eigenen Interessen offen darzulegen. Mit Hilfe einer digitalen Signatur kann der Empfänger nachweisen, dass eine bestimmte Nachricht von einem genau bestimmbaren Absender stammt, und mit diesem Bewusstsein kann auch das Vertrauen erhöht werden.

5.5 Kommunikation über E-mail

Das Fehlen nonverbaler Elemente, mangelndes schriftliches Ausdrucksvermögen, zeitlichen Verzögerungen der E-mails, schlechte Strukturierung der Beiträge oder auch ein unsicherer Umgang mit der Tastatur können das Verfahren empfindlich beeinträchtigen und erschweren. Die Teilnehmer haben das Gefühl den Überblick über den Ablauf des Prozesses zu verlieren und werden ungeduldig und aggressiv statt kooperativ nach Lösungswegen zu suchen, die virtuelle Diskussion eskaliert. Mit Hilfe eines klar und festgelegten strukturierten Kommunikationsleitfadens können solche Konflikte großteils vermieden werden, und eventuell ist zur Erleichterung und zum zügigeren Vorankommen eine telefonische Klärung eines fraglichen Faktors anzustreben. Kommunikation über E-mail hat den Vorteil, dass man innerhalb eines vorgegebenen Zeitrahmens frei ist zu entscheiden, wann man antworten will, ohne in Zeitdruck kommen zu müssen, was man konkret antworten möchten. Online-Mediationsoftware gibt den Mediatoren einen größeren Handlungsspielraum in der Gestaltung des online Kommunikationsprozesses. Dazu werden interaktive Webseiten verwendet, die auch "virtuelle Arbeitsräume" oder "workspaces" genannt werden.

6 BÜRGERBETEILIGUNG IM INTERNET

Weitere nachhaltige Anwendungsgebiete für Online-Mediation sind in Bürgerbeteiligungsverfahren, die in der Stadt- oder Regionalplanung eingesetzt werden, in Umweltverträglichkeitsprüfungen, bei "Runden Tischen" für Umweltkonflikte. Ein Programm sollte hier erwähnt werden – Zeno - das bei aktuell laufenden Projekten der Regional- und Stadtentwicklungsplanung erprobt wird. Das Wissenschaftszentrum Berlin für Sozialforschung Gemeinnützige Gesellschaft mbH hat eine Software (ZENO) zur Unterstützung von Mediationsverfahren entwickelt.

Wie soll die Bürgerbeteiligung im Internet umgesetzt werden, damit diese ähnlich der Face-to-face- Bürgerbeteiligungsverfahren eine nachhaltige erarbeitete Vereinbarung erreicht?

Gut strukturierte und geplante Beteiligungsforen im Internet bilden das „Herzstück“ eines modernen Bürgerbeteiligungsverfahren. Mittlerweile verfügt fast jede größere Stadt über eine Homepage. Über sie lassen sich Informationen zum “Stand der Dinge“ und Ansprechpartnern abrufen. „Fortgeschrittene“ Planer bieten ihren BürgerInnen heute neben reinen Informationen auch die Möglichkeit, bei der Umsetzung des Projektes, elektronisch mitzukommunizieren. Vielerorts wird daran gearbeitet, auch

Kommunikation online abzuwickeln. BürgerInnen können dann an der Diskussion von zu Hause aus teilnehmen – rund um die Uhr. Verstärkt zu beobachten ist dabei der Trend, die Aufnahme partizipatorischer Elemente – die Teilhabe am kommunalen Leben via Internet. Solche Beteiligungen können informell gestaltet sein, z.B. durch die Einrichtung von Chats und Foren oder Umfragen zu aktuellen Themen. Experimentiert wird aber auch mit formellen Beteiligungen über das Internet, z.B. bei der Erstellung von Flächenwidmungsplänen.

Anwendungen sollen potenziell alle „Zielgruppen“ eines Verfahrens erreichen: BürgerInnen, Wirtschaft, und nicht zuletzt die Verwaltung und Politik selbst. Die verschiedenen Zielgruppen werden verschieden adressiert, aber gleich gut informiert.

Wie schon eingangs erwähnt gibt es verschiedene erfolgreich angewandte Formen von Bürgerbeteiligung mit Hilfe des Internets, wie z.B. Moderation oder Mediation, welche eine Einflussnahme der BürgerInnen auf das Bürgerbeteiligungsverfahren ermöglicht. Voraussetzung für einen „gut funktionierenden“ Dialog zwischen BürgerInnen und Entscheidungsträgern ist die gemeinsame Zielsetzung und eine gemeinsame Erarbeitung von Lösungen.

Anfang 2001 untersuchten Fietkau, Renz & Trénel (2001) fünf Fallbeispiele, in denen das Internet zur Bürgerbeteiligung in öffentlichen Konfliktlagen benutzt wurde. In der Regel beteiligten sich zu wenige BürgerInnen mit zu geringer Kontinuität an den Diskussionsforen, als dass richtige durchgehende Diskussion hätten entstehen können.

Der Einsatz von Informations- und Kommunikationstechnologie unterstützt die Partizipationschancen erheblich bei allen Kommunikationsprozessen. Folglich wird es möglich werden, wie zum Beispiel Ziele von Flächenwidmungsverfahren transparenter darzustellen, und eine Steigerung der Effektivität und Effizienz des Verhandelungsstands aufzuzeigen.

7 CHANCEN UND AUSBLICKE

Trotz aller Vorteile dürfte das größte Problem der Online-Mediation, aber die Akzeptanz in der Bevölkerung darstellen (siehe "Ersten österreichischen Mediations-Wochen 2002 in Graz und Wolfsberg"). Ist die traditionelle Mediation zumindest in Österreich noch nicht sehr weit verbreitet und auch die Zahl der Internetbenutzer gemessen an der Gesamtbevölkerung noch einigermassen gering, so dürfte insbesondere eine Verbindung dieser zwei Bereiche vielfach noch auf Skepsis stoßen und damit den Anwendungsbereich vorerst begrenzen.

Im Zusammenhang mit nachhaltiger Regional- und Stadtentwicklung kann Face-to-face-Mediation und/oder online-Mediation als zusätzliche Werkzeuge (Tool) und als Ergänzung zum ordentlichen Verfahren für die raumplanerische Ebene angeboten werden. Die Entwicklung von Decision Support Systemen für die Verwaltung unter Berücksichtigung von Partizipation im weitesten Sinn wird für die Zukunft von zunehmender Bedeutung sein. Die Durchführung von Mediationsverfahren trägt langfristig zur Stärkung gesellschaftlicher Partizipation und damit zur Demokratisierung des Entscheidungsprozesses regionaler und städtebaulicher Planungsaufgaben bei. Nachhaltige Verhandlungsergebnisse können erzielt werden, weil jene, die an der Entscheidung mitwirken, auch die Ergebnisse stärker akzeptieren und mittragen. Mediation bei Projektvorhaben und gesellschaftlich relevanten Themen ist nicht nur dann ein Erfolg, wenn in allen Punkten ein Konsens gefunden werden konnte. Auch Teilerfolge auf der inhaltlichen Ebene, die Verbesserung des Gesprächsklimas und der Vertrauensbasis sowie das soziale Lernen stellen einen Mehrwert von Mediationsverfahren dar. Die Parteien lernen im Laufe der Mediation die Alternative besser kennen und einschätzen. Im öffentlichen Bereich mit seinem grossen gesetzlichen Ermessensspielraum kann dies Jahre sparen und viele gute Ideen retten.

Wer sich einmal für eine Mediation entschieden hat, wird auf dieses Verfahren auch in Zukunft gerne wieder zurückgreifen.

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geoTalk: eine Raum-Zeit-Kommunikationsplattform

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ZUSAMMENFASSUNG

Zwischenmenschliche Kommunikation erfolgt nur zu etwa 20% über das gesprochene Wort. Speziell bei Kommunikation über räumliche Phänomene setzen wir Gesten, Skizzen und ähnliche Hilfsmittel ein. Bei Kommunikation mit Hilfe von Chat-Technologie ist das nicht möglich. geoTalk schliesst diese Lücke, indem Internet-Chat-Technologie mit geographischen Informationssystemen kombiniert wird. Der vorliegende Beitrag diskutiert den Ansatz von geoTalk sowie mögliche Anwendungsszenarien.

ABSTRACT

Interhuman communication uses the the words spoken for approximately 20% of the information transferred. Communication about spatial phenomena depends on gestures, sketches an similar aids. Communication with chat-technology does not allow using such methods. geoTalk solves this problem by combining Internet-chat-technology with geographic information systems. The paper discusses the fundamentals of geoTalk and shows some fields of application.

1 EINFÜHRUNG

Der Mensch ist ein soziales Wesen. Als solches ist er auf die Kooperation mit seinen Mitmenschen angewiesen. Damit eine zufriedenstellende Kommunikation erreicht werden kann müssen zweierlei Voraussetzungen erfüllt sein: Zum einen muss man fähig sein, sich verständlich zu machen. Zum Anderen, muss man in der Lage sein, das Gesagte zu verstehen. Werden beide Aspekte in zufriedenstellender Weise erfüllt, so kann von einer funktionierenden Kommunikation gesprochen werden.

Die Zufriedenheit der Menschen wird wesentlich vom Funktionieren der Kommunikation mitbestimmt. Ein anschauliches Beispiel dafür ist die Gestaltung des Lebensraumes. Können Anrainer in konstruktive Weise in die Planung der Neugestaltung ihres Umfeldes eingebunden werden, ist mit einer hohen Akzeptanz und damit Zufriedenheit bei der Umsetzung zu rechnen. Die vielen gescheiterten Bürgerbeteiligungsprojekte sind ein Indikator dafür, dass Kommunikation häufig nicht zufriedenstellend funktioniert. Das in diesem Beitrag vorzustellende Konzept geoTalk, beschäftigt sich im Wesentlich mit der Optimierung der Kommunikation über räumliche Problemstellungen via Chat. Bevor wir jedoch diesen speziellen Anwendungsfall näher eingehen, erscheint es notwendig einen allgemeinen Blick auf das Phänomen Kommunikation zu richten.

Analysiert man die direkte Kommunikation zwischen zwei Menschen, so stellt man fest, dass unterschiedliche Ebenen zur Informationsübertragung verwendet werden. Beachtliche 50% der Kommunikation finden dabei auf nonverbaler Ebene statt, also durch Gestik, Mimik, Körperhaltung und ähnliches. Weitere 30% der Kommunikation verwenden Ton und Gebrauch der Stimme und nur 20% der Kommunikation erfolgt über die gesprochenen Worte (Mehreabian 1972). Der Anteil nonverbaler Kommunikation steigt sogar noch bis zu 63%, wenn die Kommunikation nur in einer Richtung erfolgt, also beispielsweise bei einem Vortrag. Somit werden beim Chatten über das Internet maximal 20% der Nachricht auch tatsächlich übertragen. Diese Tatsache kann jedoch auch ein Vorteil sein, da gerade die interpersonelle Einstellung über nonverbale Kommunikation übermittelt wird (Argyle 2002). Verzicht auf nonverbale Kommunikation bietet daher die Möglichkeit einer stärkeren Objektivität.

Die rasante Entwicklung der Informations- und Kommunikationstechniken hat dazu geführt, dass sich Kommunikationspartner häufig nicht am selben Ort befinden. Die Kommunikation erfolgt daher über ein Medium (Telefon, Internet etc.). Abgesehen von der Videokonferenz, können sich die Gesprächspartner nicht sehen und müssen daher auf die nonverbale Ebene verzichten.

Neben dem Telefon und dem Email erfolgt die ortsungebundene Kommunikation auch über Chatsysteme im Internet. Der Chat ermöglicht es mehreren Personen zur gleichen Zeit in schriftlicher Form miteinander zu kommunizieren. Körpersprache und Gebrauch der Stimme können beim Chat demzufolge nicht für Informationsübermittlung verwendet werden. Via Chat können im Vergleich zur direkten Kommunikation also lediglich 20 Prozent der Information übertragen werden.

Auf den ersten Blick erscheint dies ein großer Nachteil der Chatkommunikation zu sein. Bedenkt man jedoch, dass ein Großteil der nonverbalen Kommunikation zur Übermittlung von interpersonellen Einstellungen (emotioneller Zustand, Selbstdarstellung etc.) verwendet wird kann dies auch als Vorteil gesehen werden. Dort wo das Inhaltliche im Vordergrund steht und Argumente anstelle von Emotionen eingesetzt werden sollen, kann der Chat eine sinnvolle Ergänzung des Kommunikationspektrums sein. Dies könnte für viele der oben erwähnten Bürgerbeteiligungsprojekt gelten.

Das Beispiel über die Gestaltung des Lebensraumes führt uns aber zu einem weiteren Aspekt der nonverbalen Kommunikation den wir noch nicht erwähnt haben. Es ist dies die räumliche Komponente in der Kommunikation. Allgemein läßt sich sagen: Kommunikation über räumliche Phänomene erfordert eine räumliche Komponente in der Kommunikation. Es ist beispielsweise schwer, einen Weg zu beschreiben ohne Richtungen mit den Händen zu zeigen oder eine Skizze zu machen.

Die Verwaltung und Auswertung räumlicher Komponenten ist die Domäne geographischer Informationssysteme (GIS). Hier gibt es ebenso bereits effektive Methoden um räumliche Informationen über das Internet anzubieten, wie die Vielzahl an vorhandenen Routenplanern oder Kartenservices zeigt.

Die Idee von geoTalk ist es, die beiden Technologien Chat und GIS miteinander zu kombinieren um besser über räumliche Phänomene kommunizieren zu können. Ein weiteres Beispiel neben Bürgerbeteiligungsprojekten wäre die Koordination von Hilfskräfen in Kriesengebieten. Üblicherweise werden solche Arbeiten von einer Vielzahl an nationalen und internationalen Organisationen unternommen. Die Tätigkeiten all dieser Organisationen müssen einerseits koordiniert werden, andererseits müssen die Einsatzteams der Organisationen aber auch erfahren, wo sie welche Tätigkeiten zu verrichten haben. geoTalk könnte beispielsweise auf Basis eines Luftbildes die Grundlage für Erfassung notwendiger Reparaturarbeiten und die Einsatzplanung bilden.

2 GEOGRAPHISCHE INFORMATIONSSYSTEME

„Almost everything that happens, happens somewhere. Knowing where something happens is critically important." (Longley, Goodchild et al. 2001)

Nahezu alle Daten haben Raumbezug. Das kann die reine Position (in Koordinaten) sein, an der die Daten erfasst wurden (wie es beispielsweise bei statistischen Daten der Fall ist), es können aber auch nachbarschaftliche Beziehungen zwischen Daten vorhanden sein. So besteht beispielsweise ein starker Zusammenhang zwischen der Nutzung benachbarter Grundstücke (direkt neben einem Wohngebiet ist z.B. keine Industrienutzung erlaubt). Moderne Methoden der Datenerfassung (Walford 2002) produzieren eine enorme Quantität an Daten. Diese Daten müssen organisiert, archiviert und analysiert werden (Laurini und Thompson 1992). Für diese Aufgaben wurden GIS entwickelt. Die Grundfunktionalität von GIS umfaßt daher Eingabe, Lagerung, Analyse, Manipulation und Visualisierung von raumbezogenen Daten.

Breite Verwendung finden GIS als Werkzeug für Planung und Informationspräsentation (Schaller 1992; Worrall 1992; Frank 1998; Zagel 2000). Hier sind sie bereits weit verbreitet, so z.B. in Bundes- und Landesverwaltungen, Gemeinden und Stadtverwaltungen aber auch in der Privatwirtschaft, z.B. bei Bauprojekten, in der Forstwirtschaft oder im Flotten-Management. Die Anwendungsbereiche umfassen Geographie, Geodäsie, Stadt- und Regionalplanung, Land- und Forstwirtschaft, Militär, Navigation, Standortplanung, Standortanalyse und vieles mehr.

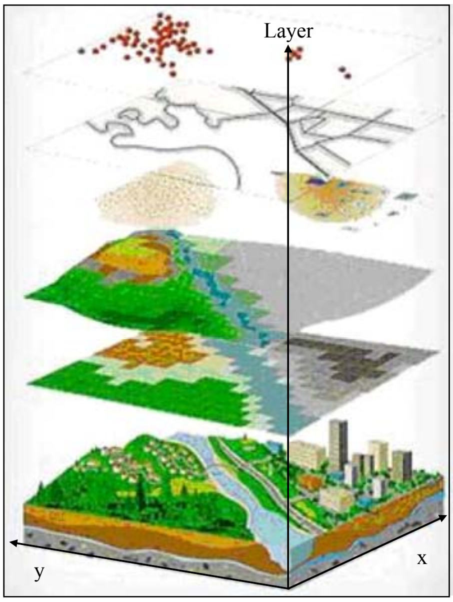

Abbildung 1: Layerstruktur in geographischen Informationssystemen

Die Organisation der Daten erfolgt meist in „thematischen Ebenen", sogenannten Layers. Dabei werden Daten einer Kategorie in Ebenen zusammengefasst und gemeinsam gespeichert bzw. bearbeitet. Abbildung 1 zeigt dieses Konzept. Zusammengefügt werden alle Layer mit Hilfe von Koordinatensystemen. Dadurch ist bei unterschiedlichen Koordinatensystemen eine Überführung in ein gemeinsames Koordinatensystem möglich können die Daten können gemeinsam bearbeitet werden, wodurch die Berücksichtigung gegenseitiger Abhängigkeiten möglich wird (z.B. Temperatur und Höhe über dem Meeresspiegel).

Die Erfassung der Daten erfolgt entweder mit Methoden der Fernerkundung (flugzeug- und satellitengestützte Sensoren) oder über terrestrische Erfassung (Vermessung, Entnahme von Proben, Zählung oder ähnliches). Daraus resultieren dann

- Rasterdaten (Fernerkundung) oder
- Vektordaten (terrestrische Erfassung – Punkt, Linie, Fläche und Attributsdaten).

Zwischen beiden Typen von Daten kann prinzipiell transformiert werden, es können also Rasterdaten in Vektordaten umgewandelt werden und umgekehrt. Dabei muss jedoch oftmals ein Qualitätsverlust in Kauf genommen werden. Generell erfolgt jedoch eine Vereinfachung der Realität, die von der gewünschten Auflösung abhängig ist.

Seit einigen Jahren werden große Anstrengungen unternommen, um Daten und Services plattformübergreifend verwenden zu können, da erkannt wurde, dass nur so brachliegendes Marktpotenzial erschlossen werden kann. In erster Linie ist hier auf das OpenGIS-Consortium (Buehler and McKee 1996) und die Norm TC211 zu verweisen, aber auch Standards wie GML (ein XML-Derivat für geographische Daten) oder SVG (Scalable Vector Graphics) sind in der Praxis von Bedeutung. Zusätzlich gibt es auch auf der Ebene der Datenproduzenten Bestrebungen, den Datenaustausch zu vereinheitlichen um die Mehrfacherfassung von Daten zu reduzieren.

Speziell an Standards für Web Map Services (WMS) wird momentan intensiv gearbeitet. Ein WMS ist ein ganz spezieller Service, der Karten auf Bedarf erstellt und über Internet verteilt. Das Besondere ist nun, dass die Karte in Form eines georeferenziertes Rasterbildes gesendet wird. Dadurch kann man Karten von unterschiedlichen Quellen zusammenspielen, auch wenn verschiedene

Koordinatensysteme verwendet werden. Twaroch (2003) hat gezeigt, wie man unter Verwendung von OpenGIS-Standards und kommerzieller Software eine Kombination von Daten aus unterschiedlichen Services durchführen kann. Der große Vorteil dieser Methode ist, dass man GIS-Funktionalität in eine Internet-Applikation einbinden kann ohne tatsächlich selbst ein GIS laufen zu haben, da man bestehende Karten-Services verwendet. Abbildung 2 zeigt, wie Open-GIS-kompatiblen WMS aussehen können.

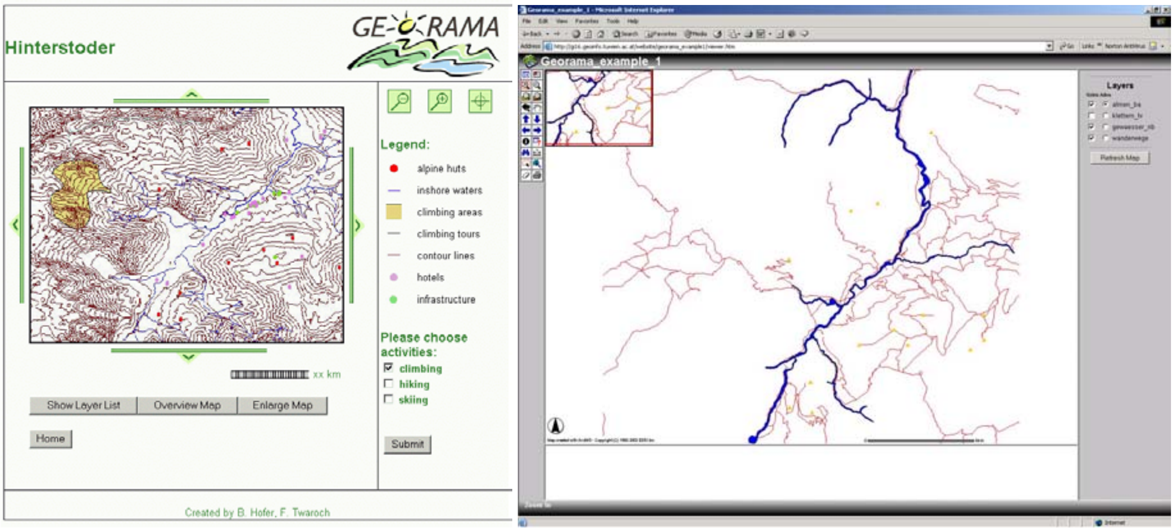

Abbildung 2: Beispiele für Webmapping-Applikationen – links kombinierte Darstellung von Daten aus mehreren Quellen, rechts der Viewer der Firma ESRI

3 CHAT-TECHNOLOGIE

Der Begriff ‚Chat' bezeichnet in der Regel die (fast) gleichzeitige, interaktive Kommunikation von mindestens zwei Personen über das Internet. Heute üblich sind webbasierte Chats, bei denen ein Chat-Client-Programm in einer Website integriert ist.

Die Vorteile eines webbasierten Chats liegen auf der Hand. Die Kosten für ‚reale' Treffen sind enorm, wenn die Anzahl der Teilnehmer hoch ist oder die Teilnehmer weit voneinander entfernt arbeiten. Es wurden daher unterschiedlichste Technologien entwickelt, um das persönliche Treffen durch andere Kommunikationsmethoden zu ersetzen oder zumindest zu ergänzen. Die am häufigsten verwendeten Strategien sind dabei Briefe (per Post, FAX oder eMail) und Gespräche (Funk oder Telephon).

Eine Reihe von Aspekten sind ausschlaggebend für welchen Zweck bzw. in welchem Umfeld eine bestimmte Kommunikationsform am ehesten geeignet ist:

- Kommunikationskosten: Wie teuer ist die Nutzung des Mediums?
- Medienkompetenz: Haben alle an der Kommunikation Beteiligten die notwendige Kompetenz das Medium zu bedienen (Telefonkonferenzen und Chats richtig abzuwickeln bedarf viel Erfahrung oder Einschulung)?
- Protokollierbarkeit: Soll das Kommunizierte protokolliert werden (Der Chat ist ein geschriebenes Gespräch und damit automatisch auch ein authentisches Protokoll)?
- Bandbreite: Steht die notwendige Bandbreite zur Verfügung (Das ist häufig auch eine Kostenfrage)?
- Komplexität: Wie ist der Grad an Komplexität des zu besprechenden Sachverhaltes.

Die Verbindung zwischen dem Chat und anderen Methoden der Kommunikation wird klar, wenn die Arten der Kommunikation systematisch angeordnet werden. Die Arten der Kommunikation lassen sich einerseits in synchron und asynchron unterteilen und andererseits gibt es bei einigen Kommunikationsarten eine digital nutzbare Dokumentation. Synchrone Kommunikation bedeutet, dass Sender und Empfänger zur selben Zeit an der Kommunikation beteiligt sind. Ein Telephonat ist beispielsweise eine synchrone Methode der Kommunikation. Bei asynchronen Kommunikationsmethoden sind Sender und Empfänger nicht gleichzeitig sondern hintereinander an der Kommunikation beteiligt. Eine gängige asynchrone Methode der kommunikation ist E-Mail. Digital nutzbare Dokumentationen in schriftlicher Form sind immer dann verfügbar, wenn die Kommunikation über einen digitalen Kanal verläuft und die Texte übertragen werden. Somit ergibt sich die Anordnung aus Tabelle 1 (Harnoncourt 2003):

	keine digital nutzbare Dokumentation in schriftlicher Form	digital nutzbare Dokumentation in schriftlicher Form
synchron	Besprechung Videokonferenz Telefonkonferenz	Chat
asynchron	Voice Mail Brief Fax	SMS E-Mail-Rundschreiben Diskussionsforen

Tabelle 1: Einteilung der Arten von Kommunikation

3.1 Unterschiedliche Chat-Konzepte

Es gibt eine Reihe unterschiedlicher Chat-Konzepte und daher auch verschiedene Chat-Technologien. Ihnen allen gemeinsam ist, dass gleichzeitig in geschriebener Form über ein Computernetzwerk kommuniziert wird. Die wohl am weitesten verbreitete Chat-Technologie ist der Standard Chat den wir im folgenden Seriellen Text-Chat nennen werden.

Eine typische Benutzeroberfläche eines seriellen Text-Chats hat einen Bereich für die vergangenen Nachrichten aller Beteiligten eines Gesprächs, meist ‚History' genannt. Diese ist als Liste auf dem Bildschirm sichtbar. Dabei ist anhand einer Nutzerkennung (dem Chatnamen) erkennbar, wer welchen Text geschrieben hat. Neue Textbeiträge erscheinen am unteren Ende dieser History und ältere Beiträge wandern Zeile für Zeile nach oben. Sind die Beiträge am oberen Rand angelangt verschwinden sie aus der Anzeige wobei jedoch ein zurückblättern in der Regel möglich ist. Unter dem History-Bereich befindet sich eine Eingabezeile in der ein Benutzer seine Nachrichten eintippen kann. Mit dem Drücken der Enter-Taste wird die Nachricht losgeschickt und erscheint binnen kurzer Zeit im History-Feld aller Chat-Teilnehmer.

Kaum verbreitet aber vom Konzept her sehr spannend ist der sogenannte Threaded Chat. Threaded Chat ist der Versuch, Kommunikation zu strukturieren und zu kanalisieren. Die Baumstruktur wird dabei von Diskussionsforen übernommen, bei denen es unterschiedliche Diskussionsstränge (‚threads') gibt, die sich weiter aufspalten können. Kernpunkt der Struktur ist die Tatsache, dass immer eine klare Zuordnung zwischen den Gesprächsbeiträgen zu einem bestimmten Aspekt besteht. Die Erweiterung bei einem Chat ist nun die synchrone Kommunikation, also Sender und Empfänger der Nachricht (Postings) sind zum selben Zeitpunkt online und fertig geschriebene Texte können sofort gelesen werden.

3.2 factchat

Eine Weiterentwicklung der bisherigen Chat-Technologien stellt der von der Wiener Firme factline hergestellte factchat dar. Das Spezielle an dieser Technologie ist die einfache Herstellung nachvollziehbarer Bezüge zwischen Chatbeiträgen. Erreicht wird dies durch eine Diskussionsfläche, auf der jeder Benutzer seine Nachrichten an beliebiger Stelle positionieren kann. Reaktionen auf eine Nachricht können nun in direkter räumlicher Nähe zu der ursprünglichen Nachricht abgelegt werden. Zusätzlich können Nachrichten mit Verbindungslinien zueinander in Beziehung gesetzt, also verlinkt werden. Abbildung 3 zeigt dieses Prinzip. Dabei wird im linken Bild gezeigt, wie auf Fragen geantwortet werden kann indem die Antwort in räumlicher Nähe zur Frage plaziert wird (beispielsweise darunter). Das rechte Bild zeigt die Möglichkeit der Verbindungslinie, mit der beispielsweise ein Diskussionsstrang in zwei oder mehrere Stränge aufgespalten werden kann.

Die Unterscheidung zwischen neuen und alten Nachrichten erfolgt durch Unterschiede in der Darstellung. Im laufe der Zeit werden Beiträge immer blasser dargestellt und verschwinden schliesslich im Hintergrund. Somit sind die aktuellsten Nachrichten auch am deutlichsten sichtbar. Um einem Gesprächsverlauf folgen zu können gibt es eine Zeitleiste, auf der man zunächst beliebig weit in die Vergangenheit zurückgehen kann und anschliessend den Disussionsverlauf wie auf einem Video verfolgt. Auch dieses Verblassen ist in Abbildung 3 erkennbar. Die beiden unteren Diskussionsbereiche im linken Bild sind wesentlich blasser, also älter als der Text in der Mitte der Diskussionsfläche.

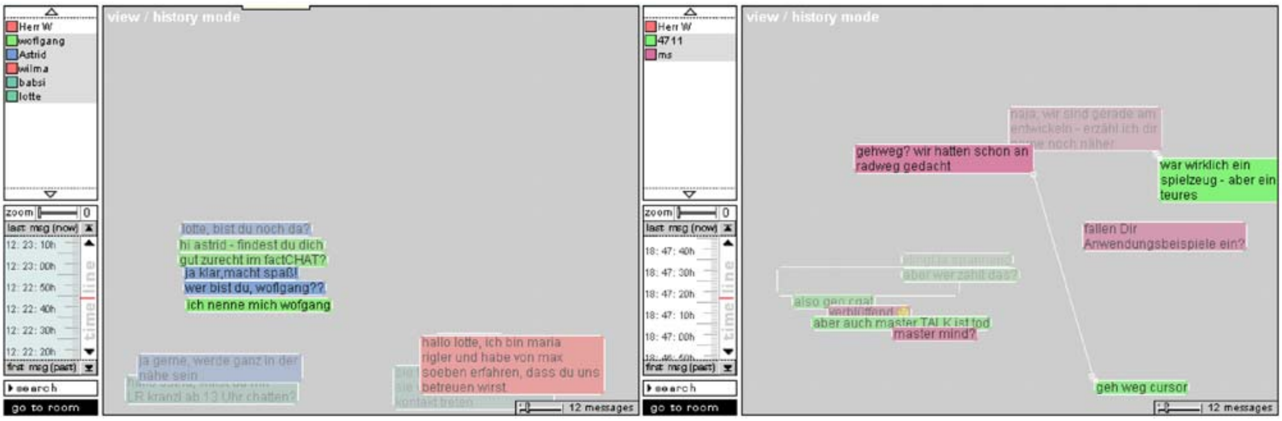

Abbildung 3: Beziehung zwischen Nachrichten und Reaktionen auf die Nachricht durch räumliche Nähe (links) und Verbindungslinien (rechts)

Grundsätzlich besteht die Erweiterung des factchat gegenüber herkömmlichen Chat-Systemen also in der Strukturierung nach Raum und Zeit. Die räumliche Strukturierung ergibt sich dabei aus der Positionierung der Texte durch die Anwendet. Die zeitliche Komponente wird von der Software erfasst und entsprechend über die Intensität der Schrift dargestellt.

Alle Beiträge des Chats bleiben erhalten, wobei neben dem Text selbst auch die Position und die Zeit erfasst und gespeichert werden. Somit entsteht eine Chronologie der Beiträge, wie es auch bei herkömmlichen Diskussionsforen der Fall ist. Abbildung 4 zeigt eine Diskussion zu vier verschiedenen Zeitpunkten. Alten Beiträge können wiederhergestellt werden, indem an der Zeitleiste links von der Diskussionsfläche zurückgeblättert wird. Somit kann man sich entlang der Zeitlinie vorwärts und rückwärts bewegen.

Abbildung 4: Chronologie im factchat

4 GEOTALK

Um den factchat für Kommunikation über räumliche Aspekte einsetzen zu können benötigen wir eine geographische Komponente im Chat. Die einfachste Methode ist es, ein statische Bild statt des grauen Hintergrundes in der Diskussionsfläche zu verwenden. Technisch ist eine solche Änderung kein Problem. Abbildung 5 zeigt, wie ein solche Chat mit einem Satellitenbild im Hintergrund aussehen könnte.

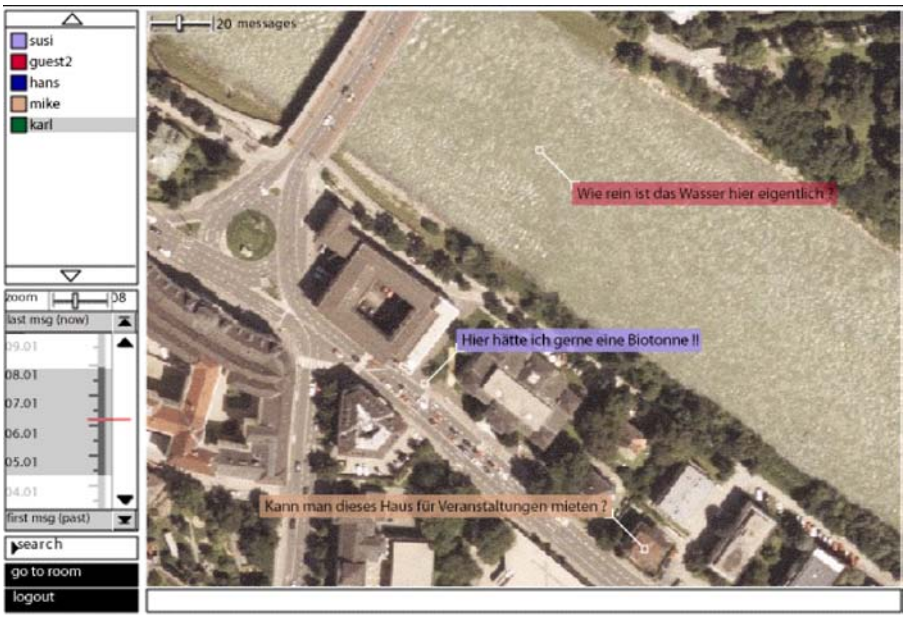

Abbildung 5: factchat mit statischem Hintergrundbild

Der Nachteil dieser einfachen Lösung ist jedoch die Einschränkung des Diskussionsgebietes. Es wäre nur eine Realisierung für Gebiete möglich, die sich mit ausreichender Genauigkeit in der Diskussionsfläche darstellen lässt. Es ist beispielsweise nicht möglich, eine Karte von Österreich einzublenden und über die Radwegesituation zu diskutieren. Daher haben wir uns für einen anderen Weg entschieden, der im Folgenden kurz skizziert werden soll.

4.1 Kombination von GIS und factchat

Um den Nachteil des factchat bezüglich der Größe der Diskussionsfläche zu überwinden planen wir den Einsatz eines WMS. Dabei stellt der WMS das georeferenzierte Hintergrundbild dar und auf Basis dieses Bildes kann komuniziert werden. Dazu muss der factchat um Operationen ergänzt werden, mit denen das Hintergrundbild beeinflusst werden kann. Die einfachsten hier zu erwähnenden Operationen sind Zoom (Ändern des Bildmaßstabes) und Pan (Ändern des Bildmittelpunktes). Weiters muss der factchat den Aufbau der Verbindung zu einem WMS ermöglichen, wobei der factchat die Darstellung der Diskussion übernimmt und der WMS die Hintergrundbilder generiert.

Ein weiteres Problem ist die Darstellung der Diskussionsbeiträge. In kleinen Maßstäben ist es nicht sinnvoll, sämtliche Beiträge in lesbarer Größe darzustellen. Der Anwender muss jedoch erkennen, in welchen Teilgebieten Diskussionsbeiträge veröffentlicht wurden. Wenn die betreffenden Gebiete auch im Interesse des Anwenders liegen, kann er näher in das entsprechende Gebiet hineinzoomen und erhält dann erst die Beiträge in lesbarer Form. Dazu ist eine symbolhafte Darstellung der vorhandenen Beiträge notwendig.

Wichtig ist für jeden Beiträgen die Art der räumlichen Referenz. Dies kann ein Punkt, eine Linie oder eine Fläche sein. Die Frage nach der Biotonne in Abbildung 5 ist ein Beispiel für eine punktförmige Referenz, während sich die Frage nach der Wasserqualität auf eine (nicht genau definierte) Fläche bezieht. Hier muss während der Entwicklung des Produktes noch Forschungsarbeit geleistet werden.

4.2 Einsatzmöglichkeiten

geoTalk wird als möglichst offene Umgebung konzipiert. Wichtig ist bei der Entwicklung vor allem eine breite Einbildung von bereits bestehenden Produkten. Kern des Systems sind der factchat und ein Content und Community Management System (CMS), die beide bereits zur Verfügung stehen. Die Anbindung and unterschiedliche Datenbanksysteme zur Speicherung der Texte und Positionen existiert bereits. Ebenso sollen unterschiedlichste Web Mapping Services unterstützt werden. Das wird durch strikte Beschränkung auf die vom OpenGIS Consortium (OGC) standardisierte Schnittstelle erreicht (Kolodziej 2003). Abbildung 6 zeigt den grundlegenden Aufbau von geoTalk.

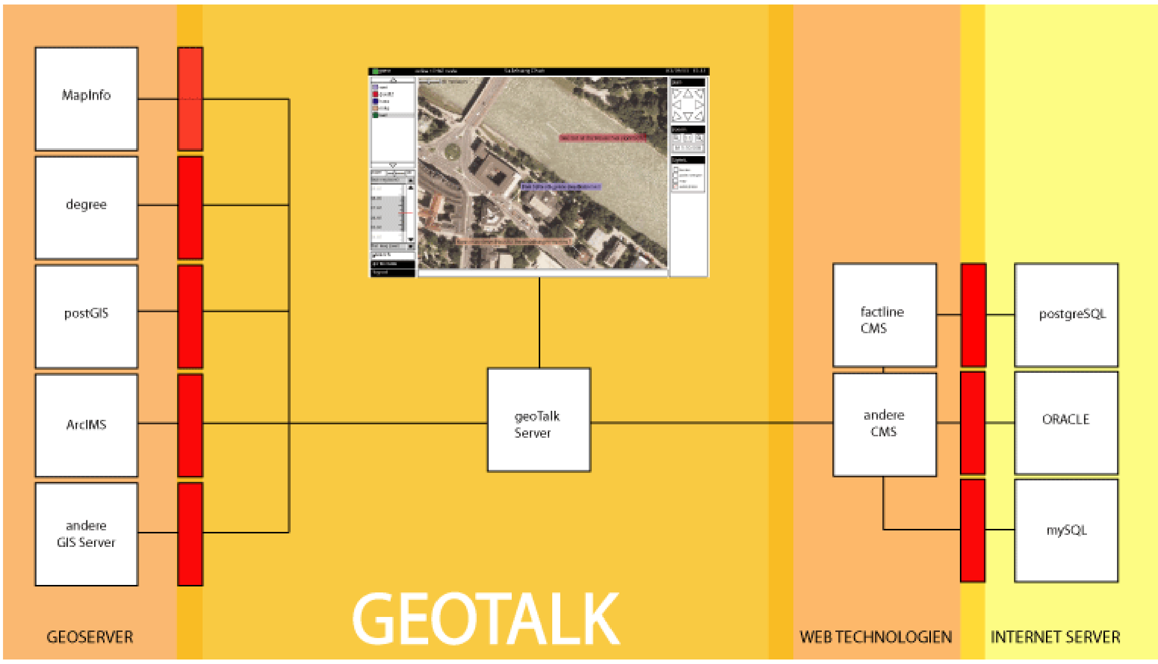

Abbildung 6: Konzeption von geoTalk

Um einen Breiten Einsatz von geoTalk zu ermöglichen wird eine Modularer Aufbau angestrebt. Die einzelnen Module (= Funktionen) sollen je nach Anwendungsbedarf zusammengestellt werden. Im Folgenden finden Sie beispielhaft einen Auszug an Standardfunktionen wie sie sich in verschiedenen Kommunikationszenarien einsetzen lassen:

- Möglichkeit, räumlich verknüpfte (verortete) Information anzubringen,
- Möglichkeit, auf verortete Information zu reagieren/antworten,
- Möglichkeit, gleichzeitig (synchron) mit anderen über Räumliches zu kommunizieren,

Daraus ergeben sich unterschiedlichste Szenarien, in denen das System zum Einsatz kommen kann. Im folgenden sind einige mögliche Szenarien angegeben:

- Öffentlicher Sektor – Bürger: Im Rahmen von Bürgerbeteiligung bei Planungsarbeiten kann geoTalk als Diskussionsforum genutzt werden
- Firma – Firma: Kommunikation zwischen allen beteiligten Firmen an einem Großprojekt muss ständig dokumentiert werden. Eine Abwicklung der Kommunikation über geoTalk würde die Dokumentation automatisch durchführenn.

- Firma – Kunden: Die Planung von Bauvorhaben beispielsweise von Wohnhäusern könnten mit geoTalk schrittweise den Wünschen der zukünftigen Bewohner angepasst werden. Die zukünftigen Bewohner könnten mit dem Bauführer Details der eigenen Wohnung besprechen und sich über das System für Alternativen entscheiden oder Sonderwünsche anmelden. Das die Kommunikation direkt auf Basis des Bauplanes durchgeführt werden kann ist eine sofortige Einarbeitung der neuen Informationen in die Planungsunterlagen möglich.

5 ZUSAMMENFASSUNG

geoTalk bietet eine neue Form der Kommunikation über geographische Probleme. Die bisherige Lösung beinhaltet immer persönliche Treffen, entweder vor Ort oder unter Verwendung von Karten- und Planmaterial. Problematisch sind dabei jedoch immer die Kosten des persönlichen Treffens. geoTalk ermöglicht die Kommunikation ohne dass die Kommunikationsparten an einem Ort sein müssen. Es ist sogar eine asynchrone kommunikation möglich. Die bedeutendste Neuerung ist jedoch die Einbindung der geographischen Komponente in die Kommunikation. Es wird direkt auf einer graphischen Darstellung über die Problematik gesprochen. Dadurch werden Sätze wie „Ich wünsche mir hier eine Schaukel für meine Kinder!“, die bei persönlicher Kommunikation gang und gäbe sind, auch bei Telekommunikation sinnvoll.

6 DANKSAGUNG

Bedanken möchten wir uns speziell bei allen Kollegen, die an der Erarbeitung des Konzeptes mitgewirkt haben. Das ist besonders Manfred Schrenk, der gemeinsam mit Max Harnoncourt die Idee zu geoTalk hatte. Wertvolle Hinweise kamen aber auch von Bernhard Snizek sowie vom Institut für Publizistik und Kommunikationswissenschaften der Universität Wien (Roland Burkart und Ursula Seethaler) und dem Institut für Wirtschaftinformatik der Wirtschaftsuniversität Wien (Christian König). Schliesslich gilt unser Dank auch noch Christine Rottenbacher für Diskussionen zum Thema Kommunikation über räumliche Phänomene und Florian Twaroch für Anregungen zum Thema Webmapping Services (beide vom Institut für Geoinformation und Landesvermessung der Technischen Universität Wien).

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Moderation internetbasierter Planungs- und Beteiligungsprozesse

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ABSTRACT

Moderation ist einer der wesentlichen Erfolgsfaktoren für internetbasierte Kooperations- und Beteiligungsprozesse. Aus den Bereichen der klassischen Planungsvorgänge über Visions- und Leitbildentwicklungen bis hin zu Entscheidungen mit vielen Parteien profitieren die Prozesse durch eine neutrale und kontinuierliche Moderation. Die Moderation begleitet den gesamten Prozess, wobei der Moderator nicht nur Koordinator sondern auch Vermittler (Mediator) und Botschafter ist. Eine wichtige Frage in diesem Zusammenhang ist, ob der Moderator auch ein Fachexperte sein muss. Im Gegensatz zu on-site Moderation erlaubt die on-line Moderation nicht nur den Einsatz synchroner sondern auch den Einsatz asynchroner Moderationsmethoden. Dies ist, besonders vor dem Hintergrund der Fülle an Software-Werkzeugen und Medien, ein neues Feld, auf dem erst noch Erfahrung gesammelt werden muss.

Dieser Beitrag stellt im Rahmen der Erfolgsfaktoren der E-Partizipation die Aufgaben der Moderation dar. Prozesstypen und unterschiedliche Ansätze von E-Partizipation werden geschildert, wobei besonders die Rolle der Online-Moderation betrachtet wird. Eine in diesem Beitrag erstveröffentlichte Besonderheit ist die vermittelnde Rolle der Moderation als Fachredaktion bei komplexen Aufgabenstellungen. Weiterhin werden unterschiedliche Moderationsmethoden, erläutert und schließlich ein Überblick über relevante Software-Werkzeuge für Online-Moderation gegeben.

1 RAHMENBEDINGUNGEN FÜR EINE ERFOLGREICHE ONLINE-MODERATION

Diskursive Kommunikationsprozesse sind oft in einen größeren Rahmen eingebettet und werden typischerweise geplant, moderiert und nachbereitet. In diesem Beitrag geht es hauptsächlich um in wesentlichen Teilen computerunterstützt durchgeführte Kommunikationsprozesse in kooperativen Prozessen.

Moderation ist unabdingbar für die Koordination der Kooperation. Elektronische Diskurse setzen sich meist aus mehreren Phasen oder Schritten zusammen und sollten deshalb sorgfältig geplant werden. Die Planung eines Diskurses und die Nachbereitung mit Dokumentation, Evaluation und Präsentation gehören zu den Aufgaben der Diskursmoderation im weiteren Sinne. Im engeren Sinne muss die Moderation die einzelnen Phasen in den ausgewählten Medien betreuen. In der englischsprachigen Literatur findet sich auch der Begriff des „Facilitators". Das ist eine neutrale Person, deren Aufgabe entweder die erfolgreiche Durchführung des Prozesses (process facilitator) oder die erfolgreiche Lösung des Diskursgegenstandes (content facilitator) ist (Bush & Folger, 1994). Neutralität ist ein wichtiger Faktor für erfolgreiche Diskurse, insbesondere dann, wenn Interessenskonflikte eine Rolle spielen.

Die Abteilung Wissen und Kommunikation des Fraunhofer-Instituts Autonome Intelligente Systeme AIS beschäftigt sich seit einigen Jahren mit der Planung, Durchführung und Evaluation internetbasierter Planungs- und Entscheidungsprozesse. Im Rahmen dieser Forschungsarbeiten wurden Erfolgsfaktoren für E-Partizipationsprozesse aufgestellt (Märker *et al.*, 2003a; Voss *et al.*, 2003), (Märker & Trenél, 2003), die als Säulen visualisiert werden können (siehe Abbildung 1).

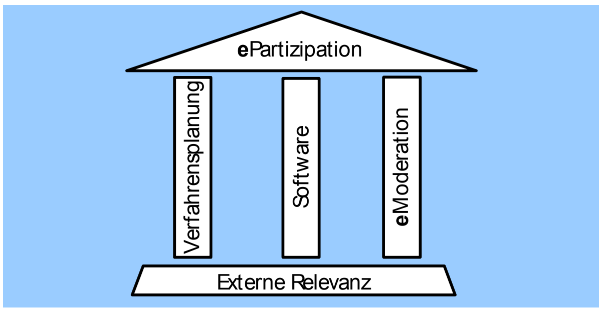

Abb.1: Säulen der E-Partizipation

Basis für eine erfolgreiche Beteiligung ist die externe Relevanz. Nur wenn die Beteiligung umfassend in das entsprechende Verfahren – sei es informativ, konsultativ oder kooperativ – eingebettet ist, werden sich genügend Teilnehmer für das Beteiligungsverfahren interessieren. Die potenziellen Teilnehmer müssen zum richtigen Zeitpunkt beteiligt werden, damit ihr Beitrag im Verfahrensfluss berücksichtigt werden kann. Außerdem muss für die Teilnehmer des Verfahrens deutlich sein, welche Themen und Fragestellungen zur Diskussion stehen, und vor allem, wie entwickelte Ergebnisse – meist Ideen-sammlungen, Richtlinien oder Lösungsvorschläge – in das Verfahren eingehen. Nur wenn diese externe Relevanz dem potenziellen Teilnehmerkreis glaubhaft vermittelt wird, wird er sich am Prozess beteiligen.

Die Moderation internetbasierter Prozesse durch neutrale, unabhängige Dritte ist für die Beteiligten ein sehr wichtiger Vertrauensfaktor. Sobald Zweifel an der Neutralität der Moderation aufkommen, ist es fraglich, ob die Teilnehmer sich noch weiterhin am Prozess beteiligen werden. Die Software ist ebenfalls ein besonders wichtiger Faktor, vor allem da die Auswahl der Software die Verfahrensgestaltung beeinflusst. Software und Verfahrensplan bedingen sich gegenseitig. Die Verfahrensplanung orientiert sich zunächst am generellen Aufgabentyp des Prozesses und der Art der Zusammenarbeit der betroffenen Parteien. Diese kann man fließend auf einer Skala von informativ über konsultativ bis hin zu kooperativ einordnen.

In diesem Beitrag geht es hauptsächlich um die Säule der Moderation, obwohl die Software, als eine Voraussetzung für gute Online-Moderation, in einem eigenen Kapitel angesprochen wird. Hier wird vor allem unsere eigene E-Partizipationsplattform zu Erläuterungen herangezogen. Die Software Dito® (Voss, 2002), vormals Zeno®, wurde bereits von uns zur Begleitung von Bürgerbeteiligungsverfahren eingesetzt (Trénel *et al.*, 2001), für kooperative Standortplanung (Voss *et al.*, 2002), zur Zusammenarbeit in virtuellen Unternehmen (Lavrac *et al.*, 2001), zur Optimierung von Geschäftsprozessmodellen (Voss & Althoff, 2002) und zum gemeinsamen, computervermittelten Lernen (Börding & Voss, 2002).

2 PROZESSE UND PROZESSTYPEN ALS UNTERSCHIEDLICHE ANSÄTZE ZUR E-PARTIZIPATION

Partizipative Planungs- und Beteiligungsprozesse ermöglichen den Akteursgruppen (zu denen auch oft die Bürger gehören), ihr Wissen und ihre Erfahrung in den Prozess einzubringen. Es werden nicht nur Informationen bereitgestellt, sondern auch Rückmeldung ermöglicht, bzw. erwartet. Neben der Qualifizierung von Planungsprozessen durch die Bürger kann günstigenfalls auch deren Akzeptanz gegenüber Entscheidung erhöht werden, da sie so eine gewisse Kontrollfunktion ausüben können. Auch bei rein informativen Prozessen wird angestrebt, allen Beteiligten gleichermaßen das Wesentliche zu vermitteln, um Transparenz und Akzeptanz zu schaffen.

Es gibt eine Vielzahl von Fällen, die eine kooperative Bearbeitung ermöglichen oder erfordern. Unserer Erfahrung nach ist es von Vorteil, Beteiligungsprozesse frühzeitig durchzuführen, möglichst vor den entsprechenden Fachplanungen und deren Verwaltungsschritten. Auf diese Weise kann sichergestellt werden, dass die Ergebnisse der Beteiligung in das Verfahren einbezogen werden können.

Wir haben während unserer Forschungsarbeit drei verschiedene Prozesstypen bearbeitet:

- Visions- und Leitbildprozesse
- Prozesse zu städtebaulichen Veränderungen und Stadtgestaltung
- Prozesse zur Verteilung von Ressourcen, Anlagen oder Einrichtungen

Der vorliegende Beitrag wird sich im Wesentlichen auf die Moderation des Dialogverfahrens zur Aufstellung des kommunalen Haushalts in Esslingen beziehen (ein Prozess der Kategorie „Verteilung von Ressourcen“). Folgende Prozesse haben wir mit Online-Moderation begleitet:

Visions- und Leitbildprozesse

Die Stadt Bonn hat in Kooperation mit dem Fraunhofer-Institut AIS und dem Generalanzeiger Bonn eine Online-Diskussion zum **Thema Baukultur in Bonn** durchgeführt. Anlass war der erste Konvent zur Baukultur, der vom 5.-7. April in Bonn stattfand. Zielgruppe der begleitenden Online-Diskussion waren ohne Ausnahme alle Bonner Bürger und an Bonn Interessierten. Besonders angesprochen wurden jene Bürger, die bereits beruflich oder durch ihre Arbeit in Interessensverbänden in anderen Projekten mit der Stadt Bonn zusammenarbeiten. Ziel der Diskussion war, auf der Grundlage einiger vorgegebener Themen aus dem Bereich Baukultur, eine möglichst breite Ideensammlung zur zukünftigen baukulturlichen Entwicklung von Bonn zu erhalten. Der General Anzeiger, eine Bonner Tageszeitung, berichtete im Voraus und parallel zu den Online-Foren über das Angebot. Die zusammengefassten gedruckten Ergebnisse der Diskussion überreichte die Stadt Bonn ihren mit den entsprechenden Themen befassten Gremien als Anregung für die zukünftige Arbeit.

Der internetbasierte **Ideenwettbewerb zum städtebaulichen Leitbild „Metropole Hamburg – Wachsende Stadt“** hatte zum Ziel, die Bürgerschaft der Stadt Hamburg über die Ziele des Leitbildes „Wachsende Stadt“ qualifiziert zu informieren und darüber hinaus die Bürger und Bürgerinnen zu motivieren, gute Projektideen für die zukünftige Stadtentwicklung Hamburgs zu entwickeln. Der internetbasierte Ideenwettbewerb wurde als ein reines Online-Verfahren durchgeführt, bestehend aus einer Ideenfindungsphase (Woche 1), einer Vertiefungsphase in Unterforen (Woche 2, 3) und einer Validierungsphase (Woche 4) zur Überprüfung der Ideen im Hauptforum. Nach Auswertung und Dokumentation der Online-Diskussion entschied eine unabhängig Jury über die besten Ideen. Die Gewinner wurden zur Präsentation ihrer Projektideen zu einem gemeinsamen Essen im Gästehaus des Senats mit dem Ersten Bürgermeister, Ole von Beust, eingeladen (Lührs, 2003), (Trénel *et al.*, 2003).

Prozesse zu städtebaulichen Veränderungen und Stadtgestaltung

In Esslingen wurde eine internetbasierte **Bürgeranhörung zu einem geplanten Neubaugebiet** durchgeführt. Zielsetzung dieses Angebotes war die Qualifizierung der Bürger durch ein umfassendes Informationsangebot im Internet und die Ermittlung von nutzbarem Abwägungsmaterial für das anschließende formale Verfahren. In der Vorbereitungsphase wurden Gespräche mit unterschiedlichen Akteuren des Auftraggebers geführt, um den Verlauf zu planen und die Relevanz des Verfahrens zu sichern. Parallel dazu wurde das Beteiligungsportal mit Informationen zum Planungsprojekt und asynchronen Diskussionsforen aufgebaut. Die Ergebnisse wurden durch die Moderation zusammengefasst und dem politischen Planungsgremium präsentiert und als Abwägungsmaterial übergeben (Trénel *et al.*, 2001), (Märker *et al.*, 2001).

Im Rahmen des Prozesses zur **Umgestaltung des Berliner Alexanderplatzes** gab die Berliner Senatsverwaltung im Vorfeld des Architektenwettbewerbs die Durchführung einer internetgestützten Bürgerbeteiligung in Auftrag. Die Bürger bekamen die Möglichkeit, im Internet ihre Anregungen und Vorstellungen für die zukünftige Gestaltung des Alexanderplatzes einzubringen und miteinander zu diskutieren. Die Ergebnisse der Diskussion wurden von den Planern in den zwischenzeitlich angefertigten Planungen explizit einbezogen (Hagedorn, 2003).

Prozesse zur Verteilung von Ressourcen, Anlagen oder Einrichtungen

Im Auftrag der Stadt Esslingen konzipierten wir ein internetgestütztes Dialogverfahren zur Information und Einbeziehung der Bürger bei der **Aufstellung des kommunalen Haushaltes**. In Kooperation mit der Stadtkämmerei und den zuständigen Ämtern wurden Informationen bereitgestellt und zur Diskussion aufbereitet. Themen waren z.B. wo laufende Kosten eingespart werden können und welche geplanten Investitionen welche Priorität für die Bürger haben. Die Ergebnisse, zu denen eine Liste mit Sparvorschlägen gehört, wurden der Stadt zur Kenntnisnahme für das weitere Haushaltsverfahren zu Verfügung gestellt (Poppenborg & Scholz, 2003).

3 UND WAS IST EINE LSA? DIE FACHREDAKTION ALS KOMMUNIKATIONSVERMITTLER ZWISCHEN VERWALTUNG UND BÜRGERINNEN

Bei internetgestützten Beteiligungsverfahren kann die Komplexität des Diskursgegenstandes und der Grad der Interaktion zwischen Verwaltung und Bürgerschaft sehr unterschiedlich sein. Ziel des Esslinger Projekts „Haushalt im Dialog“ war die Information und Diskussion über die kommunale Haushaltssituation. Doch wie soll man über einen der komplexesten kommunalen Sachbestände diskutieren? Ein Papierwerk von rund 700 Seiten so zur Verfügung stellen, dass der interessierte Bürger, die interessierte Bürgerin nicht erschlagen wird von den komplexen Zusammenhängen und verzweifelt an den verwaltungsinternen Formulierungen scheitert? Das waren die Fragen, die dazu führten, dass im Esslinger Verfahren erstmals zu der Moderation der Diskussion auch eine kontinuierliche Fachredaktion eingesetzt wurde. Diese hatte als Vermittler zwischen Verwaltung und BürgerInnen vor allem zwei Funktionen:

1. Redaktionelle Aufbereitung und „Übersetzung“ der Verwaltungsinformationen

2. Anfragen an die Ämter stellen und Rückmeldungen ins Forum stellen

Wie ist der kommunale Haushalt aufgebaut? Wo kommen die Gelder her, wo gehen sie hin? Könnte man das Geld für die Sporthallen auch für neue Innenstadtparkplätze ausgeben? Was kostet z.B. die Müllbeseitigung?

Die allgemeinverständliche Aufbereitung solcher Grundinformationen des kommunalen Haushalts wurde von der Fachredakteurin im Vorfeld vorgenommen und in das Diskussionsforum (Bereich „Bibliothek“) gestellt. Dabei wurde vor allem darauf geachtet, dass verwaltungsinterne Fachtermini vermieden oder erklärt wurden. Wurde zum Beispiel vom zuständigen Amt die Information „Die Unterhaltung einer LSA beläuft sich jährlich auf…Euro“ bereitgestellt, übersetzte die Fachredakteurin diese Information in „Eine Ampel kostet jährlich…Euro“ und stellte sie ins Forum. Ein kleines Beispiel, aber ohne diesen Vermittlungsschritt wäre es für viele BürgerInnen unmöglich gewiesen, die vom Amt bereitgestellte Information zu verstehen. Aber nicht nur das Vokabular, auch die Darstellungsform von Informationen war häufig zu übersetzen. So kann die Bürgeranfrage, wie sich die Pro-Kopf-Verschuldung in den letzten 20 Jahren in der Stadt entwickelt hat und von der Stadtkämmerei wurde eine Graphik zur Verfügung gestellt, die verwaltungsintern eindeutig die Antwort auf diese Frage war, aber verwaltungsextern zwei Kurven enthielt, die auf den ersten Blick sehr verwirrend waren. Die Fachredakteurin ließ sich diese Graphik in einem telefonischen Gespräch mit dem Stadtkämmerer erklären und stellte diese Kontext- und Erklärungsinformationen gemeinsam mit der Graphik ins Forum. Ohne diesen Vermittlungsschritt wäre Verwirrung auf beiden Seiten entstanden und die Anfrage trotz Antwort unbeantwortet geblieben. Neben dieser Übersetzungs- und Erklärungsarbeit leitete die Fachredakteurin die Informationsanfragen der BürgerInnen auch per mail oder telefonisch an die zuständigen Amtsleiter oder Verwaltungsmitarbeiter weiter. So sollte sicher gestellt werden, dass die Anfrage erstens auch bei dem/der MitarbeiterIn landet, der/die sie beantworten kann und zweitens, dass sie zeitnah beantwortet wird, denn nicht jeder Verwaltungsarbeitsplatz verfügt über einen Internetanschluss. So konnten manche VerwaltungsmitarbeiterInnen erst durch den Telefonanruf von der Anfrage informiert werden. Die Fachredakteurin ließ sich den Sachbestand am Telefon erklären und stellte ihn als Antwort in das Diskussionsforum. Manche Fragen, die auf den ersten Blick einfach erscheinen, wie z.B. „Was ist teurer? Eine Ampel oder ein Kreisverkehr?“ ist verwaltungsintern ein komplexer Sachverhalt und die konkrete Beantwortung benötigt etwas Zeit und Zusatzinformationen. Dass diese Frage einfach klingt, aber verwaltungsintern nicht einfach ist, wurde z.B. ebenfalls von der Fachredakteurin ins Forum rückgemeldet. Ihre Aufgabe war es somit auch, den aktuellen „Bearbeitungsstand“ der Informationsanfrage ins Forum zu stellen. Diese Schnittstellenfunktion und Kommunikationsvermittlung war für alle Akteursgruppen von großem Nutzen: die BürgerInnen hatten die „Garantie“, dass ihre Frage nicht im Forum „versauert“, sondern an die zuständige Stelle weitergeleitet wird und die Informationen verständlich zur Verfügung gestellt werden. Die VerwaltungsmitarbeiterInnen wurden auf direkte Anfragen zu ihrer Fach- und Zuständigkeitsgebiet aufmerksam gemacht und bei der Beantwortung der Frage redaktionell unterstützt. Die Moderatoren konnten sich auf die Strukturierung und Begleitung des Diskurses konzentrieren.

Abschließend lässt sich sagen, dass sich die zusätzliche Einrichtung einer Fachredaktion als Kommunikationsvermittler zwischen Verwaltung und Bürgerschaft bei einem komplexen Sachverhalt sehr hilfreich sein kann und zu empfehlen ist. Für die redaktionelle Aufbereitung der Informationen und die inhaltliche Koordinierung und das Nachverfolgen der Informationsanfragen sind journalistische Erfahrungen von großem Vorteil. Fachkenntnisse sind nicht zwingend erforderlich – wer wenig weiß, fragt um so genauer.

4 DER ONLINE-MODERATOR ALS MULITFUNKTIONALER UNTERSTÜTZER DES BETEILIGUNGSPROZESSES

(E-)Moderation - kein Selbstzweck!

Die aktive Gestaltung der Kommuniaktion zwischen den Teilnehmern einer Diskussion ist ein wesentlicher Erfolgsfaktor für die Qualitätssicherung von Planungs- und Beteiligungsprozesse mit mehreren Akteursgruppen. Moderation ist aber nur möglich, wenn der Moderator bei allen Teilnehmern als neutraler Unterstützer („*facilitator*") des Prozesses akzeptiert wird (Coleman & Goetze, 2001). Dies gilt umso mehr, da das Internet als Diskussionsumgebung für viele Menschen ungewohnt ist und die anonyme Kommunikation unfaire Beiträge begünstigt (Märker *et al.*, 2001). Das Vertrauen der Teilnehmer in ihre Moderation ist daher für die Produktivität und Qualität des Diskussionsprozesses und seiner Ergebnisse von enormer Bedeutung.

Um sowohl das Vertrauen der Teilnehmer zu erhalten, als auch den Kommunikationsprozess effektiv und ergebnisorientiert zu gestalten, identifizieren Trénel et al (Trénel *et al.*, 2001), Märker (Märker *et al.*, 2003b) und Bremer (Bremer, 2003) verschiedene Strategien und Aufgaben der Moderatoren:

- *Sicherung der Übersichtlichkeit und Ergebnisorientierung der Diskussion:* Hierzu gehört sowohl die Einleitung von verschiedenen Phasen des Diskurses, die Initiierung, Aufrechterhaltung und Unterstützung der Diskussion, die forenübergreifende Vernetzung von Ergebnissen und Beiträgen, sowie die Erstellung von Zusammenfassungen und Zwischenberichten und die Restrukturierung oder Schließung von Threads (Strängen).
- *Herstellung einer gewissen Dynamik in den Foren:* Die Moderatoren sollten den Teilnehmern vermitteln, dass in dem Forum „etwas passiert". Deswegen sollte auf Anfragen oder Änderungswünsche von Teilnehmern oder bei Bedienungsproblemen promt oder durch persönliche Ansprache reagiert werden. Die Vorstellung des Moderatorenteams (inklusive Fotos) dient ebenfalls der Lebendigkeit der Diskussion.
- *Förderung der Diskursivität:* Der Moderator sollte Argumentationen herausfordern und weiterentwickeln und die Teilnehmer gegebenfalls durch persönliche email zur Stellungnahme auffordern.
- *Reflexivität des Verfahrens ermöglichen:* In einem separaten Diskussionforum sollten die Moderatoren zur Metakommunikation einladen. Das heißt, die Teilnehmer haben die Möglichkeit, das den Ablauf, als auch die Relevanz des Internetangebots zu kommentieren. Änderungswünsche sollten noch während der Laufzeit des Beteiligungsangebotes umgesetzt werden.

Prinzipiell unterscheiden sie sich diese Techniken und Strategien nicht von denen, die auch in konventionellen präsenzgebundenen Verfahren eingesetzt werden können. Die Besonderheiten der Online-Moderation liegen vielmehr darin, dass die Teilnehmer internetbasierter Verfahren in der Regel asynchron und meist räumlich verteilt miteinander kommunizieren.

Asynchrone Kommunikationsverfahren können entweder mit Hilfe von Mailiglisten, in Newsgroups oder in Foren geführt werden. In jedem Fall ist eine kontinuierliche Betreuung mit Hilfe der oben skizzierten Moderationsstrategien notwendig. Dies gilt insbesondere, wenn das Verfahren über längere Zeiträume (inklusive Wochenenden und Feiertagen) andauert und gleichzeitig mehrere und komplex miteinander verzahnte Themen behandelt werden. Da die Betreurung solcher Verfahren nur schwer von einem einzelnen Moderator geleistet werden kann (Märker *et al.*, 2001), ist die interne Koordination des Moderatorenteams eine zusätzliche Aufgabe, die idealer Weise durch einen fest institutionalisierte Moderationsleitung übernommen wird.

Auf diese Weise konnte bei den Projekten „Berlin Alexanderplatz" und „Esslinger Haushalt im Dialog" (beide 2003) während der jeweils mehrwöchigen Online-Phasen eine zeitnahe und konsistente Moderation durch mehrere Mitarbeiter des Projektteams gewährleistet werden.

Zusätzlich zu den Mitarbeitern des Projektteams wurden im Projekt „Esslinger Haushalt im Dialog" 12 Esslinger Bürger zu Online-Moderatoren ausgebildet. Unter der Unterstützung eines Mitarbeiters des Fraunhofer-Projektteams wurden sie in der letzten Online-Phase in drei Schichten pro Tag als Moderatoren eingesetzt. Der Einsatz Esslinger Bürger als Moderatoren hatte den Vorteil, dass die Diskussion „noch näher am Geschehen" moderiert werden konnte, als dies durch das externe Projektteam des Fraunhofer Instuts hätte geleistet werden können. Gleichzeitig wurde die Neutralität der Moderation durch das Projektteam gewährleistet, welches neben den supervisorischen Funktionen auch die oben erwähnten Aufgaben der technische Strukturierung, Zusammenfassung, etc. aktiv unterstützte bzw. übernahm. Durch den Einsatz von ausgebildeten und betreuten, ehrenamtlichen BürgermoderatorInnen können zukünftig anfallende Moderationskosten gesenkt werden.

Besonderheiten synchroner Kommunikation im Internet

Der Einsatz leistungsfähiger Software ermöglicht neben asynchron stattfindenenden moderierten Online-Diskussionen auch die Durchführung synchroner moderierter Online-Events. Synchrone Veranstaltungen im Web unterscheiden sich von asynchronen vor allem durch den sehr viel knapper bemessenen Zeitraum, in dem dieses Angebot zur Verfügung steht. Das Zeitfenster und die damit verbundene Wahl des Zeitpunktes der Veranstaltung bestimmen in entscheidendem Maße den potenziellen Teilnehmerkreis. Ebenso wie bei konventionellen Präsenzveranstaltungen können nur diejenigen Akteure an der Diskussion teilnehmen, die zu dem Termin nicht anderweitig verpflichtet sind. Darüber hinaus muss eine Anbindung an das Internet zur Verfügung stehen. Dabei spielt nicht nur der effektive Zugang eine Rolle, sondern auch (wie etwa am Arbeitsplatz) die Erlaubnis, diesen privat zu nutzen. Die Wahl des Zeitpunktes synchroner Online-Events ist daher für die Vermeidung einer Digital Divide zwischen verschiedenen potentiellen Akteursgruppen von entscheidender Bedeutung.

Neben der selektiven Auswahl des Teilnehmerkreises limitiert die während der Veranstaltung nur in begrenztem Maße zur Verfügung stehende Zeit die Zahl der interaktiv beteiligten Teilnehmer. Dies scheint im Widerspruch zur These unbegrenzter Kommunikationsmöglichkeiten des Mediums Internet zu stehen. Tatsächlich ist in Analogie zu präsenzgebundenen Veranstaltungen die Möglichkeit realer Interaktion vor allem dadurch eingeschränkt, dass steigende (unbegrenzte) Teilnehmer- und Beitragszahlen den einzelnen Teilnehmern eine reflektierte und interaktive Teilnahme an der Diskussion verwehren. Das Dilemma zwischen den (potenziell) unbegrenzten Möglichkeiten des Mediums Internet und den Limitierungen des Kommunikationsmodus kann jedoch durch angemessene Moderationsstrategien und geeignete Softwarelösungen aufgefangen werden. Beide müssen sich vor allem an den Bedürfnissen der antizipierten Zielgruppen und Zielen der Veranstaltung orientieren.

Online-Interviews und Online-Gespräche

Im Rahmen zweier durch das Fraunhofer Institut AIS begleitete Beteiligungsprojekte wurden in Ergänzung zu moderierten asynchronen Diskussionsforen jeweils ein Online-Interview und ein Online-Gespräch durchgeführt. Das Setting einer solchen kombinierten Veranstaltung gleicht einem Interview mit anschliessender offener moderierter Gesprächsrunde. Der entscheidende Unterschied liegt darin, dass die Kommunikation über das Internet erfolgt, die Teilnehmer also nicht in direktem physischen Kontakt stehen. Im Falle der beiden durchgeführten Veranstaltungen wurde die Internetplattform Dito für textbasierte Kommunikation benutzt.

Visionsprozess „Baukultur in Bonn“: Die Gliederung der Veranstaltung in die beiden Teile *Interview* und *offene Runde* bot sich aus mehreren Gründen an. Während des Interviews konnten das Fraunhofer-Projektteam und die Interviewpartner (im Falle des Esslinger Projekts der Oberbürgermeister und der Finanzbürgermeister) wichtige Themen ansprechen und diskutieren. Da die „anwesenden“ Bürger während dieser Phase nur lesend teilnehmen konnten, beschränkten sich die Aufgaben der Moderatoren auf das strukturierte einstellen der Fragen und ggf. deren technische Verknüpfung mit den Antworten der Interviewpartner. Auf diese Weise konnten bis zum Ende des Interviews eine große Bandbreite von Themen angesprochen und den Bürgern Gelegenheit gegeben werden, weitergehende Fragstellungen zu diesen Themen zu entwickeln. Die übliche Aufgabe des Moderators, Lebendigkeit in der Diskussion zu erzeugen, entfiel dadurch. In der zweiten Phase, der offenen Runde des Online-Gespräches, wurde der Diskussionsbereich in Dito auch für die breite Öffentlichkeit freigeschaltet. Nun bestand die Möglichkeit, den beiden Politikern Fragen zu stellen bzw. die bereits angesprochenen Themen zu vertiefen. Ab diesem Zeitpunkt erweiterte sich der Kreis der Kommunizierenden. Gleichzeitig bedeutete dies, dass die Moderatoren, die zuvor die Rolle der Interviewer übernommen hatten, sich nun der Moderation des Forums widmen mussten, um so ihre Aufgabe als neutrale Mittler der Kommunikation zwischen den Akteuren wahrzunehmen.

Prozess zur Aufstellung des kommunalen Haushalts „Esslingen im Dialog“: Die Moderation stellte auch hier zu Anfang wie in einem Interview Fragen. Im Unterschied zum Prozess Baukultur in Bonn konnten die Bürger jedoch von Anfang an mitmachen und ebenfalls Fragen stellen. Am Anfang wurde die Situation durch die Bürger eher beobachtet und erst im Laufe der Zeit wurden durch die Bürger Fragen eingestellt. Die vorbereiteten Fragen der Moderation halfen von Anfang an Struktur und Inhalte entstehen zu lassen, die im weiteren Verlauf der Diskussion von den Bürgern aufgenommen wurden. Um die Übersichtlichkeit während der offenen Runde für alle Beteiligten zu gewähren war es möglich, die eingehenden Fragen der Bürger zu numerieren bzw. sie durch Aufforderung zur Antwort gezielt einem der beiden anwesenden Bürgermeister zuzuleiten. Weiterhin wurde durch wiederholte Aufrufe, weitere Fragen zu stellen deutlich gemacht, dass es noch Raum für weitere Diskussionen gab. Gleichzeitig zu dieser Vermittlung zwischen den Akteuren oblag den Moderatoren die Aufgabe, die Beiträge, wenn nicht bereits durch die Autoren selbst geschehen, in übersichtlichen Diskussionsstrukturen zu ordnen.

Zusammenfassend betrachtet sind die Aufgaben der Moderatoren in asynchronen und synchronen internetbasierten Kommunikationsprozessen durchaus vergleichbar. Allerdings variiert die Dynamik der Prozesse beträchtlich. Der Faktor Zeit ist sowohl für (naturgemäß kürzere) synchrone Veranstaltungen von größerer Bedeutung, als für asynchrone. Letztere sind über das Internet ständig erreichbar, erstere vielleicht nur während einer oder zwei Stunden. Es liegt daher in der Verantwortung der Moderatoren sowohl einen möglichst sinnvollen Zeitrahmen vorzugeben, als auch den Prozess effektiv und übersichtlich zu strukturieren. Nur so können in kurzer Zeit viele Argumente effektiv ausgetauscht und interaktiv diskutiert werden. Asynchrone Phasen sollten überwiegen und mit synchronen Events, in denen Schlüsselpersonen „zum Anfassen“ im Netz erlebt werden können, „garniert“ werden. Synchrone Events beleben die asynchronen Diskussionsphasen. Zudem können entstandene Ideen, Fragen oder Anmerkungen aus der asynchronen Phase aufgenommen und als Input für Interviews und Gespräche benutzt werden. Ergebnisse von Online-Gesprächen sollten umgekehrt auch wieder als Input für die asynchrone Kommunikation verwendet werden.

5 GEEIGNETE SOFTWARETOOLS FÜR ONLINE-MODERATION UND DEREN EINSATZ

Die Vielzahl der klassischen Moderationsmethoden spiegelt sich im Spektrum der Software Werkzeuge zur online Moderation wieder. So gibt es spezielle Software zum Brainstorming, zur Visualisierung, zur Diskussion und für Abstimmungen. Sowohl aus Sicht des Moderators als auch aus Sicht der Teilnehmer ist die Bedienung dieser Werkzeuge das größte Hemmnis zur erfolgreichen Online-Moderation. Diesem Hemmnis kann nur durch eine konsequente Integration der Werkzeuge entgegengetreten werden. Die Integration der Werkzeuge reduziert den Aufwand zur Einarbeitung in die Bedienung, den Aufwand zur Koordinierung der Tools untereinander und beugt inkonsistenten Datenbeständen vor.

Da es eine nahezu unüberschaubare Vielfalt von Software auf dem Markt gibt, beschränken wir uns in der Erklärung auf die Diskursplattform Dito, die wir eigens für die Durchführung von Planungs- und Beteiligungsprozessen entwickelt haben, und kontinuierlich an die Anforderungen, die sich aus den Herausforderungen der Online-Moderation ergeben, anpassen. Im Folgenden beschreiben wir die Integration und den Nutzen verschiedener Moderationswerkzeuge, die unsere Diskusplattform Dito bietet.

- Grundlegend ist die Integration auf der *Datenebene*, darüber die Integration der Benutzeroberfläche und schließlich die gemeinsame Steuerung der Tools. Auf der Datenebene gewährleistet eine gemeinsame relationale Datenbank einen konsistenten Datenbestand.
- Die *Benutzeroberfläche* der einzelnen Werkzeuge wurde in die modulartig zu erweiternde Oberfläche von Dito integriert, so dass für den Anwender kein Wechsel zwischen den Applikationen wahrzunehmen ist.
- Die gemeinsame *Steuerung* wird letztlich durch die vorherigen Ebenen der Integration erreicht, wodurch ein kontinuierlicher Datenfluss und eine medienbruchfreie Konfiguration der Werkzeuge möglich wird. Beispielsweise ist kein Speichern oder Laden notwendig, um Beiträge aus einer Diskussion in das Abstimmungswerkzeug zu übernehmen oder die Beiträge zu visualisieren.

Alle im folgenden kurz beschriebenen Werkzeuge sind in die Plattform Dito in dieser Hinsicht integriert. Abbildung 2 zeigt den Verlauf der Entwicklung dieser und einiger weiterer Tools.

Abb. 2: Roadmap für E-Diskursplattformen (Salz *et al.*, 2003)

Diskussionen moderieren mit Dito

Die aktuelle Version der E-Diskursplattform Dito bietet Bereiche für die zentrale Speicherung des Diskurses. Bereiche enthalten Unterbereiche (zum Beispiel für einzelne Prozessschritte), Beiträge als Elemente des Diskurses und Themen (Topics) zur thematischen Einordnung und Gruppierung von Beiträgen. Nutzer können aus Dito heraus auch explizit E-Mails als Benachrichtigung über einen Beitrag, ein Thema oder einen Bereich an andere Nutzer versenden. Überdies können Nutzer Bereiche abonnieren. Zusätzlich kann über die abonnierten Bereiche ein täglicher Bericht per E-Mail angefordert werden. Das Erscheinungsbild und das Angebot an Funktionen kann dynamisch durch Stylesheets angepasst werden. Beispielsweise kann der Befehl „Neuer Beitrag“ in bestimmten Prozessphasen ausgeblendet werden, um zu erreichen, dass nur auf vorhandene Beiträge Bezug genommen wird.

Durch die Benutzung von Etiketten, Schlüsselbegriffen, Start- und Enddatum oder Links können Beiträge semantisch angereichert werden. Dito unterstützt externe Links auf Ziele im Web und interne Links zwischen Diskursbereichen, Themen oder Beiträgen. Interne Links können etikettiert werden und sind an beiden Endpunkten sichtbar. Jedem Bereich kann ein spezifischer und jederzeit modifizierbarer Satz von Etiketten zugewiesen werden. Etiketten können beispielsweise gemäß dem IBIS-Modell von Kunz und Rittel (Kunz & Rittel, 1970) zur Strukturierung „bösartiger Probleme“, dem Argumentationsmodell von Toulmin (Toulmin, 1958) oder in Anlehnung an jede andere („ad hoc“) Diskurs-Ontologie vergeben werden (Märker *et al.*, 2003c).

Der Zugang zu Dito-Bereichen wird nach Rollen differenziert. Personen, Gruppen oder Gemeinschaften können Bereiche als Beobachter, als aktive Teilnehmer (Beiträge oder Verknüpfungen erstellen) oder als Editoren betreten. Die Editorenrolle erlaubt Diskursplanern und E-Moderatoren, beliebig Unterbereiche hinzuzufügen, Themen, Beiträge und Links zu ändern und Beiträge oder Beitragsgruppen zu verschieben oder zu kopieren (unter automatischer Beibehaltung der Verknüpfungsbeziehungen).

Editoren können eigene Moderatorenetiketten (Qualifiers) vergeben, zum Beispiel gelbe oder rote Karte als Verwarnungen für Beiträge oder „offen / geschlossen“, „verworfen“ oder „offene Fragen“ für Themen. Mit der Editorenrolle können Beiträge veröffentlicht oder entzogen werden (publish / un-publish), Beiträge, Themen oder ganze Bereiche für weitere Diskussionen geschlossen oder wieder geöffnet oder diese für alleinigen Zugang für Dritte vorübergehend gesperrt werden.

Synchron kommunizieren mit erweitertem Chat

Synchroner Chat ist insbesondere für kurze Prozessschritte / Diskursphasen geeignet, etwa für einfache Koordinationsaufgaben oder für kurze Brainstorming-Runden zur Generierung von Ideen (Divergenz). Umfrage und Abstimmung (Polling) ist eine sehr interessante Methode, die zur Zusammenführung des Diskurses (Konvergenz) genutzt werden kann.

Der für die E-Diskursplattform Dito jetzt fertig gestellte Chat ist so integriert, dass die Aufzeichnung (Log) einer Chat-Session zu einzelnen Beiträgen eines Diskursbereiches umgewandelt werden kann, um diese dann semantisch angereichert und (re-)strukturiert für nachfolgende, asynchrone Diskussionen als Ausgangsmaterial zur Verfügung zu stellen.

Umfragen in Dito

Das für Dito entwickelte Abstimmungswerkzeug (Dito Polling) soll E-Moderatoren die Durchführung von Umfragen ermöglichen, um etwa Themen zur Diskussion für eine nachfolgende Phase zu identifizieren, oder die Umsetzung einer Wahl zwischen – im Diskurs entwickelten – Optionen, um eine Diskussion(sphase) abzuschließen (Salz & Voss, 2003). Dabei werden Abfragen so in Dito integriert, dass Textantworten auf offene Fragen zu Beiträgen und umgekehrt, Dito-Beiträge als Fragen in einem Fragebogen genutzt werden können.

Wie wir im vorangegangenen Abschnitt gezeigt haben, können Online-Moderatoren durch Funktionen zum (dynamischen) Editieren und Konfigurieren und spezifische Moderationsfunktionen umfassende Eingriffsmöglichkeiten zur Verfügung gestellt werden.

Allerdings bieten HTML-Interfaces bei umfassenden (Re-) Strukturierungsarbeiten nur eingeschränkte Darstellungs- und Editiermöglichkeiten, so dass für Moderatoren zusätzliche graphische Oberflächen zur Strukturierung und Visualisierung zur Verfügung gestellt werden sollten.

Visualisierung und Analyse von Kommunikation

Beispielsweise können mit dem von uns entwickelten DIGALO Beiträge und Links eines Diskursbereiches als graphische Darstellung angezeigt werden. Durch dieses graphische Strukturierungswerkzeug ist es möglich, Verknüpfungen und Etiketten sehr schnell zu ändern oder Beiträge zu editieren. Strukturen können per „Drag and Drop“ modifiziert werden. Das DIGALO und der Dito-Server können jeweils mittels XML Inhalte exportieren bzw. importieren. Es ist geplant, eine Online-Version des DIGALOs zu entwickeln, durch die jede Aktion vom DIGALO direkt zu einem Dito-Bereich übermittelt wird und umgekehrt .

Desweiteren wird ein Awareness-Server entwickelt, der alle Ereignisse, die durch Dito-Nutzer erzeugt werden, erfasst, zusammenfassend analysiert und als Diskursdiagramme ausgibt. Die Diagramme geben der E-Moderation Hinweise darauf, dass ein Teilnehmer vielleicht im Vergleich zu anderen ein „Unruhestifter“ ist, der nicht nur selbst viele Einwände und Fragen einbringt, sondern auch Dritte zu solchen herausfordert (Wolff, 2003).

Discourseflows: Vorlagen für künftige Projekte

Bei komplexen E-Diskursen ist es sinnvoll, diese explizit in Phasen oder Schritte einzuteilen und einen Plan zu erstellen. Jeder Plan eines E-Diskurses sollte beschreiben, welche Schritte mit welchen Zielen, Akteuren, Kommunikationswerkzeugen und in welchen Zeitfenstern durchgeführt werden sollen. Als Kommunikationswerkzeuge kommen neben E-Mail beispielsweise Diskussionsforen, Chat, Umfragen und Abstimmungen (Polling), GruppenEditoren, Shared Whiteboards, Application Sharing, Audio- oder Videokonferenzen aber auch Fax, Telefon oder SMS in Frage.

Mit Diskursflüssen bezeichnen wir e-Diskurspläne in einer Form, die durch Computerprogramme unterstützt werden kann. In vielen Diskursen aus unterschiedlichen Anlässen und Anwendungsbereichen (z.B. kommunaler Bürgerhaushalt , Bauleitplanung, Leitbildentwicklung, Negotiated Rulemaking (Troja, 2001), Mediation, Optimierung von Geschäftsprozessen usw.) treten gleiche oder ähnliche Probleme immer wieder auf. Daher sollte es möglich sein, einen entwickelten Diskursplan zu speichern, (wenn möglich) zu verallgemeinern, anzupassen und wieder nutzen zu können sobald ein guter Plan zur Deliberation und Entscheidungsfindung für ein Problem definiert wurde. Schließlich sollte eine intelligente und automatisierte Anleitung (Wizard) den prozessverant-wortlichen Moderator unterstützen, die geeignetsten Pläne aus einer Bibliothek auszuwählen. Wir benutzen den Begriff diskursives Wissensmanagement (Discourse Knowledge Management) für die Wiederverwendung früherer E-Diskurse – mit oder ohne Diskursinhalte – als Pläne oder Schablonen. In diesem Zusammenhang kommt dem weiter oben skizzierten Diskurs-Awareness-Server eine wichtige Rolle zu, da Discourseflow-Ausführung und -Kontrolle den Vergleich eines Plans mit dem tatsächlichen Ablauf eines E-Diskurses verlangt.

6 DISKUSSION UND AUSBLICK

Es wurde gezeigt, dass – neben der Einbettung von Verfahren in das politisch-administrative System – die Verfahrensplanung, integrierte Softwaremodule und eine aktive Moderation wichtige Rahmenbedingungen für Planungs- und Beteiligungsprozesse stellen.

Insbesondere der intelligenten Abstimmung von Verfahrensplan, informatischem Werkzeug und Moderationsstrategien sollte die weitere Forschungspraxis Aufmerksamkeit schenken. Dem soziotechnischen Charakter der Prozesse sollte durch Begleitforschung besseres Verständnis zukommen. Auf diese Weise sollte auch noch mehr methodisches Wissen aufgebaut werden, das unterschiedliche Beteiligungskontexte, Nutzergruppen, Kommunikationsaufgaben und –modi berücksichtigt. Die zukünftige Forschung sollte die effektive und erfolgreiche Planung und Durchführung *multi-modaler* Bürgerbeteiligungsverfahren vereinfachen. Ein möglicher Weg dorthin zeigt sich im Zusammenhang unserer Forschung bereits in der Möglichkeit der Wiederverwendung früherer Diskurse als Pläne oder Schablonen.

Wir erfassen seit ca. zwei Jahren Diskurspläne und -vorlagen aus öffentlichen Beteiligungsprojekten und experimentellen Rollenspielen. Eine über die Erstellung und Konfigurierung hinaus gehende Unterstützung zur Planung von E-Diskursen wird derzeit durch unsere Dikursplattform Dito noch nicht angeboten. Können diese Funktionen in Dito erst einmal zur Verfügung gestellt werden, wird es auch möglich sein, Discourseflow-Schablonen, Discourseflow-Bibliotheken und Computerunterstützung durch Assistenten und Diskursmonitore zu realisieren. (Märker *et al.*, 2003c), (Voss *et al.*, 2003).

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Die Berücksichtigung des Landschaftsbildes bei raumrelevanten Planungen

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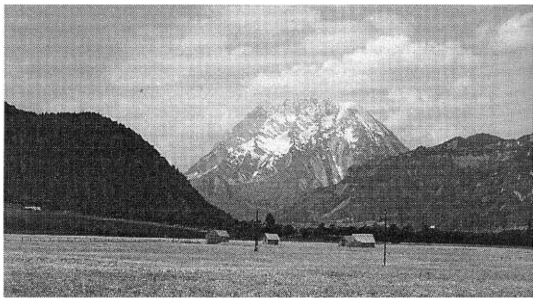
Das Landschaftsbild ist ähnlich wie Luft, Boden und Wasser ein Schutzgut gemäß zahlreicher Naturschutzgesetze. Bei der Behandlung des Begriffes Landschaft sind zunächst folgende Aspekte des Landschaftsraumes zu differenzieren, die häufig gemeinsam unter dem Begriff Landschaftsbild subsumiert werden:

- Landschaftshaushalt (ökologischer Aspekt)
- Landschaftsstruktur (struktureller Aspekt)
- Landschaftsgeschichte (historisch-genetischer Aspekt)
- Landschaftsnutzung (sozio-ökonomischer Aspekt)
- Landschaftsbild (physiognomischer, gestalt-ästhetischer Aspekt)

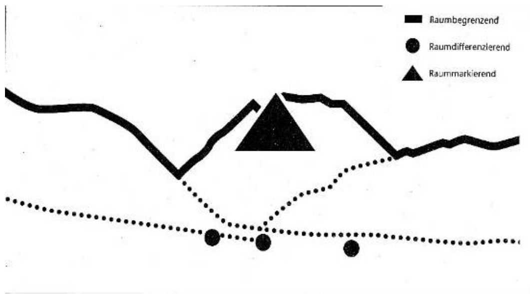
Die Landschaft läßt sich einerseits als Ressource für eine Vielzahl möglicher emotionaler, sinnlicher, ästhetischer und konkreter räumlicher Bezüge sowie als Nutzungsgrundlage für unterschiedliche Arten von Raumbedürfnissen und Flächennutzungen begreifen.

Es lassen sich zwei charakteristische (wirkungs- und daher bewertungsrelevante) Bereiche von Landschaftselementen differenzieren:

- Landschaftselemente als Gestaltfaktoren für die Raumbildung, das sind die Raumbegrenzung, die Raumdifferenzierung sowie die Raummarkierung (Abbildung 1) – nur um die soll es hier gehen – und
- Landschaftselemente als ökologische Parameter. Dazu zählen landschaftsökologische Kriterien wie etwa Fragen der Diversität, Komplexität, Kontinuität, Seltenheit sowie Reproduzierbarkeit von Landschaftsräumen (Natur aus zweiter Hand; Ausgleichsmaßnahmen).[1]



Landschaft | original



Landschaft | auf Gestaltfaktoren reduziert

Abbildung 18:Raumbegrenzung, Raumdifferenzierung und Raummarkierung [RICICA (1997), S. 105 und 106.]

Landschaften stimmen allerdings nicht überein mit dem parzellenscharfen Eigentum an Grund und Boden. Diese parzellenscharfen Flächen unterliegen zahlreichen sehr konkreten Nutzungsbedingungen. Neben den Eigenschaften von Flächen als privatem Eigentum kommt speziell für öffentlich zugängliche Gebiete (Wälder, Gewässer etc.) der Landschaft die Funktion eines öffentlichen Gutes zu. Dieser gleichsam doppelte Zugriff auf denselben Raum (z.B. Produktionsfläche für den Bergbauern UND Erholungsraum für den Touristen) erfordert eine Konsensfindung zwischen den Nutzern, die klassischerweise als hoheitliche Aufgabe (im Rahmen des Naturschutzes) gesehen wird. Dabei darf jedoch nicht übersehen werden, daß eine intakte Natur- bzw. Kulturlandschaft nicht ausschließlich für den Naturschutz relevant ist, sondern zunehmend auch als Grundlage für den Tourismus eine wirtschaftliche Dimension erhält.

Speziell verkehrsinfrastrukturelle Planungen haben zum Teil massive Eingriffe in die Landschaft zur Folge, führen doch Trassen fast zwangsläufig auch durch schützenswerte Gebiete im Hinblick auf das Landschaftsbild.

Die eigentliche Veränderungen im Stadt- und Landschaftsbild, als nur ein Aspekt von vielen, haben neben anderen Effekten (Veränderungen des Kleinklimas, Trennwirkung etc.) per se keine besonderen ökologischen Implikationen, sondern bewirken im wesentlichen „nur" Veränderungen (Neuerungen) in der ästhetisch visuellen Wahrnehmung unserer (gewohnten) Umwelt.

Das Bild der Stadt oder der Landschaft, das wir vor allem durch unseren Gesichtssinn, aber auch durch olfaktorische und akustische Reize wahrnehmen, ist dabei entscheidend geprägt durch unterschiedliches kulturelles, aber auch modisches und medial gesteuertes

1 Vgl. PLACHTER (1991).

Bewußtsein. In verschiedenen Zeiten wurden beispielsweise immer wieder andere „Ideallandschaften“ bevorzugt bzw. ähnliche Landschaften im Zeitablauf völlig unterschiedlich bewertet.[2]

Das Landschaftsbild ist also zunächst nichts Absolutes, sondern das Bild, das sich der Mensch von einer Landschaft aufgrund verschiedener Einflüsse, die er erlebt und denen er unterworfen ist oder von denen er zumindest beeinflußt wird, macht. Daher ist diese natürliche Ressource kein fester Wert, sie ist dem Wertewandel der Gesellschaft ausgesetzt (Abbildung 2).[3]

Abildung 2: Problematik der Messung und Bewertung ästhetischer Aspekte (GROSCINNY und UDERZO (1969), S. 10.)

Tendenziell neigt man dazu, Altes, Vertrautes bzw. Gewohntes mehr zu schätzen als Veränderungen bzw. Neuerungen, zumal sich beispielsweise für bestimmte Zweckbauwerke (etwa Brücken) die Maßstäblichkeiten bzw. Pro¬portionen im Laufe der Zeit deutlich verändert haben (Abbildung 3).

Die Ganter-Brücke

Die Lavarezzo-Brücke

Abbildung 3: Brücken als Gegenstand ästhetischer Betrachtung

Die Erscheinung einer Landschaft wird geprägt durch Landnutzungsmuster (Siedlungen, Landwirtschaft, Wälder, Verkehrswege etc.) sowie durch deren Strukturmerkmale und Ausstattungselemente (siehe Tabelle 1).

Durch Abgrenzungen von strukturähnlichen Bereichen (flächenhafte, linienförmige oder punktförmige Landschaftselemente) lassen sich Landschaftsräume raumbildend (raumbegrenzend, raummarkierend und raumdifferenzierend) gliedern. Das Landschaftsbild besitzt damit also durchaus eine objektivierbare Komponente. Die Bewertung des Landschaftsbildes ist allerdings mehr als andere ökologische Faktoren der Subjektivität des Betrachters unterworfen. Jeder Mensch empfindet andere Dinge als schön oder nicht schön. Damit sind aber auch die mit diesen Strukturmerkmalen verbundenen Erlebnisqualitäten höchst subjektiv (Tabelle 2).

2 So wurden etwa die Alpen im 12. Jahrhundert so beschrieben: „Ein schrecklicher Urwald, starrend von ewigem Frost und Schnee. Eine wilde Einöde, die vor noch gar nicht langer Zeit ein Gehege der wilden Tiere und eine Brutstätte der Drachen gewesen ist.“ (Quelle: Nationalpark Berchtesgaden (2003). Ein paar hundert Jahre später schreibt GOETHE aus der Schweiz: „Ja wir sollen das Schöne kennen, wir sollen es mit Entzücken betrachten und uns zu ihm, zu seiner Natur zu erheben suchen; und um das zu vermögen, sollen wir uns uneigennützig erhalten, wir sollen es uns nicht zueignen, wir sollen es lieber mitteilen, es denen aufzuopfern, die uns lieb und wert sind.“ Quelle: GOETHE (1840). Hier klingt bereits der Erhaltungsgedanke von ästhetisch wertvollem an. Heute sind die Alpen eine der wichtigsten Tourismusregionen in Europa.

3 „Man liebt weit mehr das Bild, das man sich macht, als den Gegenstand, auf den man es anwendet.“ ROUSSEAU (1993).

In zahlreichen Naturschutzgesetzen finden sich fast gleichlautend formulierte Aussagen, die auf die Sicherung und Entwicklung der Vielfalt, Eigenart und Schönheit von Natur und Landschaft abzielen. Insbesondere der Aspekt der Schönheit fällt in diesem Zusammenhang auf, weil damit auf einen ganz bestimmten Aspekt des Landschaftsraumes abgezielt wird.

	flächenhaft	**linienförmig**	**punktförmig**
Oberflächenformen (Relief)	Höhenlagen, Hangzonen, Talräume, Ebenen, Terrassen etc.	Grat, Kamm, Silhouette, Graben, Kerbtal, Schlucht, Horizontlinie etc.	Spitze, Doline, Scharte
Gewässer	stehende Gewässer (See, Teiche)	fließende Gewässer (Bach, Fluß)	Quellen
Vegetation	Äcker, Weingärten, Obstgärten, Wiesen, Weiden etc.	Waldränder, Baumreihen, Bachauen, Hecken	Baum, Baumgruppen
Flurformen	Blockflur, Einödblockflur etc.	Streifenflur, Gewannflur	-
Erschließung (Verkehr)	Bahnhöfe, Hafenanlagen, flächenhafte Erschließung, Flugplätze	Fußwege, Radwege, Straßen, Schienenwege, Skilifte	kleinere Parkplätze
Bebauung	Stadt, Dorf, Gebäudegruppen	Fluchtlinienverlauf, Raumkanten, Einfriedungen	Einzelbauwerke

Tabelle 1: Räumliche Strukturmerkmale der Landschaft

flächenhaft	**linienförmig**	**punktförmig**
Weite, Freiheit, Offenheit, Großzügigkeit, Einförmigkeit, Information, Spannung, Abweisung, Produktivität, Erholung etc.	Information, Orientierung, Vielfalt, Spannung, Abweisung, Vertrautheit etc.	Information, Orientierung, Seltenheit, Spannung, Symbolgehalt, Identität, Aktivität etc.

Tabelle 2: Mögliche, durchaus ambivalente Erlebnisqualitäten einer Landschaft in Abhängigkeit von der Art der Strukturmerkmale (RICICA (1997), S. 85.)

Die Wahrnehmung der räumlichen Umwelt inklusive des damit verbundenen Landschaftserlebnisses ist jedoch in seiner Gesamtheit aufgrund von möglichen widersprüchlichen individuellen Bewertungen objektiv nicht zu operationalisieren. Darum begnügt man sich häufig damit, lediglich visuelle Wahrnehmungen als Ausschnitt der gesamten Umweltwahrnehmung zum Bewertungsmaßstab bei baulichen Eingriffen zu machen und diese auf gleichsam physikalische bzw. weitgehend unstrittige (aber durchaus unterschiedlich bewertbare) Parameter zu reduzieren. Für verkehrsinfrastrukturelle Maßnahmen sind dies insbesondere:

- Veränderungen von relevanten Sichtbeziehungen (Sichthindernisse) durch Dammlagen, Brücken oder Lärmschutzeinrichtungen,
- Verschattungsbereiche (durch Geländemodellierungen, Führung der Infrastruktur in Hochlage oder durch Lärmschutzwände),
- Änderungen der Raumbegrenzung (Horizont) sowie
- Änderungen von vertikalen und horizontalen Strukturelementen (Einschränkung oder Bereicherung der vorhandenen Landschaftsstruktur).

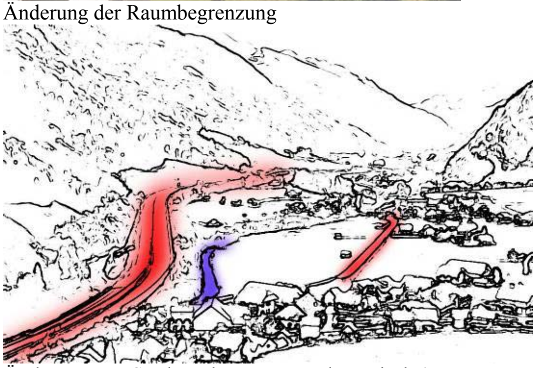
In Abbildung 4 sind einige dieser Einflußgrößen auf das Landschaftsbild exemplarisch dargestellt.

Änderung der Sichtbeziehungen

Beschattung angrenzender Flächen

Änderung der Raumbegrenzung

Änderung von Strukturelementen



Änderung von Strukturelementen – schematisch (rot: Verkehrswege, blau: regulierter Fluß)

Abbildung 4: Unterschiedliche Auswirkungen einer Straße auf das Landschaftsbild

Zusammenfassend läßt sich sagen, daß die Berücksichtigung des Landschaftsbildes bei raumrelevanten Planungen ein wichtiger Planungsgrundsatz sein soll, daß man sich aber unter keinen Umständen der Illusion hingeben darf, das Landschaftsbild per se bzw. die Veränderungen des Landschaftsbildes wie auch immer objektiv bewerten zu wollen. Im Rahmen von formaliserten Bewertungsverfahren sollten daher Aspekte des veränderten Landschaftsbildes jedenfalls als qualitative Zusatzargumente beschrieben und erläutert werden, nicht aber in den eigentlichen formalisierten Bewertungsprozeß einbezogen werden, da sich die Veränderungen weder hinreichend quantifizieren und schon gar nicht plausibel monetarisieren lassen.[4]

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4 Siehe dazu auch HAUGER (2003).

Windparks: GIS-gestützte Planungsmethoden zur räumlichen Steuerung

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Die Nutzung von Windenergie zur Stromerzeugung nimmt in Österreich zur Zeit rasch zu. Der Trend geht zur Errichtung größerer Anlagen und zur Konzentration auf ertragreiche Standorte. Nach den Plänen der Landespolitiker soll der Osten Österreichs künftig ein Eldorado für die Stromerzeugung aus Windenergie werden. Klar ist: Die Zukunft dieses Landschaftsraumes wird wesentlich von Windparks geprägt werden.

Die umweltpolitische Rechtfertigung der Nutzung erneuerbarer, nachhaltiger Windenergie sowie deren Akzeptanz in der Öffentlichkeit werden jedoch aufs Spiel gesetzt, wenn folgendes passiert: Wenn Windparks in Gebieten errichtet werden, welche aus Sicht des Naturschutzes und des Landschaftsbildes bedeutsam sind!

Aus diesem Grund erfordert die räumliche Steuerung von Windparks eine umfassende und mit anderen Nutzungsansprüchen koordinierte Planung. Das ÖIR wurde bereits mehrmals damit betraut, die überdurchschnittlichen Anforderungen von Windenergieanlagen in einem Regionalen Rahmenkonzept zu betrachten und die Auswirkungen im regionalen Zusammenhang abzuschätzen. Aufbauend auf diesen Erfahrungen wird hier den Fragen nachgegangen: Welche Instrumente stehen der Regionalplanung zur Verfügung, um mögliche Windparkstandorte in ihrer Einzel- und Summenwirkung zu beurteilen? Und: Welchen Beitrag leistet dabei ein Geografisches Informationssystem?

EIN REGIONALES RAHMENKONZEPT

Soziale Akzeptanz von Windrädern

Die Akzeptanz von Windrädern hängt sowohl vom Standort der Windräder als auch von sozialen und gesellschaftlichen Einstellungen der Anwohner ab. Dabei steuert die allgemeine Einstellung zur Windenergienutzung die Akzeptanz von Windrädern am meisten. Aber auch das Empfinden, daß das Landschafts- und Ortsbild beeinträchtigt wird, führt oftmals zu einer ablehnenden Haltung gegenüber Windrädern.

Diesem Gefühl kann zum Einen über die Standortwahl, also geographisch, zum Zweiten über eine Verbesserung der allgemeinen Einstellung zur Windenergie, also sozial, entgegengewirkt werden. Aufgabe eines Regionalen Rahmenkonzeptes ist es, im regionalen Zusammenhang geeignete Standorte zur Nutzung der Windenergie zu identifizieren und so dem Gefühl der Beeinträchtigung über die Standortwahl und Standortgestaltung entgegenzuwirken.

Gesucht: Eine verantwortungsbewußte Strategie

Zunächst einmal grob umrissen: Welche Auswirkungen und Risken verursachen Windparks? Wenn ein Windpark errichtet wird, verändert sich das Landschaftsbild und die Windenergieanlagen (= Windräder) wirken in unterschiedlicher Art und Weise auf die Umgebung ein. Dies abzustreiten, ist schon allein aufgrund der Dimension eines Windrades sinnlos. Ein Windrad läßt sich nicht einfach hinter Hügeln oder Wäldern verstecken! Moderne Windräder weisen in Österreich Turmhöhen von 100 m auf. Die Rotorblattspitze befindet sich in einer Höhe von bis zu 140 m Höhe, was etwa der Höhe des Wiener Stephansdomes entspricht. Damit ist klar: Die Auswirkungen von Windrädern sind sichtbar und oft auch hörbar. Die Existenz eines Windrades läßt sich nicht abstreiten. Es ist da oder es ist nicht da.

Auch über sein Gefährdungspotenzial als große Maschine gibt es keinen Zweifel. Wer unter einem Rotor steht, spürt und hört die unglaubliche Kraft der drehenden Masse. All dies sehen, hören und spüren, heißt gewahr werden, daß die Erzeugung von Strom ihren Preis hat - auch wenn der Strom aus Windenergie erzeugt wird! Da die Auswirkungen und Risken von Windenergie bekannt und klar begrenzt sind, ist es gegenüber anderen Formen der Stromerzeugung jedoch leichter, eine verantwortungsbewußte Strategie im Umgang mit Windenergie zu entwickeln. Warum aber gerade eine Strategie im Rahmen der Regionalplanung?

Warum Regionalplanung?

In Österreich lautete am Anfang die Devise: Die Bundesländer führen für Windenergieanlagen eine eigene Widmungskategorie ein, die Gemeinden steuern. Denn schließlich: Gemeinden haben es in ihrer Hand, ob sie Grundstücke als Bauland widmen und somit für die Errichtung von Windrädern freigeben oder nicht. Eine Zeit lang ging dies auch gut; zum Einen, weil sich die Windenergie in Österreich anfangs nur zaghaft entwickelte, zum Anderen, weil sich Windräder früherer Generationen im Vergleich zu heute in ihren Dimensionen und Maßen bescheiden gaben.

Mit anderen rechtlichen Rahmen- und Förderbedingungen sowie neuer Technologie erlebte die Nutzung von Windenergie in Österreich einen Aufschwung. Der Trend geht heute zur Errichtung größerer Anlagen und zur Konzentration auf ertragreiche Standorte. In Österreich weisen Burgenland und Niederösterreich die ertragreichsten Standorte auf. Andere interessante Standorte finden sich nach längerer Suche auch in der Steiermark, Oberösterreich, Salzburg und Kärnten.

Als die Fernwirkung der neuen Anlagen erkannt wurde und zueinander nahsituierte Windparks auch Summenwirkungen verursachten, meldeten sich immer mehr Vertreter des Natur- und Landschaftsschutzes zu Wort; so geschehen in Tourismusregionen oder in Gebieten mit bedeuteten Vogelpopulationen und deren Zugstrassen. Aber auch Menschen, die um das Landschaftsbild ihrer Heimat fürchteten, begannen, vor einer „Verwindradelung“ zu warnen.

Die umweltpolitische Rechtfertigung der Nutzung der Windenergie sowie deren Akzeptanz in der Öffentlichkeit standen auf dem Spiel. Gleichzeitig waren Investoren beunruhigt, führte dies doch zu großen Unsicherheiten in der Planung. Deutlicher denn je zeigte sich, dass die räumliche Steuerung von Windparks eine umfassende und mit anderen Nutzungsansprüchen koordinierte Planung erfordert. Zunehmende Fern- und Summenwirkungen von Windparks machten klar, daß die Regionalplanung diese Aufgaben am besten zu erfüllen vermag.

OPTIMIERUNG VON WINDPARKS IN HINBLICK AUF DIE LANDSCHAFT

Landschaftsästhetik

Windräder produzieren Energie. Jedoch: Energie zu produzieren ist nicht das einzige Bedürfnis. Der Mensch hat auch ästhetische Bedürfnisse. Im selben Ausmaß wie wir materielle Bedürfnisse nach Nahrung, Wärme und Behausung haben, haben wir auch immaterielle Bedürfnisse nach Liebe, Identität und Schönheit. Freilich spricht jede Person einzelnen immateriellen Bedürfnissen eine unterschiedliche Bedeutung zu. Dies gilt aber auch für materielle Bedürfnisse.

Und so verhält es sich eben mit den ästhetischen Werten einer Landschaft. Schönheit, Eigenart und Vielfalt einer Landschaft werden von Person zu Person unterschiedlich und somit subjektiv geschätzt, sind deswegen aber nicht weniger wirklich! Natürlich gibt es den Standpunkt: Ästhetische Folgewirkungen gehören ausgeklammert, da die ästhetische Wahrnehmung subjektiv ist. So eine Haltung verhindert jedoch, mit den am Prozess interessierten Menschen ins Gespräch zu kommen und läßt ästhetische Folgewirkungen als minderwertig erscheinen.

Auch wenn ästhetische Eigenarten einer Quantifizierung trotzen - sie lassen sich beschreiben. Eine Beschreibung erfordert Feldarbeit. Manchmal kann es notwendig sein, eine Befahrung und Begehung zu unterschiedlichen Tages- und Jahreszeiten und bei unterschiedlichen Wetterbedingungen zu wiederholen. Auch kann es helfen, den Standort zu verändern, um Auswirkungen eines Windparks von mehreren Blickwinkeln aus zu beurteilen.

Es ist vielleicht aufschlußreich, sich vor Augen zu führen, dass Fachleute in Österreich gleichwie in anderen westlichen Gesellschaften die Auswirkungen von Windrädern auf das Tierleben mehrfach untersuchten, über soziale und landschaftsästhetische Auswirkungen von Windparks bis heute jedoch wenig geforscht wurde. Windparkbetreiber werden hingegen immer wieder vor die Frage gestellt, wie sie mit den Ängsten der Leute umgehen; Ängste, welche durch den raschen Landschaftswandel im Zuge der Entwicklung der Windenergie hervorgerufen werden.

Generell wird eine Landschaft um so stärker von Windrädern beeinträchtigt, je mehr Anlagenhöhe, Baumasse und Farbe eines Windrades der Charakteristik der umgebenden Landschaft widerspricht. Die Beeinträchtigung einer Landschaft durch Windräder hängt also einerseits von der Ausführung der Anlage, andererseits von der Charakteristik der umgebenden Landschaft ab. Welche Instrumente stehen der Regionalplanung folgerichtig zur Verfügung, um die Einzelwirkungen von Windrädern zu beurteilen? Zum einen läßt sich der Landschaftsraum in Bezug auf Windräder charakterisieren, zum anderen werden Aussagen über die Ausführung und Optimierung von Windparks getroffen und in Form von Sichtbarkeitsanalysen wird die Gesamthöhe von Windrädern berücksichtigt.

Charakteristik des Landschaftsraumes

Mit Hilfe der Charakteristik des Landschaftsraumes in Hinblick auf Sichtweite, vertikale Struktur und technische Vorbelastung wird die Empfindlichkeit der Standorte in einem Untersuchungsgebiet gegenüber Windrädern entwickelt. Auch der Erhalt bedeutsamer Kulturlandschaften und Kulturgüter steht dabei im Vordergrund.

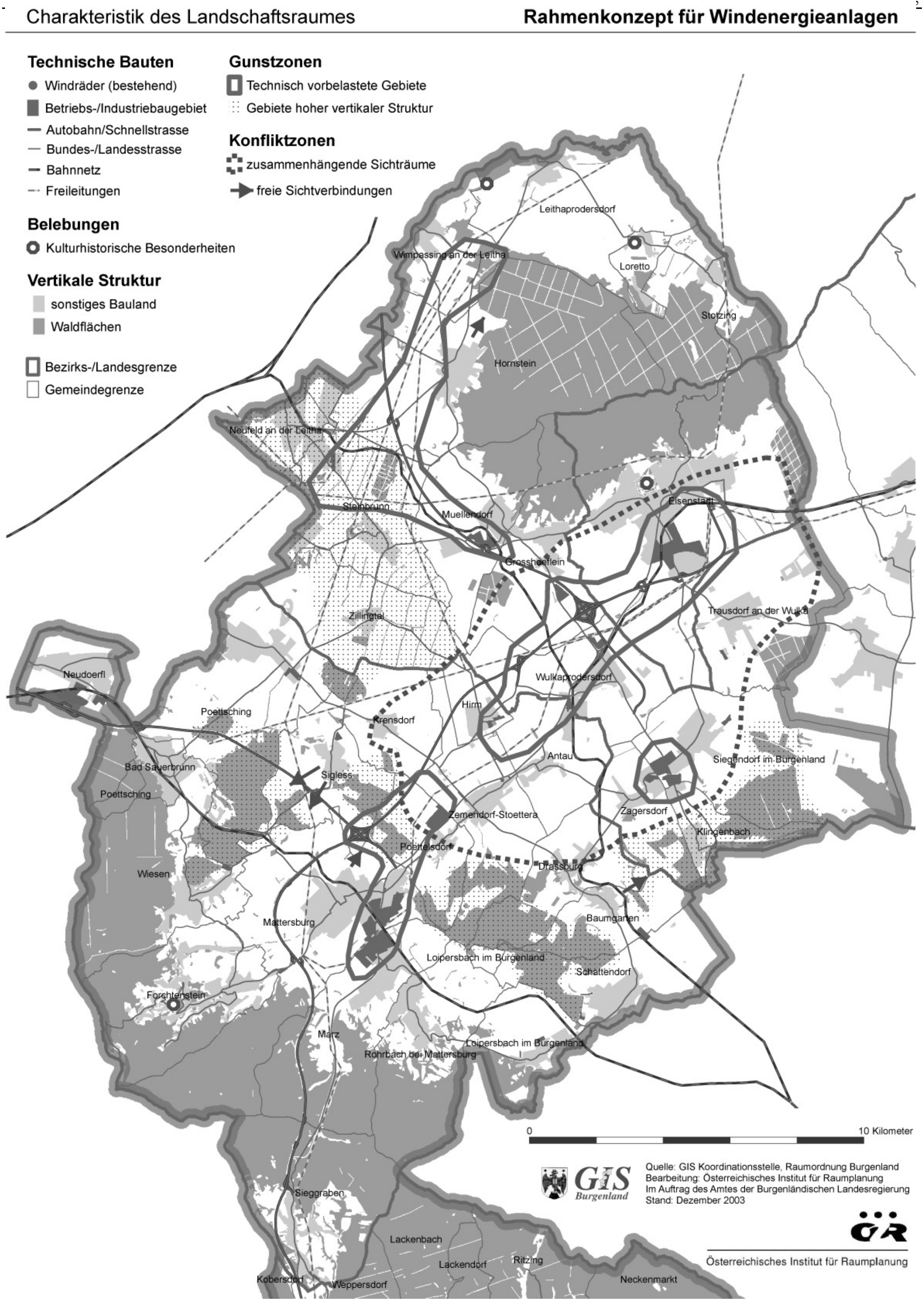
Es werden Kriterien gesucht, welche die „Empfindlichkeit“ und „Schutzwürdigkeit“ einer Landschaft gegenüber Windenergieanlagen beschreiben. Eine Landschaft ist gegen störende Eingriffe um so empfindlicher, je schutzwürdiger sie ist und je leichter sie „visuell verletzt“ werden kann. Im burgenländischen Zentralraum wurden diese Kriterien angewandt und in der Karte “Charakteristik des Landschaftsraumes” Gunst- und Konfliktzonen ausgewiesen.

Visuelle Verletzlichkeit einer Landschaft

Die visuelle Verletzlichkeit einer Landschaft steht im Zusammenhang mit ihrer Einsehbarkeit und vertikalen Strukturierung. Die Sichtweite bestimmt den Raum, der eingesehen werden kann. Die vertikale Strukturierung, im wesentlichen durch Gehölze und Bebauung, gliedern die Landschaft und begrenzen den Blick. Darüber spielt die Anordnung dieser Elemente für das Zustandekommen von Eigenart und Vielfalt eine wichtige Rolle.

In einer Studie von HASSE (1992) zeigte sich, daß Sichtweite und Vertikale Strukturierung in Verbindung mit Störungen und Belebungen eine deutliche Aussage über die visuell-ästhetische Empfindlichkeit einer Landschaft geben konnten. Als Grundlage dafür dienten folgende verifizierten Aussagen:

- Eine Landschaft ist gegenüber einem Eingriff durch Windräder um so verletzlicher, je größer die landschaftsspezifische Sichtweite ist.
- Je stärker eine Landschaft durch vertikale Elemente strukturiert ist, um so weniger ist sie gegenüber diesem Eingriff verletzlich.
- Je stärker eine Landschaft durch technische Bauwerke gestört und vorbelastet ist, um so weniger ist sie verletzlich.


Charakteristik des Landschaftsraumes
Rahmenkonzept für Windenergieanlagen
Technische Bauten
Windräder (bestehend)
Betriebs-/Industriebaugebiet
Autobahn/Schnellstrasse
Bundes-/Landesstrasse
Bahnnetz
Freileitungen
Gunstzonen
Technisch vorbelastete Gebiete
Gebiete hoher vertikaler Struktur
Konfliktzonen
zusammenhängende Sichträume
freie Sichtverbindungen
Belebungen
Kulturhistorische Besonderheiten
Vertikale Struktur
sonstiges Bauland
Waldflächen
Bezirks-/Landesgrenze
Gemeindegrenze
Leithaprodersdorf
Wimpassing an der Leitha
Loretto
Stotzing
Hornstein
Neufeld an der Leitha
Steinbrunn
Muellendorf
Eisenstadt
Grosshoeflein
Zillingtal
Trausdorf an der Wulka
Neudoerfl
Wulkaprodersdorf
Poettsching
Hirm
Krensdorf
Antau
Bad Sauerbrunn
Sigless
Siegendorf im Burgenland
Poettsching
Zemendorf-Stoettera
Zagersdorf
Klingenbach
Poettelsdorf
Wiesen
Drassburg
Baumgarten
Mattersburg
Loipersbach im Burgenland
Schattendorf
Forchtenstein
Marz
Loipersbach im Burgenland
Rohrbach bei Mattersburg
0
10 Kilometer
GIS Burgenland
Quelle: GIS Koordinationsstelle, Raumordnung Burgenland
Bearbeitung: Österreichisches Institut für Raumplanung
Im Auftrag des Amtes der Burgenländischen Landesregierung
Stand: Dezember 2003
ÖIR
Österreichisches Institut für Raumplanung
Sieggraben
Lackenbach
Lackendorf
Ritzing
Kobersdorf
Weppersdorf
Neckenmarkt

Schutzwürdigkeit einer Landschaft

Die Schutzwürdigkeit einer Landschaft im landschaftsästhetischen Sinn bezieht sich auf Belebungen und Störungen.

Als Belebungen gelten:

- Kulturhistorische Landmarken wie Kirchen und Windmühlen
- Natürliche Landschaftselemente, wenn sie so angeordnet sind, daß sie die Vielfalt und Abwechslung der Landschaft erhöhen und Horizont oder Landschaft gliedern. Dazu zählen beispielsweise Gehölzgruppen, Hecken, Alleen, Bachläufe und Felsformationen.
- Anthropogene Landschaftselemente, wenn auch sie die Vielfalt und Abwechslung der Landschaft erhöhen und den Horizont gliedern. In jedem Fall müssen sie dabei dem Maßstab der umgebenden natürlichen Landschaftselemente entsprechen, wie beispielsweise Einzelgehöfte.

Als Störungen gelten Landmarken der technischen Zivilisation, welche folgende Kriterien aufweisen:

- Sie dominieren aufgrund ihrer Unmaßstäblichkeit große Landschaftsräume, wie beispielsweise kalorische oder Kernkraftwerke. Vielfach sind sie mit negativen Inhalten verbunden.
- Sie nivellieren aufgrund ihrer Ubiquität eine Landschaft und machen sie beliebig. Dabei wird hin und wieder auch der natürliche Maßstab überschritten, wie beispielsweise bei Hochspannungsleitungen oder Großgebäuden. Aufgrund ihrer Ubiquität werden auch manche Ferienhaussiedlungen zu diesen Störungen gezählt.

BEITRAG EINES GEOGRAPHISCHEN INFORMATIONSSYSTEMS

Geographische Informationssysteme sind ein hervorragendes Hilfsmittel, zuerst einmal mit Pufferbildung notwendige Mindestabstände zu Wohnbauland und zu bedeutenden Infrastruktureinrichtungen zu berücksichtigen. In einem zweiten Schritt werden mit Hilfe von GIS Aussagen über die tatsächliche Sichtbarkeit von möglichen Windparks getroffen und Summenwirkungen von Windparks aufgezeigt. Schließlich lassen sich so in der Zusammenschau mit der Charakteristik des Landschaftsraumes Eignungzonen für Windenergieanlagen identifizieren.

Mindestabstände

Basierend auf einer Studie von KURY (2001) über Mindestabstände von WEAs und einer persönlichen Auskunft[1] lassen sich für ein Untersuchungsgebiet folgende Mindestabstände von WEAs zu Wohnbauland, Verkehrswegen und Hochspannungsleitungen festlegen:

- ■ 1.000 m zu Wohnbauland und sonstigen Gebäuden mit Wohnnutzung
- ■ 100 m zu hochrangigen Straßen und oberirdischen Bahntrassen
- ■ 100 m zu Freileitungen ab einer Spannung von 110 kV

Konflikte entstehen vermehrt dort, wo die Windenergienutzung mit bereits bestehenden Raumnutzungen und –funktionen wie beispielsweise der Wohnfunktion konkurriert. Aus diesem Grund wird zuerst das Wohnbauland betrachtet. In einer Untersuchung kam EGERT (2001) zu dem Ergebnis, daß jene Anwohner, die näher als 1 km von WEAs entfernt wohnen, Windenergieanlagen signifikant weniger akzeptieren als Anwohner, die weiter weg wohnen. Auch KURY weist darauf hin, daß er bei Windparks mit mehr als einer WEA einen Mindestabstand von 1 km zum nächst gelegenen Wohnbauland festlegt. Ein geringerer Mindestabstand von 750 m kann nur bei Einzelanlagen in Betracht gezogen werden.

Sichtbarkeitsanalyse

Basierend auf einem digitalen Geländemodell werden im GIS Sichtbarkeitsanalysen erstellt, die zeigen, wo Windräder gesehen werden und wo sie sich im Sichtschatten des Geländes befinden. Um den mit steigender Entfernung abnehmenden Effekt der ästhetischen Wirksamkeit räumlich zu analysieren, wird eine Zoneneinteilung vorgenommen. Die Autoren unterscheiden dabei zwischen bis zu drei kreisförmigen ästhetischen Wirkzonen mit abnehmender Eindruckstärke.

Um den optischen Eindruck von Windparks zu beurteilen, wird der mit steigender Entfernung abnehmende Effekt der ästhetischen Wirksamkeit betrachtet. Dieser Effekt wurde u.a. in der Anwohnerbefragung von EGERT (2001) nachgewiesen. Um diesen Effekt der ästhetischen Wirksamkeit räumlich zu analysieren, wird eine Zoneneinteilung, für die es mehrere Ansätze gibt, vorgenommen.

NOHL (1993) unterscheidet je nach Art des Vorhabens zwischen bis zu drei kreisförmigen ästhetischen Wirkzonen mit abnehmender Eindruckstärke.

ENGSTRÖM (1980) unterscheidet in einer Untersuchung zwischen vier Zonen:

- Rotorzone als unmittelbare Umgebung des Turmes

[1] Auskunft von G. KURY am 22.8.2002

- Blickbindungszone bis zu einer Entfernung etwa der dreifachen Höhe der Anlage. Innerhalb dieser Blickbindungszone muß der Beobachter das Windrad mit verschiedenen Blickrichtungen fixieren, um sie ganz zu erfassen. Auf diese Weise lenkt das Windrad die Aufmerksamkeit eines Beobachters fast zwangsläufig auf sich.
- Dominanzzone von der dreifachen bis zur zehnfachen Höhe der Anlage. Bis zu diesem Abstand wird der Einfluß des Windrades als dominant beurteilt.
- Sichtbarkeitszone, welche die weitere Umgebung umfaßt.

Die Frage, ob solche Gliederungen ausreichend untermauert sind, ist berechtigt. Diese Gliederungen geben aber in jedem Fall einen ersten Anhaltspunkt über die Reichweite der optischen Wirkungen. Bei der Beurteilung einzelner Standorte empfehlen die Autoren in jedem Fall, Sichtverschattungen infolge des Geländes sowie die ästhetische Erheblichkeit im Kleinraum zu berücksichtigen.

Summenwirkungen und Aufstellungsmuster von Windparks

Generell wurde bisher davon ausgegangen, daß das Landschaftsbild eher durch eine vermehrte Zahl an Windrädern als durch deren Größe beeinträchtigt wird. Es besteht nach MIELKE (1996) weitgehend Übereinstimmung, daß kompakte Windparks landschaftsästhetisch verträglicher sind als eine verstreute Häufung von Einzelanlagen. Daher sollen größere Teile der Landschaft und die entsprechenden Sichtachsen frei von Windrädern bleiben, auch wenn dies dazu führt, daß Windparks in anderen Gebieten in konzentrierter Form errichtet werden.

Auch die Orientierung von Windparks an landschaftlich dominanten Leitlinien wie an Waldrändern, Straßen, Hochspannungsleitungen, ... führt dazu, daß das Aufstellungsmuster als weniger chaotisch wahrgenommen wird. Das Ziel, den Landschaftsverbrauch von Windparks zu begrenzen, führt zu möglichst geringen Abständen zwischen den einzelnen Windrädern.

Abstände zwischen Windparks

Auch Abstände zwischen den Windparks sollen die Überlastung von Landschaften vermeiden helfen. In den „Empfehlungen" des niedersächsischen Innenministeriums wird ein Abstand von 5 km zwischen Windparks vorgeschlagen. Für mit Bäumen und Sträuchern stärker strukturierte Landschaftsbereiche mit geringeren Sichtweiten wird ein Abstand von 4 km für ausreichend gehalten. Demgegenüber ist der Kreis Nordfriesland der Meinung, daß die Korridore 15 bis 20 km breit sein sollten (MIELKE, 1996).

Die beste Lösung bei der Frage nach passenden Abständen zwischen Windparks ist demnach regionsspezifisch unterschiedlich. In weniger strukturierten Landschaften mit großen Sichtweiten stellen wenige große Windparks bei einem Freihalten der übrigen Landschaftsteile die sinnvollste Lösung dar. In landschaftlich anders gegliederten Gebieten hingegen sind wiederum kleinere Windparks, welche mehr der Landschaft eingefügt sind, zu empfehlen.

Gefragt ist: Zusammenarbeit in der Forschung

Allein schon, um im Tourismusland Österreich die Akzeptanz der Windenergie in der Bevölkerung und bei erholungssuchenden Gästen zu sichern, gilt es, eine Forschung über soziale und landschaftsästhetische Auswirkungen von Windparks ins Leben zu rufen und voranzutreiben. Denn: Wir müssen den Menschen ihre Bedürfnisse und Ängste zugestehen. Fragen der Standortwahl von Windparks können erst dann optimal beantwortet werden, wenn wir mehr darüber wissen. Eine Zusammenarbeit zwischen Sozialwissenschaft und Landschaftsplanung wird notwendig sein. Laßt uns damit beginnen, ehe es zu spät ist!

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Future Landscape(s) - Möglichkeitsräume zwischen Polarisierung und Balance

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1 EINLEITENDE GEDANKEN

Eingeübte Routine und traditionsbehaftetes Denken bestimmen häufig unsere Raumvorstellungen. Klassische Theorien und räumliche Modelle sind fragwürdig geworden. Haben sie ausgedient oder können sie zukunftsbeständig gemacht werden? Darunter leiden die Glaubwürdigkeit gegenüber den Betroffenen und die Überzeugungskraft gegenüber den Entscheidungsträgern. Weitsicht und Offenheit sind weiterhin kaum Entscheidungsgrundlagen. Die Zukunft kann schon deswegen nicht gesamthaft gestaltet werden. Auf permanentes Versagen diesbezüglich braucht gar nicht näher hingewiesen werden. Andererseits, vielleicht ist die vorgefundene Raumstruktur besser als ihre fachliche Reputation? Trägt sie mehr Anzeichen der Zukunft in sich, als PlanerInnen wahrhaben wollen?

Mit beachtlichem Mittelaufwand wird versucht, traditionelle Landschaftsbilder und gewohnte Raumeindrücke zu erhalten, weil bzw. obwohl die ökonomische Grundlage eigentlich schon längst hinfällig geworden ist. Der *ländliche Raum als Gegenpol zur Stadt* befindet sich in Auflösung, ebenso wie das europäische Modell von Stadt. Was bleibt, ist das Phänomen der Peripherie, nur folgt diese nicht mehr unbedingt dem Zentrums-Rand-Gefälle, sondern fokussiert sich in *Rückzugsräumen*, die ihre funktionelle Vielfalt verlieren, oder in *Zwischenräumen*, die eine Neudefinition erfahren.

Zwischenräume lösen in Zeiten fallender Grenzen und dynamischer Vernetzungen zunehmend die Ränder ab. Verkettungen treten als Raumphänomen stärker hervor, während Gradienten immer mehr Diskontinuitäten aufweisen. Historische Kernstädte verlieren ebenso Funktionen an die Zwischenräume wie ländliche Kernregionen. Der *Speckgürtel* thriumphiert. Die *Zwischenstadt* konkurrenziert das Städtesystem und saugt gleichzeitig den sich auflösenden ländlichen Raum aus. Vielfalt als Grundvoraussetzung der Lebensbedingungen vollzieht sich in immer größeren Maßstäben. Das Verständnis von Region unterliegt einem dramatischen Wandel.

Es ergibt sich das Paradoxon, dass das traditionelle Konzept von Stadt und/bzw. Land bereits als Gegenmodell zum aktuellen Befinden und Zustand des Raumes fungiert. Aber kann dieser Rückgriff zukunftsfähig sein? Es scheint an zukunftsfähigen Konzepten zu mangeln, die den aufkommenden Raumkategorien gerecht werden und das Gesetz des Handelns im öffentlichen Interesse wieder reaktivieren können. Anhand einer Karte der kommenden Raumkategorien werden die Möglichkeiten der Zukunftsgestaltung ausgelotet.

2 DAS FORSCHUNGSVORHABEN (2001-2003)[1]

Das Projekt beschäftigte sich mit den Auswirkungen eines Rückzugs der Landwirtschaft aus der flächenzusammenhängenden Bewirtschaftung und der Frage des Verantwortungstransfers zu anderen Landnutzern, aber auch mit den Bedingungen, die für eine Aufrechterhaltung der landschaftssichernden Funktion des Agrarsektors zuträglich sind. Im Mittelpunkt standen dabei Strategien zur Sicherung der Offenlandschaften im außeralpinen Raum. Die aktuellen Fachdebatten zur künftigen EU-Agrarpolitik („Agenda 2007“), zur Positionierung von Ökologie und Naturschutz (Stichwort: „neue Wildnis“) und zu soziokulturellen Phänomenen der Raumentwicklung (Stichwort: „Zwischenstadt“) bestätigten die Relevanz des Themas. Jüngst trat die Frage der Transparenz agrarischer Erzeugungsprozesse, z.B. in gentechnikfreien Produktionszonen, noch in den Vordergrund.

Methodisch hatte man sich an die komplexe Thematik in zweifacher Weise angenähert: Quantitative Regionalanalysen des Projektraumes ergründeten die Ausgangspositionen für die weitere Kulturlandschaftsentwicklung, während explorative Bausteine, wie eine Delphi-Umfrage, helfen sollten, handlungsorientierte Zukunftsszenarien zu entwickeln. Der Projektraum umfasst 202 ländliche Teilregionen in Österreich, in Süd-Bayern, im südlichen Baden-Württemberg und in der mittelländischen Schweiz. Anhand von elf Auswahlregionen wurde die Situation der Offenlandschaft greifbar herausgearbeitet. Das Interesse galt der Frage, inwieweit diese mitteleuropäischen Regionen ähnlicher naturräumlicher Charakteristik Gemeinsamkeiten in der Status-quo-Analyse und in der Zukunftserwartung in bezug auf ihre Landbewirtschaftung aufweisen. Folgendes trifft jedenfalls für die betrachteten Länder zu, nämlich ein hoher politischer Stellenwert der sog. flächendeckenden Landwirtschaft und eine hohe Wertschätzung für die traditionelle Kulturlandschaft.

3 TRENDS AUS DER DELPHI-UMFRAGE 2002

Die Delphi-Umfrage wurde im Jahr 2002 in zwei Durchgängen durchgeführt. An ihr haben sich 445 (1. Runde) bzw. 323 Personen (2. Runde) aus den Akteursgruppen Landnutzung, Politik und Interessenvertretung, Forschung und Bildung sowie Verwaltung und Planung beteiligt. Zu etlichen Detailthemen wurde sowohl nach der bisherigen Erfahrung als auch nach der Einschätzung auf zehnjährige Sicht gefragt. Aus dem Spannungsverhältnis zwischen der Status-quo-Reflexion und der Zukunftserwartung der Akteure

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[1] Am Projekt „Verantwortung für die Kulturlandschaft im 21. Jahrhundert – Prognose, Leitbilder und Konsequenzen künftiger Landnutzungsmuster“ im Rahmen des BMBWK-Forschungsschwerpunktes Kulturlandschaft (www.klf.at) haben neben dem Autor mitgewirkt: Dr. Richard DIETRICH, Lauterach (Agrarökonomie); DI Monika FIBY MLA, Wien (Delphi-Durchführung); PD Dr. Andreas HILBERT, Universität Augsburg (Wirtschaftsmathematik); Dr. Roland KALS, Salzburg (Angewandte Geographie); DI Eveline POHL-ISER (Landschaftsökologie), Wien und DI Inge SCHILLER, Wien/Landshut (Raumplanung).

sollte auf die Entwicklungspotentiale für die Regionen stellvertretend für den Projektraum geschlossen werden. Folgende Trends lassen sich resümieren:

- Die (ländlichen) Regionen besinnen sich auf ihre *Marktstärken* und suchen ihren „eigenen Weg". Daher gilt die Biolandwirtschaft nicht unbedingt als alleiniges Idealbild und die agrarindustrielle Bewirtschaftung gemeinhin nicht als Schreckgespenst. Für die Raumentwicklung ergibt sich daraus eine zunehmende Vielfalt von Regionen, unter denen sich profilierende „Player", aber auch bedeutungslos werdende „Non-Player" befinden werden.
- Im *Konzert der Regionen* nimmt der Wettbewerb um Marktpositionen, auch in Nischen, um Boden oder Produktionskontingente zu. Für die Kulturlandschaft bringt diese Entwicklung eine stärkere Differenzierung im Landnutzungsmuster und eine Anreicherung mit technoid wirkenden, der Spezialisierung dienenden Elemente im Landschaftsbild mit sich. Dazu kommen in Rückzugsgebieten größere Verwaldungs- und Wildnis-Flächen. Die Spezialisierung sowohl intensiv als auch extensiv genutzter Landschaftsräume nimmt zu und deren Konfigurationen werden großzügiger.
- Innerhalb der Regionsgemarkungen können gegensätzliche Entwicklungen mit unterschiedlichen Geschwindigkeiten Platz greifen. *Traditionelle und innovative Milieus* werden dann parallel wirtschaftlich wirksam und landschaftlich prägend. Die Vielfalt im Landschaftsbild verlagert sich von der Ebene des vielseitig produzierenden Betriebes auf die Ebene unterschiedlich wirtschaftender Kleinregionen. Für diese „Agrarzellen" sind durchaus Standortanforderungen wichtig, wie sie für andere marktnah produzierende Wirtschaftsstandorte (Verkehrsanbindung, Synergie im Cluster) gelten. Darauf muß u.a. die Raumordnung eine zeitgemäße Antwort finden.
- Die Voraussetzungen für die *Existenzfähigkeit bäuerlicher Haupterwerbsbetrieben* müssen angesichts der europäischen Integration und der verschärften Marktanforderungen realistisch bewertet werden. Der Schwellenwert für eine nachhaltig existenzfähige Betriebsgröße steigt an (im Durchschnitt ab 60 ha aufwärts, abgesehen von Sonderproduktionen). Flächenaufstockungen in der Umgebung, aber auch in benachbarten Regionen schreiten fort. Herkömmliche Standortbindungen lockern sich dadurch, die Einstellung zum Boden wird tendenziell „utilitaristischer" (= der Nützlichkeit der Situation unterworfen). Ein Wandel im „Größen-Verständnis" ist feststellbar. Galten früher Schlaggrößen im Ackerbau von 5 ha in agrarökologischer Hinsicht gerade noch als verträglich, so werden nunmehr unter den kommenden Bedingungen der Präzisions-landwirtschaft auch 30 ha für akzeptabel gehalten, wenn gleichzeitig eine Betriebsauditierung stattfindet.[2]
- *Landschaftspflege und -entwicklung* bleiben subsidiär zu erledigende und hauptsächlich öffentlich finanzierte Aufgaben. Die Möglichkeiten, freiwillige öffentliche oder private Mittel aufzutreiben, sind aber beschränkt. Es mangelt an überzeugenden Trägerschaftsmodellen, die im Falle von Systembrüchen - wie dem Zerreißen der flächendeckenden Landbewirtschaftung - wirksam werden können.
- Die wachsende Bedeutung der *Freizeitgesellschaft bzw. -wirtschaft* wird akzeptiert und als Verbreiterung der Wirtschaftsbasis begrüßt. Die agrarische Grundprägung der Offenlandschaft wird allerdings relativiert. Nutzungskonflikte, wie man sie aus dem stadtnahen Raum kennt, breiten sich auf das weitere Land aus. Das Bedürfnis nach Abschottung sensibler Nutzungen, etwa der hochproduktiven Landwirtschaft, der Jagdwirtschaft, des Naturschutzes oder lukrativer Freizeiträume, nimmt zu. Unter dieser fortschreitenden Funktionalisierung der Landschaften, die schließlich zu „Themenparks" mutieren, leidet nicht nur der freie Landschaftszugang.

4 ABLEITUNG VON SZENARIEN-GRUNDTYPEN

Im Allgemeinen ergeben sich Szenarien aus ethischen, sozialen, historischen und technologischen *Grundströmungen*, wie sich am Beispiel des Biolandbaues gut nachvollziehen lässt. Diese Grundströmungen sind raumübergreifend im Rahmen des gesellschaftspolitischen Diskurses wirksam und wurden durch die Delphi-Umfrage aufgegriffen. Es kann angezweifelt werden, ob eine Region heute angesichts der exogenen Einflüsse überhaupt noch für sich ein eigenständiges Entwicklungsszenario aufzustellen vermag, oder ob nicht bestenfalls nur die Strategie dorthin planbar ist, sie also Szenarien je nach ihrer räumlichen Disposition adaptiert.

Aus den Ergebnissen der 1. Delphi-Runde wurden acht, zunächst als „weichenstellend" apostrophierte Szenarien abgeleitet, deren mittelfristige Einschätzung auf ihre Durchsetzungswahrscheinlichkeit in einer ausgewählten Region in der 2. Runde erfolgte.

Es waren dies drei Grundtypen mit acht landschaftswirksamen Leitfunktionen:

- **Bioland**: Versorgung, Tourismus
- **Industrieland**: Agrarinsel, Freizeit, Gewerbe
- **Waldland**: Naturaufforstung, Energiewald, Wildnis

Dabei hat die Breite der denkmöglichen Entwicklungen doch überrascht. So wurde nicht einmal das „extreme" Wildnis-Szenario gänzlich abgelehnt und eine prinzipielle Koexistenz zwischen agrarindustrieller Produktionsausrichtung (sozusagen kein Schreckgespenst) und dem Biolandbau (kein alleiniges Idealbild) anerkannt. Die Entwicklungen zur Freizeitgesellschaft konnten sogar als Hoffnungsszenarien interpretiert werden.[3]

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[2] Vgl. HABER, 1998

[3] Der Überblicksbericht zur Delphi-Umfrage kann unter www.futurelandscape.org/ergebnis.htm heruntergeladen werden (Vgl. DÖRR, 2003 und DÖRR, KALS, 2003a)

Zwar spielen die Szenarien eine vorbereitende Rolle bei der regionalen Leitbilderstellung, sie sind aber mit existenziellen Leitzielen hinterlegbar bzw. mit allgemein gültigen Optimierungskonzepten verknüpfbar. Zur prägnanten Benennung der Szenarien-Typen ist anzumerken, dass damit in den Grundzügen die *raumwirksamen Politiken*, die sich daraus formenden *Raummuster* und die *qualitativen Konsequenzen für die Kulturlandschaft* beschrieben werden sollten.

So stehen die **Bioland-Szenarien** für eine „sanfte", *natürliche Prozesse möglichst nützende, u. U. sogar unterstützende Raumnutzung*. Dagegen treten Zielscheiben, wie Hochleistungsfähigkeit der Produktionsvorgänge, transregionale Wettbewerbsfähigkeit der Standorte und Leitprodukte oder die quantitativ ausgerichtete Arbeitsplatzschaffung vor Ort, in den Hintergrund. Es wird damit eine unvollkommene ökonomische Trag- bzw. Existenzfähigkeit zutreffender Standorträume in Kauf genommen. Damit erscheint die Abgeltung der besonderen multifunktionalen und regionsüberschreitenden Leistungen im Rahmen öffentlicher Ausgleichszahlungen verbunden. Solchen Räumen können andererseits Ersparnisse für den geringeren Infrastrukturbedarf angerechnet werden.

Zu den **Industrieland-Szenarien** ist klarzustellen, dass der Begriff als von (lat.) „industria" = Fleiß abgeleitet verstanden und a priori nicht negativ gesehen wird. Bei diesem Szenarientyp haben *wirtschaftliche Ziele bzw. Leistungsparameter einen Primat*, welche aber mit Leitplanken der Regulierung und mit Gestaltungsanforderungen verbunden werden müssen, um dennoch eine gedeihliche Entwicklung in Hinsicht auf Umwelt- und Lebensqualitätsstandards zu gewährleisten.. Solche Standorträume leisten ökonomische Impulse über ihre Grenzen hinaus, indem sie Arbeitsplatzdefizite anderswo kompensieren oder Exporterlöse und Steuerrückflüsse im gesamtwirtschaftlichen Interesse erzielen. Sie benötigen prinzipiell keine laufende Förderung, haben aber einen erhöhten Mittelbedarf im Bereich der Infrastruktur, des Umweltschutzes und der Landschaftspflege.

Die **Waldland-Szenarien** stellen summarisch betrachtet *passive Sanierungsstrategien* dar, wenn die endogenen Kräfte bzw. Ressourcen in einer Region offenkundig nicht ausreichen, um sich der Wucht der von außen einwirkenden Driving Forces entgegenzustellen. Es besteht in diesem Fall die Neigung der Standorteigentümer, wenig wettbewerbsfähige Flächen aus der Nutzungsvolatilität zu nehmen, d.h., sich regelmäßige wirtschaftsstrategische Entscheidungen darüber zu ersparen und eine Nutzung auf bescheidenem Ertragsniveau dauerhaft zu fixieren. Im Extremfall lohnt nicht einmal eine Aufforstung und es kommt zu einem natürlichen Sukzessionsablauf, der in eine Wildnis mündet.

5. VERRÄUMLICHUNG DER SZENARIEN

Szenarien werden in der planungsnahen Forschung gerne als Instrument der Zukunftsexploration eingesetzt. Aus einer Gesamtschau der Delphi-Antworten zu den Szenarien wurde eine Art von Präferenzreihung ersichtlich, die zeigt, dass die weitere Kulturlandschaftsentwicklung als sehr offener Prozess eingeschätzt wird. Anders gesagt, für die Regionen wurden mehrere Weichenstellungen für denkbar, wenngleich nicht unbedingt für wünschenswert gehalten, je nachdem, wie sich die von außen einwirkenden Kräfte entwickeln werden. In einer nüchternen Einschätzung relativiert sich daher die Vorstellung über die Machbarkeit endogener, selbstbestimmter Regionalentwicklung im ländlichen Raum. Schon aus diesem Grund geht es weniger um die Auswahl eines „besten" Szenarios (im Sinne eine „Vollumstellung" einer Region), sondern um das Herausfinden von in der weiteren Entwicklung (als Umstieg oder Schwerpunktverschiebung) miteinander kombinierbaren Szenarien. Diese Szenarien sollten daher *mindestens kompatibel* (in bezug auf gegenseitige Nutzungskonflikte und gemeinsam akkumulierte Verlust- und Belastungspotentiale) und *möglichst synergetisch* (etwa in Hinblick auf wirtschaftliche Interaktionen zur regionalen Wertschöpfungserhöhungen) in Beziehung stehen (DÖRR, KALS, 2003a). Regionen, die imstande sein werden, von einem Entwicklungspfad auf einen anderen (als Exit-Strategie) umzusteigen, haben künftig vermutlich die besseren Karten in der Raumentwicklung.

Szenarien bleiben abstrakte Zukunftsvorstellungen, solange sie zwar mit einem Wertebezug, aber ohne konkreten Raumbezug ausgestattet sind. Hierbei stellt sich die Schwierigkeit, dass dieser ein doppelter sein muß. Einerseits müssen die Wirkungsräume ablaufender bzw. zu beeinflussender Prozesse im Raum identifiziert werden, andererseits sind die Handlungsräume zu beachten, die die Plattform der Auseinandersetzung über die Zukunftsgestaltung darstellen. Nicht nur, dass Wirkungsräume komplexer Prozesse auch eine komplexe Konstitution und Konfiguration aufweisen, sind sie im allgemeinen auch selten mit den traditionellen bzw. rechtsgemäßen Handlungsräumen ident.

Die Szenarien lassen sich in bezug auf die ***Handlungsebenen*** - zumeist Gebietskörperschaften - bzw. ***Wirkungsräumen*** - im wesentlichen als Geoökotope konfiguriert - folgendermaßen einordnen:

- Auf der **transnationalen (europäischen) Ebene** als Raumstrategien einer Entwicklung im Spannungsfeld zwischen *Polarisierung und Balance* (auf verschiedenen Niveaus der Wettbewerbsfähigkeit, der Wohlstandsschöpfung oder der Umweltgerechtigkeit),
- heruntergebrochen auf die **transregionale (nationale) Ebene** als Schwerpunktsetzungen zwischen *integrativen und spezialisierten Leitbildern / Konzepten* (interregionaler Funktionalismus, quasi ein Land als Themenpark, oder sich freiwillig abgrenzende Biosphärenparks),
- und schließlich auf der **Ebene der regional handelnden Akteure** vor allem in Hinblick auf die endogene Machbarkeit zwischen *aktiver Zukunftsgestaltung und passiven Sanierungsstrategien*, sollte sich die Landwirtschaft zurückziehen müssen.

6. EMERGENTE RAUMSTRUKTUR(EN)

Für den Einsatz von Szenarien bei der räumlichen Leitbildentwicklung bedeutet das, dass *effektive Anwendungsräume* identifiziert werden müssen. Daher wurden mit Blick auf die deutschsprachige und internationale (vor allem französische) Fachdiskussion (vgl. EUREK, 1999; DATAR, 2002; STIENS, 2003) mehr oder minder emergente Raumkategorien postuliert, die die ***Möglichkeiten der Raumentwicklung*** abbilden sollen. Sie stellen „alternative" Anwendungsobjekte für fachdisziplinäre Evaluierungen und die Entwicklung problemlösender Konzepte dar. Sie dienen auch der Vermittlung zwischen den eigentlich handlungsmächtigen

Territorien, also den Planungsregionen , weil sie regionenübergreifend auftreten können. Sie bilden daher **räumliche Interessen- und Handlungsverbünde** und **soziokulturelle Raumeinheiten**. Ihr Kitt ist in der Hauptsache nicht, wie beim Verständnis der funktionalen Region, die Verflechtung, etwa über einen wirtschaftlichen Faktoraustausch, sondern das gemeinsame Problemlösungsspektrum bzw. ein gemeinsamer Gestaltungsbedarf der Zukunft. Sie sind aber auch keine auf ihrem Entwicklungspfad vergleichbar homogen strukturierte Regionen. Vielmehr stellen sie Raumkategorien dar, deren Spektrum an Weichenstellungen entweder sehr vielfältig, eingeschränkt oder auf einen monofunktionalen Zustand hinsteuernd ausgeprägt ist. Wesentlich ist, dass das **„Zugriffspotential" externer Effekte** thematisiert wird. Damit kommen diese Raumkategorien der Vorstellung eines Möglichkeitsraumes mit seiner Mehrdeutigkeit recht nahe.[4] Sie wurden in Anlehnung an die Literatur folgendermaßen bezeichnet:

Ballungsraum

Zwischenstadt[5]

Korridorraum

Agrarinsel[6]

Freizeitlandschaft

Biosphärenpark

Ressourcenschutzgebiet

Rückzugsraum zu Wald/Wildnis[7]

Naturreservat

6.1 Konstitutive Merkmale der Raumkategorien

Diese „emergenten" Raumkategorien unterscheiden sich durch ihr Funktionalitäts- und Dispositionsprofil sowie ihre Intensitäts- und Verschränkungs-Charakteristik. Es sind Merkmale der

- ***Funktionalität:*** Thematische Ausrichtung der Region und daraus folgend der Umfang des funktionalen Angebotes.
- ***Disposition:*** Multioptionalität der Standorte, Volatilität der Nutzungen, Agrarpräsenz im Raum, Brachflächenangebot.
- ***Intensität*:** Dichte- und Konzentrationsparameter der Bebauung, Zerschneidung und Versiegelung.
- ***der (inneren und äußeren) Verschränkung:*** Synergien von Playern (endogene Wirtschaftskreisläufe oder exportorientierte Leitproduktionen im regionalen Cluster), Symbiosen von Playern und Non Playern (Einbindung von Nonbasic Activities), Verankerung eigenständiger (ansässige Leitbetriebe) oder ferngesteuerter Player (Konzernfilialen).

Raum-kategorien:	***Funktionalität:***		***Disposition:***				***Intensität:***		
	Thema (Stichwort)	*Spann-weite*	*Multiop-tionalität*	*Nutzungs-volatilität*	*Agrar-präsenz*	*Brach-flächen*	*Baudichte*	*Zerschnei-dung*	*Versiege-lung*
Ballungsraum	Stadt	++	+	❸	❸❸	❸	+++	+++	+++
Zwischenstadt	im Grünen	++	+++	+++	📼	+	+	++	++
Korridorraum	Transit	📼	+	+	++	+	❸	+	📼
Agrarinsel	Leitprodukte	❸	❸	++	+++	❸	❸❸	❸	❸❸
Freizeitlandschaft	Wellness	📼	❸	+	++	📼	📼	📼	❸
Ressourcenschutz	Güte	❸❸	❹	❸	❸	❹	❸❸	❸	❸❸
Biosphärenpark	Natürlichkeit	📼	📼	📼	+++	❸	❸	❸	❸❸
Rückzugsraum	Rückgabe an Natur	❸❸	❸	❹	❸	+	❸	❸	❸❸
Naturreservat	Unberührtheit	❸❸	❸❸	❹	❸	❹	❸❸	❸❸	❸❸

Relevanz-Stufung: + + + = höchste Werte, + + = sehr hoch, + = hoch, 📼 = bedeutend (ausbalanciert), ❸ = gering, ❸❸ = unbedeutend oder nicht vorkommend, ❹ = irrelevant oder unbestimmbar

Tab. 1: F-D-I-Profile zur Ermittlung und Eingrenzung von emergenten Raumstrukturen

Der für die Zukunftsentwicklung entscheidende Faktor der Disposition lässt sich anhand der *„Multi-Optionalität" des Standorte-systems*, also dem Spektrum der Gelegenheiten zur (Um-)Nutzung aufgrund der naturräumlichen und infrastrukturellen Ausstattung und deren wirtschaftlicher Ausnutzbarkeit, anhand der *„Volatilität"* (lat. Unbeständigkeit) *des realen Nutzungsgefüges*, also der

[4] Zur Definition des Möglichkeitsraumes aus planungstaktischer Perspektive vgl. DAVY, 2002, S.529ff

[5] (Wieder-)Eröffnet wurde die Debatte 1997 zu diesem Raumphänomen von SIEVERTS (1999).

[6] Der Begriff wurde Mitte der 1990er Jahre in Deutschland von Agrarökonomen (HEISSENHUBER, 1995) aufgegriffen und später von Raumforschern auf seine langfristigen Perspektiven untersucht (DOSCH, BECKMANN, 1999b). Er bezeichnet weiträumige, hochleistungsfähige Produktionsgebiete, die nicht mehr zwangsläufig im räumlichen Zusammenhang stehen müssen.

[7] Ausgehend von einer Position in der (v.a. deutschen) ökologischen Debatte, die eine großräumige „Rückgabe" von der Landwirtschaft aufgegebener Flächen an die natürliche Sukzession vertritt (ANU, 2001).

Bewertung des Aufwandes, um eine Ausgangs- durch eine Folgenutzung zu ersetzen, und unterstützend durch die *Agrarpräsenz* bzw. das *Brachflächenangebot* beurteilen. Die Agrarpräsenz im Raum ist einerseits in Hinblick auf die Flächenrückhaltung für kommende (einschließlich agrarischer) Nutzungsbedarfe, andererseits zur Gewährleistung multifunktionaler Leistungen, wie die Grünraumsicherung in überlasteten Regionen, von Bedeutung. Die „flächenspendende“ oder „flächensichernde“ Rolle der Landwirtschaft bestimmt - neben der wichtiger werdenden Rolle des Bauflächenrecyclings - wesentlich die Umnutzungsmuster im Raum.

Emergente Raumstrukturen stellen eine permanente Herausforderung für die räumliche Forschung und Planung dar, weil sie einerseits Anzeichen für das Versagen bisheriger Raumkonzepte in sich verbergen, andererseits weil sie wirksam werden, ohne dass man darauf vorbereitet gewesen wäre. D.h., es fehlen eine Zeit lang Handlungsrezepte, da zwar die Entwicklungen und Probleme örtlich punktuell und sachlich segmentiert zu erkennen sind, für eine strategische Reaktion darauf aber der räumliche Anwendungsrahmen nicht hinreichend abgeklärt ist.

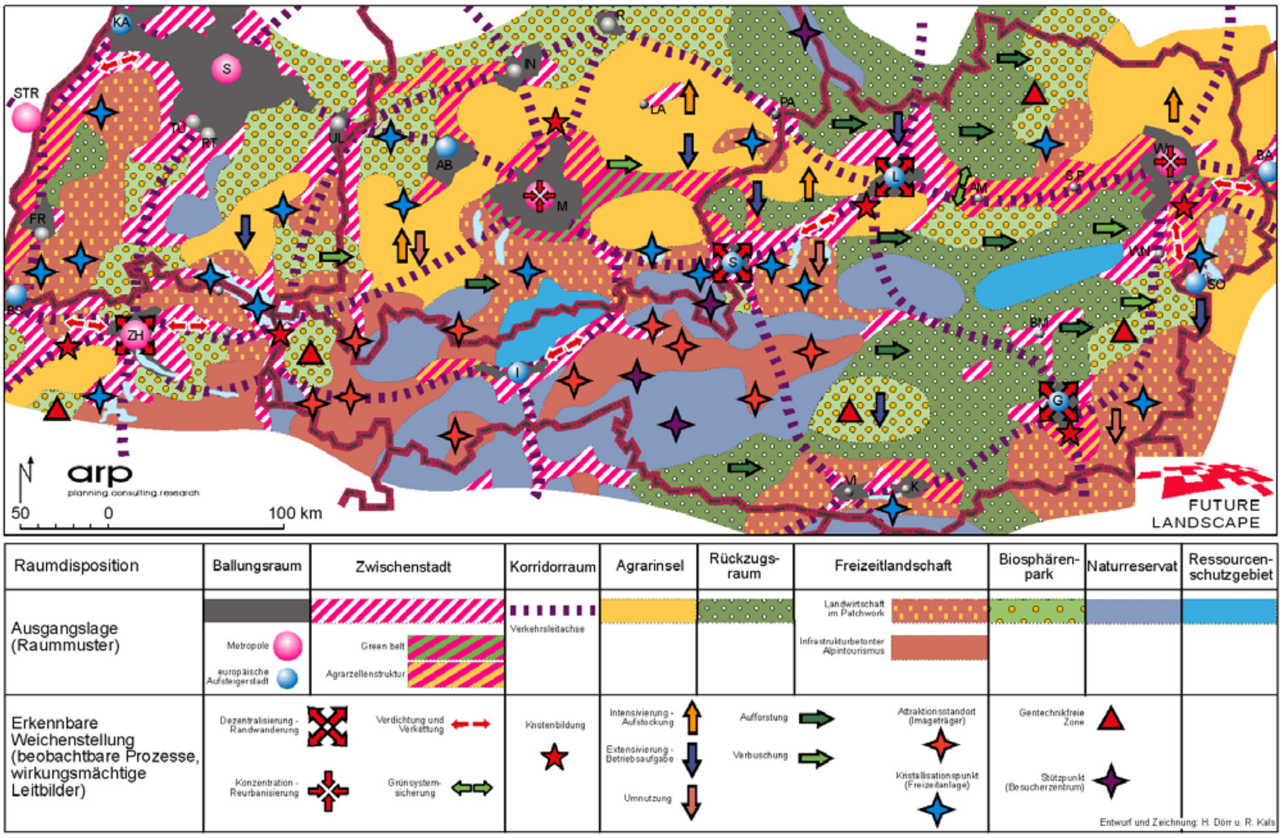

Abb. 1: Karte der Möglichkeitsräume (Quelle: DÖRR, KALS, 2003b, Abb. 6)

6.2 Emergente Raumstrukturen in einer Karte der Möglichkeitsräume

Da sich diese Raumeinheiten nicht mit denen der Territorialstatistik decken, ist die Abgrenzung und Datenzuordnung mit Aufwand verbunden und nicht routinemäßig zu erledigen. Darüberhinaus bestehen noch wenige fachliche Erfahrungen mit griffigen Schwellenwerten bzw. Bandbreiten oder mit der Kombination geeigneter Merkmale bzw. dazu verfügbarer Daten. An der Operationalisierung ist also noch zu arbeiten. Einige der konstitutiven Merkmale lassen sich schon recht brauchbar auf Ebene der Gemeinden und eventuell der Landkreise (D) bzw. Bezirke (A) anwenden. Andere müssen über die Bildebene (Fernerkundung oder thematische Karten) zugeordnet werden. Aufgrund der heutzutage vorhandenen dichten Grundlageninformationen lässt sich das in groben Zügen jedenfalls bewerkstelligen. So entstand eine Landkarte von Möglichkeitsräumen, die eigentlich keine scharfen Grenzen und eine schemenhafte Mehrdeutigkeit beinhaltet.

Im Unterschied zu herkömmlichen Annäherungen an Phänomene des Landschaftswandels wurde hier nicht von der Wachstums-dynamik des Siedlungssystems oder der Verlustdynamik von Naturwerten ausgegangen, sondern die ungewisse Rolle der Landwirtschaft in der kommenden Raumentwicklung in den Mittelpunkt gerückt. An die Stelle einer klassischen Eignungsbewertung, mit dem Ziel ein optimales Landnutzungssystem zu finden, tritt die Bildung von Raumkategorien, um deren „Elastizität“ in Hinblick auf nicht klar voraussehbare Zukunftsentwicklungen auszuloten. Wie ersichtlich wird, kristallisiert sich eine „thematische“ Raumgliederung heraus, die zwischen den Polen Ballungsraum und Naturreservat eine fortschreitende funktionelle Ausdifferenzierung erahnen läßt. Diese geht Hand in Hand mit einem Umbau des zentralörtlichen Versorgungssystems (Metropolen mit globalen Funktionen, „Aufsteigerstädte" mit europäischer Ausstrahlung[8], Aufrüstung der Zwischenstadt mit transregionalen Funktionen), einer Spezialisierung von Landnutzungen (z.B. in hochleistungsfähige Agrarinseln oder gentechnikfreie Zonen im Biosphärenpark), einer Verschränkung symbiotischer Nutzungen (wie im „Patchwork" der Freizeitlandschaft) und einer Perfektionierung der übergeordneten Infrastrukturen.

Diese Karte stellt freilich kein Leitbild dar, sondern beschreibt den Pfad der ablaufenden Raumentwicklung und damit indirekt auch den Aufwand, der nötig wäre, um diesen Pfad zu verlassen, also eine dem Prozess entgegenwirkende Weichenstellung zu vollziehen. Um das zu verdeutlichen: Ein *Rückzugsraum zu Wald oder Wildnis* ist nicht auf Gedeih und Verderb festgelegt, aber der Aufwand an öffentlichen und privaten Mitteln, um diesen Weg zu verlassen und andere Standortpotentiale zu schaffen, ist voraussichtlich ein sehr hoher. Ein zweites Beispiel anhand der *Zwischenstadt:* Um den Urbanisierungsprozess dort zu stoppen, ist eine restriktive Ordnungsplanung erforderlich, die versucht, die zumeist durch umfassende Infrastrukturinvestitionen zuvor geschaffene Standortattraktivität herabzusetzen. Die Erfahrung zeigt allerdings, dass sich derartige Standortpotentiale nicht dauerhaft absenken oder gar „vernichten" lassen, sondern sich über längere Sicht die dazu affinen Nutzungen einstellen. Sehr wohl ist es dort eine sinnvolle Aufgabe, eine systematische, konfliktminimierende Gliederung und eine qualitätvolle städtebauliche sowie grünräumliche Gestaltung vorzusehen.

Schließlich zeigt sich, dass emergente Raumstrukturen, wie die „Zwischenstadt" oder die „Korridorräume" und auch die „Agrarinseln", die größte Vielfalt im Veränderungspotential und damit die größte Unbestimmtheit aufweisen (Tab. 1). Das stellt eine Herausforderung für die Raumordnung dar, die nicht nur mit Regulierungen allein beantwortet werden kann. Vielmehr verdichten sich in Hinkunft die Monitoring- und (Land)Management-Aufgaben in effizienten Anwendungsräumen. Die Karte der Möglichkeitsräume soll nicht zuletzt dafür Anregungen bieten.

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[8] In Anlehnung an KRÄTKE (2000, S. 120) werden als „Aufsteigerstädte" solche verstanden, die imstande sind, nachhaltig europäische Aufmerksamkeit auf sich zu ziehen, sei es in wirtschaftlich-technologischer oder urbanistisch-kultureller Hinsicht (jüngstes Beispiel die Europäische Kulturhauptstadt Graz 2003).

Die Bewertung der Nachhaltigkeit innovativer städtebaulicher Maßnahmen mit dem Simulationsmodell MARS

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1 EINLEITUNG

Nachhaltigkeit ist eine der großen gesellschaftlichen und planerischen Herausforderungen. Eine gängige Definition von Nachhaltigkeit ist Chancengleichheit zwischen der heutigen und den zukünftigen Generationen (May et al. 2003) S. 12. Unterziele der Nachhaltigkeit sind unter anderem die Schonung nicht erneuerbarer Ressourcen und der Schutz der Umwelt (May et al. 2003) S. 13. Es gibt zahlreiche Befunde, die zeigen, dass weltweit städtische Verkehrssysteme und städtische Flächennutzung nicht nachhaltig organisiert sind. Indikatoren, die diese These unterstützen, sind zum Beispiel Zersiedelung, Luftverschmutzung und der Verbrauch fossiler Brennstoffe. Die bisherigen Strategien zur Lösung städtischer Verkehrsprobleme haben zu keinen messbaren Veränderungen in Richtung Nachhaltigkeit geführt. Zunahme von Stau, Emissionen, Lärm, Zersiedlung und der damit verbundene Verlust von Lebensqualität sind ein Indiz für eine Verschlechterung der alltäglichen Verkehrssituation. Qualitative Analysen unter Verwendung der Methode der Causal-Loop-Diagramme zeigen, dass die derzeitige Planungspraxis zwangläufig zu einem exponentiellen Wachstum der Zersiedlung führt (Emberger and Pfaffenbichler 2001; Pfaffenbichler 2001). Daher ist die Entwicklung neuer innovativer Strategien und Maßnahmen notwendig. In der vorliegenden Arbeit werden für die Stadt Wien die Auswirkungen geplanter konventioneller städtebaulicher Maßnahmen (U-Bahn Erweiterung, Umfahrungsstraße, Verkehrsmanagementsystem) sowie neuer, innovativer Maßnahmen (Sammelgaragen und Telearbeit) mit einem dynamischen Flächennutzungs- und Verkehrsmodell simuliert. Ziel der Untersuchung ist es, die Maßnahmen hinsichtlich ihrer Wirksamkeit zur Verwirklichung eines nachhaltigen Stadtsystems zu bewerten.

2 NACHHALTIGKEITSINDIKATOREN

Die Entwicklung der Indikatoren Flächenverbrauch, Verbrauch fossiler Treibstoffe und Treibhausgasemissionen in Österreich illustriert, dass es um die Nachhaltigkeit der heutigen Städte nicht gut bestellt ist. Die bisherigen Maßnahmen haben nicht die gewünschten Effekte erzielt.

2.1 Flächenverbrauch

In Wien ist zwischen 1995 und 1999 der Verbrauch an Bauflächen um 10.4 Quadratkilometer oder 8.3% gestiegen (Petz 2001) S. 14. Das entspricht in etwa einer jährlichen Steigerungsrate von 2%. Die Verkehrsflächen nahmen zwischen 1991 und 1998 um rund 4 Quadratkilometer oder 8.3% zu (Petz 2001) S. 14. Das entspricht einer durchschnittlichen jährlichen Steigerungsrate von etwa 1.1%. Im Vergleich dazu ist im gleichen Zeitraum die Zahl der Einwohner nur um etwa 0.1% pro Jahr gewachsen (ÖSTAT 1995; Statistisches Amt der Stadt Wien 2003). Abb. 1 illustriert die zunehmende Zersiedelung am Beispiel der oberösterreichischen Hauptstadt Linz.

Abb. 1: Zersiedelung und Flächenverbrauch am Beispiel der Stadt Linz (Stift 2002)

2.2 Fossile Treibstoffe, Treibhausgasemissionen

Trotz des sinkenden durchschnittlichen Treibstoffverbrauchs[1] der österreichischen Fahrzeugflotte nehmen die Treibhausgasemissionen weiter zu. Die Verbesserungen im Bereich der Treibstoffeffizienz werden durch eine steigenden MIV-Nutzung[2] kompensiert. Im Zeitraum 1980 bis 1999 nahmen die CO_2-Emissionen des Verkehrs um etwa 50% zu (Abb. 2). Die anderen Luftschadstoffemissionen weisen dagegen eine fallende Tendenz auf.

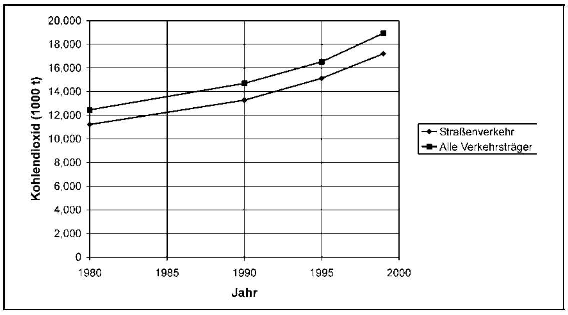


Abb. 2: Entwicklung der Kohlendioxidemissionen des österreichischen Verkehrs von 1980 bis 1999 (Herry et al. 2002) S. 168

3 DAS INTEGRIERTE, DYNAMISCHE FLÄCHENNUTZUNGS- UND VERKEHRSMODELL MARS

Das aggregierte, dynamische Flächennutzungs- und Verkehrsmodell MARS (Metropolitan Activity Relocation Simulation) wurde als Kernstück eines Systems zur Beurteilung der Nachhaltigkeit entwickelt. Das Modell basiert auf der Hypothese, dass Städte selbstorganisierende System sind und daher die Prinzipien der Synergetik zur Beschreibung des kollektiven Verhaltens angewendet werden können. Aufbauend auf Wiener Forschungsergebnissen wurde zuerst ein qualitatives Modell erstellt. Dabei kam die Methode der Causal-Loop-Diagramme zur Anwendung. Auf dieser Basis wurde ein quantitatives Modell entworfen und in Computercode transformiert. MARS wurde mit Daten der Stadt Wien kalibriert. Ein umfangreiches Testprogramm wurde unter Verwendung von Daten der Periode 1981 bis 2001 durchgeführt. Die Simulation der Periode 1981 bis 2001 und Sensitivitätsanalysen haben die Anwendbarkeit von MARS nachgewiesen. Eine vollständige Beschreibung des Modells MARS wird in (Pfaffenbichler 2003) gegeben. Die Entwicklung des Modells wurde unter anderem auch im Rahmen der CORP präsentiert (Pfaffenbichler and Emberger 2003; Pfaffenbichler and Emberger 2001).

4 INNOVATIVE STÄDTEBAULICHE MAßNAHMEN

4.1 Äquidistanz

(Knoflacher 1980) schlägt zur Lösung der Verkehrsprobleme und der Zersiedlung eine Änderung der Parkraumorganisation vor. Die Attraktivität der Verkehrsmittel wird sehr stark von der Länge und der Gestaltung der Zugangswege bestimmt. Die Zu- und Abgangszeiten sowie Warte- und Umsteigzeiten werden als unangenehm empfunden und subjektiv überschätzt (Abb. 3). Um die Chancengleichheit zwischen motorisiertem Individualverkehr (MIV) und öffentlichem Personennahverkehr (ÖPNV) zu gewährleisten, soll die Entfernung von der Wohnung zum Parkplatz zumindest der Entfernung zur nächsten Haltestelle entsprechen (Äquidistanz). In der Praxis könnte dies durch zentrale Sammelgaragen an den Haltestellen verwirklicht werden (Abb. 4). Der Raum zwischen Wohnung und Haltestelle ist bis auf wenige Ausnahmen wie Müllabfuhr, Gehbehinderte oder Zulieferdienste autofrei. Langfristig kehren Nahversorgungsbetriebe wieder in das direkte Wohnumfeld zurück. Dadurch verringert sich der Flächenverbrauch und ein nachhaltiges Verkehrssystem kann entstehen.

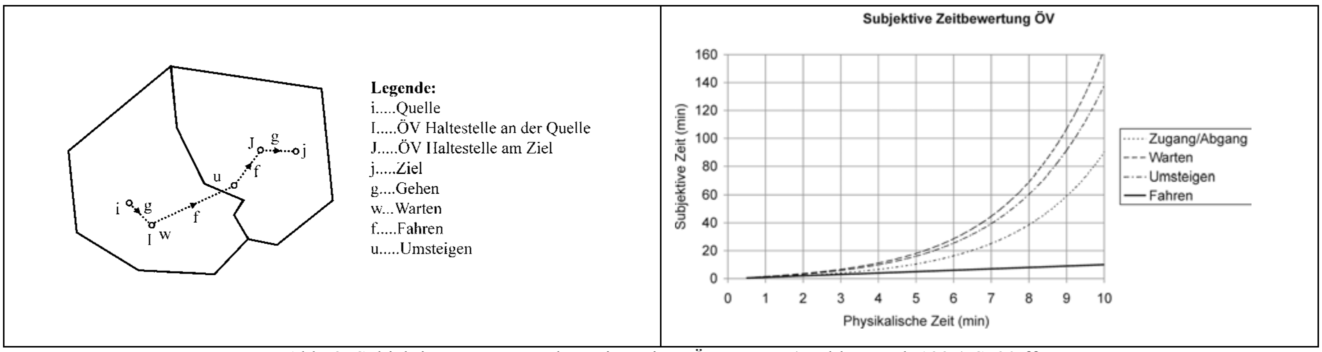


Abb. 3: Subjektive Bewertung der Zeiten eines ÖV Weges (Walther et al. 1997) S. 20 ff

[1] Von 8,4 Liter je 100 Kilometer im Jahr 1992 auf 8,1 Liter je 100 Kilometer in 1996/97. Herry, M., Russ, M., and Wolf, S. (2002). *Verkehr in Zahlen - Österreich*, Bundesministerium für Verkehr, Innovation und Technologie Abteilung K4, Wien. S. 165

[2] Der Anteil des MIV an den Arbeitswegen in Wien stieg von 1981 40.4% auf 1991 43.8%. ÖSTZ. (1985). *Volkszählung 1981 - Hauptergebnisse II Wien*, Österreichisches Statistisches Zentralamt, Wien. ÖSTAT. (1995). *Volkszählung 1991 - Hauptergebnisse II Wien*, Österreichisches Statistisches Zentralamt, Wien.

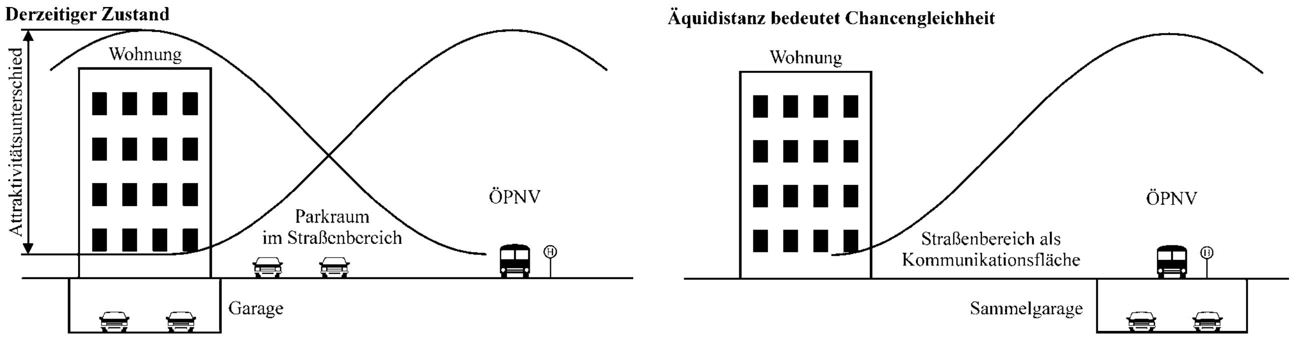


Abb. 4: Prinzip Äquidistanz Parkplatz und ÖPNV-Haltestelle (Knoflacher 1980) S. 178

4.2 Telearbeit

Die Verkehrs- und Stadtplanung verspricht sich von der Maßnahme Telearbeit, d.h. der temporären Arbeit in den eigenen vier Wänden, sehr viel. Es wird erwartet, dass sie die Mobilität der betroffenen Personen ändert und den Verkehrsaufwand verringert (Zängler and Karg 2003) S. 56. Für die Stadt München wird zum Beispiel bei ein bis zwei Telearbeitstagen pro Woche ein Reduktionspotenzial von 8.5% des im Berufsverkehr erbrachten Verkehrsaufwands genannt (MOBINET 2003) S. 49.

5 FALLSTUDIE WIEN

5.1 Konventionelle Planungsmaßnahmen

Derzeit laufen in der Stadt Wien drei große Verkehrsplanungsprojekte: der U-Bahnausbau, der Bau eines autobahnähnlichen Straßenrings und das Projekt Verkehrsmanagement Wien (VEMA). Geplant ist in den nächsten Jahren ein Ausbau der U-Bahnlinien U1, U2 und U6 (Stadtentwicklung Wien 2002; Stadtentwicklung Wien 2003a; Stadtentwicklung Wien 2003b; Stadtentwicklung Wien 2003c). Die Arbeiten zur Verlängerung der U1 und der U2 sind bereits im Gange. Die verlängerte U1 soll im Jahr 2006 eröffnet werden, die verlängerte U2 vor Beginn der Fußballeuropameisterschaft im Jahr 2008. Die Ausbauarbeiten an der Linie U6 sollen im Zeitraum 2013 bis 2015 fertiggestellt werden. Abb. 5 skizziert den Verlauf des bestehenden Netzes und der Erweiterungen. Betroffen sind hauptsächlich die nördlichen Außenbezirke 21 und 22 sowie die Bezirke 10 und 20. In der Modellrechnung wird der Eröffnungszeitpunkt einheitlich mit dem Jahr 2006 angenommen. Die Stadt Wien plant außerdem eine autobahnähnliche Ringstraße im Osten von Wien (PGO 2003). Abb. 5 skizziert, welche Wiener Bezirke davon betroffen sind. Im laufenden Projekt VEMA werden die Verkehrsleitzentrale erneuert und Verkehrmanagementmaßnahmen umgesetzt (Hermann 2000). In der Modellrechnung wird angenommen, dass dadurch die Kapazitäten für den motorisierten Individualverkehr um etwa 10% steigen.

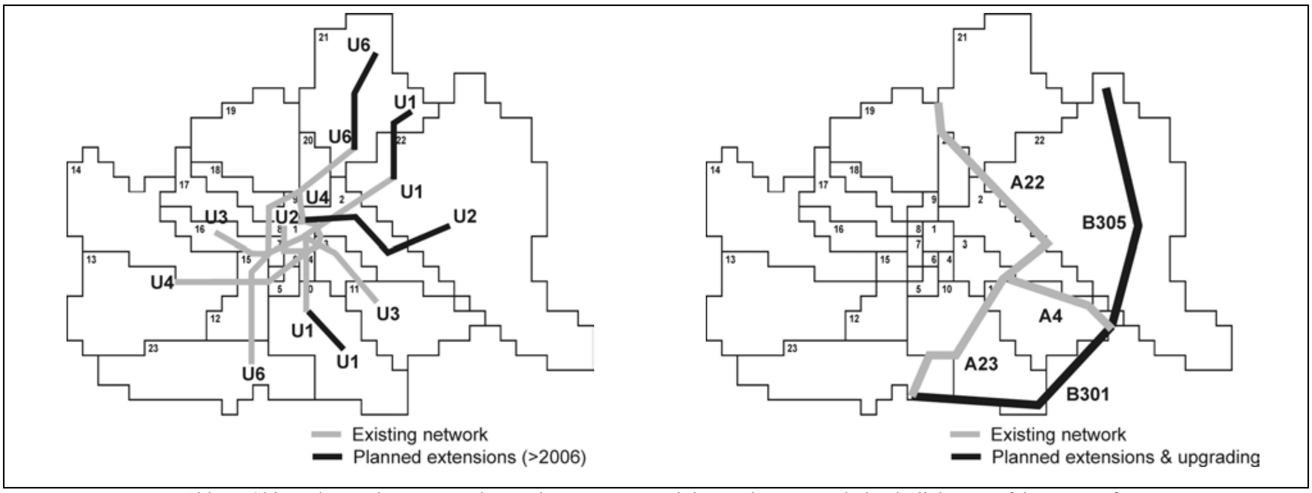


Abb. 5: Skizze der geplanten U-Bahn Verlängerungen und der geplanten autobahnähnlichen Umfahrungsstraße

Abb. 6 zeigt die Ergebnisse der MARS Modellrechnungen für eine Kombination der drei Projekte (Pfaffenbichler 2003) S. 200 f. Die Abbildung „Modal Split“ links oben zeigt die Entwicklung der Verkehrsmittelwahl über die 30 jährige Simulationsperiode. Die Implementierung der vorgeschlagenen Maßnahmen (U-Bahn Erweiterung, Umfahrungsstraße, VEMA) führt zu einer Verschiebung des Modal Splits hin zum motorisierten Individualverkehrs. Diese Verschiebung geht großteils zu Lasten des Anteils der nicht motorisierten Verkehrsteilnehmer (Fußgeher und Radfahrer). Diese Entwicklung widerspricht diametral den in Stadtentwicklungsplan und Verkehrskonzept ausgewiesenen Zielvorgaben der Stadt Wien[3] (Stadtplanung Wien 1994a; Stadtplanung Wien 1994b). Die Abbildung links unten zeigt die Entwicklung der CO_2-Emissionen. Die CO_2-Emissionen steigen sogar stärker als im Szenario ohne Umsetzung von Maßnahmen („Do Minimum“). Die Vorgaben des Kyoto-Protokolls (UN 1998) werden eindeutig nicht erfüllt. Die Abbildung rechts zeigt die Veränderung der Einwohner und Arbeitsplätze am Ende der 30-jährigen

[3] Reduktion des Anteils des motorisierten Individualverkehrs auf 25% bis zum Jahr 2010.

Simulationsperiode relativ zum „Do Minimum“ Szenario. Die Einwohner- und Arbeitsplatzdichten nehmen in den Innenbezirken ab und in den Außenbezirken zu. Das bedeutet steigende Zersiedelung und ein damit verbundener höherer Mobilitätsaufwand. Die geplanten Maßnahmen sind nicht geeignet, ein nachhaltiges Stadtsystem zu erreichen.

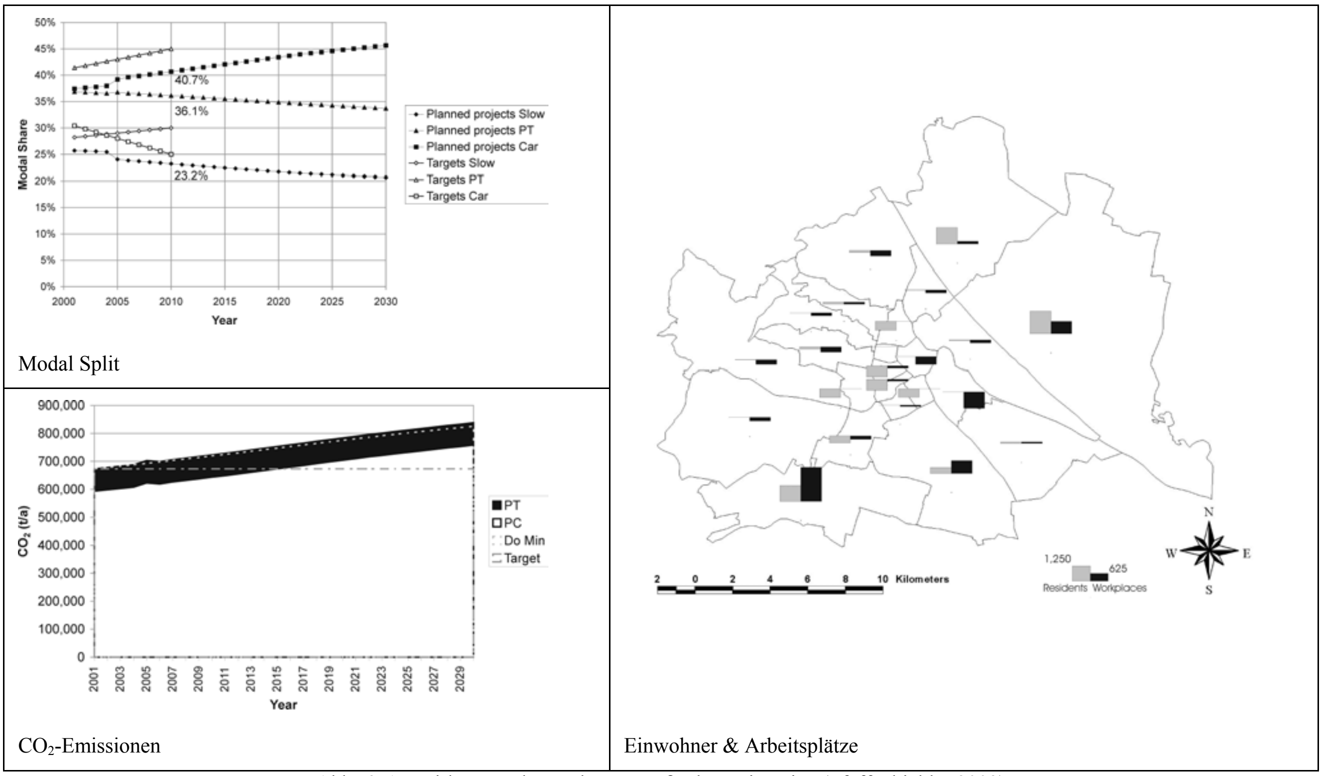


Abb. 6: Auswirkungen der geplanten Maßnahmen in Wien (Pfaffenbichler 2003)

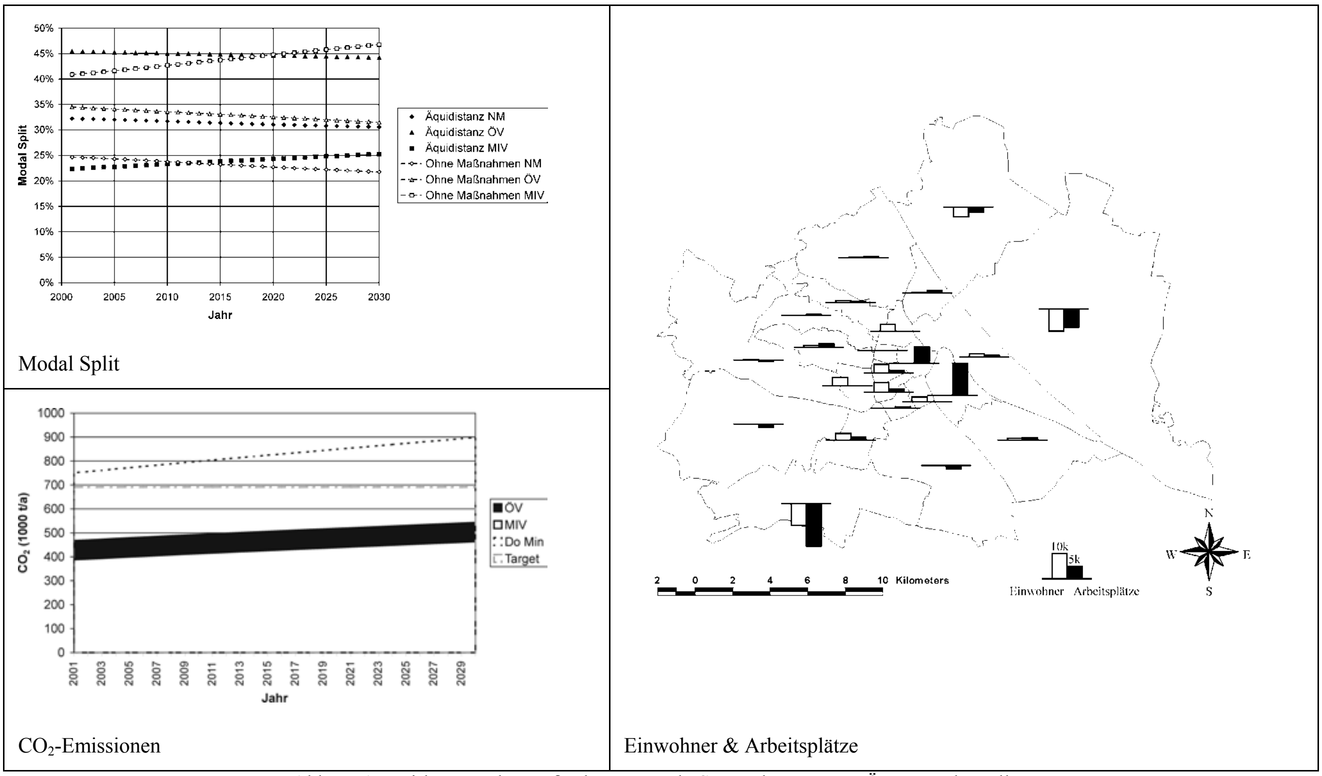
5.2 Innovative Maßnahmen

5.2.1 Zentrale Sammelgaragen („Äquidistanz“)

Abb. 7 zeigt die Ergebnisse der für die vorliegende Arbeit durchgeführten MARS Modellrechnungen für die Maßnahme „Äquidistanz“. Die Abbildung „Modal Split“ links oben zeigt die Entwicklung der Verkehrsmittelwahl über die 30 jährige Simulationsperiode. Das Szenario „Ohne Maßnahmen“ ist durch weiße Punkte markiert. Das Szenario „Äquidistanz“ ist durch schwarze Punkte gekennzeichnet. In der Modellrechnung wurde angenommen, dass die Maßnahme „Äquidistanz“ ab dem ersten simulierten Jahr umgesetzt wurde. Das Ziel der Reduktion des motorisierten Individualverkehrs auf 25% (Stadtplanung Wien 1994b) im Jahr 2010 kann erreicht werden. Sowohl der Anteil des öffentlichen Verkehrs als auch der des nicht motorisierten Verkehrs steigt zu Lasten des privaten Autoverkehrs. Dadurch werden signifikante CO_2-Emissionsreduktionen erzielt (Abb. 7, links unten). Die Zielvorgaben des Kyoto-Protokolls (UN 1998) können erreicht werden. Relativ zum Szenario „Ohne Maßnahmen“ steigen die Einwohner- und Arbeitsplatzdichten in den Innenbezirken (Abb. 7, rechts). Eine kompaktere, fußgeherfreundliche Siedlungsstruktur entsteht. Funktionsmischung und geringe Umweltbelastungen sind das Resultat einer auf Äquidistanz basierten Siedlungsstruktur. In den Modellrechnungen wurde von einem stetigen, moderaten Bevölkerungs- und Wirtschaftswachstum ausgegangen. Derzeit kann das Modell MARS keine Verdichtung in der bestehenden Baustruktur (z.B. Dachgeschossausbau oder Brownfield Development) abbilden. Dadurch kann der steigende Bedarf an Wohn- und Betriebsflächen in den Modellrechnungen nicht zur Gänze in den Innenbezirken befriedigt werden und es steigen die absoluten Einwohner- und Beschäftigtenzahlen in den Außenbezirken weiter an. Das erklärt die über die Simulationsperiode leicht steigende Tendenz der Autonutzung (Abb. 7, links oben).

5.2.2 Telearbeit

Die verkehrlichen Auswirkungen der Maßnahme „Telearbeit“ in der Modellrechnung sind sehr gering (Abb. 8, links). Die eingesparten Arbeitswege werden großteils durch vermehrte Freizeitmobilität kompensiert. Eine leichte Reduktion der CO_2-Emissionen kommt durch das andere Verkehrsmittelwahlverhalten in der Freizeit zustande (Abb. 8, rechts). Da in der Modellrechnung davon ausgegangen wurde, dass jeder Arbeitnehmer durchschnittlich einen Tag je Woche zu Hause arbeitet, kommt es zu keinen Auswirkungen auf die Einwohner- und Arbeitsplatzdichten. Da Telearbeit nicht in allen Branchen umsetzbar ist, wäre für zukünftige Modellrechnungen eine detailliertere Betrachtung wünschenswert.

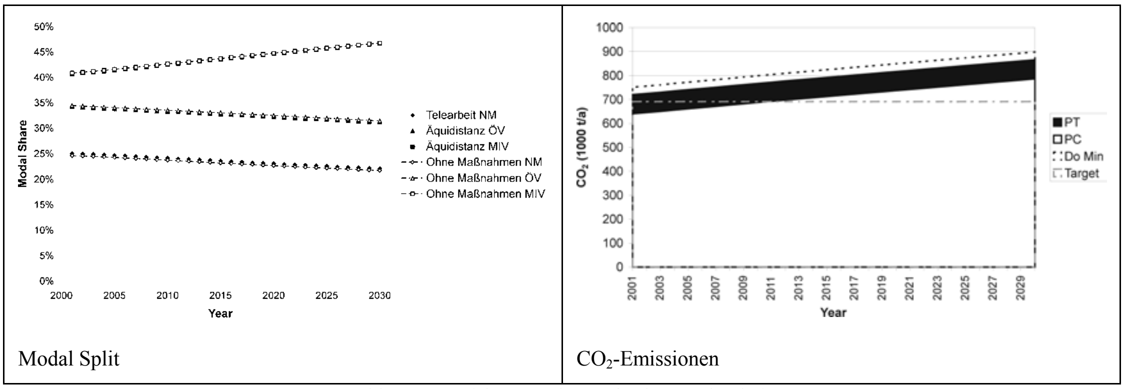


Modal Split

CO_2-Emissionen

Einwohner & Arbeitsplätze

Abb. 7: Auswirkungen der Maßnahme zentrale Sammelgaragen an ÖPNV Haltestellen



Modal Split

CO_2-Emissionen

Abb. 8: Auswirkungen der Maßnahme Telearbeit

6 ZUSAMMENFASSUNG UND SCHLUSSFOLGERUNGEN

Um ihren Beitrag zum Ziel Nachhaltigkeit zu beurteilen, wurden in der vorliegenden Arbeit folgende Szenarien anhand einer Fallstudie Wien simuliert:

Eine Kombination konventioneller Planungsmaßnahmen (U-Bahn Erweiterung, Umfahrungsstraße und Verkehrsmanagement),

zentrale Sammelgaragen (Äquidistanz) und

Telearbeit.

Die konventionellen Planungsmaßnahmen (U-Bahn Ausbau, Umfahrungsstraße, Verkehrsmanagement) führen neben einer Attraktivitätssteigerung des öffentlichen Verkehrs zu einer Kapazitätssteigerung des motorisierten Individualverkehrs. Diese führt zu einer weiteren Zersiedelung des Stadtgebietes und einem Anstieg der CO_2-Emissionen. Die offiziell angestrebte Reduktion des Anteils des motorisierten Individualverkehrs auf 25% im Jahr 2010 (Stadtplanung Wien 1994a; Stadtplanung Wien 1994b) kann mit diesen verkehrsplanerischen Maßnahmen nicht erreicht werden. Im Gegenteil ist die Summe der Maßnahmen dabei sogar kontraproduktiv. Die beschriebenen konventionellen Planungsmaßnahmen haben negative Auswirkungen in Bezug auf das Ziel Nachhaltigkeit. Wird das Ziel Nachhaltigkeit ernsthaft verfolgt, dann ist es notwendig geeignete innovative Maßnahmen und Strategien zu entwickeln.

Durch die Kompensation durch Freizeitmobilität hat die Maßnahme Telearbeit nur ein sehr eingeschränktes Potenzial das Ziel Nachhaltigkeit zu unterstützen.

Das Planungsszenario „Sammelgaragen" ist als innovativ, jedoch politisch schwer umsetzbar anzusehen. Eine flächendeckende Umsetzung der Äquidistanz in einer existierenden Stadt benötigt starken politischen Willen und eine sehr lange Implementierungszeit. Eine derartige Stadtorganisation ist nach heutigen Maßstäben nur schwer vorstellbar, hat aber das Potenzial, das Ziel nachhaltige Stadt zu erreichen. Der Fußgeheranteil und der Anteil des öffentlichen Verkehrs wird zu Lasten des motorisierten Individualverkehrs erhöht. Eine Verdichtung der städtischen Funktionen und ein damit verbundener geringerer externer Energieverbrauch für Mobilität sind die Folge. Die Zersiedlung kann gestoppt werden. Ein dynamisches Gleichgewicht der Stadtentwicklung kann sich einstellen. Sowohl die offiziellen Ziele der Stadt Wien (Stadtplanung Wien 1994a; Stadtplanung Wien 1994b) als auch die Vorgaben des Kyoto-Protokolls (UN 1998) können in einer derartig organisierten Stadt erreicht werden.

7 ABKÜRZUNGEN

MARS .... Metropolitan Activity Relocation Simulation

MIV .... Motorisierter Individualverkehr

NM .... Nicht motorisierter Verkehr

ÖPNV............. Öffentlicher Personennahverkehr

ÖV .... Öffentlicher Verkehr

PC................... Private car (Motorisierter Individualverkehr)

PT .... Public transport (Öffentlicher Verkehr)

Slow................ Slow modes (Nicht motorisierter Verkehr)

VEMA .... Verkehrsmanagement Wien

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Untersuchung der Siedlungsentwicklung in Relation zu Flächenverbrauch und Haushaltsentwicklung im Oberösterreichischen Zentralraum

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1 EINLEITUNG

In den meisten städtischen Regionen Europas konnte in den vergangenen Jahrzehnten ein grundsätzlich ähnlich verlaufender Suburbanisierungsprozess beobachtet werden: getrieben v.a. durch steigende Grundstückspreise und Flächenknappheiten in zentralen Lagen in Verbindung mit der zunehmenden Motorisierung der Bevölkerung verlagerte sich die Siedlungsentwicklung (Wohnen, Betriebe, Einkaufs- und Entertainmentzentren) in das Stadtumland. Allerdings war diese Entwicklung in nahezu allen Stadtregionen mit negativen Verdichtungserscheinungen wie Überlastungen im Verkehrssystem, Luftgüteproblemen oder erhöhten Nutzungskonflikten verbunden. Die Entwicklung eines effektiven Raumordnungsinstrumentariums benötigt neben einem gesteigerten Problembewusstsein der Entscheidungsträger geeignete Instrumente zum Monitoring der kritischen Problemindikatoren und zur ex-ante und ex-post Evaluierung von Planungsinstrumenten. Zensusdaten liefern in diesem Kontext zwar Querschnittsinformationen, die sich auf statistische Raumeinheiten wie Bezirke, Gemeinden oder Zählsprengel beziehen, die geographische Ausprägung der Entwicklungen innerhalb der statistischen Einheiten wird jedoch in der Regel nicht erfasst. Hier liefert die Fernerkundung komplementäre realräumliche Information, die durch Verknüpfung mit demographischen Daten Aussagen über Flächenverbrauch und Siedlungsdichten zulässt.

Der vorliegende Beitrag analysiert die Entwicklungen im Oberösterreichischen Zentralraum in den letzten dreißig Jahren. Das Auseinanderklaffen von Siedlungsflächenentwicklung und Bevölkerungsentwicklung zeigt erstmals deutlich auf, in welchem Ausmaß sich der tatsächliche Flächenverbrauch sowohl für den Wohnbau aber auch für die Betriebsansiedlung von der Bevölkerungs- und Arbeitsplatzanzahl entkoppelt haben. Die Analysen bestätigen, dass die Nachfrage nach Wohnungen und der daraus resultierende Flächenverbrauch vor allem in engem Zusammenhang mit der Anzahl der Haushalte stehen. Im räumlichen Muster dieser Entwicklung ist ablesbar, dass einerseits eine Konzentration an den Hauptverkehrsachsen (vor allem für betriebliche Nutzungen) in eingeschränktem Ausmaß stattgefunden hat. Andererseits aber hat in vielen Umlandgemeinden eine äußerst disperse Siedlungsflächenentwicklung stattgefunden, die keine räumlichen Orientierungsmuster erkennen lässt.

2 ANALYSE VON FLÄCHENVERBRAUCH UND HAUSHALTSENTWICKLUNG

Die Untersuchungen basieren auf der Verknüpfung von Information über Siedlungsflächen aus Satellitendaten mit Bevölkerungs- und Haushaltsdaten aus dem Zensus. Die dafür eingesetzten Methoden wurden bereits ausführlich diskutiert und können in STEINNOCHER et al. (2000), STEINNOCHER & KÖSTL (2001) und STEINNOCHER et al. (2003) nachgelesen werden.

Die Abgrenzung des Untersuchungsraumes wurde unter Berücksichtigung der verwendeten Datenquellen durchgeführt. Der gemeinsam abgedeckte Raum der IRS-1C Satellitenszene des Jahres 2001 und des CORONA-Aufnahmestreifen von 1965 wurde mit den Gemeindegrenzen von 1999 verschnitten, wobei nur vollständige Gemeindeflächen berücksichtigt wurden. Diese Vorgangsweise stellt sicher, dass der Vergleich zwischen den beiden Zeitpunkten sowohl auf real-räumlicher als auch auf statistischer Ebene in konsistenter Art und Weise möglich ist. Um den Fehler bei der Abschätzung des Flächenverbrauches aufgrund der zeitlichen Unterschied der Eingangsdaten (Satellitenaufnahme 1965 – Volkszählung 1971) zu minimieren, wurden die Einwohner- und Haushaltszahlen für 1965 aus den Volkszählungsdaten 1961 und 1971 linear interpoliert.

2.1 Vergleich des Untersuchungsraumes mit ausgewählten Teilräumen

Der Untersuchungsraum bedeckt eine Fläche von ca. 2134 km² und umfasst neben der Landeshauptstadt Linz 89 Gemeinden des oberösterreichischen Zentralraumes, darunter auch die Städte Steyr und Wels. Tabelle 1 zeigt die Entwicklung der Wohnsiedlungsfläche (Wosi), der Bevölkerung (Bev) und Haushalte (Hh) in aggregierter Form. Für einen regionalen Vergleich wurden zusätzlich der Bezirk Linz-Land, die Gemeinden nördlich der Donau (zusammengefasst als Raum NO) und Linz separat ausgewertet. In Abbildung 1 auf der nächsten Seite sind die relativen Änderungen des Wohnsiedlungsfläche, der Bevölkerung und der Haushalte des Untersuchungsraumes und der Teilräume dargestellt. Zusätzlich sind die daraus resultierenden Größen Pro-Kopf-Flächenverbrauch (durchschnittliche Wohnsiedlungsfläche pro Einwohner), Haushaltsdichte (Anzahl der Haushalte pro Wohnsiedlungsfläche) und durchschnittliche Haushaltsgröße (Einwohner pro Haushalt) dargestellt.

	Anz.d.Gem.	Fläche [ha]	Wosi65 [ha]	Wosi01 [ha]	Bev65	Bev01	Hh65	Hh01
Untersuchungsraum	90	213.367	10.277	16.920	528.379	626.923	181.279	269.828
Bezirk Linz-Land	22	46.075	2.368	4.006	88.513	129.059	27.693	53.085
Raum NO	21	42.274	1.247	2.563	46.294	78.096	12.079	29.244
Stadt Linz	1	9.559	1.764	2.456	200.643	183.504	85.807	91.658

Tab. 1: Entwicklung der Wohnsiedlungsfläche, der Bevölkerung und der Haushalte im Oberösterreichischen Zentralraum

Die Wohnsiedlungsfläche im Untersuchungsraum hat um 64,6 % zugenommen, während die Bevölkerung nur um 18,7 % gestiegen ist. Das ergibt einen Anstieg des Flächenverbrauches von beinahe 40 %. Der massive Bevölkerungsanstieg im Raum NO und im Bezirk Linz-Land sowie die damit verbundene Siedlungstätigkeit geht sicherlich großteils auf Kosten der Stadt Linz, die einen Bevölkerungsrückgang von über 8 % aufweist. Da Linz gleichzeitig einen Wohnsiedlungsflächenanstieg von über 39 % aufweist, steigt der statistische Flächenverbrauch um mehr als 50 %! Dies erklärt z.T. den hohen Anstieg im gesamten Untersuchungsraum, während im Bezirk Linz-Land und im Raum NO der Anstieg des Flächenverbrauches mit 16,0 bzw. 21,8 wesentlich moderater ist. Dabei ist jedoch zu berücksichtigen, dass die Zunahme der Wohnsiedlungsfläche in den Teilräumen Raum NO und Linz-Land auf einem im Vergleich zur Stadt Linz sehr niedrigen Niveau der Einwohnerdichte (Einwohner je ha Baufläche) stattgefunden hat. Während nördlich der Donau am Ende der Untersuchungsperiode die durchschnittliche Einwohnerdichte bei ca. 30 EW je ha Wohnsiedlungsfläche lag und im Teilraum Linz-Land bei ca. 32 EW / ha, war dieser Wert in Linz trotz des enormen Zuwachses an Bauland je Einwohner (bedingt weniger durch geringere Bebauungsdichten als hauptsächlich durch die Bevölkerungsverluste) mit einem Wert von fast 75 EW / ha mehr als doppelt so hoch wie in den beiden anderen Vergeleichsräumen.

Bei den Haushaltsanzahlen fällt der enorme Zuwachs im Raum NO auf. Mit einem Plus von über 140 % unterscheidet sich dieser Teilraum stark vom gesamten Untersuchungsraum. Auch im Bezirk Linz-Land kommt es beinahe zu einer Verdoppelung der Haushalte, im gesamten Untersuchungsraum beträgt der Zuwachs hingegen nur etwa 50 %. Aufgrund des hohen Anstiegs an Haushalten wächst auch die Haushaltsdichte in den beiden ländlich geprägten Teilräumen, während sie im gesamten Untersuchungsraum um knapp 10 % fällt (was wiederum durch die Entwicklung in Linz zu erklären ist, wo die Haushaltsdichte um beinahe 20 % fällt). Die durchschnittliche Haushaltsgröße nimmt - wie erwartet – ab, sowohl in den 3 Teilräumen (wenngleich auch nördlich der Donau stärker als in den beiden anderen Teilräumen) als auch im gesamten Untersuchungsraum.

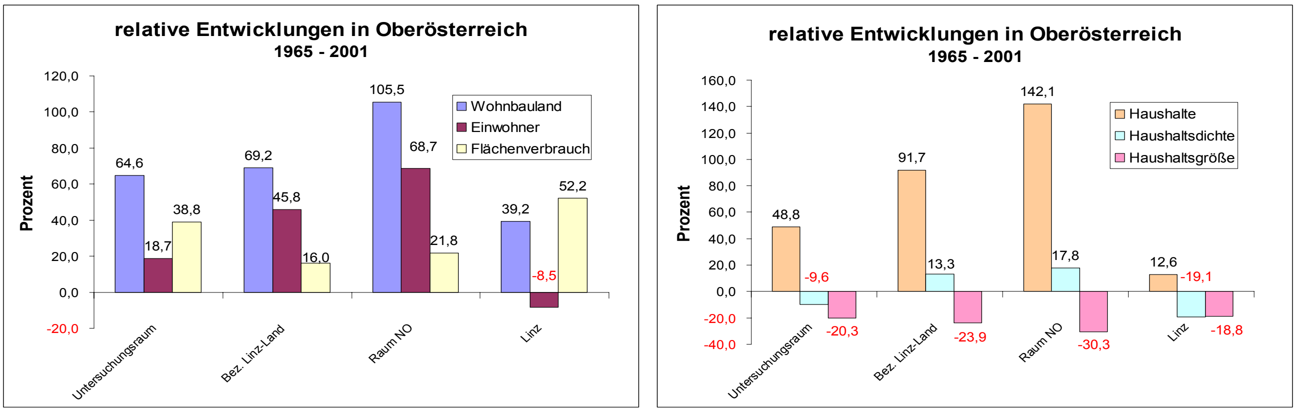


Abb.1: Prozentuelle Änderung der Wohnsiedlungsfläche, der Bevölkerung und des Pro-Kopf-Flächenverbrauchs (links) sowie der Haushalte, der Haushaltsdichte und der durchschnittlichen Haushaltsgröße (rechts) während des Untersuchungszeitraums

2.2 Zeitliche Detailbetrachtung

Ein Vergleich der Entwicklung von Flächenverbrauch, Haushaltsdichte und Haushaltsgröße aller Gemeinden ist in den Abbildungen 2 - 4 zu sehen. Die diagonale Linie entspricht dabei einem gleichbleibenden Flächenverbrauch bzw. einer gleichbleibenden Haushaltsdichte oder Haushaltsgröße. Der Abstand von der Diagonale zeigt die Größe der Änderung der jeweiligen Kenngröße zwischen den beiden Zeitpunkten.

Wie leicht zu erkennen ist, weist der überwiegende Anteil der Gemeinden einen mehr oder weniger großen Anstieg des Flächenverbrauches auf, d.h. die Siedlungsfläche ist im Vergleich zur Bevölkerung überproportional gewachsen. Einzig in drei Gemeinden (neben Asten sind dies Leonding und Puchenau) nimmt der Flächenverbrauch ab, in drei Gemeinden bleibt er ungefähr gleich (vgl. dazu auch Abbildung 5c). Hier spiegelt sich der unterschiedlich hohe Anteil an mehrgeschossigen Wohnbauten wieder, der insbesondere in den Gemeinden Leonding, Asten und Puchenau überdurchschnittlich stark zugenommen hat.

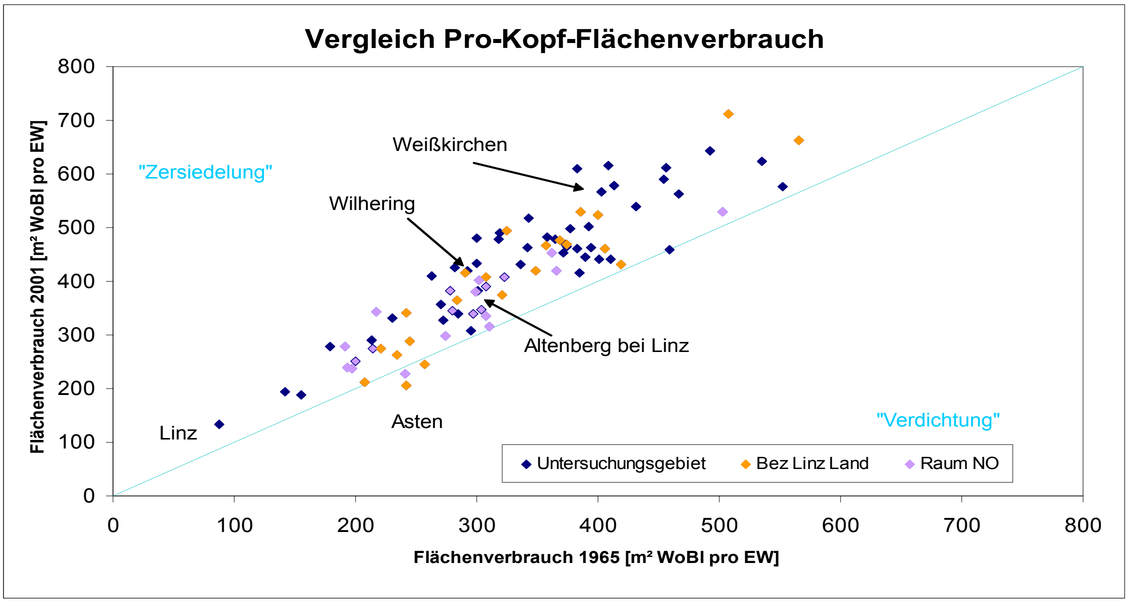


Abb. 2: Vergleich des Pro-Kopf-Flächenverbrauch in [m²/Ew] 1965 und 2001 im Untersuchungsraum

Vergleicht man die Haushaltsdichte zu beiden Zeitpunkten, sieht man, dass der Großteil der Gemeinden zu beiden Zeitpunkten unter 20 Haushalte pro Hektar Wohnsiedlungsfläche liegt, einzig die großen Stadtgemeinden Linz, Wels und Steyr weisen höhere Werte auf. Auffallend ist der extreme Rückgang in Linz, der jedoch nahezu ausschließlich durch die stark rückläufige Bevölkerungs- und Haushaltsanzahl bedingt ist. Die Entwicklung in Wilhering hingegen dürfte durch ein Einzelereignis bedingt sein, das keine allgemeine Interpretation erlaubt (vgl. auch Abb. 5e) und muss noch im Detail untersucht werden. Auf der anderen Seite steigt die Haushaltsdichte in Asten von 11,6 auf 19,3 (das ist ein Plus von über 66 %!). Vergleichbare Anstiege gibt es noch in Lichtenberg (+51 %) und in Puchenau (+45 %). Insgesamt nimmt die Haushaltsdichte in 62 Gemeinden zu und in 28 ab. Vor allem in den Gemeinden der Teilregionen Linz-Land und Raum NO kommt es vermehrt zu einem Anstieg. Dies könnte ein Indiz dafür sein, dass bedingt durch steigende Baulandpreise die Größe der Baugrundstücke leicht rückläufig war.

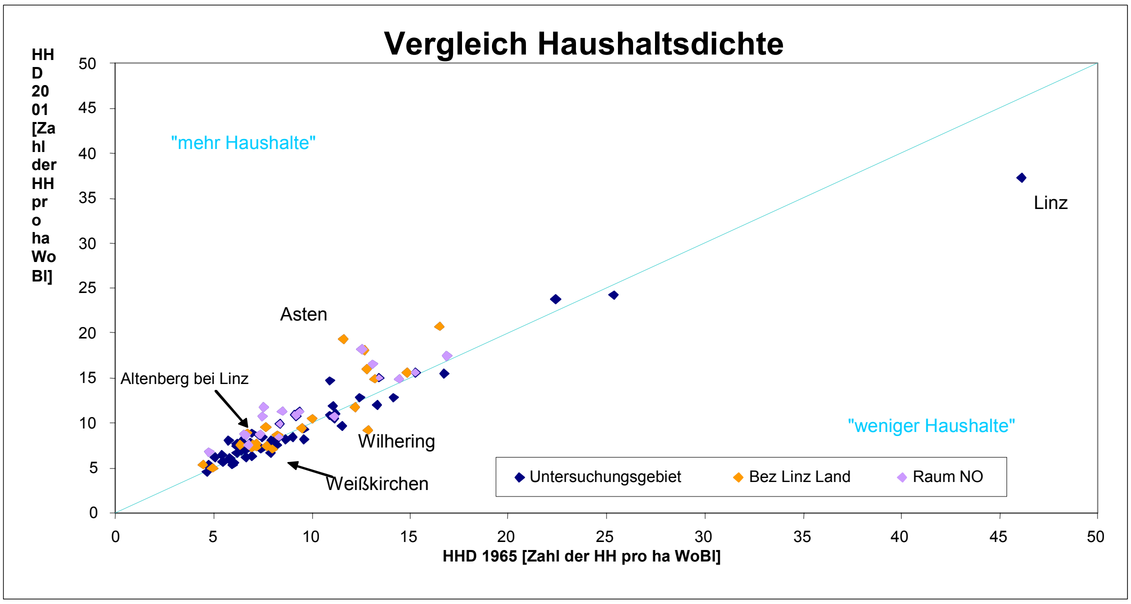


Abb. 3: Vergleich der durchschnittlichen Haushaltsdichte in [Hh/ha]] 1965 und 2001 im Untersuchungsraum

Als dritte Kenngröße wird die durchschnittliche Haushaltsgröße betrachtet. Wie nicht anders zu erwarten war, nimmt diese in allen Gemeinden ab. Den geringsten Wert zu beiden Zeitpunkten hat die Gemeinde Linz, in der die durchschnittliche Haushaltsgröße von ca. 2,5 auf 2 Einwohner pro Haushalt fällt. Spitzenreiter sind die beiden Mühlviertler Gemeinden Altenberg und Alberndorf mit einem Rückgang von jeweils mehr als 2 Einwohner. Generell ist der Rückgang um so größer, je höher die Haushaltsgröße 1965 war, was v.a. auf die nördlich der Donau gelegenen Gemeinden zutrifft.

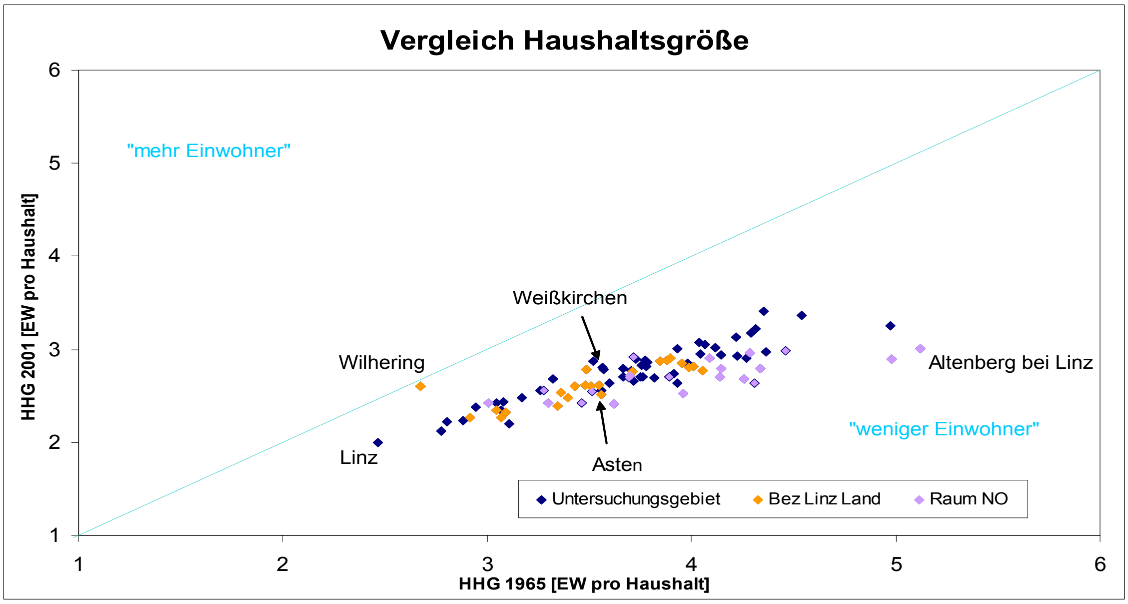


Abb. 4: Vergleich der durchschnittlichen Haushaltsgröße in [Ew/Hh] 1965 und 2001 im Untersuchungsraum

2.3 Räumliche Detailuntersuchungen

In Abbildung 5 sind die relativen Änderungen der 6 Kennzahlen aller Gemeinden des Untersuchungsraumes dargestellt. Der Vergleich der räumlichen Muster erlaubt Aussagen über die regionalen Unterschiede der zeitlichen Entwicklung.

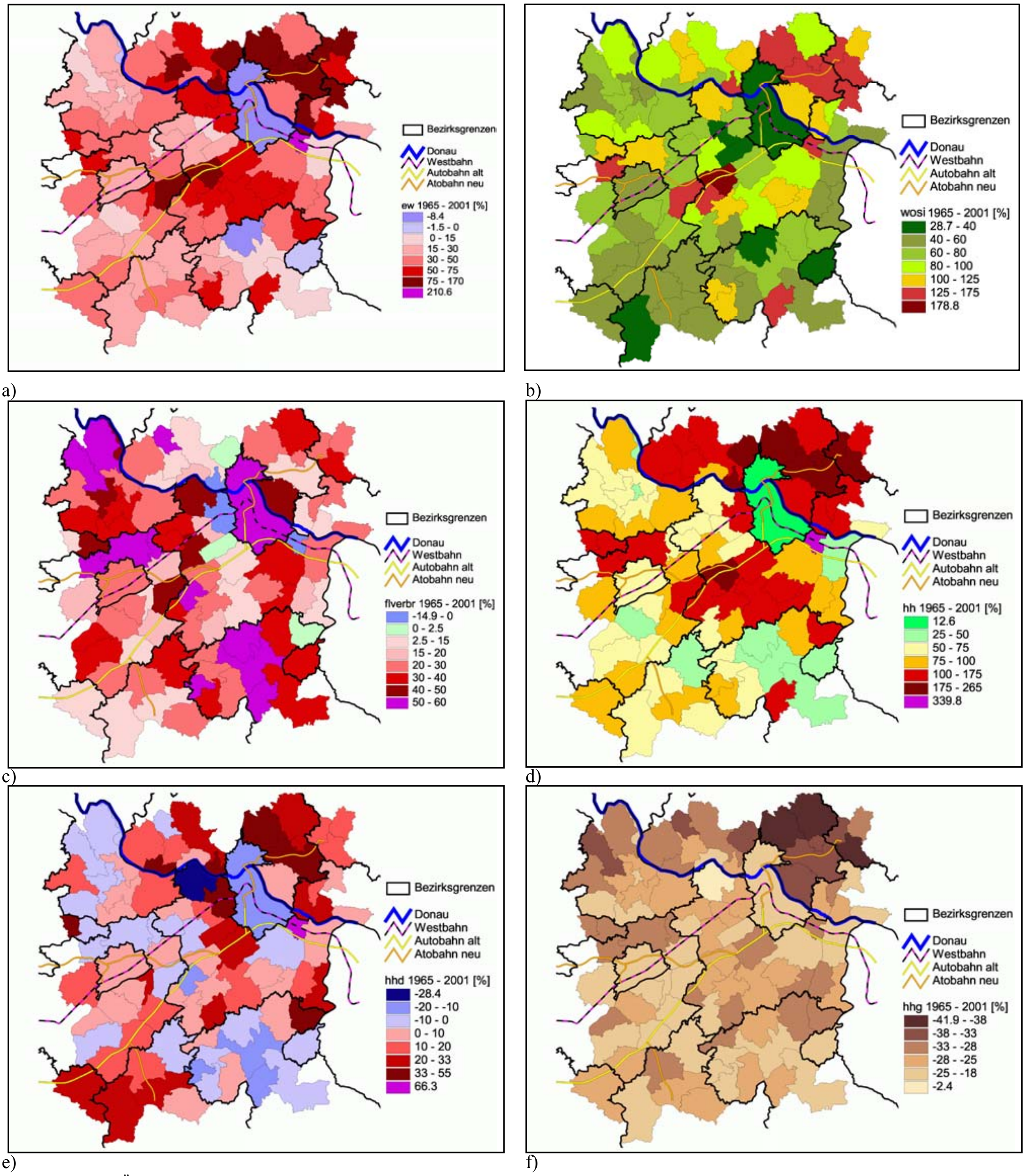


Abb.5: Relative Änderung der Bevölkerung (l.o.), der Wohnsiedlungsfläche (r.o.), des Flächenverbrauches (l.m.), der Haushaltszahl (r.m.) sowie der durchschnittlichen Haushaltsdichte (l.u.) und Haushaltsgröße(r.u.) zwischen 1965 und 2001 (Erklärung im Text)

Die stärksten prozentuellen Zuwächse der Bevölkerung weisen naturgemäß kleinere Gemeinden auf, vor allem die nördlich und nordöstlich von Linz gelegenen Gemeinden. Das dürfte zum Teil mit der besseren Anschließung dieser Region durch den Bau der Mühlkreisautobahn zu erklären sein, zum Teil auch durch Verlagerung von Wohnbevölkerung auf die beliebten Wohnlagen über der Nebelgrenze von Linz im Zuge der Suburbanisierung. Ein weiteres Gebiet mit sehr starkem Anstieg der Bevölkerung liegt im Zentrum des Untersuchungsraumes – hier v.a. an der West- und Inkreisautobahn. Den höchsten Zuwachs besitzt Asten mit über

210%. Die Gemeinde mit dem zweithöchsten Anstieg – Puchenau – liegt mit etwas unter 170% schon wesentlich darunter. Für beide Gemeinden ist jedoch festzuhalten, dass der Zuwachs auf einige Großprojekte im mehrgeschossigen Wohnbau bzw. verdichteten Flachbau (Gartenstadt Puchenau) zurückzuführen sind. Einen Rückgang der Bevölkerung zeigen neben den Städten Linz und Steyr nur die beiden Gemeinden Aschach an der Donau und Schiedlberg.

Ein ähnliches Bild zeigt auch die Entwicklung der Wohnsiedlungsfläche. Hier kommt es ebenfalls im Raum NO und im Zentrum zu eiem verstärkten Zuwachs. Zuwächse über 125 % weisen daneben noch Asten, Aschach an der Steyr (im Südosten des Untersuchungsraumes) und Krengekbach bei Wels auf.

Bevölkerungsentwicklung und Zunahme der Wohnsiedlungsfläche spiegeln sich im Flächenverbrauch wider. Spitzenreiter ist hierbei Aschach an der Steyr mit einem Plus von 60 %, gefolgt von Holzhausen (+ 59,6 %) und St. Gotthard im Mühlkreis (+ 58,4). Ein Rückgang (vgl. Abb. 3) tritt nur in Asten, Leonding und Puchenau auf.

Bei den Haushalten fällt der enorme Anstieg in Asten auf (+339,8 % !), während Linz mit +12,6 % das Schlusslicht bildet. Generell treten die höchsten Anstiege wiederum in jenen Regionen auf, wo auch Bevölkerung und Wohnsiedlungsfläche stark steigen, also im Raum NO und im Zentralraum.

Die Haushaltsdicht errechnet sich aus dem Verhältnis von Wohnsiedlungsfläche und Haushaltszahl. Betrachtet man den Untersuchungsraum, sieht man, dass es wiederum v.a. im Raum NO zu einem vermehrten Anstieg kommt. Neben einzelnen Gemeinden im Umland der drei großen Städte Linz, Wels und Steyr gibt es ein zweites Zentrum stark ansteigender Haushaltsdichte im Südwesten des Untersuchungsraumes. Diese steigende Haushaltsdichte resultiert jedoch vor allem aus den abnehmenden Haushaltsgrößen und zeigt deshalb keinen sparsameren Umgang im Baulandverbrauch je Einwohner an.

Die Haushaltsgröße nimmt in allen Gemeinden ab, besonder stark nördlich der Donau.

3 ANALYSE DER ZERSIEDELUNG

Wie im vorherigen Kapiteln festgestellt wurde, tritt in den allen Gemeinden mit Ausnahme von Asten, Leonding und Puchenau ein Zuwachs des Pro-Kopf-Flächenverbrauches auf, der als Indikator für Zersiedelung innerhalb einer Gemeinde angesehen werden kann. Abbildung 6 zeigt den absoluten Flächenverbrauch für die Jahre 1965 und 2001. Im Vergleich zur relativen Entwicklung (Abbildung 5, l.m.) zeigt sich hier ein deutlich anderes räumliches Muster. Vor allem südlich von Wels werden 2001 Werte von über 550 m² pro Einwohner erreicht.

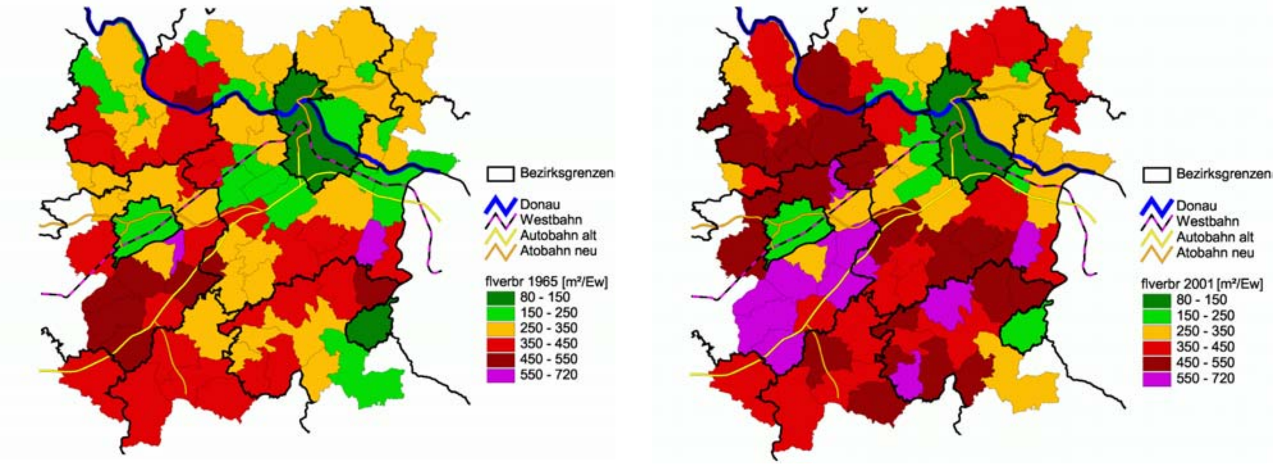


Abb.6: Absoluter Flächenverbrauches 1965 und 2001

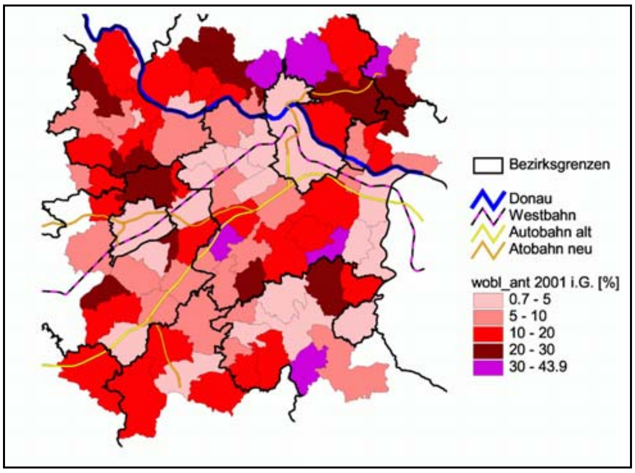
Der Pro-Kopf-Flächenverbrauch pro Gemeinde liefert jedoch nur beschränkt Aussagen über den tatsächlichen Zersiedelungsprozess, da er keine Rückschlüsse auf räumliche Veränderungsmuster innerhalb einer Gemeinde zulässt. Nun ist im Untersuchungszeitraum eine deutliche Zunahme der Zersiedelung und Erweiterung bestehender Siedlungssplitter festzustellen. Dass sich die Siedlungsstruktur bzw. das Ausmaß der Zersiedlung auf den Infrastrukturbedarf (und damit auch auf die öffentlichen Haushalte) auswirkt, zeigte DOUBEK et al. in einer Untersuchung aus dem Jahr 1999. Während in der Stadt Linz mit einer kompakten städtischen Siedlungsstruktur die Länge des Straßennetzes mit innerer Erschließungsfunktion (also ohne überörtliche Verbindungs-funktion) etwa 1,5 lfm je Einwohner und Arbeitsplatz betrug, war für disperse Siedlungsstrukturen mit einem hohen Zersiedlungsgrad ein bis zu 27 fach höherer Wert (40 lfm) festzustellen.

Um den Zersiedelungsgrad auch geo-statistisch betrachten zu können, wurde folgender Indikator angewendet: durch Ausweisen derjenigen Wohnsiedlungs- bzw. Industrie- und Gewerbeflächen, die nicht an ursprünglich (im vorliegenden Fall 1965) bebaute Flächen angrenzen, d.h. von diesen unabhängig entstanden sind, läßt sich die Zersiedelungstendenz abschätzen. Je höher der Anteil dieser neuen - sozusagen „im Grünen“ liegenden - Flächen ist, desto stärker wird der Zersiedlungsgrad einer Gemeinde angegeben. Um auch die 1965 gerade in Entstehung begriffenen Siedlungsteile bzw. Industrieareale zu berücksichtigen, enthält „im Grünen“ neben den seither neu bebauten Flächen auch jene bebauten Flächen, die 1965 kleiner als 0,5 Hektar waren (d.h. die Erweiterung von bestehenden Siedlungssplittern). Tabelle 2 zeigt diese Anteile - sowohl für Wohnsiedlungsfläche (Wosi) als auch für betrieblich genutzte Flächen (Ind) - wiederum in aggregierter Form für den gesamten Untersuchungsraum und die drei regionalen Teilräume.

	Wobl01 [ha]	Wosi01 [ha] „im Grünen"	Ant. an ges. Wosil01 [%]	Ind01 [ha]	Ind01 [ha] „im Grünen"	Ant. am ges. Ind01 [%]
Untersuchungsraum	16.920	1.511	8,9	3.559	1.153	32,4
Bezirk Linz-Land	4.006	274	6,8	851	457	53,7
Raum NO	2.563	454	17,7	129	79	61,4
Stadt Linz	2.456	47	1,9	1209	76	6,3

Tab. 2: Zuwachs an Wohnsiedlungsfläche und Industrie-/Gewerbegebiet „im Grünen" im Oberösterreichischen Zentralraum

Vergleicht man den Wohnbauanteil in Abbildung 7 mit Abbildung 5c (relative Änderung des Flächenverbrauchs) und Abbildung 6 sieht man deutlich, dass v.a. die Gemeinden nördlich der Donau einen wesentlich höheren Anteil an Wohnsiedlungsfläche im Grünen aufweisen – d.h. hier kam es zu einer tatsächlichen Zersiedelung. In vielen anderen Gemeinden hingegen (v.a. entlang der Hauptverkehrlinien südlich der Donau sowie im Südosten des Untersuchungsraumes) treten wesentlich geringere Werte auf. Daraus läßt sich schließen, dass trotz steigenden Pro-Kopf-Flächenverbrauches in diesen Gemeinden kompaktere Siedlungsflächen auftreten und somit die Ressource Freiland maßvoller genutzt wurde.



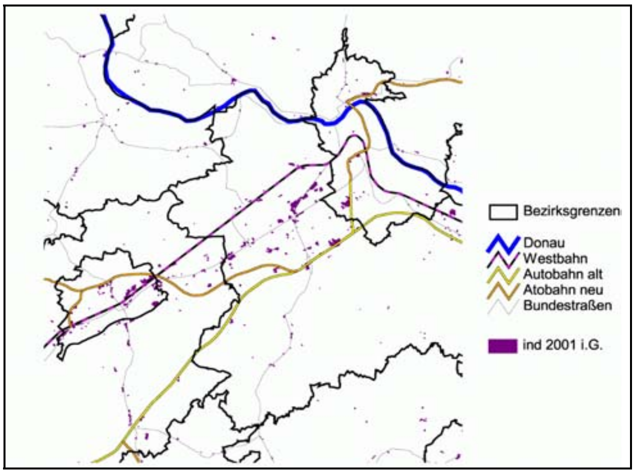


Abb.7: Anteil der neu „im Grünen" entstandenen Wohnsiedlungsflächen an der gesamten Wohnsiedlungsfläche (li.) und neue „im Grünen" betrieblich genutzte Flächen im Raum Linz-Wels (re.)

Für betrieblich genutzte Flächen ist eine vergleichbare Darstellung nicht sinnvoll, da die Größe dieser Flächen von Gemeinde zu Gemeinde extrem unterschiedlich ist - in manchen Gemeinden gibt es gar keine ausgewiesenen Industrieflächen - und somit ist kein direkten Vergleiche möglich sind. Daher wurden hier nur die neu entstanden Flächen im für den Zentralraum Linz-Wels dargestellt. Wie erwartet nehmen Industrie- und Gewerbeflächen v.a. entlang der Hauptverkehrslinien zu.

4 CONCLUSIO

Die vorliegende Arbeit zeigt die Synergien einer Verknüpfung von realräumlichen Daten aus der Fernerkundung mit demographischen Daten aus dem Zensus. Satellitendaten ermöglichen die flächendeckende und kontinuierliche Beobachtung der räumlichen Entwicklung von Siedlungsflächen. In Kombination mit Zensusdaten können dadurch räumlich differenziertere Aussagen über die Bevölkerungsentwicklung abgeleitet werden. Aufgrund der einheitlichen Erfassungsmethode sind die Ergebnisse sowohl für die Erstellung von Zeitreihen einer Region geeignet, als auch für Vergleiche zwischen unterschiedlichen Regionen. Bei der Betrachtung einzelner Gemeinden können auch eher zufällige Entwicklungen festgestellt werden, die nicht durch regionale Kriterien zu erklären sind, mit der verwendeten Methode jedoch analysiert werden können. Die Informationen dienen somit als aussagekräftige Entscheidungsgrundlagen für die Raumplanung und können die Gestaltung von effizienten Planungsintsrumenten und –maßnahmen unterstützen.

ACKNOWLEDGMENT

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GIS-basierte Informationsinstrumente zur Unterstützung einer nachhaltigen Entwicklung der Flächennutzung in Siedlungs- und Verdichtungsräumen

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1 EINLEITUNG

Die Problematik der Inanspruchnahme von Freiflächen für Siedlungs- und Verkehrszwecke – kurz Flächenverbrauch – ist nach wie vor eines der wesentlichen umweltpolitischen Themen und Handlungsfelder. Die neusten Zahlen zum Flächenverbrauch, laut einer Presseerklärung des Statistischen Bundesamtes vom 6.11.2003, belegen, dass die Siedlungs- und Verkehrsfläche 2002 in der BRD um durchschnittlich 105 ha pro Tag zugenommen hat (s. Statistisches Bundesamt). Damit kann zum zweiten Mal in Folge nach 2001 mit 117 ha eine rückläufige Tendenz in der Siedlungs- und Verkehrsflächenentwicklung vermeldet werden. Zuvor lag der Wert zwischen 1993 und 2000 immer zwischen 120 und 130 ha pro Tag. Ob mit diesen Erfolgsmeldungen allerdings tatsächlich eine Trendwende hin zu einer ressourcenschonenden und flächensparenden Sieldungsentwicklung begonnen hat, muss angezweifelt werden. Denn als Grund für diesen Rückgang wird in erster Linie die konjunkturelle Entwicklung in den letzten Jahren und damit einhergehend ein Einbruch bei den Bauinvestitionen genannt.

Die Tatsache, dass der Verbrauch von Freiflächen für Siedlungs- und Verkehrszwecke zu reduzieren ist, ist spätestens seit der Konferenz für Umwelt und Entwicklung 1992 in Rio und der Habitat-Konferenz 1996 in Istanbul allgemein anerkannt. Deutschland hat sich diesbezüglich ehrgeizige Ziele gesteckt: Die Bundesregierung (2002) hat in ihrer nationalen Nachhaltigkeitsstrategie, die sie anlässlich der Rio plus 10 Konferenz in Johannesburg 2002 verabschiedetet hat, als eine zentrale Zielsetzung festgelegt, dass der Flächenverbrauch in Deutschland bis zum Jahr 2020 auf nur noch 30 ha pro Tag reduziert werden soll. Dies entspricht einer Reduzierung der täglichen Inanspruchnahme von Freiflächen für Siedlungs- und Verkehrszwecke auf ca. ein Viertel der heutigen Werte.

2 INSTRUMENTE ZUR STEUERUNG DES FLÄCHENVERBRAUCHS

Es herrscht in der Fachwelt ein Konsens darüber, dass zur Verwirklichung dieser Zielsetzung ein umfangreiches und vielfältiges Steuerungsinstrumentarium notwendig ist. Müller (1999) spricht in diesem Zusammenhang von einem Instrumenten-Mix, ist der zu entwickeln und anzuwenden ist. Den derzeit angewendeten planungs- und ordnungsrechtlichen Instrumenten wird dabei nur bedingt eine tatsächliche Steuerungswirkung attestiert. Um dennoch wirkungsvoll die Flächeninanspruchnahme zu reduzieren, wird daher seit einigen Jahren die Ergänzung des bestehenden Instrumentariums um ökonomische und informatorische Steuerungsinstrumente diskutiert (s. u.a. Bergmann et al. 1999).

Die den ökonomischen Instrumenten zugrunde liegende Idee, basiert auf einer stärkeren Steuerung der Siedlungsentwicklung nach marktwirtschaftlichen Prinzipien, um so eine bessere mengensteuernde Wirkung zu erzielen. Steuern, Abgaben und handelbare Ausweisungsrechte dienen dabei nicht primär der Erhöhung der Einnahmen zur Finanzierung öffentlicher Aufgaben, sondern zielen darauf ab, Haushalte und Betriebe in ihren Standortentscheidungen und Verhaltensweisen durch Anreize und Vorgaben im Sinne einer nachhaltigen Entwicklung zu beeinflussen. Um eine ökologische Lenkungswirkung zu entfalten, werden aus ökologischer Sicht unerwünschte Verhaltensweisen verteuert und umweltfreundliches Handeln belohnt. Dem zugrunde liegt das Konzept der Internalisierung externer (Umwelt)kosten, das ökonomische Pendant zum juristischen Verursacherprinzip.

Ein zentrales Merkmal aller ökonomischen Instrumente ist, dass sie räumlich unspezifisch wirken. Die Berücksichtigung qualitativer Aspekte des Freiraumschutzes macht aber einen stärker raumspezifischen Ansatz erforderlich. Dieser kann mittels geeigneter Informationsinstrumente, die bei entsprechender Ausgestaltung – etwa durch Berücksichtigung aller Umweltmedien – die ökologische Treffsicherheit der Planung erhöhen können, geleistet werden. Neben der Unterstützung informeller Planungsstrategien, wie sie im Zuge einer sich wandelnden Planung zunehmend an Bedeutung gewinnen, können auch formale Planungsverfahren durch solche Informationsinstrumente unterstützt werden. Ihre Wirkungsfelder sind nach Siedentop (1999) die Unterstützung von Abwägungsprozessen bei der Entwicklung von Zielvorstellungen, die Aufklärung und Information von Politik und Öffentlichkeit, permanentes Monitoring der Flächennutzungsentwicklung sowie die Evaluierung von Raumordnungsplänen.

Zusammenfassend lassen sich aus Nachhaltigkeitsperspektive für Informationssysteme, die einen Beitrag zur Reduzierung der Freiflächeninanspruchnahme leisten sollen, zwei zentrale Anforderungen formulieren: Zum einen benötigen sie eine geeignete räumliche Differenzierung sowohl der Datenbasis als auch der produzierten Informationen; zum anderen ist eine Querschnittsorientierung notwendig, die alle nachhaltigkeitsrelevanten Themen berücksichtigt. Diese beiden Anforderungen erzwingen geradezu den Einsatz von Geographischen Informationssystemen, da mit den im GIS vorgehaltenen Funktionen der Datenverwaltung, -bearbeitung und -analyse ihnen sehr gut entsprochen werden kann.

3 KONZEPTION DES INFORMATIONSSYSTEMS NACHHALTIGE FLÄCHENNUTZUNG

Kernstück dieses kommunalen Informationsinstrumentes ist die Verbindung von Strategien zur Umsetzung des Konzeptes der nachhaltigen Entwicklung mit dem inzwischen zum methodischen Standardrepertoire gewordenen Instrumentarium, das Geographische Informationssysteme zur Verfügung stellen. Das Ziel, welches mit der Entwicklung des Informationssystems verfolgt wird, ist es, planungsrelevante Informationen über die aktuelle und zukünftige Entwicklung der Flächennutzung unter dem Aspekt der Nachhaltigkeit bereitzustellen. Diese übergreifende Zielsetzung kann in mehrere Grundprinzipien, die mit dem Informationssystem einzulösen sind, untergliedert werden. Ziel sollte es sein, räumlich differenzierte Aussagen über die Entwicklung der Flächennutzung zu generieren, dabei eine integrative Betrachtung verschiedener Aspekte der Entwicklung der Flächennutzung, orientiert an dem Leitbild der nachhaltigen Entwicklung, zu gewährleisten und eine flexible Anwendbarkeit des Informationssystems für vielfältige Planungsaufgaben sicherzustellen.

Aus diesen Grundprinzipien ergeben sich die folgenden Anforderungen bezüglich Datenbasis und Ausgestaltung des Informationssystems: Das Prinzip der räumlich differenzierten Aussagen erfordert einen Raumbezug für alle Grundlagendaten; um das Prinzip der integrativen Betrachtung der drei Nachhaltigkeitsdimensionen sicherzustellen, bedarf es einer einheitlichen Raumbezugsbasis; letztlich muss das Prinzip der flexiblen Anwendbarkeit mittels geeigneter Nutzer-Schnittstellen eingelöst werden.

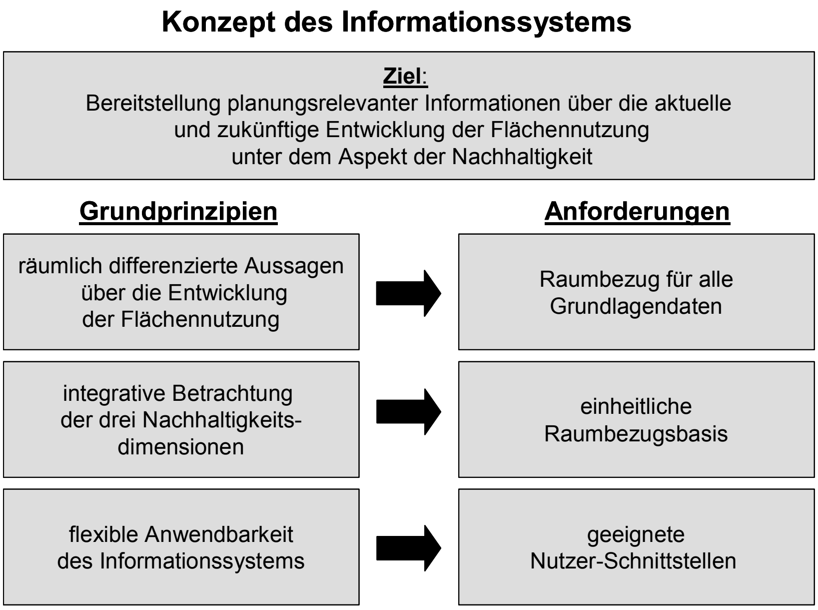

Abb. 1: Komponenten des Informationssystems

3.1 Aufbau und Komponenten des Informationssystems

Wesentliche Komponenten des Informationssystems (s. Abb. 2) sind ein mehrstufiges Ziel- und Indikatorensystem, das die abstrakten Ziele nachhaltiger Entwicklung schrittweise operationalisiert, eine umfassende Daten- und Methodenbank, die die Erfassung von raumdifferenzierenden Indikatoren ermöglicht, eine Raumgliederung und -typisierung als gemeinsame Raumbezugsbasis sowie ein Set von Orientierungswerten. Mit Hilfe des Informationssystems kann die Entwicklung der Flächennutzung kleinräumig analysiert und können planungsunterstützende Informationen bereitstellt werden.

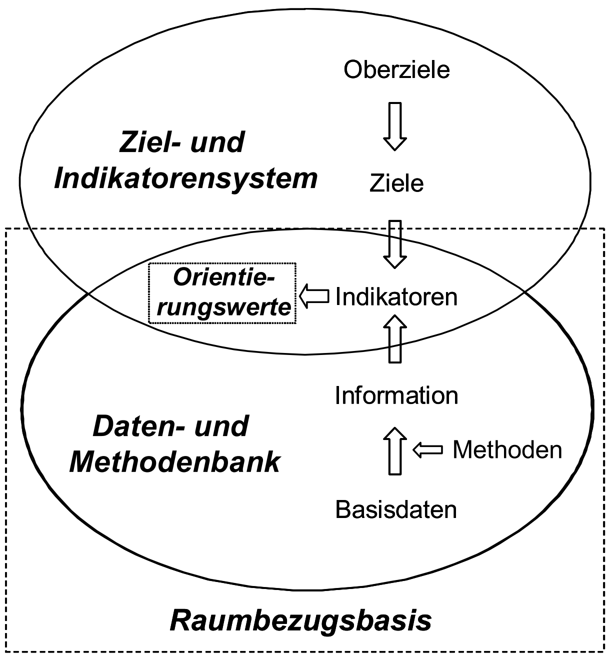

Abb. 2: Komponenten des Informationssystems

3.1.1 Ziel- und Indikatorensystem

In dem Ziel- und Indikatorensystem werden in mehreren Stufen die allgemeinen Ziele nachhaltiger Entwicklung in Ziele einer nachhaltigen Entwicklung der Flächennutzung konkretisiert. Deren Auswahl erfolgt anhand der Kriterien Bezug zum Oberziel, Bezug zum Handlungsfeld Flächennutzung, Raumbezug und Handlungsorientierung. Aus Gründen der Übersichtlichkeit wird nur eine begrenzte Anzahl an Zielen ausgewählt. Darunter fallen sowohl eindimensionale Ziele, die sich auf das Oberziel einer Nachhaltigkeitsdimension beziehen, als auch mehrdimensionale Ziele, die die Oberziele von mindestens zwei Nachhaltigkeitsdimensionen unterstützen (s. Abb. 3). Dadurch werden etwaige Konflikte bereits auf der Zielebene offensichtlich und können bei der Entwicklung von Orientierungswerten berücksichtigt werden. Im nächsten Schritt werden zu den Zielen anhand der Kriterien der Gültigkeit (Validität) und der Zuverlässigkeit (Reliabilität) geeignete Indikatoren ermittelt, mit denen die Zielerreichung überprüft werden kann. Ausgewählt wurden die folgenden sieben Indikatoren:

- Freiflächenanteil
- Freiflächenqualität
- Zerschneidungsgrad
- Siedlungsdichte
- Wohnraumversorgung
- Freiraumversorgung
- Nutzungspotenzial

Für diese werden geeignete GIS-basierte Erhebungs- und Analyseverfahren entwickelt, die es erlauben, die Indikatoren in einer gemeinsamen Raumbezugsbasis zu erfassen und kleinräumig abzubilden.

Im Zuge der Analyse von Wechselwirkungen und Zielkonflikten werden zwischen den einzelnen Zielen/Indikatoren bestehende Ursache-Wirkungsverknüpfungen herausgearbeitet. Diese durch die Verknüpfungen entstehenden Auswirkungen der Entwicklung eines Indikators auf einen anderen Indikator werden in positive, d.h. das ursprüngliche Ziel unterstützende Auswirkungen und negative, d.h. zu dem ursprünglichen Ziel konträr verlaufende Auswirkungen unterschieden. Beispielsweise kann sich der Erhalt des Freiflächenanteils positiv auf die Sicherung der wohnungsnahen Freiraumversorgung und auf die Sicherung einer hohen Freiflächenqualität auswirken. Zugleich kann sich aus der Erhöhung der Siedlungsdichte ein negativer Effekt auf die Sicherung der wohnungsnahen Freiraumversorgung oder auch auf den Erhalt großer unzerschnittener Freiflächen einstellen (s. Abb. 3). Erst durch die Analyse solcher Wirkungsbeziehungen wird aus dem Indikatorensatz ein Indikatorensystem und kann der Gleichrangigkeit zwischen den ökologischen, sozialen und ökonomischen Zielen nachhaltiger Entwicklung entsprochen werden.

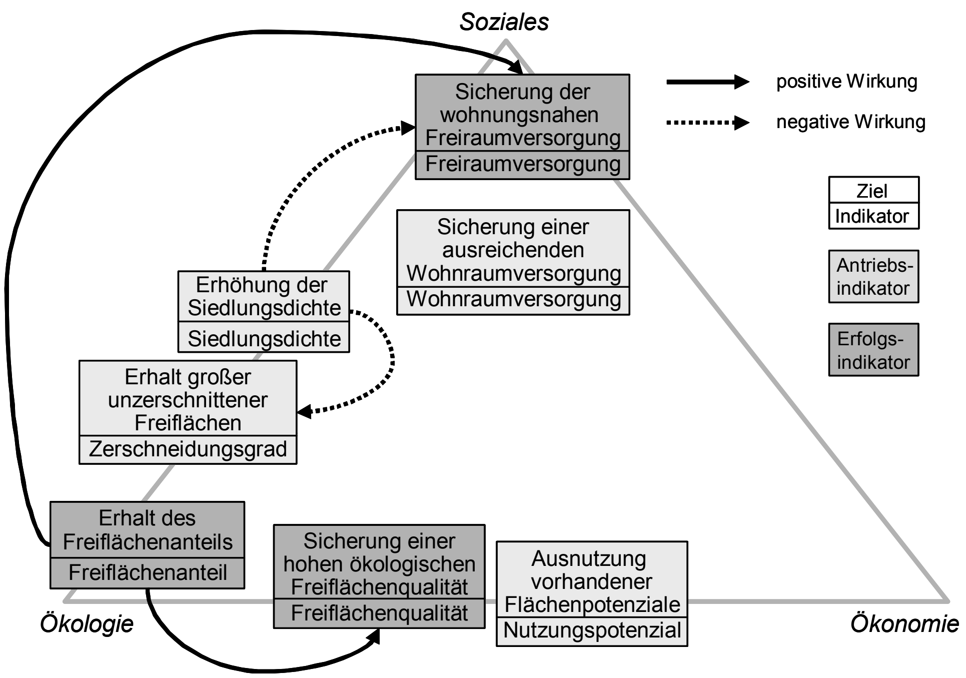

Abb. 3 exemplarische Wirkungsbeziehungen zwischen den ausgewählten Indikatoren

Anhand dieser Analyse werden sog. Antriebsindikatoren und Erfolgsindikatoren definiert. Als Antriebsindikatoren werden diejenigen Indikatoren aufgefasst, die Ursachen für eine bestimmte Entwicklung abbilden. Zentrale Eigenschaft der Antriebsindikatoren ist, dass über sie die Flächennutzungsentwicklung gesteuert werden können. Den Antriebsindikatoren stehen die Erfolgsindikatoren gegenüber. Sie fungieren als Anzeiger dafür, inwieweit die Entwicklung der Flächennutzung im Sinne einer nachhaltigen Entwicklung positiv beeinflusst wurde; anders ausgedrückt, an ihnen ist der Grad der Zielerreichung auf dem Weg zu einer nachhaltigen Entwicklung der Flächennutzung abzulesen. In der Anwendung des Informationssystems unterscheiden sich die beiden Indikatortypen dadurch, dass für sie unterschiedliche Formen von Orientierungswerten entwickelt werden.

3.1.2 Daten- und Methodenbank

"Information entsteht erst durch problemorientierte Aufbereitung von Daten oder Nachrichten, sie kann nicht gesammelt, sondern muss erarbeitet werden“ (Fürst et al. 1996, S. 4). Basis hierfür ist eine umfangreiche Datenbank, in der Grundlagendaten zu allen nachhaltigkeitsrelevanten Themen räumlich möglichst disaggregiert vorliegen. Um aus den Grundlagendaten Informationen zu generieren, werden Methoden benötigt, die auf die Daten angewendet werden. Hierbei handelt es sich sowohl um Methoden auf der Verfahrensebene, d.h. GIS-Funktionen zum Selektieren, Klassifizieren, Verschneiden und Aggregieren der Basisdaten, wie auch Methoden auf der Wissensebene, d.h. Methoden zur Erhebung, Systematisierung, Interpretation und Auswertung von Daten auf der Grundlage vorhandenen Fachwissens (vgl. Duttmann 1999, S. 363). Die Informationen werden soweit verdichtet, dass sie letztendlich die ausgewählten Indikatoren abbilden.

3.1.3 Gemeinsame Raumbezugsbasis

Grundlage der Erfassung und Darstellung von räumlich differenzierenden Indikatoren ist deren Aussageeinheit, d.h. der räumlichen Ebene auf der die Indikatoren abgebildet werden. Bei der Wahl der richtigen Bezugsebene gilt es einen Kompromiss zu erzeugen, der zwischen dem Anspruch auf möglichst homogene Bereiche, der Notwendigkeit des Vergleichs verschiedener Nachhaltigkeitsdimensionen und der Forderung nach einer übersichtlichen, schnell zu erfassenden Aussage vermittelt[4].

Für das Untersuchungsgebiet, das Stadtgebiet von Bochum, wurde eine Raumgliederung entwickelt, die die statistischen Viertel nach ihrem Flächennutzungsmuster typisiert. Mittels einer Clusteranalyse der realen Flächennutzungsanteile konnten sechs Typen mit einer ähnlichen Verteilung der Hauptflächennutzungsarten ausgewiesen werden, die als Flächennutzungstypen bezeichnet werden. Die statistischen Viertel erweisen sich als so homogen, dass signifikante Unterschiede in der Ausprägung der ausgewählten Nachhaltigkeitsindikatoren nachgewiesen werden konnten. Sie sind deshalb als Bezugsräume für ein räumlich differenziertes Zielsystem der nachhaltigen Siedlungsentwicklung gut geeignet.

3.1.4 Orientierungswerte

Die vollständige Operationalisierung des Konzeptes der nachhaltigen Entwicklung umfasst als letzten Schritt die „Ableitung, soweit möglich, von quantitativen Nachhaltigkeitszielen bezogen auf die Nachhaltigkeitsindikatoren“ (COENEN 1999, S. 5). Diese Quantifizierung der Zielaussagen durch Orientierungswerte ist die notwendige Voraussetzung für die Bewertung der durch die Indikatoren angezeigten Sachverhalte und die Ableitung von Handlungsempfehlungen.

Die ausgewählten Orientierungswerte basieren zum einen auf den Ergebnissen einer Ist-Analyse, berücksichtigen zweitens Zielvorgaben der Stadt Bochum, rekurrieren drittens auf Richt- und Orientierungswerte aus der wissenschaftlichen Literatur und nehmen viertens vorhandene Zielvorgaben anderer Städte in den Blick. Diese Vorgehensweise ersetzt nicht die üblicherweise notwendige Diskussion geeigneter Orientierungswerte für Nachhaltigkeitsindikatoren in einem umfassenden gesellschaftlichen Prozess. Vielmehr dient sie dem Aufzeigen möglicher geeigneter Orientierungswerte aus wissenschaftlicher Perspektive und der Verdeutlichung der Anwendbarkeit des Informationssystems.

Die ausdifferenzierten Antriebs- und Erfolgsindikatoren unterscheiden sich in der Form ihrer Orientierungswerte: Für Antriebsindikatoren, durch welche die Flächennutzungsentwicklung gesteuert werden kann, werden Intervalle zulässiger Ausprägung definiert, innerhalb derer von einer nachhaltigen Entwicklung in Bezug auf diesen Indikator zu sprechen ist. Für Erfolgsindikatoren, die als Anzeiger für den Erfolg einer nachhaltigen Entwicklung der Flächennutzung fungieren, sind hingegen Schwellenwerte definiert, die – im Sinne einer nachhaltigen Entwicklung – nicht zu über- bzw. unterschreiten sind.

4 ANWENDUNG DES INFORMATIONSSYSTEMS

Am Beispiel der Stadt Bochum ist die Anwendbarkeit des Informationssystems getestet worden (s. Flacke 2003). Hierzu ist zunächst eine Analyse des Status quo anhand der ausgewählten Indikatoren durchgeführt worden. Diese ergab ein differenziertes Bild der Versorgung in den einzelnen Vierteln, anhand dessen Problembereiche identifiziert und Handlungsschwerpunkte definiert werden konnten.

Darüber hinaus sind zwei Applikationen entwickelt worden, mit denen der kommunale Planungsprozess unterstützt werden kann. Auf der gesamtstädtischen Ebene sieht das System die Durchführung von Szenarien der Flächenutzungsentwicklung vor, mit deren Hilfe „Zukunftsbilder“ der Flächennutzung erstellt werden können. Dazu sind in Abhängigkeit von der jeweiligen Zielsetzung die jährlichen Zuwachsraten für definierte Parameter der Flächennutzung vorzugeben. Verschiedene Strategien der Stadtentwicklung (z.B. verstärkte Innenentwicklung) können über die Verteilung der Zuwachsraten auf die einzelnen Flächennutzungstypen abgebildet werden. Die Durchführung alternativer Szenarien verdeutlicht, dass mittels der konsequenten Anwendung von Strategien einer ressourcenschonenden Siedlungsentwicklung der negative Trend der Flächenentwicklung weitgehend aufgehalten werden kann.

In der zweiten Applikation liefert das Informationssystem kleinräumig auf Ebene der statistischen Viertel planungsverwertbare Aussagen. Zum einen können die aktuellen Ausprägungen der einzelnen Indikatoren abgefragt werden; zum anderen bietet es die Möglichkeit, die Auswirkungen konkreter Planungsmaßnahmen auf die durch die Indikatoren dargestellten Sachverhalte zu erfassen. Das jeweilige Vorhaben kann so – vereinfacht – in seinen Auswirkungen auf die ausgewählten Indikatoren abgeschätzt werden, wobei die definierten Orientierungswerte dazu dienen, nicht verträgliche Entwicklungen anzuzeigen.

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Methoden räumlicher Agglomerationsraumabgrenzung in Europa. Ansätze und praktische Erfahrungen aus dem EU-Forschungsprojekt COMET

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1 EINLEITUNG UND PROBLEMSTELLUNG

Städtewachstum und Suburbanisierungsprozesse orientieren sich nicht an administrativen Stadtgrenzen. Zur Analyse dieser Tendenzen ist die Herausbildung statistischer Raumbezugseinheiten unter Anwendung einheitlicher Methoden zur Agglomerationsraumabgrenzung Voraussetzung. Das Methodenspektrum der Delimitierung reicht von morphologischen bis zu dynamisch-funktionalen Ansätzen. Unter dem Blickwinkel der internationalen Vergleichbarkeit und Praktikabilität stützt sich die metropolitane Abgrenzung im EU-Forschungsprojekt COMET[1] auf eine Methode, die von N.U.R.E.C. (Network on Urban Research in the European Union) basierend auf einer UN-Definition in den Jahren von 1991 bis 1994 für alle Agglomerationen mit mehr als 100.000 Einwohner der Europäischen Union mit Gebietsstand vor der Erweiterungsphase 1995 neu entwickelt wurde. Zudem sollen andere Methoden zur Agglomerationsraumabgrenzung dargestellt und am Beispiel der Agglomeration Wien diskutiert sowie eine Verknüpfung vom 'statistischen Raum' zu einer international harmonisierten Datenbank mit Sekundärdaten der amtlichen Statistik präsentiert werden.

2 AUSGEWÄHLTE METHODEN RÄUMLICHER AGGLOMERATIONSRAUMABGRENZUNGEN IN EUROPA

Bei der Auswahl einer geeigneten Agglomerationsraumabgrenzungsmethode in Europa stellt sich prinzipiell die Frage nach dem Maßstab (Scale), verbunden mit dem gewünschten Detaillierungsgrad der Untersuchung sowie nach dem Anspruch der Datenvergleichbarkeit und praktischen –verfügbarkeit auf europäischem Niveau, der einheitlichen Methode und deren Praktizierbarkeit und Genauigkeitsanspruch unter dem vorgegebenen Zeit- und Kostenrahmen. Wie allgemein bekannt, bietet EUROSTAT europäische Vergleichsdaten nur auf dem relativ grobrastrigen Niveau der NUTS 3 Einheiten an; feingliedrige und zweifelsohne besser geeignete Daten auf Gemeindeniveau (NUTS 5) erfordern einen nicht zu unterschätzenden Mehraufwand bei der Datenharmonisierung auf europäischem Niveau. Weiters ist es Faktum, dass die bei dynamisch-funktionalen Methoden vielfach verwendeten Pendlerdaten weder national in Zeitreihen noch international harmonisierbar sind.

Zu hinterfragen ist ferner, ob für die postmoderne Stadt von heute jene deduktiven Methoden zutreffend sind, die ein Stadtregionsmodell postulieren, das von einem Kerngebiet und in konzentrischen Kreisen abfallende Außenzone ausgeht, besonders im Hinblick auf das Pendlerverflechtungsmuster. Aufgrund der Bildung von neuen, suburbanen Kernen entstehen auch neue Verflechtungsmuster, die das historische Wirtschaftszentrum zunehmend ausklammern.

2.1 Morphologische Methode

Für die vergleichende Stadtforschung reicht eine Analyse von Prozessen innerhalb der administrativen Stadtgrenzen nicht aus, da das Stadtwachstum als Suburbanisierung des Wohnens und der Wirtschaft längst die angrenzenden Gemeinden erfasst hat. Die Bezugseinheit für die Stadtforschung ist daher der Agglomerationsraum, wobei darunter eine Region mit hoher Bevölkerungs- und Arbeitsplatzdichte, sowie hoher wirtschaftlicher und funktionaler Konzentration verstanden wird, die eine Anzahl administrativer Basiseinheiten umfasst.

Seit der Gründung des 'Network on Urban Research in the European Community' (N.U.R.E.C.) 1989, mit der Zielsetzung der Entwicklung einer international anwendbaren räumlichen Agglomerationsraumabgrenzungsmethode, wurden mit Unterstützung von EUROSTAT bis 1994 in der Europäischen Union mit Gebietsstand vor der Erweiterungsphase 1995 330 mit mehr als 100.000 Einwohnern morphologisch abgegrenzt.

Ein wesentlicher Vorteil der N.U.R.E.C.-Methode begründet sich durch die relativ einfache Anwendbarkeit auf unterschiedliche Agglomerationen, sodass Aktualisierungen und Neuabgrenzungen mit geringerem Aufwand vorgenommen werden können (Ausnahmen: lineare Verbauung entlang von Verkehrswegen wie in den Niederlanden und Belgien, insbesondere für die Agglomeration Brüssel geltend). Durch die Projektion des geschlossenen verbauten Gebietes auf die entsprechenden kleinsten international vergleichbaren administrativen Basiseinheiten (in Österreich: Gemeinden) ist eine Verknüpfung mit Daten der amtlichen Statistik gewährleistet. Die ermittelte, international nach den gleichen Kriterien abgegrenzte Raumbezugseinheit ermöglicht somit eine vergleichende Metropolenforschung über die Ländergrenzen innerhalb der Europäischen Union.

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[1] COMET (Competitive Metropolises - Economic Transformation, Labour Market and Competition in European Agglomerations) wird vom Institut für Stadt- und Regionalforschung der Österreichischen Akademie der Wissenschaften in Wien koordiniert (Koordinator: Borsdorf A., wissenschaftliche Direktorin der Gesamtprojekts: Paal M.) und von der Europäischen Kommission im 5. Rahmenprogramm 'Die Stadt von Morgen und das kulturelle Erbe' (Projektnummer: EVK4_CT_2001_0035) sowie vom Österreichischen Bundesministerium für Bildung, Wissenschaft und Kultur unterstützt. Der Projektantrag zum EU-Forschungsprojekt COMET wurde von Borsdorf A., Paal M. und Pöckl A. entwickelt, die wissenschaftliche Konzeption geht auf Paal M. zurück. 16 europäische Partner analysieren seit Ende 2001 sieben Agglomerationen (Amsterdam, Barcelona, Berlin, Brüssel, Kopenhagen, Strassburg und Wien), das Projekt läuft bis Ende 2004. Für weitere Informationen siehe auch www.comet.ac.at.

Die angeführten Kriterien wurden nach folgenden Maßgaben von N.U.R.E.C. festgelegt:

- internationale Anwendbarkeit (in der Europäischen Union)
- wirklichkeitsnahe Abgrenzung der Agglomerationen

Die N.U.R.E.C.-Methode stützt sich dabei auf folgende Abgrenzungskriterien und -schritte:

- ‚Gebäude'

z. B. Wohnbauten, Industrieanlagen, Dienstleistungseinrichtungen, Verwaltungsbauten, religiöse Bauten, öffentliche Gebäude und Anlagen, Verkehrsflächen, Grünanlagen, Friedhöfe, Sportanlagen.

- ‚Geschlossenes verbautes Gebiet' (‚contiguous built-up area' CBU)

Gruppe von Gebäuden mit einem Maximalentfernungswert von 200 m; Parks und Grünflächen, die völlig von Gebäuden umschlossen sind, werden unabhängig von deren Größe als Teil der CBU betrachtet.

- Unterbrechungen der CBU (Ausschließungskriterien)

Grün- / Freiflächen mit einer Breite > 500 m und einer Fläche > 25 ha; Grün- / Freiflächen, die für eine Bebauung ungeeignet sind und eine siedlungsgebietstrennende Funktion einnehmen; Wald-, Landwirtschafts-, Brach-, Öd-, Weideflächen; Gewächshäuser, Gärtnereien.

- Abgrenzung der administrativen Basiseinheiten

Aufgrund der Notwendigkeit der Interpretation von Daten der amtlichen Statistik, werden die CBU auf die administrativen Basiseinheiten projeziert, wobei N.U.R.E.C. mit NUTS 5-Einheiten (in Österreich und Deutschland: Gemeinden) arbeitet. Eine Gemeinde ist dann Teil des Aggolmerationsgebietes unter Anwendung der N.U.R.E.C.-Methode, wenn in der entsprechenden CBU zumindest 50 % der Gemeindebevölkerung wohnt (vgl. N.U.R.E.C., 1994, S. 11-18).

‚Eine Agglomeration umfasst demnach jene Fläche, in der sich das kleinste komplette Set dichter Verbauung mit dem Netz der administrativen Basiseinheiten überlappt.' (Paal M., 1999, S. 121).

2.2 Dynamisch-funktionale Methode

2.2.1 Exkurs: Die US-amerikanischen Functional Urban Regions (FURs)

Die ‚Functional Urban Regions' haben im US-amerikanischen Raum Tradition. Ein von Warner S. B. jr. und Fleisch S. an der Boston University entwickeltes sozio-ökonomisches Indikatorenmodell weist für Bevölkerungsdaten aus dem US-Zensus von 1970 für die USA 171 FURs aus. Als Indikatoren wurden beispielsweise Arbeitspendler, Zentren und Ausbreitungsgrad von Zeitungen, Großhandels- und Bankinteraktionen verwendet und neben demographischen Merkmalen (Einwohnerzahl, Alters- und Geschlechtsproportionen, der Anteil der Afro-Amerikaner und der im Ausland Geborenen, Haushaltsgrößen, Bevölkerungsveränderungen, etc.) wurden auch ökonomische Kriterien wie sektorale Bruttowertschöpfungen herangezogen. Für einzelne Indikatoren konnten lange Zeitreihen von 1820 bis 1970 entwickelt werden (vgl. Warner S. B. jr., Fleisch S., 1976; Warner S. B. jr., Fleisch S., 2001).

2.2.2 Ausgewählte dynamisch-funktionale Abgrenzungsmethoden in Europa

Am International Institute for Applied Systems Analysis (IIASA) in Laxenburg, Niederösterreich entwickelte Sherrill K. ein Modell der Functional Urban Regions für Österreich (vgl. Sherrill K., 1976). Ein Jahr später wies Sherrill für Deutschland funktional-urbane Gebiete aus. Hier umfasste der ‚Urban Core' zumindest 20.000 Beschäftigte am Arbeitsort und 50.000 Einwohner; die Verflechtung mit dem ‚Hinterland' wurde durch Berufspendlerströme manifestiert. Für die Schweiz definierte er zentralörtliche Regionen, die konzeptionell ähnlich dem Modell der ‚Functional Urban Regions' angepasst wurden. Räumlich-urbane Netzwerke und analytische Studien über regionales Wachstum und deren Veränderungen konnten für die beiden österreichischen Nachbarstaaten für die Dekade von 1960 bis 1970 untersucht werden (vgl. Sherrill K., 1977).

Aufgrund der Verfügbarkeit von Bevölkerungs- und Beschäftigungsdaten, vorwiegend auf der Ebene der politischen Bezirke, wählte Sherrill K. diese als administrative Bezugseinheit für Österreich. Mittels der Tagespendler der Volkszählung 1971 wurden 13 österreichische Stadtregionen abgegrenzt, wobei elf das Kriterium ‚20.000 Beschäftigten am Arbeitsort' erfüllten, jedoch von diesen fünf die minimale Bevölkerungszahl nicht aufweisen. Zwei weitere umfassen je drei Städte, die für sich gesehen das Bevölkerungs- oder Beschäftigungskriterium nicht erfüllten. Fasst man diese aufgrund der räumlichen Nähe zusammen, so erfüllten sie gesamt gesehen die Kriterien: Bregenz, Dornbirn und Feldkirch sowie Leoben, Bruck an der Mur, Kapfenburg. Die für Österreich ausgewiesenen Stadtregionen weisen jedoch aufgrund

- der relativ groben Abgrenzung auf Bezirksebene auf Basis der Pendlerverflechtungen und
- der für Österreichs Stadtregionen charakteristischen und schwach ausgeprächten Berufspendlerströme aus dem ‚Hinterland' in die ‚Urban Core Area' (ausgenommen Wien und Linz)

überraschende Ergebnisse auf (so wird z. B. der gesamte Bezirk Bregenzerwald der ‚Urban Core Area' von Bregenz zugezählt, wohingegen diese Kategorie für Wien nur das Bundesland Wien umfasst) (vgl. Hall P., Hay D., 1980, S. 79 f.)

Basierend auf der französischen Methode europäischer Functional Urban Areas entwickelten Perlik M., Messerli P. und Bätzing W. eine Abgrenzung von Verstädterungsbereichen in den Alpen (Perlik M., Messerli P., Bätzing W., 2001, S. 243-252).

Das Interreg IIC Projekt ‚Group for European Metropolitan Areas Comparative Analysis, second project' (GEMACA II) untersuchte 14 Functional Urban Regions Nord-West-Europas mit mehr als einer Million Einwohner: Antwerpen, Birmingham, Brüssel, Dublin, Edinburgh, Glasgow, Lille, Liverpool, London, Manchaster, Paris, Randstad, Rhein-Main und Rhein-Ruhr.

Die Abgrenzung im GEMACA II Projekt erfolgte auf Basis der NUTS 3 Einheiten nach folgenden Kriterien:

- ‚Economic Core(s) of the Metropolitan Area'

  alle benachbarten Städte mit einer Beschäftigungsdichter > 7 Beschäftigungen / ha

- Das / die ‚Economic Core(s) of the Metropolitan Area' umgebende ‚Hinterland':

  alle benachbarten Städte, wenn mehr als 10% der dort wohnhaften Erwerbstätigen in den ‚Economic Core(s)' arbeiten (Lecomte D., 2001).

Die OECD grenzte Functional Urban Regions international nach Arbeitsmarktbezirken (in Österreich entspricht das der NUTS 4 Ebene) ab, wobei diese Arbeitsmarktbezirke für Österreich nicht deckungsgleich mit den politischen Bezirken sind; Sekundärdaten der amtlichen Statistik können somit nur begrenzt für Analysen herangezogen werden (Cattan N., 2002).

3 DIE METHODIK DES ÖSTERREICHISCHEN STATISTISCHEN ZENTRALAMTES[2]

3.1 Die ÖSTAT-Methode (Version 1971)

Um dem Bedürfnis öffentlicher Institutionen der Verwaltung nach vergleichbaren statistischen Daten über Stadtregionen gerecht zu werden, wurde im Jahre 1983 vom Österreichischen Statistischen Zentralamt mit den Volkszählungsergebnissen von 1971 und den Arbeitsstättenzählungsergebnissen von 1973 ein Konzept entwickelt, das die Stadtregionen in Österreich ausweist. Definiert wurde die österreichische Stadtregion als ein geschlossenes Gebiet von Gemeinden mit mindestens 15.000 Einwohnern, bestehend aus einem Kernraum (einer Stadt bzw. einer Gruppe benachbarter Städte) mit mindestens 10.000 Einwohnern und einer Außenzone von Gemeinden mit mindestens 20 % Tagespendern in den Kernraum gemessen an Beschäftigten am Wohnort (vgl. Helczmanovszky H., 1982, S. 4ff; Findl P., 1982, S. 320).

Bei der Abgrenzung des Kernraumes griff man auf das morphologische Konzept zurück: Mit Hilfe von Luftbildern wurden die Siedlungseinheiten Österreichs auf Zählsprengelebene aufgrund einer zusammenhängenden verbauten Fläche mit mehr als 2.000 Einwohnern ermittelt (vgl. Desoye H., 1982, S. 4 ff.). Von den mit dieser Methode ermittelten 296 Siedlungseinheiten Österreichs wurden nur jene mit mindestens 5.000 Einwohnern (lt. Volkszählung 1971) oder mindestens 2.500 nichtlandwirtschaftliche Beschäftigen (lt. Arbeitsstättenzählung 1973) einem genaueren Prüfungsverfahren zur Identifizierung von Kernstadträumen unterzogen. Bei der Kernraumabgrenzung ging es darum, den Missing-link von den morphologischen Kernraumsiedlungseinheiten auf Zählsprengelbasis zu den statistischen Einheiten der Gemeinden herzustellen. Man bediente sich dabei folgender Modelle (vgl. Fuchs I., 1986, S. 429):

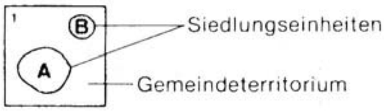


Abb. 1: Modell 1: Zusammenfassung aller Siedlungseinheiten auf demselben Gemeindegebiet

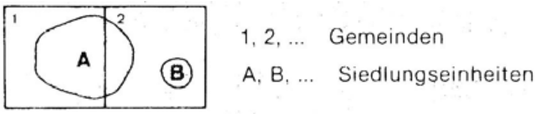


Abb. 2: Modell 2: Zusammenfassung von Nachbarsiedlungseinheiten auf verschiedenen Gemeindegebieten, wenn das unverbaute Areal zwischen den Siedlungseinheiten inmitten des Gemeindeterritoriums liegt.

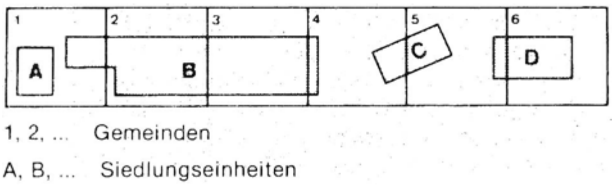


Abb. 3: Modell 3a (1971): Index der gegenseitigen Pendlerverflechtung (IgPV) auf Gemeindebasis zur Zusammenfassung von Gemeinden mit Siedlungseinheiten.

$$IgPV = \left(\frac{Pij}{WBi} + \frac{Pij}{BAj} + \frac{Pji}{ABi} + \frac{Pji}{WBj} \right) * 100$$

P_{ij}	Tagespender von i nach j
P_{ij}	Tagespender von i nach j
P_{ji}	Tagespendlier von j nach i
WB	wohnhafte Beschäftigte

[2] Im Jahr 2000 wurde das Österreichische Statistische Zentralamt in Statistik Austria umbenannt, siehe auch http://www.statistik.at.

AB	Arbeitsbevölkerung

Zur räumlichen Zusammenfassung musste der Index der gegenseitigen Pendlerverflechtung mindestens 30.0 betragen (vgl. Fuchs I., 1983, S. 6).

Bei der Erfassung der Außenzone wurden die Arbeitsmarktverflechtungen als Basis herangezogen. Mittels Schwellenwertanalysen der Tagespendlerquoten aus den Gemeinden in die Kernräume konnte die Tagesauspendlerquote mit 20 % festgelegt werden. Kleingemeinden mit weniger als 20 % Tagesauspendlern wurden als Enklaven in die Außenzone inkludiert.

Als Ergebnis konnten endgültig 1983 vom Österreichischen Statistischen Zentralamt aufgrund der Datenbasis der Volkszählung von 1971 und der Arbeitsstättenzählung von 1973 die 42 bedeutendsten Stadtregionen Österreichs präzisiert werden. Der Kernraum der Stadtregion Wien umfasste nach dieser ÖSTAT-Methode und der Datenlage aus den 1970er Jahren neben dem Bundesland Wien mit seinen 23 Stadtbezirken 26 niederösterreichische Wiener Umlandgemeinden (vgl. Fuchs I., 1983, S. 8-12).

3.2 Die ÖSTAT-Methode (Version 1981)

Das Österreichische Statistische Zentralamt hielt bei der Neubeurteilung und –abgrenzung der Stadtregionen Österreichs aufgrund der Volkszählungsergebnisse von 1981 am deduktiven Modell der ‘Stadtregion’ fest. Nach Überlegungen des Österreichischen Statistischen Zentralamts handelt es sich bei den ‘Stadtregionen’ um Funktionsräume im Umfeld der bedeutendsten Zentren infolge der stärkeren Trennung von Wohn- und Arbeitsfunktion innerhalb eines Staatsgebietes (vgl. Fuchs I., 1986, S. 428). Die von der Ersterfassung auf Basis der Volkszählungsdatensätze aus 1971 übernommenen Ansätze wurden unverändert angewendet. Aufgrund der Volkszählungsdaten von 1981 konnten in Österreich 305 Siedlungseinheiten mit mindestens 5.000 Einwohnern am Wohnort oder mindestens der Hälfte außerhalb der Land- und Forstwirtschaft beschäftigten Personen ausgewiesen werden. Hier folgte wiederum - wie in der Dekade zuvor – ein Testverfahren zur räumlichen Ausweisung von Stadtregionen. Die Methode zur Stadtraumabgrenzung von 1971 wurde weitgehend unverändert beibehalten. Lediglich beim Modell 3 zur Abgrenzung der Kernräume wurde der Index der gegenseitigen Pendlerverflechung (IgPV) durch den Berufspendlerverflechtungsindex (PVI) ersetzt (vgl. Fuchs I. 1986, S. 429).

Modell 3b (1981): Berufspendlerverflechtungsindex (PVI) als Interaktionsmaß zur Bestimmung der funktionellen Geschlossenheit des Stadtregionskernes. Der PVI mit über 36.1 Punkten wies aufgrund der Ergebnisse des Zensus von 1981 die ‘kumulierten potentiellen Kernräume’ aus (vgl. Fuchs I., 1986, S. 429).

$$PVI = \left(\frac{P_{ij}}{BW_i} + \frac{P_{ij}}{BA_j} + \frac{P_{ji}}{BW_j} + \frac{P_{ji}}{BA_i} \right) * 100$$

i	potentieller Kern (auf Gemeindebasis abgegrenzt)
j	Nachbarkern (auf Gemeindebasis abgegrenzt)
P_{ij}	Berufstagespendler von i nach j
P_{ji}	Berufstagespendler von j nach i
BW	Beschäftigte am Wohnort
BA	Beschäftigte am Arbeitsort

Zur Umgrenzung der Außenzone wurde 1981 ebenfalls eine ‘kernraumorientierte Tagesauspendlerquote’ herangezogen. Der generelle Trend und österreichweite durchschnittliche Anstieg der Tagespendlerquote um 8,6 % von 1971 auf 1981 machte es notwendig, den Schwellenwert der Auspendlerquote von 20 % (1971) auf 24,6 % (1981) anzuheben (vgl. Fuchs I., 1986, S. 431).

Mit dem Datensatz der Volkszählung 1981 wies das Österreichische Statistische Zentralamt – wie schon in der Version 1971 – 42 Stadtregionen in Österreich aus. Zusammenfassend wird festgestellt, dass sich österreichweit in fünf Fällen die Kernräume markant vergrößert haben, wobei der Kernraum von Wien um drei niederösterreichische Umlandgemeinden erweitert wurde. Bei der Beurteilung der Außenzonen ergibt sich eine Drittelung: ein Drittel der Stadtregionen weist eine stabile Position auf, bei einem Drittel wurde ein ‘räumlicher Rückbau’ ausgewiesen und bei einem weiteren Drittel ergeben sich erhebliche Gebietserweiterungen. Diese Expansionssituation ist für die Außenzone von Wien, die großen Landeshauptstädte und die neugegründete NÖ Landeshauptstadt St. Pölten zutreffend.

In diesem Zusammenhang sei auch auf die Gegensätze und das Spannungsfeld zwischen dem inhaltlich postulierten Begriff der ‘Stadtregion’ und der tatsächlich aufgrund der Kriterienwahl statistisch ausgewiesenen ‘Stadtregion’ des Österreichischen Statistischen Zentralamtes hingewiesen, wobei die Deckungskonformität im Kernbereich am zufriedenstellendsten ausfiel, hingegen zeigten sich bei der Außenzone aufgrund eines einzigen Indikators der Berufpendeltätigkeit stärkere Diskonformitäten.

3.3 Die ÖSTAT-Methode (Version 1991)

Das Konzept der ‘Stadtregionen 1991’ des Österreichischen Statistischen Zentralamtes hält generell am Gravitationsmodell fest, wobei eine Neudefinition von Kernräumen als hochverdichtete Pole (mit einer Wohn- und Arbeitsbevölkerungsdichte von 1.000 und mehr / km² Dauersiedlungsraum oder mindestens 200 / ha Gebäudefläche im potentiellen Kernraum einer österreichischen Stadtregion) oder miteinander agglomerierten Städten den Schweizer Agglomerationen bzw. den deutschen Verdichtungsräumen näher kommt als früher. Österreich weist - ähnlich wie die Schweiz - wesentlich kleinere Agglomerationen als Großstaaten aus, eine international vergleichbare Mindestgröße für österreichische Stadtregionen wurde nicht adaptiert, da in erster Linie eine interne österreichweite Vergleichbarkeit angestrebt wurde.

Dem Stadtregionskonzept von 1991 des Österreichischen Statistischen Zentralamtes liegen die auf Gebäudeebene morphologisch abgegrenzten Siedlungseinheiten von 1996 zugrunde, wobei – in Anlehnung an die N.U.R.E.C.-Methode – Freiflächen mit einer maximalen Erstreckung von 200 m inkludiert wurden. Die Herabsetzung der Siedlungseinheiten auf 501 Einwohner (gegenüber 2.000 für 1971 und 1981) wies eine wesentlich größere Zahl (1.360) von Siedlungseinheiten aus. Die Überleitung von den Siedlungseinheiten zur Gemeindeebene (viele zur Abgrenzung nötige Indikatoren liegen nur auf diesem räumlichen Niveau vor) erfolgte unter Anwendung des folgenden Regelwerkes:

- Zusammenfassung aller Gemeinden, die von einer städtischen Siedlungseinheit zu mehr als 50 % der Einwohner oder mit mindestens 500 Einwohnern betroffen sind.
- Zusammenfassung der diversen Siedlungseinheiten zugehörigen Gemeinden.
- Gemeinden wurden im Falle der Ausdehnung von diversen Siedlungseinheiten ausschließlich der dominierenden Siedlungseinheit zuerkannt oder keiner, wenn die 50 % Marke der Gemeindebevölkerung außerhalb der vorhandenen Siedlungseinheit lag.

In aufbauenden Bearbeitungsstufen wurden weitere Kriterien zur Identifikation von Kernräumen der Stadtregionen festgesetzt:

- Als städtisch gilt eine Siedlungseinheit mit maximal 6 % Agrarquote der wohnhaften Berufstätigen.
- Bei der Größe der in Betracht zu ziehenden Regionspole wird eine Untergrenze von 5.000 Einwohnern angenommen.
- Ausschließlich die im Inland Berufstätigen bzw. Beschäftigten bilden die Bezugsbasis für alle arbeitsortrelevanten Indikatoren.
- Bei der Vereinigung dicht beisammenliegender Siedlungseinheiten sind maximal 400 bis 600 m, je nach Morphologie der Landschaft bzw. Besiedelung, zulässig.
- Der gegenseitige Pendlerverflechtungsindex (PVI) auf Gemeindeebene basiert 1991 ausschließtlich auf ein Inlandskonzept und musste mindestens 35 Indexpunkte aufweisen.
- Die Kriterien von mindestens 10.000 Einwohner oder mindestens 5.000 nichtlandwirtschaftlich Berufstätige in den städtischen Siedlungseinheiten des Kernraumes wurden beibehalten.

Zur Herausprägung der Außenzone wurde – wie schon in diesem Artikel kritisiert – ein einziger Indikator auch für 1991 festgelegt. Der Prozentsatz der 'kernraumorientieren Tagespendler" an den wohnhaften inländischen Berufstätigen wurde auf mindestens 30 % (1981: 25 %) angehoben.

Zusammenfassend wurde nach der ÖSTAT-Methode von 1991 in Österreich 39 Stadtregionen zweizonig ausgewiesen, wobei eine Untergliederung in 16 kleinstädtische Kernräume (unter 25.000 Einwohner), 16 mittelstädtische mit Einwohnerzahlen zwischen 26.000 und 73.000 sowie 6 Kernräume der großen Landeshauptstädte (von 99.000 bis 294.000 Einwohnern) und in die Metropolitan Area Wien (mit einem Kernraum von 1.795.000 Einwohnern) vorgenommen wurde. 1991 lebten 65,8 % der österreichischen Bevölkerung [das sind lt. Volkszählung 1991 5.128.422 Einwohner] in Stadtregionen auf 27 % der österreichischen Gesamtkatasterfläche. Die Gewinner von 1981 bis 1991 waren die großen Landeshauptstadtregionen und die identifizierten Außenzonen, wobei die Metropolitanregion Wien eine Sonderstellung einnimmt. Die positivsten Entwicklungstrends wurden in den westlichen Bundesländern festgestellt, allen voran die Stadtregion Feldkirch mit einem Plus von 9,4 Punkte. Hingegen mussten die obersteirischen Stadtregionen in der Mur-Mürz-Furche und Altindustriegebiete merkliche Rangverluste aufgrund sinkender Einwohnerzahlen hinsichtlich der Reihung innerhalb der österreichischen Stadtregionen hinnehmen.

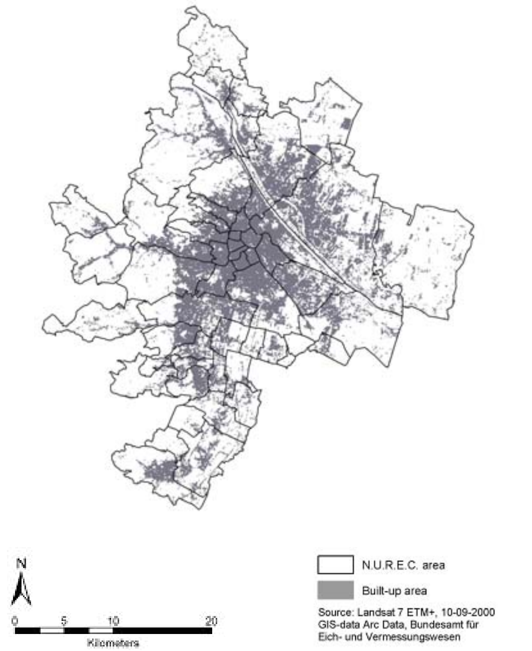
4 ERFAHRUNGSWERTE IM RAHMEN DES EU-FORSCHUNGSPROJEKTS COMET FÜR DIE AGGLOMERATION WIEN

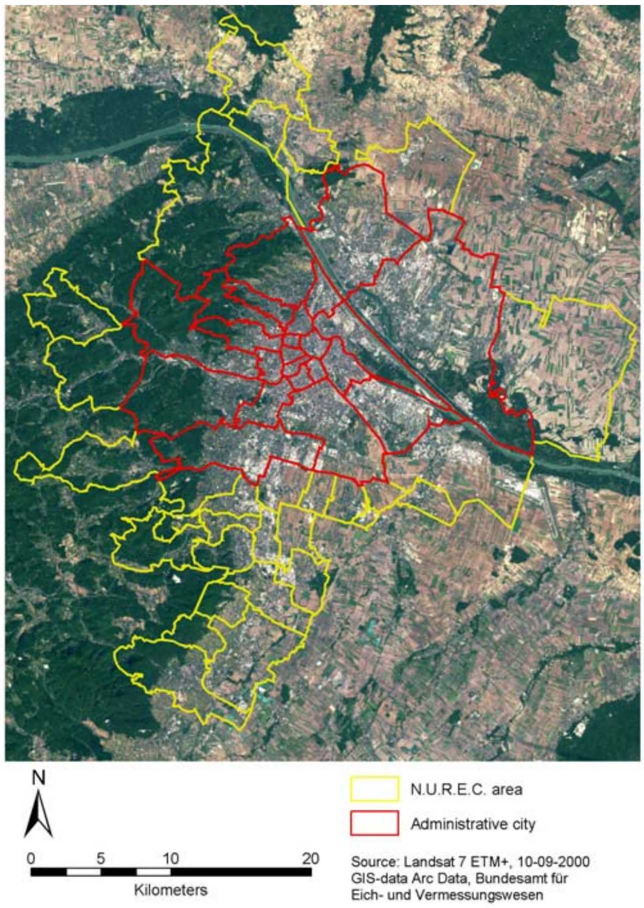
Das EU-Forschungsprojekt COMET verwendet für die Agglomerationsraumabgrenzung die morphologische Methode nach N.U.R.E.C. Durch die Wahl der N.U.R.E.C.-Methode haben sich für COMET folgende wesentliche Vorteile ergeben:

- internationale Vergleichbarkeit der Abgrenzungen
- Einfache und zeitsparende Abgrenzungsmöglichkeit mittels Fernerkundung

Bedingt durch die anspruchsvollen Projektfragestellungen werden als administrative Basiseinheiten Gemeinden / Stadtbezirke und Zählsprengel verwendet. Aufgrund des späteren Beitritts Österreichs (gemeinsam mit Finnland und Schweden) zur Europäischen Union im Jahr 1995, mußte die Agglomeration Wien neu abgegrenzt werden. Weiters wurde im Rahmen von COMET die Abgrenzungen der Partnerstädte Amsterdam, Barcelona, Berlin, Kopenhagen und Strassburg aktualisiert und die N.U.R.E.C.-Abgrenzung von Wien durch die Erweiterungszone des ‚Urban Fringe' neu implementiert.

Basierend auf der Landsat 7 ETM+ Satelittenbildaufnahme vom 10.9.2000 (gemischtes panchromatisches und multispektrales Bild) für die Agglomeration Wien, wurde automationsunterstützt die CBU ermittelt. Zusätzlich wurde das Ergebnis mittels zusätzlicher ÖK25V Karten und der Ortskenntnis der Bearbeiter kontrolliert und vertieft. Die N.U.R.E.C.-Abgrenzung für Wien wurde unter der Projektleitung von Michaela Paal und der Bearbeitung durch Stefan Leichtfried im Rahmen des Projekts ‚Wien im 3. Jahrtausend' 2001 durchgeführt.

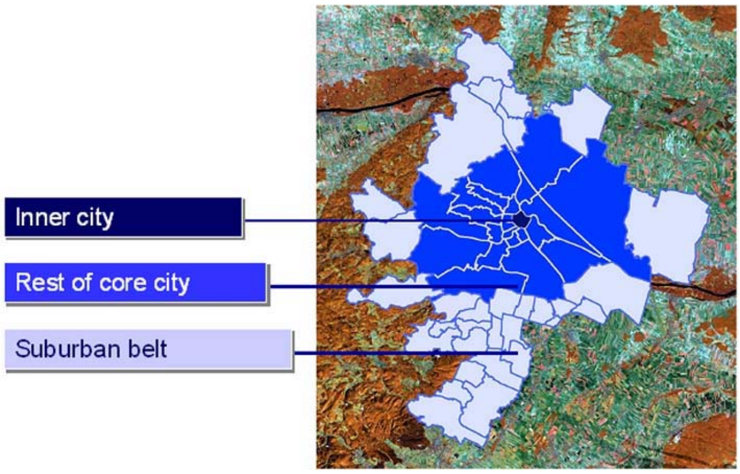




Oben: Abb. 4: Automatisierte Klassifizierung des ‚geschlossenen verbauten Gebietes 2000 (Paal M., Leichtfried., 2001)

Rechts: Abb. 5: Agglomeration Wien nach der N.U.R.E.C.-Methode 2000 (Paal M., Leichtfried S., 2001)

Die N.U.R.E.C.-Abgrenzung der Stadtregion Wien wurde weiters in drei verschiedene räumliche Bereiche untergliedert (siehe nachfolgende Abbildung), wobei die Inner-City (1. Wiener Gemeindebezirk) durch den Lokationsquotienten im Finanzdienstleistungsbereich 1991 festgelegt wurde. Das Ergebnis der Untersuchung mit Daten von 1991 wird nach Vorliegen der Volks- und Arbeitszählungsergebnisse für 2001 überprüft.



Lokationsquotient im Finanzdienstleistungsbereich

$$LQ_{it} = \left(\frac{B_{it}^{a} / B_{t}^{a}}{\sum_{n}^{a=1} B_{it}^{a} / \sum_{n}^{a=1} B_{t}^{a}} \right) * 100$$

B	Beschäftigte
i	Wirtschaftsbereich
t	Beobachtungszeitpunkt
$a=1..n$	Untersuchungseinheiten

Abb. 6: Räumliche Differenzierung der Agglomeration Wien

Zusätzlich zu den obigen Raumeinheiten der N.U.R.E.C.-Agglomeration wurde der ‚Urban Fringe' für die Untersuchung von Entwicklungen der suburbanen Außenzone abgegrenzt. Dieser umfasst die Gemeinden innerhalb eines Abstandes von 10 km von der N.U.R.E.C. Grenze, sofern 50 % der Gemeindebevölkerung oder 50 % des Gemeindegebietes innerhalb dieser Distanz liegen.

Beim Vergleich des Kernraumes nach der ÖSTAT Methode (Version 1991) mit dem Agglomerationsgebiet aufgrund der N.U.R.E.C.-Methode (das wiederum untergliedert ist in: Inner City', ‚Rest of the Core City', Suburban Belt') für Wien ist das übereinstimmende Ergebnis der unterschiedlichen Abgrenzungszugänge auffallend und überzeugend.

Die markanten Unterschiede beim Vergleich des Kernraumes lt. Statistik Austria (Version 1991) und des Agglomerationsgebietes unter Anwendung der N.U.R.E.C.-Methode ergeben sich im südwestlichen Bereich der Agglomeration Wien: Die westlichen Wienerwaldgemeinden Tullnerbach und Pressbaum, die südwestliche Kommune Kaltenleutgeben und die südlich liegenden

Gemeinden Bad Vöslaum, Kottingbrunn, Leobendorf und Sooß wurden lt. Statistik Austria ebenfalls zum Kernraum der Agglomeration Wien gezählt.

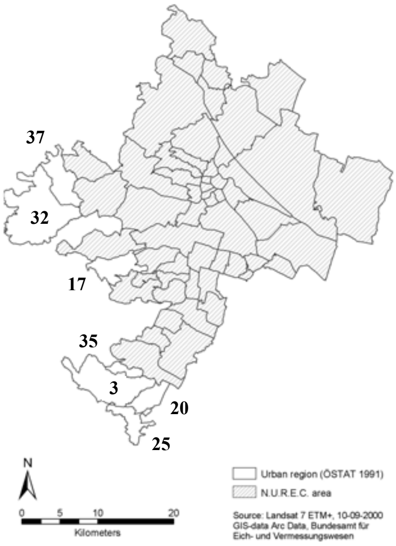


Abb.7: Vergleich des Kernraumes lt. Statistik Austria 1991 mit jenem nach der N.U.R.E.C.-Methode für die Stadtregion Wien 2000.

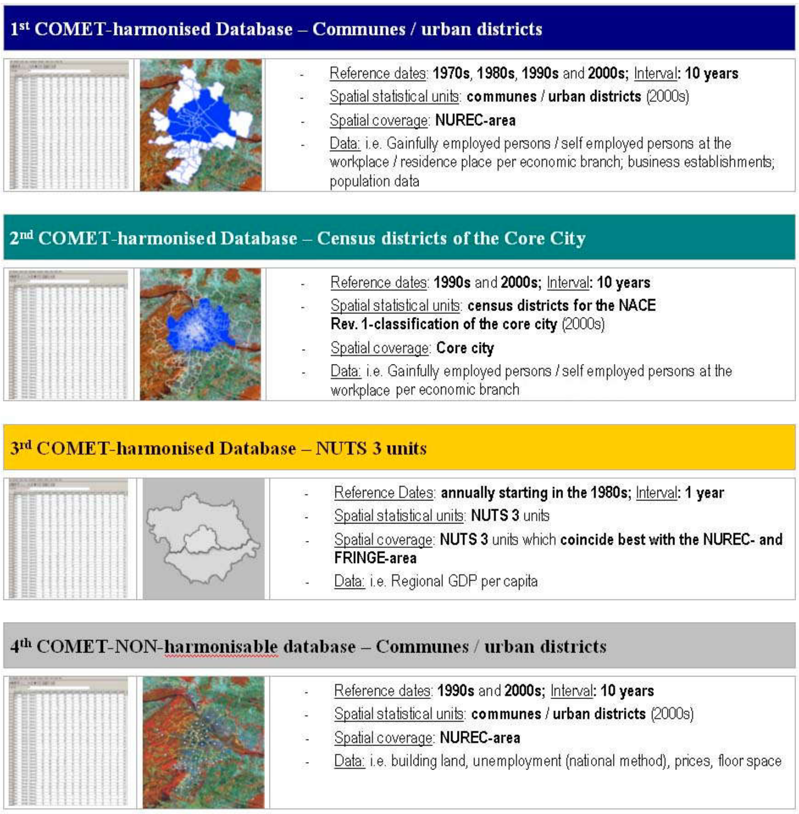
	Kernraum nach Statistik Austria 1971	1981	1991	N.U.R.E.C. 2000
1 Wien	■	■	■	■
2 Baden	■	■	■	■
3 Bad Vöslau			■	
4 Biedermannsdorf			■	■
5 Bisamberg	■	■	■	■
6 Breitenfurt bei Wien	■	■	■	■
7 Brunn am Gebirge	■	■	■	■
8 Deutsch-Wagram		■		
9 Gablitz	■	■	■	■
10 Gerasdorf bei Wien[1]	■	■	■	■
11 Gießhübl	■	■	■	■
12 Groß-Enzersdorf[2]	■	■	■	■
13 Gumpoldskirchen	■	■	■	■
14 Guntramsdorf	■	■	■	■
15 Hennersdorf	■	■	■	■
16 Hinterbrühl[3]	■	■	■	■
17 Kaltenleutgeben	■	■	■	
18 Klosterneuburg	■	■	■	■
19 Korneuburg	■	■	■	■
20 Kottingbrunn			■	

[1] Eingemeindet: Seyring (1.1.1972)
[2] Eingemeindet: Franzensdorf, Mühlleiten, Probstdorf, Schönau a.d. D., Wittau (1.1.1972)
[3] Eingemeindet: Sparbach, Weißenbach/Mödling: 1.1.1972

	Kernraum nach Statistik Austria 1971	1981	1991	N.U.R.E.C. 2000
21 Langenzersdorf	■	■	■	■
22 Lanzendorf			■	■
23 Laxenburg			■	■
24 Leobendorf[4]			■	■
25 Leobersdorf			■	
26 Leopoldsdorf			■	■
27 Maria Enzersdorf	■	■	■	■
28 Maria-Lanzendorf			■	■
29 Mödling	■	■	■	■
30 Perchtoldsdorf	■	■	■	■
31 Pfaffstätten	■	■	■	■
32 Pressbaum		■	■	
33 Purkersdorf	■	■	■	■
34 Schwechat	■	■	■	■
35 Sooß			■	
36 Traiskirchen[5]	■	■	■	■
37 Tullnerbach		■	■	
38 Vösendorf	■	■	■	■
39 Wiener Neudorf	■	■	■	■
40 Zwölfaxing	■	■	■	■

[4] Eingemeindet: Oberrohrbach, Tresdorf: 1.1.1972
[5] Eingemeindet: Oeyenhausen, Tribuswinkel: 1.1.1972

Tab.1: Vergleich der Gemeinden des Statistik Austria Kernraumes mit jenen nach der N.U.R.E.C.-Methode für die Stadtregion Wien 1971-1991, 2000 (Fuchs I., 1983, S. 11; Fuchs I., 1986, S. 431; Statistik Austria, 2000; Paal M., Leichtfried S., 2001, S. 91; Österr. Stat. Zentralamt, 1982, S. 12-22).



Die mittels der N.U.R.E.C. Methode für die Agglomeration Wien abgegrenzten Gemeinden / Stadtbezirke, Wiener Zählsprengel und NUTS 3 Regionen werden mit drei international harmonisierten Datenbanken verknüpft, welche eine vergleichende Stadtforschung mittels statistischer Analysen in Bezug auf die Thematik (Wirtschaft, Beschäftigung, Bevölkerung), räumliche und zeitliche Entwicklung erlauben. Die vierte Datenbank beinhaltet international nicht harmonisierte Daten (z. B. Flächennutzungen, Arbeitslosigkeit, Geschossflächen, Preise für Mieten, Pendler), welche einerseits maßgeblich bzw. für die individuelle Untersuchung der Agglomeration Wien notwendig sind (siehe nebenstehende Abbildung).

Durch die aufgebauten Datenbanken und der internationalen Harmonisierungsvorgänge bis in die 1970er Jahre ist es somit erstmals mit den Projektergebnissen von COMET möglich, detaillierte und international vergleichbare Strukturanalysen auf Gemeinde / Stadtbezirks- bzw. Zählsprengelniveau durchzuführen.

Abb.8: Wissenschaftliches Konzept der COMET Datenbanken (Pöckl A., Hagspiel E., Paal M., 2003)

5 FAZIT

Die gewählte N.U.R.E.C.-Methode zur Agglomerationsraumabgrenzung im Rahmen des EU-Forschungsprojektes COMET erweist sich generell gegenüber dem Ansatz der Functional Urban Regions als wesentlich praktikabler, zumal die nötigen Indikatoren, die zur Abgrenzung der FURs auf europäischem Niveau notwendig wären, nicht verfügbar bzw. nicht harmonisierbar sind. Ein zusätzliches Argument ist sicherlich auch die einheitliche, einfachere und zeitsparende Vorgangsweise bei der Anwendung der N.U.R.E.C.-Methode. Vergleicht man nun konkret für die Agglomeration Wien das Ergebnis der N.U.R.E.C.-Agglomerations-raumabgrenzung auf Basis eines Satellitenbildes aus dem Jahr 2000 mit der Statdregionsabgrenzung der Statistik Austria, Version 1991, so fällt auf, dass durch die N.U.R.E.C.-Methode im wesentlichen der Kernraum einer Stadtregion identifiziert werden kann. Die beiden Methoden kommen fast zu deckungsidentischen Ergebnissen, wobei lt. Statistik Austria 1991 etwas mehr niederösterreichische Wiener Umlandgemeinden im Westen und Südwesten zum Kernraum der Agglomeration Wien gezählt werden.

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Die Erweiterung des öffentlichen Raumes in virtuelle Welten

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1 EINLEITUNG

Die vorliegende Arbeit geht von der Annahme aus, dass öffentlicher Raum und virtuelle Welt in Beziehung zueinander diskutiert werden sollen. Hierbei möchte ich erst erläutern, wie ich den Begriff der virtuellen Welt verwende, um im Weiteren kurz abzuhandeln, inwieweit Konzeptionen des öffentlichen Raumes für die Diskussion von Interesse sind. Schließlich soll unter Bezugnahme auf den Theoretiker des Game Design und Mitentwickler des ersten MUD, Richard A. Bartle, auf die Bedeutung einer Auseinandersetzung mit virtuellen Welten hingeführt werden, um abschließend einen Fragenkatalog zu formulieren und damit einen Ausblick auf Zukünftiges zu skizzieren. Bei all dem spreche ich als Game Designer mit Interesse für soziokulturelle Fragestellungen.

2 VIRTUELLE WELT

Der Begriff „virtuelle Welt" wird in diesem Text wie folgt verwendet:

Ein Server, der über das Internet zugänglich ist, speichert den aktuellen Status einer erfundenen Welt. Wie sieht diese Welt aus, wo sind Berge, Städte, Häuser, Flüsse, Höhlen, Wolken oder Lebewesen? Wann ist wo Nacht, Sommer oder Regen? Jeder, der über einen Internetzugang und die entsprechende Clientsoftware verfügt, kann diese Welt besuchen. Er sieht diese in einer dreidimensionalen Darstellung auf seinem Bildschirm, aus der Position, in der er sich virtuell in der Online-Welt befindet. Diese Welt muss außerdem folgende Eigenschaften aufweisen[1]:

Es gibt Regeln, die es dem Besucher gestatten, auf die Welt Einfluss zu nehmen, wenn auch nicht unbedingt auf diese Regeln selbst: Eine Art von Physik, die der Besucher verstehen kann.

Die Besucher werden in dieser Welt als Individuen repräsentiert. Diese Repräsentation ist ihr *character*. Die Besucher identifizieren sich mit diesem.

Die Interaktion mit der Welt geschieht in Echtzeit. Das heißt, wenn der Besucher auf die Welt Einfluss ausübt, sieht er die durch ihn ausgelöste Veränderung sofort.

Die Welt ist für mehrere Besucher, die sich auch gegenseitig erkennen können, zugleich zugänglich.

Aktuell werden solche virtuelle Welten „MMORPGs"[2] genannt. Virtuelle Welten haben ihre Ursprünge in den *paper-and-pencil*-Rollenspielen wie AD&D[3] oder „Das schwarze Auge". Studenten haben Ende der 70er Jahre damit begonnen, solche Spiele über das Internet mittels textbasierter Clients spielbar zu machen und vor allem den Spielleiter durch ein Computerprogramm zu ersetzen. Nach wie vor laufen hunderte solcher MUDs[4] im Internet und sind weit davon entfernt, wegen Spielermangels auszusterben. Seit Ende der 90er Jahre gibt es bedeutende graphische dreidimensionale virtuelle Welten. Den Durchbruch schaffte „Ultima Online" 1997. Die Firma OSI, die „Ultima Online" produziert hat, verdiente zwölf Millionen Dollar pro Jahr. Diese virtuelle Welt ist nach wie vor aktiv. Mittlerweile sind so viele Menschen Bewohner von virtuellen Welten, wie kleine Staaten Einwohner haben. Der Umsatz, der in der Computerspielbranche global generiert wird, übersteigt bei weitem den der weltweiten Filmwirtschaft.


Abbildung 19: Screenshot aus "Ultima Online"

Virtuelle Welten haben ihren Ursprung in der Spielebranche, daher werden im Folgenden die Besucher virtueller Welten auch Spieler genannt. Eine virtuelle Welt aber auf bloße Unterhaltung zu reduzieren, heißt, sie noch nicht selbst bereist zu haben.

3 ÖFFENTLICHER RAUM

Öffentlicher Raum ist das „Produkt der Häuser", wobei der Freiraum zwischen diesen zum öffentlichen Raum wird[5]. Als öffentlicher Raum gilt weiter die „[v]on Bebauung freie Fläche, [...] [die] vor allem naturräumlich und kulturräumlich [gestaltet wird]"[6],

[1]Vgl.: Bartle, Richard A.: Designing Virtual Worlds. Indianapolis. 2003 (=New Riders Publishing)., S. 3f

[2]*MMORPGs: Massively-Multiplayer Online Role-Playing Games*

[3]*AD&D: Advanced Dungeons & Dragons*

[4]*MUDs: Multi User Dungeons*

[5]Vgl.: Schubert, Herbert: Urbaner öffentlicher Raum und Verhaltensregulierung. In: disp 136/137. Zürich. 1999., S. 17

[6]Vgl.: Schubert. 1999., S. 17

außerdem die Fläche, die allen zugänglich ist - jene Orte, an denen „Bewegung, Begegnung, Belebung“ durch Präsenz von Menschen zufällig und bewusst stattfinden kann – ohne vorherige Auswahl der Anwesenden[7].

Der öffentliche Raum soll den Menschen Begegnung ermöglichen, ohne sich dabei unsicher zu fühlen. Im öffentlichen Raum werden Verhaltensweisen ritualisiert, die deutlich von Verhaltensformen der Privatsphäre unterschieden werden können. Nach den Regeln des Anstands wird die persönliche Fassade aufrecht erhalten, die im Bereich des Privaten, der „Hinterbühne“ (vgl. Goffman) abgelegt werden kann. Im Verlauf der Zivilisierung ersetzen individuelle Verhaltenszwänge raumabhängige und sozialräumlich gefasste Fremdzwänge.[8] „In der Folge verringert sich die Abhängigkeit des einzelnen Menschen von den lokalen Beziehungsnetzwerken. Dies führt: (a) zu einer reduzierten Raumbindung der Individuen, denn sie sind weniger auf einzelne Räume, sondern mehr auf einen größeren räumlichen Radius ausgerichtet; (b) zu geringeren Kontrasten zwischen öffentlichen Räumen, weil sich die Gestalten des öffentlichen Raums vereinheitlichten; und (c) zu einer Psychologisierung der öffentlichen Räume, weil sie Merkmale der menschlichen Individualisierung aufnehmen. Öffentliche Funktionen werden in Innenräume verlagert (Shopping Malls, Passagen,...)“[9]

Der soziale Raum nach Pierre Bourdieu ist kein physikalischer Raum. Als gedachter Raum mehrerer Individuen, die soziale Lage, Milieu und Habitus miteinander teilen und sich innerhalb dieses gedachten Raums positionieren (dort ihre Identität finden), scheint diese Konzeption auf die Praxis virtueller Räume anwendbar.[10] Der soziale Raum ist ein Raum von Unterschieden, in dem Klassen virtuell existieren. Alle Gesellschaften sind also soziale Räume, d.h. Strukturen von Unterschieden.[11]

4 VIRTUELLE WELTEN ALS ÖFFENTLICHER RAUM

Die Menschen haben längst begonnen, den öffentlichen Raum in virtuelle Welten auszudehnen. Bereits 1997 war die virtuelle Welt „Lineage“ in Korea ein großer Erfolg. Die meisten Spieler steigen dort nicht von zu Hause aus in die virtuelle Welt ein, sondern machen die gemeinsame Online-Erfahrung in einem der vielen Internet-Cafés. Korea ist auch der erste Staat, der 2002 ein Verbot einführt: Das Spiel „PKing“ darf erst ab einem Alter von achtzehn Jahren gespielt werden, weil es mit Selbstmorden, Gewalt und Prostitution im wirklichen Leben in Verbindung gebracht wird.[12] Im März 1999 nennen ca. 12.000 Leute „Norrath“[13] ihr dauerhaftes Zuhause, 60.000 sind permanent anwesend. Die Einwohner verdienen durchschnittlich USD 3,42 pro Stunde, und die Arbeit der Menschen produziert ein BSP pro Einwohner, das zwischen dem von Russland und Bulgarien liegt. Die Währung „Norraths“ wird mit USD 0,0107 gehandelt.[14] Auch virtuelle Gegenstände werden gegen reales Geld verkauft. 2001 wechselt eine besonders widerstandsfähige virtuelle Rüstung für EUR 3000 ihren Besitzer.[15]

Ein weithin bekanntes Bild: Ein siebzehnjähriger Jugendlicher sitzt verwahrlost in seinem Dachbodenzimmer und verbringt seit Stunden und Tagen seine Zeit vor dem Computer. Er ist kaum ansprechbar, sozial vereinsamt und findet sich im wirklichen Leben immer weniger zurecht. Offensichtlich gibt es Menschen, die viel Zeit in virtuellen Welten verbringen, es scheint aber kaum untersucht, wie weit diese Menschen auf Bedürfnisse verzichten, die virtuell nicht befriedigt werden können: sozialer Kontakt mit Menschen über eine Fülle von Kommunikationskanälen (Geruch, Gestik, Mimik, Artikulation), Essen, körperliche Betätigung, gegenseitige Berührung, Naturerlebnis usw.

Während Bewohner virtueller Welten “online” sind, gibt es zwei Möglichkeiten für ihren Aufenthaltsort: entweder in ihrem Zimmer oder unterwegs in fremden Welten.

4.1 Eintauchen in virtuelle Welten (Levels of Immersion)[16]

Abbildung 20: Artwork aus "Dark & Light"

Mit dem Begriff der *immersion* wird der Eindruck eines Besuchers umschrieben, sich in der virtuellen Welt zu befinden. Spieler können dieses Gefühl sehr verschieden intensiv erleben, das hängt vom Spiel, von der Persönlichkeit und vor allem von der Dauer ab, in der sie sich in der Welt befinden. Bartle unterscheidet hier vier unterschiedliche Stufen der *immersion,* nämlich *player, avatar, character* und *persona*.

Zu Beginn interagieren die Spieler mit einer Welt, sie kontrollieren ein Objekt mit einem Namen und dieses Hilfsmittel sieht aus wie eine Spielfigur. Den meisten Spieler fällt es leicht, dieses Objekt als ihren Repräsentanten

[7]Vgl.: Ergebnisse des Arbeitsgruppenabend Stadtentwicklungskonzept Stuttgart. Arbeitsgruppe: Öffentlicher Raum und Kultur. 2.5.2003., auf: http://www.stadtplanungsforum.de/ergebnis-ag-stek-oer-k-13-05-03.doc (25.11.2003)

[8]Vgl.: Schubert. 1999., S. 18

[9]Schubert. 1999., S. 18

[10]Vgl.: Bourdieu, Pierre: Sozialer Raum und Klassenhabitus. Auf: http://onclick.org/homesite/Habitus.html (17.12.2003)

[11]Vgl.: Schürz, Martin: Feine Unterschiede der Kapitalarten bei P.Bourdieu. Auf: http://www.beigewum.at/schuerz.html (17.12.2003)

[12]Bartle. 2003., S. 20 und S. 620

[13]*Norrath: Name der Welt von “EverQuest”*

[14]Vgl.: Castronova, Edward: Virtual worlds: A first-hand account of market and society on the cyberian frontier. Auf: http://papers.ssrn.com/abstract=294828 (19.7.2003)

[15]Vgl.: Mueller, Dietmar: Handel mit Game-Levels ärgert Spielehersteller. Auf: http://www.zdnet.de/news/software/0,39023144,2123379,00.htm (29.11.2002)

[16]Bartle. 2003., S 154ff

anzuerkennen. Sie sprechen in der dritten Person von dieser Figur, dem *avatar*. Wenn Spieler ihre Spielfigur wie selbstverständlich als Erweiterung ihres eigenen Selbst erleben, spricht Bartle vom *character level*. Als *persona* definiert Bartle Spieler, die sich in der virtuellen Welt befinden. Sie spielen keine Figur in einer Welt, sie sind eine Figur in einer Welt. Wenn sie in einem Kampf sterben, fühlen sie nicht, dass ihre Figur gestorben ist, sondern, dass sie gestorben sind. Es gibt keine Abstraktion, keine Filter, keine Fragen: sie sind dort.

> It's about identity. When player and character merge to become a persona, that's immersion; that's what people get from virtual worlds that they can't get from anywhere else; that's when they stop playing the world and start living it.[17]

4.2 Identitätsfindung

Alles dreht sich in virtuellen Welten um das Spiel mit der eigenen Identität, darum, sie neu auszuformen oder zu stärken. Die Identität entsteht im sozialen Wechselspiel mit der Umgebung. In realen öffentlichen Räumen sind die Spielräume auf wenige Tage im Jahr begrenzt. In der Zeit des Karnevals wird die gegebene soziale Ordnung ins Gegenteil verkehrt, wird der Würdenträger zum Gespött des Volks und der Sklave zum Karnevalskönig. Das Heilige wird profan, die Unterschiede zwischen Reich und Arm, Jung und Alt sind aufgehoben. Mit dem Ende des Karnevals geht die alte soziale Ordnung neu gestärkt hervor (vgl. Michail Bachtin).

Das „[...] Schweigen ist zu einem Schutzwall der individuellen Privatheit geworden [...]. Die Begegnung im urbanen öffentlichen Raum wird von weitgehender Ignoranz geprägt, als ob Menschen, die sich im öffentlichen Raum begegnen, allein dort wären bzw. der oder die jeweilig andere nicht existent wäre“[18]. In virtuellen Welten wählt jeder Besucher gefahrlos eine Rolle, die er in dieser Welt spielen möchte. Die Kommunikation zwischen den Individuen wird vom Spiel forciert, so ist es fast in allen Welten einfacher, innerhalb Gruppen seine soziale Stellung in dieser Welt zu verbessern (oft den „Level“ des *characters* zu erhöhen). Nach Bourdieu ist es nur Individuen desselben sozialen Raumes möglich, miteinander zu kommunizieren. In virtuellen Welten gibt es meist Chat-Kanäle für Spieler mit ähnlich hohem Level; mit anderen kann man nur kommunizieren, wenn sie am selben Ort, in einer geschäftlichen Beziehung zueinander stehen oder einem gemeinsamen politischen Verbund angehören. Es ist durchaus möglich, mehrere Charaktere in einer Welt leben zu lassen, Spieler können zugleich eine kämpfende Frau und einen vergeistigten älteren Weisen spielen, je nach Lust und Laune. Alle diese Versuche und verschiedenen Charaktere können früher oder später ermöglichen, in das Spiel einzutauchen, mit einer der Figuren zu verschmelzen. Trotzdem wird ein bislang introvertierter Spieler nicht plötzlich feststellen, dass er im Verlauf des Spiels zum extrovertierten Redelsführer geworden ist, außer, er hat diesen Teil seiner Veranlagung bisher unterdrückt.[19]

Ausgrenzung aufgrund sozialer, ethnischer, kultureller, geschlechtlicher oder auch körperlicher Unterschiede ist weitgehend unmöglich. Als Barrieren gelten aber weiterhin Sprachgrenzen, starke Bildungsdifferenzen oder die fehlenden finanziellen Notwendigkeiten, um virtuelle Welten besuchen zu können. Kultur, Ethnie, Identität sind vom Menschen erdachte Konstruktionen. Die Identität trennt das Eigene vom Fremden, aber verbindet das Ich mit dem Wir. Jeder Mensch hat viele Identitäten.[20]

4.3 Mangel an öffentlichem Raum

„Es gibt heute kaum noch Raumzonen, die jedem zugänglich und die in ihrer Nutzung offen sind, Räume also, die den Namen Spielraum (im doppelten Sinne von "Raum zum Spielen" und "Freiheit zum Handeln") verdienen. [...] Selbst bei Stadtplanungen bzw. Stadtsanierungen, bei denen genügend Raum verfügbar ist, sind die Planer geneigt, jeder Raumzone eindeutige Funktionen zuzuweisen. Dies wird dadurch verstärkt, daß die ökonomische Nutzung von Räumen (etwa für intensiven Wohnungsbau, attraktive Gewerbeflächen und den Verkehr) dominiert. Eine sozialökologische Denkweise fällt im Alltag der Stadtplanung unter den Tisch. [...] Der Verkehrswert einer Baulücke in der Stadt ist so hoch, daß über den Nutzungswert (etwa als Kinderspielplatz) gar nicht mehr nachgedacht wird. [...] Kinderspiele erscheinen aus solcher Sicht nutzlos, aber kostenintensiv.“[21]

Abbildung 21: Screenshot aus "Dark & Light"

Virtueller Raum ist unbegrenzt verfügbar.

4.4 Politischer Zweck des öffentlichen Raumes

Eine Eigenheit des öffentlichen Raumes ist, dass im politischen Prozess über dessen Nutzung entschieden wird. Virtuelle Räume sind meist in privatem Besitz und ihre Nutzung im Sinne des Besitzers ist nur demjenigen erlaubt, der dafür bezahlt (~EUR 10/Monat). Manche virtuelle Welten bieten jedoch weitreichende politische Betätigungsfelder. Einzelne Spieler können Herrscher über große virtuelle Gebiete werden oder sich mit anderen Spielern für die Erreichung verschiedener Ziele zu Gilden zusammenschließen. Virtuelle Welten bieten sich für die Erprobung verschiedener politischer Konzepte und neuer Herrschaftsformen an. Wer eine Diktatur in einer virtuellen Welt erlebt hat, hat sie dort wahrscheinlich auch schon einmal bekämpft. Es finden sich auch ohne das

[17] Bartle. 2003., S 156

[18] Sennet in: Schubert. 1999., S. 19

[19] Bartle. 2003., S 159ff

[20] Katschnig-Fasch, Elisabeth: Vortragsreihe am Kulturanthropologischen Institut der Universität Graz. WS 2003/'04

[21] O.A.: Bewegung und Raum. Anthropologische Überlegungen. Auf: http://www.rrz.uni-hamburg.de/forum/bur.html (16.12.2003)

Zutun der Programmierer schnell Mittel und Wege der politischen Betätigung, wo viele Menschen aufeinander treffen, um einen gemeinsamen Ort möglichst lebenswert zu gestalten.

5 EINE “OPTIMALE” VIRTUELLE WELT

5.1 Kritische Masse

Für jede virtuelle Welt gibt es eine spezifische Anzahl an Spielern, die notwendig ist, damit die Welt funktioniert. Das Nicht-Erreichen dieser kritischen Masse ist mit Abstand die häufigste Ursache für das Scheitern einer Welt. Virtuelle Welten können noch so spannend und ausgeklügelt konstruiert und gestaltet sein, sie erscheinen öd und leer, wenn sie nicht von Spielern bevölkert sind. Neue Besucher verlassen schnell eine Welt, wenn sie nicht gleich nach dem Einloggen auf Mitspieler treffen. Es wird dadurch auch das Vertrauen in die Welt gefestigt: wo viele Menschen sind, kann es nicht so schlecht sein. Je kleiner eine Welt, desto kleiner auch die kritische Masse. Als Faustregel ließe sich anwenden, dass an einem stark frequentierten Ort, wie einer wichtigen Stadt oder einem Einstiegspunkt, immer mindestens zwei andere Spieler sichtbar sein sollten.

Das Wissen um das Problem der kritischen Masse macht die Durchführung eines sogenannten „Betatests“ als Teil der Entwicklung von Online-Spielen notwendig. Um von dem Moment an, in dem eine Spielwelt *online* geht, genügend Spieler in dieser Welt zu haben, werden von den Spieleherstellern vor dem offiziellen Start monatelange Testphasen eingeplant, in denen freiwillige Spieler kostenlos die Welt erproben können. Neben dem wertvollen Feedback dieser Testspieler liegt der größte Vorteil darin, dass die meisten Betatestspieler auch nach dem *release* in der Welt bleiben, weil sie dort ihren Wissensvorsprung einsetzen können.

Selbstverständlich müssen auch die Marketingkosten dementsprechend hoch kalkuliert werden, dass eine genügend große Spielergemeinschaft zustande kommt. Es ist davon auszugehen, dass hierfür mindestens soviel Kapital notwendig ist, wie für die Produktion der virtuellen Welt.

Eine weitere Möglichkeit, die kritische Masse an Spielern zu erreichen, ist es, die Welt für *casual gamer* genauso wie für *hardcore gamer* anzulegen. Das hieße allerdings, zwei sehr unterschiedliche Spielertypen miteinander zu verbinden.

5.2 Narratives Potential

Es ist möglich, Computerspiele in zwei Gruppen zu unterscheiden:

Spiele, die einem mehr oder weniger geradlinigen narrativen Handlungsstrang folgen. Ihnen sind eine oder auch mehrere Geschichten im vorhinein eingeschrieben, die der Spieler miterlebt. Als extreme Ausformung dieser Richtung könnten interaktive Spielfime gelten. Das Computerspiel „Gothic II“ ist ein gelungenes Beispiel für diese erste Kategorie. Auch virtuelle Welten folgen meistens dem genannten Schema. So ist in die innovative Welt „A Tale in the Desert“ eine globale Geschichte eingeschrieben, die dann fortschreitet, wenn die Spieler in ihrer Gesamtheit bestimmte Ziele erreicht haben. Wenn diese Geschichte endet, endet auch „A Tale in the Desert“. „Anarchy Online“ z.B. handelt vom Freiheitskampf der Bewohner eines Planeten gegen einen mächtigen Konzern, der Rohstoffe dieses Planeten abbaut. Die Spieler müssen sich am Anfang entscheiden, ob sie dem Konzern oder den Freiheitskämpfern beitreten oder sich neutral verhalten. Auch die „*paper-and-pencil“*-Rollenspiele, die Vorläufer der heutigen virtuellen Welten, folgen größtenteils der Geschichte, die sich der Spielleiter ausgedacht hat.

Auf der anderen Seite gibt es Spiele, die keine Geschichten, keinen Handlungsablauf vorgeben. Das sind in der Vergangenheit meist Strategiespiele gewesen, in denen das Spielziel eine Richtung vorgibt. Es bleibt dem Spieler überlassen, auf welchem Weg er dieses Ziel erreicht. Das bedeutet aber nicht, dass sich keine Geschichten ereignen würden. Manchmal bergen sie ein großes Potential an Geschichten, die sich in den Köpfen der Spieler abspielen. Schach ist ein gutes Beispiel für ein Spiel mit einfachen Regeln und einem relativ hohen narrativen Potential. Spieler können sich nach Beenden des Spiels noch leidenschaftlich darüber unterhalten, bei welchem Zug sie welche Pläne warum aufgegeben haben...

Das Spiel mit dem denkbar größten narrativen Potential ist wohl das Leben selbst. Woher kommen all diese Geschichten, die sich abspielen? Wer hat sie geschrieben? Sie entstehen aus dem Zusammentreffen unterschiedlicher Menschen. Obwohl virtuelle Welten darauf aufgebaut sind, dass sie Menschen zusammen führen, sind manche von ihnen derart organisiert, dass sich wenig Erzählenswertes ereignet oder ereignen kann.

Einige Bedingungen, die das narrative Potential einer Welt erhöhen könnten, sollen im Folgenden angedeutet werden:

Spieler können die Spielhistorie in ihren Grundzügen an einem anderen Charakter „ablesen“. Hat dieser Charakter hauptsächlich Handel betrieben oder gekämpft? Hat er sich politisch betätigt? Ist er ein Frauenheld, ist er reich? Daraus ergibt sich eine Differenzierung der Gesellschaft einer virtuellen Welt.

Spieler müssen mit Risikopotenzial konfrontiert werden: Sie müssen sich entscheiden, ob sie in Situatuionen, wo es im Extremfall um die Existenz ihres Charakters geht, mutig oder vorsichtig handeln. Daraus ergibt sich eine Handlungsdiversifizierung.

Für unterschiedliche Spielertypen[22] existieren unterschiedliche Spielziele. Möglichst jeder Spieler sollte in irgendeiner Disziplin der Beste sein können.

Spieler sollten möglichst das Gefühl haben, dass ihre Handlungen große Auswirkungen haben. Dabei müssen die Folgen zumindest zu einem gewissen Grad kalkulierbar sein.

[22] *Spielertypen: Unterteilung in achievers, explorers, socializers und killers.* (vgl. Bartle u.a.)

Spieler sollten möglichst eng miteinander leben müssen. Dem steht allerdings der Forscherdrang entgegen, neue Gebiete entdecken zu wollen. Eine zu kleine Welt begrenzt wiederum das narrative Potential, da verschiedene Umgebungen auch verschiedene Geschichten ergeben können.

Notwendige Ressourcen sollten nur begrenzt zur Verfügung stehen, damit sie erstrebenswert bleiben.

Die virtuelle Welt soll die Verschiedenheit der Menschen der sogenannten realen Welt möglichst widerspiegeln.

5.2.1 Eine „Faustregel“

Eine virtuelle Welt ist umso besser, je größer das Verhältnis von narrativem Potential zu kritischer Spieleranzahl ist. Das heißt, wenn ein kleines Spiel, das auch mit wenigen aktiven Spielern funktioniert, ein hohes narratives Potential aufweist, wird es größtwahrscheinlich zum Erfolg.

6 AUSBLICK

In absehbarer Zukunft wird wohl ein großer Teil westlicher Gesellschaften regelmäßiger Besucher einer virtuellen Welt sein. Es ist erschreckend, wie wenig hierzulande in der breiten Öffentlichkeit über folgende offene Fragestellungen nachgedacht wird:

- Semiotik: Wie lassen sich virtuelle Welten klassifizieren? Woraus bestehen sie, was sind ihre Zeichen?
- Authentizität und Realität im virtuellen Raum: Worauf kann sich der Besucher einer virtuellen Welt verlassen? Wer ist Mensch, wer/was ist Computer? Inwieweit lässt sich von Informationen einer virtuellen Welt auf die Realität schließen? Gibt es Naturgesetze, die unbedingt in allen Welten gelten müssen?
- Narratives Potential: Virtuelle Welten mit hohem narrativen Potential können als Erweiterung der Wirklichkeit verstanden werden. Was bedeutet das? Wo liegen hier die Gefahren, wo vielleicht sogar Chancen?
- Virtuelle Welt - Realer Staat? Kann es eine virtuelle Welt geben, die die Realität überlagert, sie ersetzt? Relation zwischen Abstraktion und Erleben der virtuellen Welt. (Helfen oder stören abstrakte Spielfiguren?)
- Interfaces: In virtuellen Welten benutzt der Spieler nicht nur eine Schnittstelle zu einer andere Welt, sondern eine zu einem Teil des eigenen Ich.
- Politische Fragen: Wer entscheidet über ausgelagerte Identitäten, über Geld oder andere Werte? Der Serverbetreiber als Diktator? Innerhalb von Multiplayer-Games sind politische Prozesse notwendig, weil Menschen aufeinander treffen. Welche politischen Formen und Regelwerke sind die besten? Was kann mit ihrer Hilfe erreicht werden?
- Interkulturelle Aspekte: Inwieweit heben sich Differenzen von Völkern, Geschlechtern, Sprachgruppen, Behinderungen auf? Bilden sich neue Gruppen und Klassen?
- Der Zweck: Nur Spaß in virtuellen Welten? Was sonst? Wohin kann die Entwicklung führen? Worin kann ein solcher Nutzen noch liegen? Könnten virtuelle Welten dazu beitragen, das Raumproblem urbaner Lebensräume zu lösen?
- Kommunikation in virtuellen Welten: Jeder kann mit jedem zugleich kommunizieren. Wie kann das besser gestaltet werden? Wie könnte man fehlende Kommunikationskanäle ersetzen? (*emoticons*?)
- Praktische Testreihen: Wie könnte eine "offene" Prototyp-Welt konstruiert werden, in der unterschiedliche Ausgangswerte und Parameter und deren Einfluss auf verschiedene Aspekte und Zustände einer von Menschen bewohnten virtuellen Welt wissenschaftlich untersucht werden könnten?

Die kulturelle wie gesellschaftspolitische Relevanz von virtuellen Welten anzuerkennen und damit die breite öffentliche Diskussion der oben genannten Fragestellungen und Problematiken gegenwärtig einzuleiten, halte ich für eine Notwendigkeit. Dieses Defizit als Chance wahrzunehmen, jetzt in die Forschung zu investieren, wäre Garant für ideellen wie kommerziellen Vorsprung.

Neue Rolle der Virtuellen Realität in der Architektur und Stadtplanung

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ABSTRACT

Der ‚Virtual Reality-Boom' der letzten Jahre ist abgeflaut, jedoch wird der Nutzen der Virtuellen und Erweiterten Realität (VR/AR) für die Lehre in einem stetigen Prozess immer neu ausgelotet. Im Zuge des Fortschritts der Technik, die schneller, einfacher anzuwenden und billiger geworden ist, öffnen sich ihr in der Lehre mehr Möglichkeiten als bisher. Innerhalb von CAD-Pools können einfache VR-Systeme, wie z.B. sogenannte ‚One-Walls' eingerichtet werden (Stereoprojektionswand mit Trackingsystem), die den Studierenden dann für Seminare, Projekte und Experimente wie jeder Computerarbeitsplatz frei zugänglich sind. Mit dem freien Zugang zu solchen Systemen wird das Selbstverständnis der Studierenden, VR-Projekte zu bearbeiten, erheblich gefördert. Für die Institute unterschiedlicher Fachrichtungen der Fakultäten der Architektur und Stadtplanung stellt sich daher die Frage, welche konkreten Potentiale der VR die Zukunft der Architektur und der Stadtplanung prägen werden. Da jedoch in den einzelnen Fachbereichen wenig Erfahrung damit existiert, welche Lehrinhalte mit VR vermittelt werden können, fehlt auch das Wissen darüber, ob, und wen ja, in welchem Umfang und in welche Techniken investiert werden soll.

Das Paper beschreibt den aktuellen Stand der VR-Technik und ihr Potential für den Einsatz an Hochschulen. Es liefert einen Überblick über die momentanen Anwendungsfelder von VR-Systemen in Architektur und Stadtplanung und vergleicht sie mit Anwendungsfeldern der VR in anderen Fachbereichen und mit den Themenfeldern, die in der internationalen Forschung diskutiert werden.

Neben der großen Spannweite der Themen der VR, die von der künstlerisch gestalteten virtuellen Architektur über die immersive Informations- und Simulationsvisualisierung reichen, richtet das Paper besonderes Augenmerk auf die Rolle der VR im städtebaulichen und architektonischen Entwurfsprozess innerhalb der digitalen Prozesskette. Anhand eines konkreten Vorschlags (interactive scientific simulation visualization) wird die Bedeutung der Verwendung der VR in der Architektur und Stadtplanung verdeutlicht und bewertet.

Das Paper erörtert die These, dass die Verwendung von VR in der Forschung der Ingenieurswissenschaften etablierter ist als in der Architektur und im Städtebau. Es postuliert Thesen, warum VR in der Entwurfsplanung zu einer nachhaltigeren, umweltfreundlicheren und menschenfreundlicheren Architektur und Stadtplanung führen könnte und will gleichzeitig die Diskussion zur zukünftigen Rolle, dem Sinn und Unsinn der Integration der VR in die Lehre anregen.

1 EINLEITUNG

Vordergründig scheinen für die Qualität von Entwürfen in der Architektur und in der Stadtplanung ästhetische Gesichtspunkte ausschlaggebend zu sein. Ebenso entscheidend sind aber auch ökologische bzw. physikalische Aspekte. In welchem Zusammenhang steht ein Raumgefüge zu den umgebenden klimatischen Verhältnissen? Mit welchem Winkel und mit werlcher Wirkung fällt das Sonnenlicht ein, oder werden Schatten geworfen? Wie verbreiten sich Auspuffgase in der Straße? Wie verhält es sich mit der Durchlüftung in der Stadt, der Lärmausbreitung, und, und, und?

Ziel des Entwerfens muss es also sein, physikalische Aspekte zu berücksichtigen. Das ist ein hohes Ziel. Dieses Ziel zu erreichen könnte dadurch spürbar erleichtert werden, dass die Virtuelle Realität (VR) in der Entwurfsplanung eingesetzt wird.

Denn: Physikalische Aspekte lassen sich am Computer simulieren und mit dem Computer darstellen. Handelt es sich um räumliche Simulationen, ist das entsprechende Visualisierungsmedium die Virtuelle Realität. Es hat daher den Anschein, dass VR zu einem Planungsmittel entwickelt werden kann. Für die Lehre der Architektur und Stadtplanung bedeutet das, dass VR-Systeme den Studierenden zur Verfügung gestellt werden sollten und dass sie möglichst früh den Umgang mit VR erlernen und Projekte damit bearbeiten.

Im Folgenden wird der Status quo der Entwicklung der Virtuellen Realität und ihre Potentiale für die Lehre an Hochschulen beschrieben.

2 ENTWICKLUNG DER TECHNIK

2.1 Entwurfsmedium Computer

Noch vor wenigen Jahren wurde heftig darüber diskutiert, ob der Computer ein geeignetes Entwurfsmedium ist. Inzwischen wurde diese Diskussion von der Realität überholt. Der Einsatz des Computers in Projektarbeiten ist für Architekturstudenten selbstverständlich. Studierende des Grundstudiums sind bei bestimmten Projekten zur Abgabe von CAD Plänen sogar verpflichtet. Im Hauptstudium wird von Studierenden CAD- und Modellierungssoftware und eine Vielzahl anderer Programme verwendet. Zwei Verhaltensweisen der Studierenden sind in den letzten Jahren besonders deutlich geworden:

- Der Computer wird in der Planung immer früher, also nicht nur zur Darstellung sondern schon während des Entwerfens eingesetzt.
- Für das Entwerfen am Computer weden zunehmend reine 3D Modellierungsprogramme verwendet.

Da Architekten, Stadtplaner Gestalter von Räumen sind, ist für sie das dreidimensionale Entwerfen am Computer sinnvoll. Programme, die das Gestalten von Räumen am Computer ermöglichen oder erleichtern, werden von Studierenden schnell angenommen. Daher wäre der logische nächste Schritt des Computereinsatzes in der architektonisch-städtebaulichen Planung das Entwerfen in immersiver dreidimensionaler Umgebung, also die Verwendung von VR-Systemen.

2.2 Virtuelle Realität als Entwurfsmedium?

„Virtuelle Realität ist die Technik, mit der man ein direktes Interface (Schnittstelle) zwischen Mensch und Computerbildern herstellt“ [Whoolley, 1993].

VR wird als erster Schritt zur Realisierung des Cyberspace gesehen. Es existieren viele verschiedene technischen Systeme und es ist daher nicht einfach den Begriff Virtuelle Realität genau zu definieren. Obiges Zitat von Benjamin Whoolley reduziert die Virtuelle Realität auf ihre rein visuelle Ebene. Dennoch ist das Zitat eine treffende Umschreibung der momentan gängigen VR-Systeme, die ihre immersive Wirkung überwiegend über die visuelle Wahrnehmung erzielen.

Bisher waren Computersysteme der Virtuellen Realität Hightechprodukte, die schon allein wegen ihrer hohen Anschaffungskosten nur wenigen Hochschulen zur Verfügung standen. Insbesondere an Fakultäten, die nicht über ein eigenes CAD-Institut verfügten oder nicht die Möglichkeit besaßen, Kooperationen mit Forschungsinstitutionen einzugehen, war den Studierenden der Zugang zu VR-Systemen für ihre Projekte versperrt oder zumindest sehr erschwert.

Das hat sich jetzt ageändert. Die Technik von VR-Systemen ist wesentlich einfacher, günstiger und schneller geworden. Inzwischen lassen sich VR-Systeme mit handelsüblichen Computern realisieren. Die meisten CAD- und Modellierungsprogramme besitzen eine VRML-Schnittstelle, inzwischen internationaler Standard für 3D Computergraphik, mit der sich auf einfache Weise CAD-Modelle in die VR-Umgebung übertragen lassen. Darüber hinaus ist es mit aktueller VR-Technik prinzipiell möglich, dreidimensionale Entwürfe anzufertigen, insbesondere in der Stadtplanung. VR kann den Studierenden daher sehr einfach zugänglich gemacht werden. Architekturfakultäten könnten in entsprechende Systeme investieren und sie den Studierenden frei zur Verfügung stellen. Ähnlich wie der PC und eine Vielzahl von Computerprogrammen, die aus keiner Hochschullehre mehr wegzudenken sind, wird auch die VR zunehmend von Interesse für die Studierenden sein und die Lehre der Architektur und Stadtplanung beeinflussen.

2.3 Sind Hochschulen in Zugzwang?

Wie können Hochschulen auf die technische Entwicklung und auf das Interesse der Studierenden reagieren und VR in die Lehre der Architektur und Stadtplanung integrieren? Mit welchen Konzepten kann die Lehre qualitativ verbessert werden? Und wie können Architekten und Stadtplaner an der Entwicklung von VR-Systemen teilhaben und sie mitgestalten?

Um diesen Fragen nachzugehen, lohnt es sich, einen Blick auf die bisherige Rolle von VR-Systemen in der Architekturlehre zu werfen und zu vergleichen, wie VR-Systeme in anderen wissenschaftlichen Disziplinen, wie beispielsweise in Natur- und Ingenieurwissenschaften und in der Medizin eingesetzt werden.

Nach einer Beschreibung unterschiedlicher VR-Systeme, werden VR-Projekte aus Lehre und Forschung beschrieben, in deren technischen Fortschritt die Basis dafür gesehen wurde, dass auch in Architektur und Stadtplanung neue Wege beschritten werden können. In den Projekten werden Techniken der VR und Simulationen, die in anderen wissenschaftlichen Disziplinen erfolgreich eingesetzt werden, auf Problemstellungen in der Architektur und Stadtplanung übertragen. Aus den Erfahrungen dieser Projekte lassen sich Prognosen für die zukünftigen Entwicklungen der Technik und Anforderungen an eine qualitativ bessere und nachhaltigere Lehre in der Architektur und Stadtplanung stellen.

3 VERSCHIEDENE SYSTEME

3.1 Die CAVE

„Ziel einer CAVE ist es, einen immersiven Raum zu schaffen, in dem der Betrachter sich – in Grenzen – frei bewegen kann und dabei die Illusion hat, er sei vollständig umgeben von einer virtuellen Szenerie“ [Havemann, 2002]

Eine Installation wie die CAVE ist ein viusell immersives VR-System. Sie kann aus bis zu sechs Stereoprojektionswänden mit jeweils ein bis zwei PCs und einer entprechenden Anzahl von Projektoren pro Wand und einem Trackingsystem bestehen. Je mehr Wände sie besitzt, desto immersiver ist auch die Wirkung ihrer Projektion. Die Anschaffungskosten des für CAVE-Systeme notwendigen Equipments sinken mit der Zeit stetig. Lediglich bei Trackingsystemen sind bisher keine zufriedenstellend funktionierenden und gleichzeitig sehr günstigen Lösungen erhältlich. Verschiedene Open-Source-Programme als Betriebssoftware von VR sind im Internet frei verfügbar. Sie reichen für einfache VR-Anwendungen schon aus. Einige Anbieter kommerzieller VR-Programme stellen ihre Software oder zumindest Teile ihrer Software kostenfrei für die Lehre zur Verfügung.

Eine weitere Quelle neuer Software könnte auch die Computerspielbranche sein, die daher beobachtet werden sollte. Ihre Interessen sind für die beeindruckende Leistungssteigerung der Graphikkarten von PC-Workstations in den letzten Jahren verantwortlich. Mit Gameengines oder Gameeditoren lassen sich virtuelle architektonische Welten für Echtzeitanwendungen entwerfen. Je erschwinglicher und weiter verbreitet VR-Systeme werden, desto größer wird auch das Interesse der Hersteller von Computerspielen, diesen entstehenden Markt für ihre kommerziellen Zwecke zu erobern. Man kann also weiterhin erwarten, dass von ihnen innovative Entwicklungen in Hard- und Software auch in der VR-Technologie ausgehen werden.

3.2 Die One-Wall

Bei One-Wall-Systemen (One-Wall-CAVE) ist die immersive Wirkung geringer, sie ist also nur teilimmersiv. One-Walls bestehen zwar aus den gleichen technischen Komponenten wie Mehrwandsysteme, ihre Anschaffungskosten, der Aufwand für ihren Aufbau, Systempflege und auch ihr Platzbedarf sind aber wesentlich geringer. Eine One-Wall lässt sich vergleichsweise günstig und leicht realisieren, was die Hard- und Software betrifft. Nimmt man eine weitere Einschränkung der Immersivität in Kauf, kann notfalls auch (vorerst) auf ein Trackingsystem verzichtet werden. Für Studierende ist die One-Wall momentan ein ideales Medium für den Einstieg in die VR-Produktion.

3.3 Augmented Reality

Die Augmented Reality (AR) kann als Spezialfall der VR gesehen werden. Bei AR werden computergenerierte Bilder mit der Wirklichkeit überlagert. Mit dem ARToolKit, einer AR-Open-Source-Software-Basispaket, entwickelt an der University of Washington [Billinghurst & Kato, 1999], lässt sich ein 3D-Modell in einen Videostream einer DV-Kamera integrieren. Werden spezielle sich voneinander unterscheidende Symbole (fiducial markers) in das Sichtfeld der Kamera gebracht, erkennt die Software über Video-Capturing die Marker und blendet relativ zu deren Position und Ausrichtung referenzierte Modelle in den Videostream ein. In Abb. 1 ist ein Head Mounted Display (HMD) zu sehen, an das zwei Kameras in Augenposition angebracht wurden. Mit diesem System lassen sich am Computer erzeugte Objekte sowie graphisch aufbereitete Informationen innerhalb der physischen Umgebung zwei- oder dreidimensional darstellen.

Abb. 1: Augmented Reality HMD Cy-Visor. [Quelle: HLRS, 2003]

3.4 Mixed Reality

Sowohl in der Anwendung als auch in der Technik sind die Übergänge der beschriebenen Systeme fließend. Je nach Bedarf lassen sich VR, AR und Videoprojektionsverfahren etc. fast beliebig miteinander kombinieren. Mit dem Begriff Mixed Reality (MR) werden diese unterschiedlichen Systeme und Anwendungen zusammengefasst.

Im Zuge der weiteren technischen Entwicklung wird die MR den Bildschirm der momentanen CAD-Arbeitsplätze der Architekten und Stadtplaner zumindest teilweise ersetzen. Das gilt nicht nur für Planungsphasen, für die CAD heute vorzugsweise eingesetzt wird, sondern vor allem für die Verwendung des Computers innerhalb des Entwurfsprozesses.

4 BEISPIELE FÜR DEN BISHERIGEN EINSATZ VON VR IN DER DER LEHRE DER ARCHITEKTUR UND STADTPLANUNG

4.1 Präsentation und Exploration

Bei der überwiegenden Anzahl von Studierenden, die sich mit VR beschäftigen, wird sie zur immersiven Bewertung von Entwurfsvarianten oder zur Präsentation von Entwurfsergebnissen verwendet. VR dient somit vorzugsweise der Präsentation und Exploration, was auch als Monitoring bezeichnet werden kann. Im Begriff Monitoring wird aber auch deutlich, dass die VR weit darüber hinausgehende Potentiale bietet.

4.2 Interaktion

VR ist ein interaktives Medium d.h. es können Präsentationen in VR mit Interaktionen versehen werden. Interaktion kann unterschiedlich klassifiziert werden. In der primären Interaktion besteht eine klassische Reiz-Reaktions-Beziehung, in der alle Reaktionen vorherbestimmt sind und über Schalter (Initiale Interaktivität) ausgelöst werden können. In der sekundären Interaktion kann die ausgelöste Reaktion auch im Nachhinein vom Betrachter beeinflusst werden (Reaktive Interaktivität). In der tertiären Interaktion (Kreative Interaktivität) kann sich das System auf Verhaltensweisen des Akteurs mit der Zeit einstellen [vgl. Heibach, 2003 und Hünnekens, 1997]. Eine relativ kleine Anzahl von Studierenden beschäftigen sich mit der Thematik des dynamischen Entwerfens, mit interaktiver Architektur, mit dem Verhalten des Planers und seiner Kommunikation mit interaktiven Systemen, oder mit den Auswirkungen interaktiver VR auf den architektonischen Entwurfsprozess. Solche Projekte sind nur mit hohem Aufwand zu bewältigen und setzen bei den Studierenden ein Höchstmaß an Engagement und die Bereitschaft Programmiersprachen zu erlernen voraus.

4.3 Datamining

VR eignet sich für räumliches Datamining. Datamining ist die Bezeichnung für das Visualisieren von komplexen Datenstrukturen, Simulationsdaten oder Datenströmen. Ziel dabei ist es, den Überblick über große Datenmengen schwer zu kontrollierender Datenströme zu vereinfachen und eventuell signifikante Veränderungen in ihrer Struktur oder in ihrer Dynamik einfacher ausfindig zu machen. Ein häufig als Beilspiel angeführtes Thema ist die Visualisierung von Kursverläufen und Informationen für den

Aktienhandel an der Wertpapier-Börse. Dass sich gerade Architekten und Architekturstudenten mit derartigen oder ähnlichen Themen beschäftigen, zeigt, wie vielfältig Aufgaben in der Architektur definiert werden können. Architektonisches Planen von Räumen schließt hier auch die Gestaltung von Informationsräumen bzw. das Planen in Informationsräumen ein.

4.4 Kommunikation und Kollaboration

Mit CAVE-Systemen kann die Zusammenarbeit gefördert werden. In ihnen ist es möglich, gemeinsam mit mehreren Personen einzelne Aspekte eines als CAD-Modell vorliegenden Entwurfes zu bearbeiten und zu evaluieren. Gleichzeitig kann darin ein Eindruck der tatsächlichen Größenverhältnisse eines Entwurfes, wie er physisch gebaut erscheinen würde, vermittelt werden.

Der „Luminous Planing Table (LPT)“ [Ben-Joseph et al., 2001] (Abb. 2) wurde am MIT Media Lab zur Verbesserung des städtebaulichen Planungsprozesses entwickelt. Mit ihm wurden physische und virtuelle Objekte zu einem Mixed Reality System für die kollaborative Planung und Präsentation kombiniert. Der LPT besteht u.a. aus einem Tisch auf den mehrere an der Decke hängende Beamer zwei und dreidimensionale Bilder projizieren und Kameras von denen die Oberfläche des Tisches und sich darauf befindende physische Modelle aufgenommen werden. Es können verschiedene Informationen und Aspekte eines Entwurfes (2D Pläne, Diagramme, etc.) präsentiert werden. Die Physischen Modelle erzeugen projizierte Informationen wie Lichtreflektionen, Schattenwurf von Gebäuden, Verkehrsaufkommen in Straßen und Windverhältnisse, die auf die Manipulation der Modelle simuliert und aktualisiert dargestellt werden. Ein Testprojekt hat gezeigt, dass die Kommunikation zwischen den Planungsbeteiligten gefördert werden. Der LPT war ihnen eine Hilfe dabei, sich auf ein Planungsergebnis zu einigen.

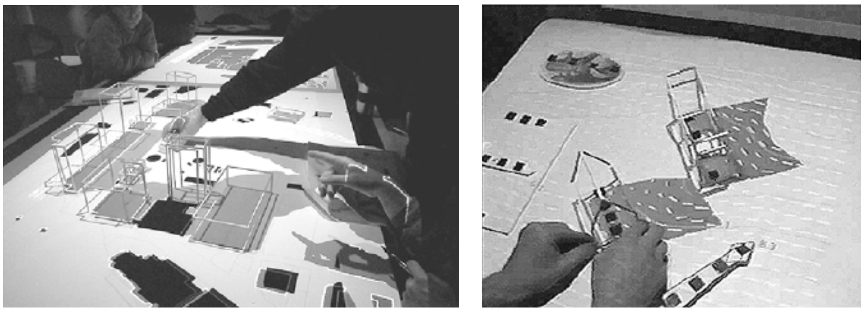

Abb. 2: Links: Der Luminous Planning Table, Kombination aus digitaler Information und physischen Modellen.
Rechts: Schattenwurf und Windfelder. [Quelle: Ben-Joseph et al., 2001]

Zusammenfassend kann festgestellt werden, dass im zunehmendem Maße bei aktuellen Projekten die vielfältigen Potentiale von VR-Systemen erkannt und ausgelotet werden. Deutlich wird dabei das Bestreben, VR nicht nur als Präsentationstool zu verwenden, sondern als integralen Bestandteil aller Phasen des Planungsprozesses.

5 BEISPIELE FÜR DEN EINSATZ VON VR IN ANDEREN DISZIPLINEN

5.1 Übung und Schulung

Zu den ältesten VR-Anwendungen überhaupt gehört der Flugsimulator. Diese sehr praxisorientierte Anwendung der VR wird zur Ausbildung von Piloten mit einigem Erfolg eingesetzt. Sie lernen dabei auf (noch) nicht wirkliche und nur der Möglichkeit nach reale Situationen zu reagieren [vgl. Born]. Piloten sollen mit den Simulationen darauf vorbereitet werden in der sogenannten echten, realen Lebenswelt auf unvorhergesehene Situationen adäquat zu reagieren. In Flugsimulatoren werden nicht nur visuelle Eindrücke eines Piloten simuliert, sondern auch Kräfte (Kurve, Steuerung) und audiovisuelle Signale der Steuerung und des Funkverkehrs.

5.2 Visualisierung von Ergebnissen räumlicher Simulationen

In der Medizin dient VR zwar auch der Schulung, denn Ärzte und Medizinstudenten können an virtuellen Operationen chirugische Eingriffe einstudieren. VR findet aber auch Verwendung in der medizinischen Diagnose. Über räumliche Visualisierung computertomographischer Daten lassen sich beispielsweise Hirntumore leichter identifizieren und lokalisieren. In Verbindung mit Echtzeit-Simulationsverfahren wird hier VR z.B. zur Simulation und Visualisierung des Blutkreislaufs eingesetzt.

In der Forschung und Anwendung der Scientific Simulation werden die Simulationsergebnisse in VR visualisiert. Erst über die räumliche Visualisierung lassen sich räumlich simulierte Sachverhalte wie Strömungen oder, im Engeneering Design, Auswirkungen von simulierten Crashtests verstehen und analysieren und Extrempunkte bzw. Störungen erkennen, die in Zahlenkolonnen oder 2D-Visualisierungen und sogar in nicht immersiven 3D Visualisierungen nicht oder nur sehr schwer verstehen lassen. VR und Simulationsmodelle werden insbesondere zur Überprüfung wissenschaftlicher Hypothesen im Bereich Scientific Simulation eingesetzt [vgl. Page et al., 1997]. Mit der Kombination VR und Simulation können Veränderungen am Modell vorgenommen und deren Konsequenzen überprüft und somit die gesamte Planung optimiert werden. Handlungsentscheidungen werden somit vereinfacht.

5.3 Visualisierung nicht wahrnehmbarer Prozesse

Die Simulation mit Computern ist eine Methode zur Analyse schwer zugänglicher oder nicht wahrnehmbarer Prozesse [vgl. Puhr-Westerheide, 1995]. Räumliche Simulationsergebnisse können in VR visualisiert werden. Gerade in der Visualisierung von in der Wirklichkeit nicht wahrnehmbaren Faktoren unterscheiden sich die Anwendungsbereiche der VR in den genannten Disziplinen am deutlichsten von den gängigen Anwendungsbereichen der VR in der Architektur.

Die Stärke der VR, diese Zusammenhänge verständlich darzustellen haben die VR in den letzten Jahren zu einem unverzichtbaren Medium in den genannten Forschungsdisziplinen werden lassen. Die dort gesammelten Erfahrungen mit VR können auch für architektonsiche und städtebauliche Fragestellungen nützlich sein und zu einem menschengerechteren Bauen führen. Verschiedene Verfahren der Modellbildung, und der entwickelten Analyse-, Simulations- und Visualisierungsmethoden lassen sich auf architektonische Fragestellungen übertragen, z.B. bei ökologischen Fragestellungen in der Stadtplanung (Wind-, Schadsoff-, Lärmausbreitung in Stadträumen, etc.).

In der Verbindung der VR mit Scientific Simulation liegen daher große bisher wenig genutzte Potentiale für die Architektur und Stadtplanung. Genauer erörtert werden müss daher zunächst, welche Simulationsmethoden für architektonische und städtebauliche Fragen relevant sind und auf welche Weise sie sich dafür anwenden lassen.

6 VR IN DER LEHRE

Hochschulen sollten für Studierende ein Ort sein, an dem neben der praxisbezogenen Ausbildung mit neuen technischen Strömungen kreativ experimentiert werden kann. Mit der Anwendung neuer Technik lassen sich neue Themenfelder für die Architektur erschließen. Neue Technik eröffnet meist auch Einblicke in bisher nicht berücksichtigte Gesichtspunkte, die dann in die Planung eingebracht werden können. Zukunftsorientierte Planer und Hochschulen sollten sich diesen Möglichkeiten keinesfalls verschließen.

6.1 Beispiel einer didaktischen und technische Integration einer ‚Open Wall'

Computerkurse (CAAD, Desktop-Publishing, Bild- und Videobearbeitung, etc.) sind bei Studierenden nach wie vor sehr gefragt. Aufbauend auf die darin erworbenen Kenntnisse können ihnen in speziellen Kursen (VRML, VR-Software, Programierkurse) die Grundlagen für die VR-Produktion vermittelt werden. In Seminaren und Projekten ist es Studierenden dann möglich, sich weitergehend mit spezifischen Fragestellungen der Schnittstellen Mensch, Architektur, Stadtplanung und Virtuelle Realität zu beschäftigen. Ein Konzept für eine VR-Installation, auf dessen Basis beispielsweise die ‚Open Wall' (Single-Wall VR-System) am zentralen Computerpool der Fakultät für Architektur und Stadtplanung der Universität Stuttgart, dem casino IT, realisiert wurde, kann VR Projekte unterstützen und vereinfachen. Die Besonderheit der Open Wall (Abb. 3) liegt nicht nur in ihrer Technik, die aus einfachen Komponenten besteht, und daher zu einer Low-Budget Lösung zusammengestellt werden kann. Ihre Besonderheit

Abb. 3: ‚Open Wall' im casino IT der Universität Stuttgart

liegt vielmehr in der Art, wie sie innerhalb des Computerpools von den Studierenden verwendet wird. Sie ist ähnlich wie jede Workstation oder jedes Peripheriegerät höchst flexibel in die Struktur des Pools eingebunden. Die Open Wall ist mobil und lässt sich mit minimalem Aufwand an einen anderen Ort transportieren und dort wieder aufbauen. Sie ist für alle Studierende frei zugänglich und steht daher prinzipiell allen frei zur Verfügung. Studierende können die Open Wall sowohl für Präsentationen als auch als Arbeitsmittel im Rahmen individueller Projekte verwenden.

6.2 Interesse und Reaktionen

VR Systeme wie eine One-Wall oder eine CAVE üben eine große Faszination auf Studierende aus. Dennoch wird sehr deutlich, dass spätestens seitdem die Internet- und Computertechnikeuphorie verklungen ist, Studierende und Lehrende der Computertechnik mit konstruktiver Skepsis gegenüberstehen. Sie lassen sich nicht mehr nur von den technischen Möglichkeiten beeindrucken, sondern setzen sich zunehmend kritisch mit der Technik und ihrer sinnvollen Integration in Arbeitsprozesse auseinander. Bemerkenswert ist, dass Studierende von sich aus Interesse an Problematiken formulieren, deren Bearbeitung sich nur mit Hilfe des Computers adäquat angehen lässt. Sie versuchen beispielsweise Methoden zu finden, mit denen ökologische Aspekte in ihren Projekten leichter zu berücksichtigen und zu bewerten sind. Parallel beginnen Studierende mit Kombinationen verschiedener Techniken der VR und AR zu experimentieren. Sie erschließen damit neue Themenfelder der Architektur und entwickeln dabei Vorstellungen über ihre eigene berufliche Zukunft und das künftige allgemeine Berufsbild von Architekten und Stadtplanern. Sie gestalten daher virtuelle Räume nicht nur als Ausdruck ihres ästhetischen Empfindens. Der virtuelle Raum wird von ihnen häufig auch als künftige Arbeitsumgebung des Entwerfers angesehen. Projektkonzepte die von Studierenden mühevoll entwickelt werden, sind kleine Schritte der Annäherung an dieses Ziel.

6.3 Konsequenzen

Das kreative Engagement von Studierenden sollte von den Lehrenden verstärktt unterstützt werden. Studierende, die sich tiefgehend mit Computertechnik und Architektur beschäftigen, haben auch das Bedürfnis, mit Hilfe des Computers komplexe Sachverhalte zu verstehen und diese in ihren Entwürfen berücksichtigen zu können. Um diesen Bedürfnissen gerecht zu werden und VR besser in der Lehre der Architektur und Stadtplanung zu etablieren, muss VR-Software entwickelt werden, die für kreatives und intuitives Planen geeigneter ist. Dazu kann zunächst auf Erfahrungen und Software, die in anderen wissenschaftlichen Disziplinen schon entwickelt wurde, zurückgegriffen werden.

7 VR-FORSCHUNG IN DER ARCHITEKTUR UND STADTPLANUNG

Die Lehre unterstützen können Programme, die auf ökologische Fragestellungen von Architekten und Stadtplanern verständliche und beurteilbare Antworten liefern. Sie bieten die Möglichkeit dafür, dass Planer ökologische Aspekte auf die Ästhetik ihrer Entwürfe anwenden können. Die Programme sollten auf die Arbeitsweise von Architekten und Stadtplanern ausgelegt sein. Entwerfer sollten mit den Programmen, ähnlich wie beim Skizzieren oder Modellbauen, vielfältige Varianten auf schnelle und flexible Weise produzieren können.

Das Forschungsrojekt „Räumliche Visualisierung Physikalischer Parameter in der Architektur (r.Vipar)“ [Boytscheff et al., 2004], ein Kooperationsprojekt der FH Konstanz und der Universität Stuttgart, wurde mit der Überzeugung angegangen, dass sich VR ideal dazu eignet, physikalische Vorgänge in den architektonischen oder statdtplanerischen Entwurfsprozeß zu integrieren, indem die VR mit Simulationsprogrammen verbunden wird. Damit Einhergehend ergibt sich eine neue Chance für die Anwendung von VR in der Praxis und Lehre. Wird diese Chance genutzt, kann die mit Hilfe von Simulationen und VR entworfene Architektur und Stadtplanung zumindest Verbesserungen in ihrer ökologischen Qualität aufweisen.

7.1 Planungsphasen

Zuerst wurde untersucht, welche Simulationen sich für welche Phase des Entwerfens eignen, und wie sich Ergebnisse der Scientific Simulations im Entwurfsprozeß anwenden lassen. Dazu wurden Skalierungseinheiten (maßstabsabhängige Planungsphasen) definiert und der Planungsprozeß in mehrere Skalierungseinheiten eingeteilt. Sie reichen von der Stadtkonzeption als Skalierungseinheit mit dem kleinsten Maßstab bis zur (Gebäude-) Innenraumkonzeption mit dem größten Maßstab. Basierend auf dieser Einteilung wurde bewertet, in welchem Maße Simulationen das Planen beeinflussen können.

Die Untersuchungsergebnisse ergaben, dass das technische Potential zur Anbindung von Simulationsprogrammen an ein Virtual User Interface (VUI) in der Skalierungseinheit ‚Stadtkonzeption' momentan am Größten ist. Die Integration von echtzeitfähigen Simulationen für den Entwurfsprozess ist also in der Stadtplanung am Ehesten zu realiseren .

7.2 Simulationsverfahren

Je mehr Gesichtspunkte der Planer berücksichtigen kann, desto hochwertiger fällt die Qualität des Planungsergebnisses aus. Mit Hilfe des Computers lassen sich physikalische Vorgänge, wie die Ausbreitung von Schadstoffen und Lärm in Stadträumen, Sonnenlicht und Sonnenenergiestrahlung, Schattenwurf, Luftströmungen simulieren. Daher wurde untersucht, wie sich Verknüpfungen von echtzeitfähigen Simulationen mit einem Virtual User Interface (VUI) für die Architektur und Stadtplanung technisch realisieren lassen. Es existieren verschiedene Arten von Simulationsprogrammen, die sich in der Architektur- und Stadtplanung einsetzen lassen. Allerdings können physikalische Vorgänge erst dann in den Entwurfsprozess integriert werden, wenn Simulationsprogramme innerhalb kürzester Zeit auf Handlungen des Planers am Entwurf reagieren und aktualisierte Ergebnisse liefern.

Echtzeitfähig ist eine Simulation dann, wenn die Berechnungszeit maximal bei einigen Sekunden liegt. Simuliert werden können u.a. Windfelder, Kaltluftabflüsse, die Ausbreitung von Luftschadstoffen an Straßen, die Tages- und Nachtlichtsituation in Straßenräumen und Gebäuden, die Sonneneinstrahlungsenergie auf Gebäude und Fassaden, die Ausbreitung von Lärm in der Stadt, etc. Je nach Simulation und verwendeten Algorithmen ist der Rechenaufwand unterschiedlich groß und dementsprechend auch die Berechungsdauer. Außerdem ist es von der Modellbildung, also von der Definition der Ziele, die mit der Simulation erreicht werden sollen, abhängig, welche Ergebnisse sie mit welchem Zeitaufwand berechnen kann. Für nahezu alle Simulationsverfahren gibt es Konzepte, die auf der Basis eines vereinfachten Simulationsmodells zu erheblich kürzeren Berechnungszeiten führen. Bei jedem Simulationsverfahren führt das zu Vor- und Nachteilen. Bei einfacher Modellbildung liegen die Vorteile in der Berechnungsgeschwindigkeit, die Nachteile in der Möglichkeit von ungenauen, im Extremfall völlig nutzlosen Berechnungsergebnissen. Neben der Modellbildung existieren weitere Ansätze (Nestingverfahren, Parallelisierung, etc.) mit denen sich echtzeitfähige Simulationen entwickeln lassen.

Vergleichsweise besonders schnell lässt sich Lärmausbreitung simulieren. Daher bietet es sich an, echzeitfähige Simulationsprogramme zur Berechnung der Ausbreitung von Lärm in Stadträumen mit dem VUI zu verbinden, und ein VR-Entwurfstool zu entwickeln.

7.3 VR-Entwurfstool

Im Rahmen des Projektes wurde daher ein Prototyp für ein VR-Entwurfstool entwickelt und implementiert. Dazu wurde eine interaktive Anbindung eines Programms zur Berechung von Lärmausbreitung in Stadträumen mit einem VR-Modeller geschaffen. Der VR-Modeller wurde bewusst einfach konzipiert, da nur wenige Modellierfunktionen im frühen stadtplanerischen

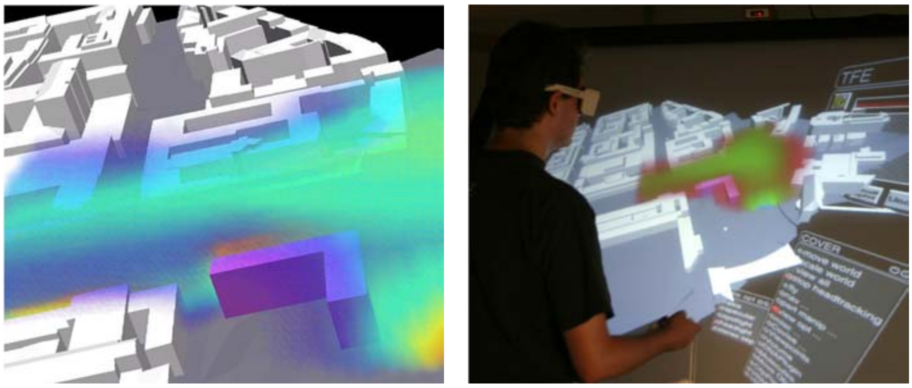

Abb. 4: Interaktives VR-Entwurfstool für die Stadtplanung (Lärmsimulation)

Entwurfsprozess ausreichen. Beispielsweise können einfache Bauquader (Boxes) erzeugt oder entfernt werden. Sie lassen sich dann mit dem VR-Modeller transformieren, also verschieben, rotieren und skaliert. Bei jeder Veränderung des VR-Modells wird über die interaktive Anbindung zur Schallsimulation die visualisierte Lärmausbreitung im Stadtraum automatisch aktualisiert.

8 WEITERER FORSCHUNGS- UND ENTWICKLUNGSBEDARF

8.1 Klärungsbedarf

In VR können Welten entworfen werden, die eigenen Gesetzen unterliegen, losgelöst von den Zwängen der Wirklichkeit. Hierin liegt großes Potential, das mittelfristig sogar zu einem eigenen Berufszweig führen könnte. Betrachtet man VR aber eher als ein mögliches Werkzeug für die konventionelle architektonische und städtebauliche Planung, dann liegt ein großes Potential der VR in der Darstellung von Faktoren, die in der Wirklichkeit mit unseren Sinnen nicht oder nur sehr schwer wahrgenommen werden können. Die Diskussion darüber, welche Faktoren in welchem Maße die Architektur und Stadtplanung beeinflussen, welche Simulationssysteme welchen Anforderungen entsprechen müssen und welche Konsequenzen VR und Simulationen für Architektur und Stadtplanung und in der Lehre hat, sollte verstärkt geführt werden.

8.2 Anpassung von VR- und Simulationssoftware

An guten VR-Anwendungsprogrammen besteht noch ein großer Bedarf. Momentan kann VR-Software nur sehr eingeschränkt benutzt werden. Das kann zuweilen sehr demotivierend für Anwender sein. Ähnlich verhält es sich mit aktuellen Simulationsprogrammen. Das Know-How für deren Benutzung liegt hier bei Fachingenieuren. Simulationsprogramme sind generell auch in der Bedienung auf die Anforderungen der Fachingenieure zugeschnitten und werden professionell fast ausschließlich von ihnen verwendet. Architekten und Stadtplaner wenden gängige Simulationsprogramme wegen ihrer Komplexität daher fast nie an. Faktoren, die Simulationen berechnen können, fließen somit nicht in den Entwurf ein, oder erst zu einem Zeitpunkt, nachdem die Konzepte von Architekten und Stadtplanern schon erarbeitet wurden und nur noch kleine Korrekturen und Anpassungen des Entwurfs möglich sind. Die Situation verbessern können VR-Entwurfstools wie der exemplarisch entwickelte Prototyp im Projekt r.Vipar, die in interdisziplinären Projekten von Architekten, Softwareentwicklern und Ingenieuren entwickelt werden.

8.3 Bewertung von Simulationsverfahren

Einige wichtige Faktoren lassen sich mit Hilfe des Computers simulieren, teilweise in Echtzeit. Sie sind aber bisher größtenteils wegen fehlenden Interesses seitens der Ingenieure, aber auch seitens der Architekten und Stadtplaner nie implementiert worden. Während des Entwurfsprozesses werden aber keine exakten Simulationsergebnisse benötigt. Es genügt, wenn die Simulation Tendenzen berechnen kann, also z.B. ob Veränderungen am Entwurf zu Verbesserungen und Verschlechterungen in der ökologischen Situation führen. Es ist für den Entwerfer viel wichtiger, dass ein Entwurfswerkzeug intuitiv benutzt werden kann. Anders ist es bei Ingenieuren die von einer Simulation möglichst exakte Simulationsergebnisse erwarten. Eine genaue Prüfung und Darstellug, die einen Überblick über echzeitfähige Simulationverfahren für architektonische Belange liefern würde, existiert bisher noch nicht. Daher wäre eine weitere konkrete Erforschung der Möglichkeiten und deren detaillierte Auflistung für planerische Zwecke notwendig.

8.4 Integration in die Lehre

Damit VR besser in die Lehre integriert werden kann, müsste der allgemeine momentane Stand der VR in der Lehre recherchiert werden. Das bedeutet, dass die Wünsche und die Bedürfnisse Studierender und Lehrender an Hochschulen im Hinblick auf die Integration physikalischer Faktoren auf die Entwurfsplanung untersucht werden müssen. Welche zukünftige Rolle können VR-Systeme im Planungsprzess des Architekten oder Stadtplaners einnehmen?

9 ZUSAMMENFASSUNG

Die technische Entwicklung der VR in den letzten Jahren hat dazu geführt, dass sie eine neue Rolle in der Lehre eingenommen hat und diese Rolle sich auch zukünftig weiter verändern wird. VR ist nicht mehr länger nur ein teures Hightech-Medium, sondern kann Studierenden ähnlich wie eine Workstation zur Verfügung gestellt werden. Es kann davon ausgegangen werden, dass allmählich die VR-Systeme die momentanen CAD-Bildschirmarbeitsplätze der Architekten und Stadtplaner ergänzen oder gar ersetzen werden. Dies wird in den Planungsphasen der Fall sein, in denen heute vorzugsweise CAD eingesetzt wird, aber auch im Entwurfsprozess.

Sowohl VR-Modeller wie auch Simulationsprogramme für den städtebaulichen Entwurfsprozess lassen sich in technisch verhältnismäßig einfach realisieren. Daher könnte die Stadtplanung eine Vorreiterrolle für die Integration von VR in der Lehre einnehmen.

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Die Virtuelle Datenbank: Technologie zur Unterstützung in der Regionalplanung

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1 EINFÜHRUNG

Räumliche Informationen werden gegenwärtig zumeist in Form von Karten oder mittels digitaler Speichermedien wie Disks, CD-ROM, etc. zugänglich gemacht. Die Beschaffung und Aktualisierung raumbezogener Daten gestaltet sich jedoch als aufwändig und kostspielig. Von zahlreichen Vertretern der GIS-Gemeinschaft wird daher die Notwendigkeit einer Online-Verbreitung von Geodaten postuliert. Insbesondere öffentliche Stellen sehen sich mit der Erwartung konfrontiert, Daten für eine breite Öffentlichkeit und die Forschung in möglichst effizienter und effektiver Form zugänglich zu machen (Peng and Tsou 2003). Eddy (1993, S. 6) schlussfolgert hierzu: „We must put in place a global data and information system that makes environmental data, past and current, available to all who need them, in a form that they can use". Verschiedene Firmen wie auch Open-Source-Projekte haben, vor dem Hintergrund einer zunehmenden Nutzung des Internets und der damit verbundenen Technologieentwicklung, in den letzten Jahren Softwareprodukte - sog. Mapserver – entwickelt. Diese dienen der Erstellung und Visualisierung von Webkarten, mit deren Hilfe sich aktuelle Daten bequem über das Internet verbreiten lassen. Allerdings lassen sich die gesendeten Daten für weitergehende Anwendungen nur begrenzt nutzen, weil sie überwiegend nur als Bilder verfügbar sind. Wir verstehen die Forderung von Eddy aber dahingehend, dass eine Nutzung der Daten auch in Richtung ihrer Analyse gehen und somit zum Beispiel die Verknüpfung mit Daten aus eigenen oder anderen Quellen ermöglichen müsste.

Dieser Aufsatz zeigt einen Weg auf, wie Datenbestände aus unterschiedlichsten Quellen über Internet mit einem allgemeinen und einheitlichen Zugriff genutzt werden können. Ziel der hier vorgestellten Virtuellen Datenbank ist es, verteilt vorliegende Datenbanken, die Geodaten beinhalten, zu integrieren, um transparent auf Datenbestände zugreifen und zielgerichtete Analysen vornehmen zu können. Es soll eine Plattform geschaffen werden, die potentiell beliebige Verknüpfungen von Daten über Internet von einem Browser aus ermöglicht. Dabei soll nach Möglichkeit mit offenen Schnittstellen gearbeitet werden. Der Zugriff auf die Daten beschränkt sich auf die Visualisierung und Abfrage von Datenbeständen sowie auf räumliche Datenbearbeitungsfunktionen. Dabei werden die Daten am Ursprungsort nicht verändert. Dies trägt auch Befürchtungen Rechnung, ein Datenproduzent oder Datenherr könne die Kontrolle oder Autonomie über seine Daten verlieren.

Den Ausgangspunkt für die Virtuelle Datenbank bildet eine Forschungsvereinbarung zwischen der Eidgenössischen Forschungsanstalt für Wald, Schnee und Landschaft (WSL) und dem Bundesamt für Umwelt, Wald und Landschaft (BUWAL). Das BUWAL lässt eine Anzahl von Umweltdatenbanken durch verschiedene Institutionen in der Schweiz verwalten. Dabei handelt es sich um Datenbanken, die Informationen zu bedrohten Tier- und Pflanzenarten, Moosen, Flechten und Pilzen speichern, sowie verschiedenste Inventare aus dem Umwelt- und Landschaftsschutz beinhalten (Moore, Auen, Trockenwiesen und -weiden, etc.). Um Daten, die über den Umfang einer einzelnen Datenbank hinausgehen, zu analysieren und umweltrelevante Fragestellungen beantworten zu können, müssen bisher Datenexporte angefertigt und verschickt werden. Oftmals ist dabei die Datenaktualität nicht gewährleistet. Das Ziel der Virtuellen Datenbank ist es, ein System oder eine Plattform zu entwickeln, die es Instititutionen ermöglicht, direkt und ohne den Umweg eines Datenexports auf aktuelle Daten zugreifen zu können. Daneben sollen die Daten auch einer breiten Öffentlichkeit und somit auch der Forschung für verschiedenste Fragestellungen offengelegt werden.

Im folgenden Kapitel werden die wichtigsten Aspekte und Grundlagen dieser Arbeit beleuchtet. Anschliessend werden wir auf die Architektur der Virtuellen Datenbank von der konzeptuellen Seite her und auf die technische Realisierung eingehen. Abschliessend soll gezeigt werden, dass die Virtuelle Datenbank über die Integration von Umweltdaten hinaus, einen potentiellen Nutzen für die Bearbeitung planerischer Fragestellungen besitzt.

2 GRUNDLAGEN

Verschiedene Entwicklungen haben in den letzten Jahren zu einem starken Anstieg der Bedeutung des Intranets/Internets für die Bereitstellung und den Transfer von Geodaten geführt:

- Entwicklung von Softwareprodukten: Die wichtigsten kommerziellen Anbieter von GIS-Produkten (ESRI, Intergraph) haben sog. Mapserver entwickelt, welche es ermöglichen, Karten in digitaler Form über das Web zu verbreiten. Neben kommerziellen Produkten wurden von OpenSource-Projekten Softwarelösungen entwickelt, die heute erfolgreich eingesetzt werden, wie zum Beispiel der UMN MapServer (http://mapserver.gis.umn.edu). Diesen Lösungen ist gemein, dass sie sich vor allem auf Aspekte des Web-Mappings, bei dem es sich um Techniken der Nutzung, Distribution und Erzeugung von Karten mittels Internet handelt (Hermann 2001), beschränken. Solche Applikationen ermöglichen es in erster Linie, vorgefertigte Karten abzurufen, thematische Karten individuell zu erstellen oder Ergebnisse raumbezogener Analysen darzustellen (Dickmann, 2000, Asche 2001). Die Manipulier-, Abfrage- und Analysemöglichkeiten sind jeweils beschränkt (Cecconi et al. 1999), was darauf zurückzuführen ist, dass in den meisten Fällen keine Daten, sondern nur digitale Karten in Form von Bildern zur Verfügung gestellt werden.
- Definition und Verbreitung offener Schnittstellen: Die Definition, Spezifikation, Implementation und Verbreitung offener Schnittstellen für die gemeinsame Nutzung und den Transfer von Geodaten wurde durch die Gründung des OpenGIS Consortiums (OGC) 1994 stark vorangetrieben. Herring (1999) und Kottmann (1999) präsentieren eine vertiefte Diskussion des Datenmodels und des Spezifikationsprozesses, die der Generierung der offenen Schnittstellen zugrunde liegt. Für den Internet-/Intranet-basierten Vertrieb von Daten spielen vor allem die OGC-Spezifikationen im Bereich der Webservices eine Rolle. Im Vordergrund steht dabei einerseits die vom OGC verabschiedete Spezifikation des Web Map

Service (WMS, Open GIS Consortium 2001), welche auf der einen Seite bestimmt, wie digitale Karten von Klienten nachgefragt werden müssen und auf der anderen Seite festlegt, auf welche Art Datenserver ihre Daten beschreiben müssen. Den WMS charakterisieren dieselben Eigenschaften, wie oben bereits beschrieben: Es lassen sich nur Karten in Form von Bilddaten austauschen, der Austausch von Daten bleibt versagt. Die zweite Spezifikation von Interesse, die Web Feature Service Spezifikation (WFS, Open GIS Consortium 2002), definiert Schnittstellen, die der Manipulation und dem Austausch geographischer Features dienen. Im Gegensatz zum WMS werden dabei nicht Graphiken, sondern Geodaten übers Internet transportiert. Die in diesem Papier vorgestellte Virtuelle Datenbank basiert auf dieser Schnittstelle, welche wir im Implementationskapitel noch vertiefter behandeln werden.

- Etablierung der Extensible Markup Language (XML, http://www.w3c.org/XML) für den Datentransfer: XML hat sich heute in verschiedensten Anwendungsgebieten als Format für den Datentransfer über das Web etabliert. Der Erfolg von XML basiert auf zwei Eigenschaften (Anderson und Moreno-Sanchez 2003): 1). Der Inhalt der Daten wird in Textform kodiert und legt somit eine Repräsentation der Datenstrukturierung vor, die sowohl für eine Interpretation durch den Menschen als auch durch eine Maschine geeignet ist. 2) Das Format sieht der weit verbreiteten Hyper Text Markup Language (HTML) sehr ähnlich. Mit XML-Schema können mittels XML Datenstrukturen definiert werden, die für eine spezifische Anwendung verbindlich sind. In der Geodatenverarbeitung spielen zwei solche Schemen entscheidende Rollen: Einerseits hat sich mit der Geography Markup Language (GML, Open GIS Consortium 2003) ein Schema etabliert, das den Austausch von Geodaten auf der Basis von XML und den Spezifikationen des OGC ermöglicht. Die oben erwähnte Spezifikation des WFS legt den Austausch der Geodaten mittels GML fest. Beim zweiten wichtigen XML-Schema handelt es sich um die Scalable Vector Graphics (SVG, http://www.w3c.org/Graphics/SVG), welche den Transfer von graphischen Daten in hauptsächlich vektorieller Form ermöglicht. Im Gegensatz zum Transfer von Bilddaten werden mit SVG graphische Elemente mit ihren verschiedenen Eigenschaften als Vektorzüge übermittelt. Daher ist das Schema auch für den Transfer und die Darstellung von geographischen Daten äusserst attraktiv (Gould und Ribalaygua 1999). Die aktuelle Implementation der Virtuellen Datenbank basiert zwar auf GML, SGV wird indessen nicht verwendet. Brändli und Sparenborg (2002) zeigen aber eine Möglichkeit auf, wie SVG auch dafür einsetzbar ist.

Die aufgezeigten Entwicklungen haben zusammen mit generellen Entwicklungen in der Informationstechnologie dazu geführt, dass heute auch im Bereich der geographischen Informationssysteme ein Trend von monolithischen Systemen hin zu verteilten Systemen zu beobachten ist. Räumliche Daten und in zunehmenden Masse auch Methoden zur räumlichen Datenverarbeitung werden durch Webservices zur Verfügung gestellt, die verteilt vorliegen und beispielsweise durch einen Webbrowser konsumiert werden können (Tsou und Buttenfield 2002, Anderson und Moreno-Sanchez 2003, Peng und Zou, 2003). Die Virtuelle Datenbank beschränkt sich im Moment auf den Zugriff verteilter Daten, weist aber das Potential für den Einbezug verteilt vorliegender Verarbeitungsservices auf.

Für die Entwicklung der Virtuellen Datenbank sind neben allgemeinen IT-Entwicklungen und der Definition offener Schnittstellen auch Entwicklungen in der Datenbanktechnologie von Bedeutung: Hingewiesen sei hier lediglich auf sog. *Component Database* Management Systems (CDBMS), die verschiedene Möglichkeiten für die Integration verteilt vorliegender Datenbanken anbieten. Neben Ansätzen zu föderierten Datenbanksystemen (FDBS), welche die Integration von Datenbanken über die Vereinheitlichung der vorliegenden Datenbankschemen anstreben (Sheth und Larson 1990), bieten CDBMS alternative Wege an (Geppert und Dittrich, 2001). Von speziellem Interesse für die Virtuelle Datenbank ist ein CDBMS, das auf einer Datenbank-Middleware basiert. Für die Vereinigung von Datenbankkomponenten wird als erstes ein gemeinsames Format definiert, in welches die lokalen Formate übersetzt werden können. Als zweites werden einheitliche Schnittstellen (Interfaces) definiert, welche die Kommunikation zwischen den einzelnen Komponenten und der Middleware regeln. Die Schnittstellen werden mittels Wrappern implementiert, die beispielsweise in der Lage sind, Queries an die einzelnen Komponenten abzusetzen und entsprechende Antworten zu interpretieren (Roth et al. 2001).

Das Konzept einer Datenbank-Middleware in Verbindung mit der Verwendung von Wrappern, die auf standardisierten und offenen Schnittstellen basieren, verfolgen wir in den nächsten beiden Abschnitten, in denen wir den Entwurf und die Implementation der Architektur der *Virtuellen Datenbank* vorstellen.

3 ARCHITEKTUR

Die konkreten Zielsetzungen der Virtuellen Datenbank sind folgende:

- Integration von verteilt vorliegenden Datenbanken und Datenbeständen auf unterschiedlichsten Systemen ohne Autonomieeinschränkungen der einzelnen involvierten Komponenten.
- Beschränkung der Funktionalität der Integration auf verteilte Abfragen. Transaktionen für das Generieren neuer oder Aufdatieren bestehender Daten sollen durch die einzelnen Komponenten durchgeführt werden.
- Zugriff auf die Daten über einheitlich definierte Schnittstellen.
- Integrierte Darstellung und Abfrage der Daten mittels Browsern und Web-Mapping Software.

Für das Erreichen dieser Ziele wurde eine Architektur entworfen, die in Abbildung 1 dargestellt ist. Diese Architketur lässt sich in einzelne hierarchisch angeordnete Schichten gliedern, deren Eigenschaften und Aufgaben kurz umschrieben werden sollen:

- Datenbanken und Files: Die unterste Schicht der Architektur bilden die Datenbestände (auch als Datenkomponenten bezeichnet). Datenbestände können sowohl in verschiedenen Datenbankensystemen als auch in unterschiedlichsten File-Formaten vorliegen.
- Zugriffsschichten: Die Datenbestände werden über Zugriffsschichten integriert, welche einerseits die Daten über vordefinierte Schnittstellen zur Verfügung stellen und andererseits Schnittstellen vorgeben, über welche die Daten abgefragt werden können. Grosse Bedeutung bei der Integration von Daten kommt auch den beschreibenden Daten - den

Metadaten – zu. Um auf diese zuzugreifen und Abfragen durchzuführen, müssen ebenfalls Schnittstellen definiert sein. Ein schnittstellenbasierter Zugriff bedeutet, dass die Daten und Metadaten nicht in einheitlichen Datenstrukturen oder -modellen vorliegen, sondern nur für den Zugriff schnittstellenkonform aufbereitet werden müssen.

- Integrationsschicht (Middleware): Dieser Schicht kommt die Aufgabe der Steuerung des verteilten Zugriffs und der Vereinigung der Daten zu. Daneben müssen die aus den Komponenten bezogenen Daten aufbereitet werden, so dass sie entsprechend visualisiert oder weiterverarbeitet werden können. Für die Aufgabe der Steuerung muss die Integrationsschicht einerseits die "Adressen" und Datenbestände der einzelnen Komponenten kennen und andererseits Anfragen, die von Benutzerseite gestellt werden, an die Komponenten verteilen. Für die Vereinigungsaufgabe braucht es Strukturen, die die Antworten der Komponenten für die weitere Bearbeitung speichern können. Parallel zur Integrationsschicht ist eine Softwarekomponente notwendig, die die graphische Aufbereitung der Daten vornimmt und sich auf Methoden des Webmappings durch die Verwendung von Mapservern stützt.
- *Browser*: Mit einem Datenbrowser soll den BenutzerInnen eine Oberfläche zur Verfügung gestellt werden, mit der räumliche und nicht-räumliche Daten ausgewählt, abgefragt, analysiert und visualisiert werden können. Für die BenutzerInnen soll dabei nicht ersichtlich sein, aus welcher Datenbank oder welchem Datenbestand die dargestellten Daten in Form von Tabellen, Graphiken oder auch digitalen Karten stammen.

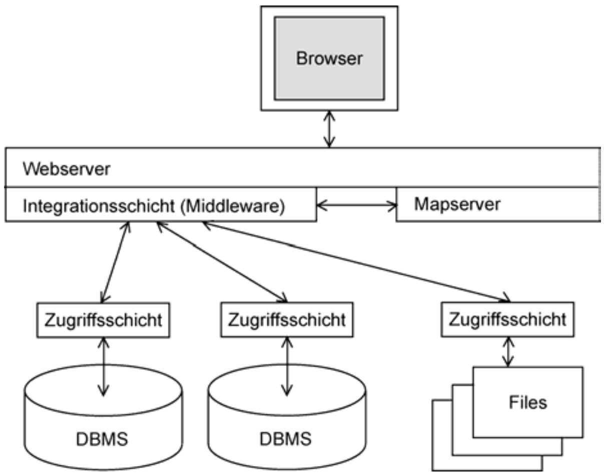

Abb.1: Architektur der Virtuellen Datenbank

4 IMPLEMENTATION

Die Implementation der einzelnen Zugriffsschichten wie auch der Integrationsschicht basiert generell auf der Programmiersprache Java und den Webkomponenten der Java 2 Plattform (Armstrong et al. 2003). Beide Schichten sind als Weblösungen implementiert und verwenden Java-Servlets (Hunter und Crawford 2001). Ein Java-Servlet ist ein Computerprogramm, das innerhalb eines sog. Servlet-Containers (z.B. Tomcat) auf einem Webserver läuft. Die Verwendung dieser Technologie bedeutet, dass sowohl die Integrationsschicht als auch die Zugriffsschichten, die verteilt vorliegen, an einen Webserver angebunden sein müssen. Als Kommunikationsprotokoll für den Transfer von Abfragen und Daten dient HTTP. Die Details der Implelementation der einzelnen Schichten werden in den nächsten zwei Abschnitten beschrieben.

4.1 Implementation der Zugriffsschichten

4.1.1 Wahl der Schnittstelle

Die Wahl der Schnittstellen für die Implementation der Zugriffsschichten fällt auf die Spezifikation des Web Feature Service WFS (Open GIS Consortium 2002). Die Spezifikation definiert Schnittstellen, die Operationen für das Abfragen, Generieren, Löschen und Aufdatieren von geographischen Objekten definiert. Für die Virtuelle Datenbank wird aber nur das vorgeschriebene Minimum implementiert, welches die drei folgenden Schnittstellen für die Datenabfrage umfasst:

- *GetCapabilities*: Beinhaltet die Angaben zu den Daten, welche über den Service bezogen und zu den Operationen, die darauf ausgeübt werden können. Die Fähigkeiten einer über die Zugriffsschicht verfügbaren Komponente werden mit einem XML-Request angefordert und über eine in XML formulierte Antwort zurückgegeben. Diese Eigenschaften beschränken sich auf die Angabe der zur Verfügung stehenden Daten, die Beschreibung der Daten und ihrer Struktur sowie das Ermöglichen des Zugriffs auf die Daten. Eine besondere Bedeutung kommt dabei den Metadaten zu, die über diese Schnittstelle abrufbar sind.
- *DescribeFeatureType*: Beinhaltet die Beschreibung der Struktur der zur Verfügung gestellten Daten. Die Struktur wird mittels XML-Schema beschrieben (http://www.w3.org/XML/Schema). Jede Komponente muss ein solches Schema bereitstellen, wofür Elemente der vom OGC spezifizierten und mittlerweile weit verbreiteten Geography Markup Language (GML) verwendet werden.

- *GetFeature*: Erlaubt den Zugriff auf die Daten über räumliche und nicht-räumliche Abfragekriterien. Wie bei den anderen beiden Operationen erfolgt die Anfrage mit einem XML-Dokument, welches Queries und Einschränkungen mit speziellen Filtern definiert. Als Antwort resultiert ein GML-Dokument, dessen Struktur mit dem vorher beschriebenen XML-Schema übereinstimmen muss. Die Bereitstellung der GML-Daten ist abhängig vom Datenbanksystem, Filesystem sowie der Strukturierung der Daten bei der jeweiligen Datenkomponente und muss in der Regel individuell implementiert werden. Mit Java wurden Grundklassen und Interfaces programmiert, die das Grundgerüst für die GML-Erstellung bilden. Für jede Komponente müssen dann in Form von objektorientierten Spezialisierungen individuelle Anpassungen vorgenommen werden. Auf zwei konkrete Beispiele gehen wir im anschliessenden Abschnitt kurz ein.

4.1.2 Zwei Beispiele für die Implementation

Als erstes Beispiel für die Zugriffsschichtimplementation dient die Datenbank des Datenzentrums Natur und Landschaft (DNL, Baltensweiler und Brändli 2004), welche an der WSL lokalisiert ist. Das DNL speichert Daten zu verschiedensten Inventaren aus dem Umweltbereich, so zum Beispiel Inventare zu Feuchtgebieten, Auengebieten, Hoch- und Flachmooren. Die Sachdaten zu den Inventarobjekten sind in einer Oracle-Datenbank abgelegt, die u.a. das Jahr der Objekterfassung und den Schutzstatus angeben. Die Objektgeometrien sind mit der Spatial Database Engine (SDE) der Firma ESRI gespeichert, einer Software, die die Speicherung und Abfrage räumlicher Daten erlaubt und als Software-Schicht zusammen mit einer relationalen Datenbank aufgesetzt wird. Diese Konfiguration der Datenspeicherung bedeutet, dass die Generierung eines GML-Datensatzes, der von der Zugriffsschicht weitergegeben wird, durch den Zugriff auf SDE erfolgen muss. Die in Oracle abgelegten Sachdaten können ebenfalls über SDE bezogen werden. Die Implementation der Zugriffsschicht verwendet daher das von ESRI für die Programmiersprache Java zur Verfügung gestellte SDE-API, das die entsprechenden Query-Möglichkeiten aufweist (Abb. 2, DNL-Komponente).

Beim zweiten Beispiel handelt es sich um eine Datenbank des Institutes für Systematische Botanik der Universität Zürich, welche verschiedene Daten zu gesammelten Moosen umfasst. Die Art der Datenspeicherung ist komplizierter als beim DNL. Die Sachdaten der Moosaufnahmen, welche u.a. wiederum das Funddatum und den Schutzstatus bezeichnen, liegen in einer Oracle-Datenbank vor. Die Fundorte der Moose, die sich eigentlich durch Punktkoordinaten auszeichnen, werden vordefinierten naturräumlichen Regionen zugeordnet, welche in einem ESRI-Shapefile gespeichert sind. Die Bereitstellung des GML-Dokumentes muss somit über den kombinierten Zugriff auf die Oracle-Datenbank und einem File im Shapeformat erfolgen. Java-seitig kommen dabei das JDBC-API von Oracle für den DB-Zugriff und speziell entwickelte Java-Klassen für die Bearbeitung von Shapefiles zum Einsatz (Abb. 2, Moos-Komponente).

Die beiden Beispiele zeigen, dass die Schnittstellen des Web Feature Service mittels Java-Klassen und Java-Servlets implementiert werden. Die entsprechenden Programme laufen an ihren jeweiligen Standorten mittels des Servlet-Containers von Tomcat (http://jakarta.apache.org/tomcat) und dem Apache-Webserver (http://httpd.apache.org/, Abb. 2).

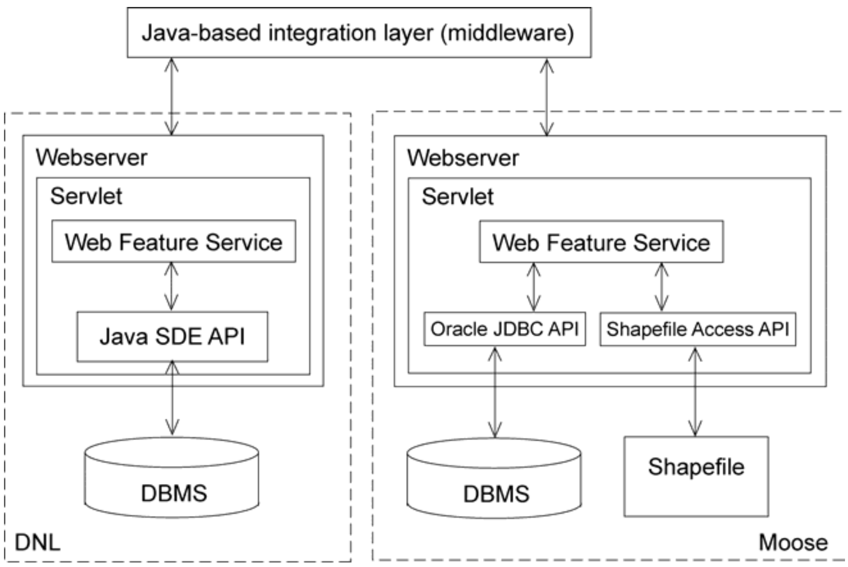

Abb.2: Beispiele für die Implementation der Zugriffsschichten

4.2 Implementation der Integrationsschicht

Analog zu den Zugriffsschichten wird auch die Middleware der Integrationsschicht mit Java und Java-Servlets auf einem Webserver implementiert. Die wesentlichen Aufgaben dieser Schicht sind das Verteilen der Anfragen und Einsammeln der Resultate an die und von den Zugriffsschichten sowie die Interpretation und das Zusammenfügen der verschiedenen GML-basierten XML-Schemen und GML-Daten. Letzteres beinhaltet hauptsächlich das Parsen von XML-Dokumenten, welches durch die Verwendung standardisierter und durch Open-Source-Projekte entwickelter Java-Klassen erfolgt (SAX-API, http://sax.sourceforge.net/).

Neben den genannten Aufgaben muss die Integrationsschicht auch die Interaktion zwischen den BenutzerInnen und der Virtuellen Datenbank regeln. BenutzerInnen arbeiten mit einem Browser, von welchem aus über HTML und JavaScript HTTP-Requests abgesetzt und Resultate in Form von HTML-Seiten erwartet werden. Die meist in Form digitaler Karten eingehenden Resultate, müssen durch die Integrationsschicht aufbereitet werden. Für die Erstellung der Karten wird der Internet Map Server *ArcIMS* von

ESRI verwendet (http://www.esri.com/software/arcims). *ArcIMS* bietet verschiedene Java-Klassen und sog. Tag-Libraries für die Programmierung von JavaServer Pages an, welche die Gestaltung von HTML-Seiten und den Einbau von graphischen Kartenelementen und Legenden server-seitig erlauben.

Während der Implementation hat sich gezeigt, dass beim Transfer von GML-Daten im Gegensatz zu den bei Webapplikationen üblicherweise im JPEG-Format transferierten Bilddaten grosse Datenmengen anfallen. Dies hat zu Datenübertragungszeiten geführt, die weit über der von Nutzern tolerierbaren Wartezeit lag. Deshalb wurde für die Integrationsschicht zusätzlich ein Caching-Mechanismus implementiert, der die grossen Mengen an Geometriedaten repliziert hält. Das Problem der Aktuellhaltung der Daten wird dadurch gewährleistet, dass die Zugriffsschichten den Status ihrer Daten überprüfen und Änderungen durch eine Meldung an die Integrationsschicht signalisieren. Diese löst ihrerseits die Aufdatierung des Replikats aus.

5 POTENZIAL FÜR DIE REGIONALPLANUNG

Auf allen Ebenen und in allen Bereichen der räumlichen Planung gehört der Umgang mit raumbezogenen Daten und Informationen zum Arbeitsalltag. Die jeweiligen öffentlichen und privaten Träger sind bei der Bearbeitung eines Planungsproblems von der Bestands- und Bedarfsanalyse bis zur Wirkungskontrolle planerischen Handelns auf Daten angewiesen, die in Ämtern und Stellen des Bundes, der Kantone und Gemeinden, Forschungsinstituten, privaten Büros und anderen Institutionen geführt werden. So bedeutet das oft zeit- und kostenintensive Zusammenstellen benötigter Daten aus verschiedenen Quellen einen nicht zu unterschätzenden Mehraufwand neben der eigentlichen Planungsarbeit.

Die Virtuelle Datenbank kann in diesem Zusammenhang zu Effizienz und Qualität in der Planung beitragen:

- Der Aufwand für Beschaffung, Organisation und Pflege von Daten kann deutlich reduziert werden. Die Auseinandersetzung mit verschiedenen Datenformaten und -strukturen wird dem Nutzer zu einem erheblichen Teil abgenommen, was die Wahrscheinlichkeit von Arbeitsfehlern, die aufgrund einer grossen Menge und hohen Komplexität von Datenbeständen auftreten, verringert.
- Eine ständige Verfügbarkeit der Datenbestände garantiert das Abrufen von Daten auf dem letzten Stand und reduziert das Risiko der Verwendung veralteter Datenbestände.
- Die schnelle Verfügbarkeit von Daten kann Prozesse der Entscheidungsfindung und Planung beschleunigen, macht sie begründeter und besser nachvollziehbar.
- Ein einheitliches, leicht bedienbares Interface, ermöglicht es, die für die spezielle Fragestellung relevanten Daten zielgerichtet abzufragen. Dabei können Datenbestände nach räumlichen und zeitlichen Kriterien selektiert bzw. mit der Eingabe der Geometrien für die jeweilige räumlichen Bezugseinheit der Planung, Datenbestände abgefragt werden.
- Die Nutzung der Virtuellen Datenbank ist plattformunabhängig. Es entstehen keine Kosten durch die Anschaffung neuer Infrastruktur und durch spezielle Mitarbeiterschulungen.
- Angesichts wachsender Möglichkeiten des IT-Einsatzes, wie GIS-Technologien, in der Planung und einer wachsenden Menge an Geodatenbeständen stellt die Virtuelle Datenbank eine Technologie dar, um letztere verfügbar, überschaubar und handhabbarer zu machen. Sie erlaubt damit einen effizienteren Einsatz von IT-Werkzeugen in der Planung.

Mit der Erhebung des Prinzips der Nachhaltigkeit zur Leitvorstellung für die Raumentwicklung in der Schweiz ist die Planung auf allen räumlichen und fachlichen Ebenen diesem Grundsatz verpflichtet. Die Regionalplanung nimmt als Vermittlerin zwischen bundes- und kommunaler sowie interkommunaler Ebene eine besondere Bedeutung für die Umsetzung des Leitbildes Nachhaltigkeit ein. Als vorausschauende, überörtliche und überfachliche Planung koordiniert sie die konkrete raum- und siedlungsstrukturelle Entwicklung einer Region. Dabei setzt sich die Erkenntnis durch, dass für eine effektive, kreative und der nachhaltigen Raumentwicklung verpflichteten Planung Sachgebiete und administrative Grenzen überschreitende Ansätze nötig sind.

Vor diesem Hintergrund haben sich in der Vergangenheit neben den formellen Plänen und Programmen informelle Planungsinstrumente wie Regionale Entwicklungskonzepte (REK) und Landschaftsentwicklungskonzepte (LEK) etabliert. Diese sollen zur Umsetzung raumordnerischer Zielstellungen eine Reihe konkreter Ziele und Massnahmen für Teilräume erarbeiten. Aufgrund der Relevanz, die diese Ansätze für die Konkretisierung nachhaltiger Raumentwicklung unter Einbeziehung regionaler Eigenheiten und Entwicklungspotentiale auf regionaler Ebene besitzen, wird im folgenden skizziert, inwieweit durch den Einsatz der Virtuellen Datenbank die Erarbeitung eines LEK unterstützt werden kann.

In der Schweiz werden LEK auf kommunaler, regionaler und kantonaler Ebene eingesetzt. In der Regel gehen sie auf die Initiative von Gemeinde, regionalen Planungsverbänden, dem Kanton oder auch einer privaten Trägerschaft zurück. Aufgrund des umfassenden Landschaftsverständnisses, auf dem ein LEK beruht, werden bei der Konzeption alle landschaftsprägenden Nutzungen bzw. Interessengruppen und Planungsperimeter in ihrem aktuellen Zustand flächendeckend einbezogen. Der integrative und kooperative Charakter des Ansätzes bedingt, wie aus den Abbildungen 3 und 4 hervorgeht, das Vorhandensein einer Vielfalt von Daten auf verschiedenen räumlichen Ebenen und das Einbinden einer Vielzahl von Akteuren.

An eine Initialisierungs- und Startphase, in der Projektziele und Schwerpunkte der Konzeption festgehalten werden, schliesst eine Phase der Bestandsaufnahme bzw. Analyse. In dieser Phase steht das zielgerichtete Beschaffen und Auswerten von Planungsgrundlagen im Vordergrund. Wie Abbildung 4 zeigt, kann dazu eine sehr grosse Bandbreite von Informationen nötig sein. So müssen Vorgaben übergeordneter Planungen, die z. B. Art und Mass der Bodennutzung, Flächen für Siedlungs- und Freiräume, Infrastrukturanlagen sowie Erholungsgebiete festlegen ebenso berücksichtigt werden wie existierende Angaben über den Ist-Zustand von Arten- und Lebensräumen, des Wassers, Bodens, Landschaftsbildes, des Klimas und der Luft als landschaftliche Schutzgüter. Auf der Grundlage dieser Informationen wird der aktuelle Wert von Landschaften aufgezeigt, werden Bedarfe und bestehende Entwicklungspotenziale ermittelt sowie Konflikte zwischen Schutz- und Nutzungsinteressen offengelegt. In der folgenden

Konzeptionsphase werden aus diesen Ergebnissen heraus die generellen Ziele konkretisiert, Massnahmen für die Umsetzungsphase erarbeitet und eine anschliessende Erfolgskontrolle geplant. Mit Hilfe der Installation einer Virtuellen Datenbank könnten die, wie in Abbildung 4 dargestellt, verstreut in Ämtern des Bundes, der Kantone und der Gemeinden sowie Forschungsinstituten vorliegenden Informationen vor allem für die entscheidenden Phasen der Analyse und Konzeption schnell und umfassend bereitgestellt werden.

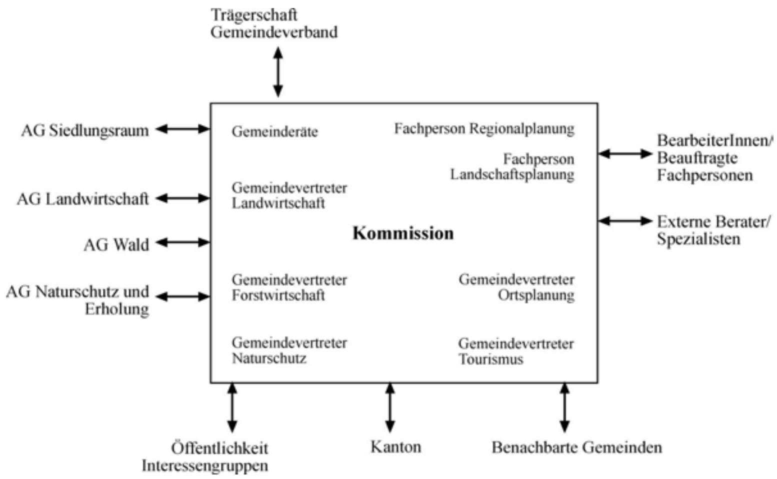

Abb. 3: Beispiel für den Aufbau eines LEK
Quelle: Adaptiert, nach Hochschule für Technik, HSR Rapperswil 2002

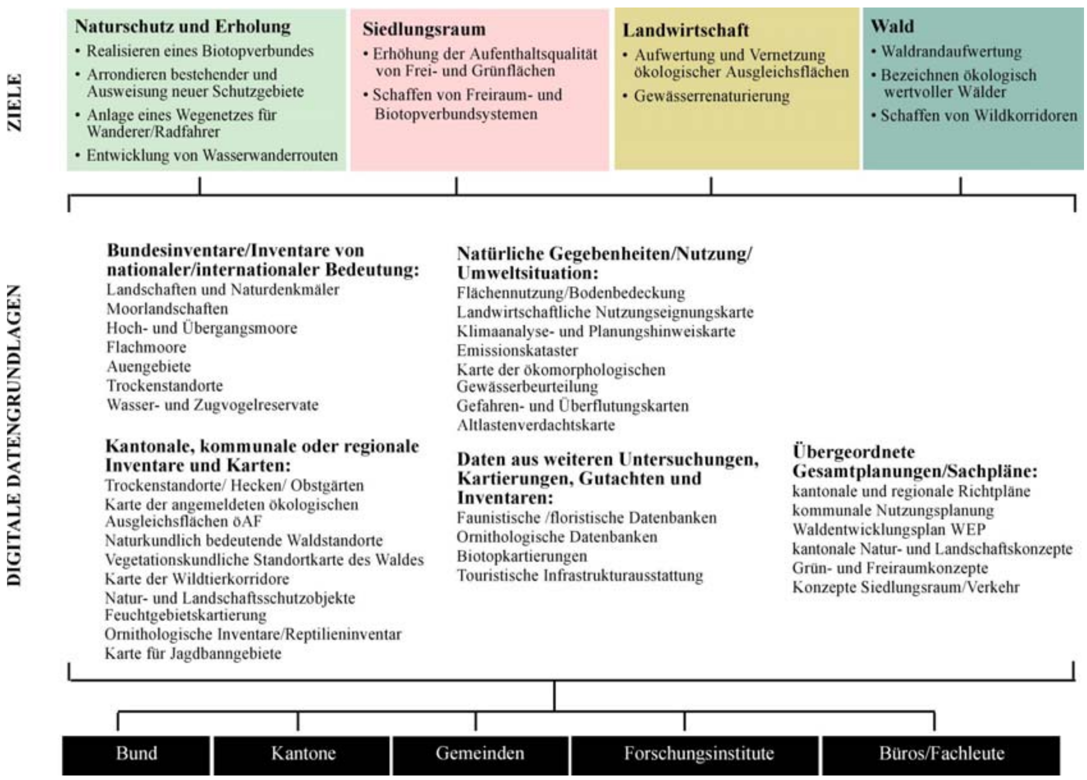

Abb. 4: Beispiel für Ziele, wichtige Datengrundlagen und Datenquellen eines LEK

Gerade für die beteiligten Gemeinden und Kantone, denen zumeist die Bereitstellung der Grundlagen obliegt, stellt eine Zusammenstellung der in den verschiedenen Institutionen geführten Datenbestände eine wesentliche, kosten- und zeitsparende Unterstützung dar und ist eine Voraussetzung für die Qualität planerischer Entscheidungen. Zudem könnten die an einem LEK mitwirkenden bzw. interessierten Akteure die Möglichkeit erhalten, sowohl die der Konzeption zugrundeliegenden Daten einzusehen und zu beurteilen, als auch Planungsergebnisse abzufragen.

6 SCHLUSSFOLGERUNGEN

Die vorgestellte Architektur der Virtuellen Datenbank ist anhand der Integration von Datenbanken aus dem Umweltbereich als Prototyp realisiert. Die Zielsetzung der Integration von Datenbeständen über die Definition einheitlicher und offener Schnittstellen ohne dass dabei die Autonomie der zu integrierenden Datenbanken eingeschränkt wird, kann mit dem vorgestellten Konzept effektiv umgesetzt werden. Die technische Realisierung des Konzepts mit der Wahl von Java als Programmiersprache und der durchgehenden Verwendung von XML als Kommunikationssprache erlaubt eine einheitliche Handhabung der Schnittstellen und Daten und bietet eine einheitliche Plattform für die Implementation. Ein grosser Vorteil bei der Verwendung von Java liegt darin, dass für die einzelnen zu programmierenden Module (Zugriffsschichten, Integrationsschicht) auf eine breite und in vielen Fällen auch freie Verfügbarkeit von existierenden und sich in Entwicklung befindenden Klassenbibliotheken zugegriffen werden kann.

Wir sind überzeugt, dass die Verwendung der Virtuellen Datenbank für verschiedenste Aufgaben grosses Potenzial besitzt. An einem Beispiel der nachhaltigen Landschafts- und Regionalentwicklung konnten wir dies übersichtsartig beleuchten. Diesbezüglich wird eine wichtige Herausforderung für die nähere Zukunft darin bestehen, aktiven Gemeinden und Regionen eine Technologie zur Verfügung zu stellen, die sie in ihrem Bemühen unterstützt, integrative und kooperative Ansätze der Planung als Grundlage einer nachhaltigen Landschafts- und Regionalentwicklung anzuwenden. Ein prioritäre Massnahme wird in diesem Zusammenhang die Installation der Virtuellen Datenbank zur Zusammenführung räumlicher Datenbeständen des Bundes, der Kantone und der Gemeinden sein. Die WSL unternimmt mit der Verknüpfung eigener Biotopkartierungen mit Inventardaten des Bundesamtes für Umwelt, Wald und Landschaft BUWAL, faunistischen/floristischen Datenbanken des Centre Suisse de Cartographie de la Faune (CSCF) und Centre du Réseau Suisse de Floristique (CRSF), sowie Datenbeständen zur Flächennutzung des Bundesamtes für Statistik erste Schritte in diese Richtung.

Die Nutzung der Virtuellen Datenbank durch die Planung und andere Anwendungsgebiete hängt gegenwärtig von der Lösung zahlreicher noch offener Fragen ab. So basiert das System auf der Partizipationsbereitschaft und Freiwilligkeit zur Bereitstellung von Informationen. Ausserdem bleiben grundsätzliche Fragen wie zum organisatorischen Aufbau, technischen Betrieb sowie zum Nutzungsrecht bzw. Nutzerzugriff zu beantworten.

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Möglichkeiten und Nutzen von objektivierten Untergrundmodellen und deren Integration in raumbezogene Informationssysteme

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1 EINLEITUNG

In Berlin existiert bereits eine Reihe von verschiedenen raumbezogenen Informationssystemen, deren Datenbestände sowohl vom Umfang als auch von der Qualität her als sehr hochwertig einzustufen sind. Dazu gehören beispielsweise die Flächennutzungsplanung, der Liegenschaftskatalog und das Baulückenmanagement.

Eine effektive Stadt- und Regionalplanung muss jedoch auch die Einflüsse des Untergrundes auf Möglichkeiten und Kosten der Bebauung oder anderweitiger Flächennutzung ins Kalkül ziehen. In innerstädtischen Ballungszentren wie Berlin mit einer langen Bauhistorie existieren über die Geologie des Stadtgebietes, das Grundwasser und die technischen Eigenschaften des Untergrundes umfangreiche Datensätze. Solche Daten für Planungszwecke nutzen zu können, setzt neben einem zeitsparenden Datenmanagement die mathematische Modellierung der Daten voraus. Dadurch entsteht ein gravierender Unterschied zu den klassischen Daten von Informationssystemen, deren wesentliches Ziel eine zusammenfassende Darstellung ist.

Am Fachgebiet Ingenieurgeologie der TU Berlin sind hierzu bislang Bohr- und Sondierungsdaten aus dem Berliner Untergrund mit verschiedenen geostatistischen Modellierungstechniken verarbeitet worden. So konnten die oberflächennahen quartären Schichten in geometrischen dreidimensionalen Modellen dargestellt werden, die zugleich Auskunft über die Auftretenswahrscheinlichkeit der darin verarbeiteten geometrischen und geotechnischen Parameter (z.B. Spitzendruck) geben. Derzeit laufende Forschungen beschäftigen sich mit den aus der Normung resultierenden Problemdefinitionen der charakteristischen Werte und der Homogenbereiche bzw. deren Einbindung in die Modellierungspraxis. Dadurch und durch die Modifikation der geostatistischen Verfahren sollen die existenten Modelle nochmals optimiert werden. Mittelfristiges Ziel ist dabei die Kopplung von geometrisch-geologischen und geotechnischen Modellen. Langfristige Zielsetzung muss jedoch die Integration dieser Modelle in bestehende Informationssysteme sein, die mit den zusätzlichen Daten aus objektivierten Untergrundmodellen einen erheblichen Fortschritt erfahren würden.

Dieser Beitrag soll zunächst den aktuellen Stand der Geoinformationssysteme in Berlin und im Bundesland Brandenburg darstellen. Anschließend soll der Nutzen der Integration baugeologischer Modelle dargestellt werden. Die damit in Verbindung stehenden Schwierigkeiten werden beschrieben und die derzeit am Fachgebiet laufenden Forschungen vorgestellt.

2 GEOINFORMATIONSSYSTEME IN BERLIN UND BRANDENBURG

In Berlin bestehen bereits zahlreiche Informationssysteme, die den räumlichen Bezug ihrer Daten berücksichtigen und verwerten. Von den entsprechenden Senatsverwaltungen der Stadt werden diese Informationssysteme mit teils sehr hohem Aufwand unterhalten. Einige Beispiele zeigt die folgende Abb.1. Die jeweils enthaltenen Daten sind von hoher Qualität, der Inhalt der Systeme wird ständig aktualisiert und erweitert.

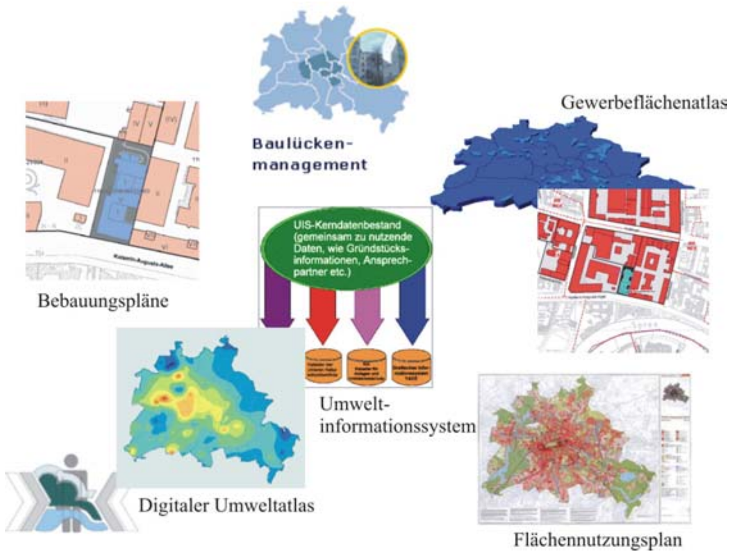

Abb.1: Geoinformationen in Berlin (verfügbar unter www.berlin.de)

Für das Bundesland Brandenburg sind zusätzlich insbesondere die Daten der Landesvermessung (Karten, Orthophotos u. a.) hervorzuheben. Allen Systemen ist jedoch in ganz deutlicher Weise das gemein, was bereits durch mehrere Studien (u. a. MICUS 2001, 2002, 2003) belegt wurde und was den Nachholbedarf der deutschen Geoinformationswirtschaft zum Ausdruck bringt: Sofern der potentielle Nutzer überhaupt von der Existenz der Systeme Kenntnis hat und versteht, welchen Vorteil oder gar wirtschaftlichen Nutzen der Erwerb GIS-gestützter Informationen für ihn haben könnte, hat er sich mit den unterschiedlichen Abgabeverfahren und der Preisgestaltung der Behörden auseinander zu setzen. Hinzu kommt, dass viele Daten ohnehin nur einem vordefiniertem und begrenztem Nutzerkreis zu Verfügung gestellt werden.

Die damit einhergehende und seit Jahren anhaltende Diskussion über die Zurverfügungstellung von Daten des öffentlichen Sektors wird durch unterschiedliche Interessen von Nutzern, Anbietern und Verarbeitern genährt. Die dabei erscheinenden juristischen Hürden sind insbesondere der Datenschutz, das Urheberrecht und die derzeit stark restriktiv wirkenden Nutzungsrechte der Daten für Weitergabe oder Veröffentlichung. Diese Diskussion hat durch die Gründung des Verbandes GEOkomm Anfang 2003 neuen Auftrieb erfahren (www.geokomm.de). Diesem Verband gehören insbesondere kleinere und mittlere Unternehmen der Geoinformationswirtschaft an – hauptsächlich aus der Region Berlin-Brandenburg – aber auch Universitätsinstitute und Landesbehörden. Binnen Jahresfrist konnte er sich zum Sprachrohr der regionalen Geoinformationswirtschaft entwickeln. Die infolge der o. a. Limitationen entstandenen Wünsche an umfassende gesetzliche Neuregelungen werden derzeit seitens des GEOkomm in konkrete Forderungen an die Politik formuliert.

Über diese rechtlichen Hindernisse hinaus bestehen scheinbar technische Schwierigkeiten, die verschiedenen Systeme effektiv zu kombinieren. Dass jedoch gerade Berlin auf eine geeignete existente Technologie zurückgreifen könnte, wird von Müller (2003) dargelegt. Dort sind verschiedene beispielhafte Anwendungsszenarien dargestellt, die deutlich werden lassen, dass die technischen Möglichkeiten dafür bereits vorhanden sind. Zudem wird der wirtschaftliche Effekt, den eine Verquickung der verschiedenen Systeme nach sich ziehen würde, demonstriert.

3 ZUR INTEGRATION GEOLOGISCHER DATEN IN GEOINFORMATIONSSYSTEME

Die finanziellen Aufwendungen für geologisch-geotechnische Vorerkundung stellen mit 0,1-0,5 % Anteil an den Gesamtkosten eines Projektes einem im Vergleich zum Nutzen geringen Aufwand dar. Denn die nachträgliche Sanierung aus dem Baugrundverhalten resultierender Schäden ist gewöhnlich ungleich teurer. Die auf den projektbezogenen geotechnischen Vorerkundungen aufbauenden Prognosen des zu erwartenden Baugrundverhaltens können durch die Einbeziehung bereits vorhandener Daten, die dann Bestandteil eines komplexen Geoinformationssystems sein müssten, wesentlich zutreffender gestaltet werden. Darüber hinaus ließen sich unter dieser Voraussetzung bereits Machbarkeitsstudien und die Konzeptionen projektbezogener Vorerkundungen optimieren. Zu beachten ist jedoch, dass sich geologische und geotechnische Daten von denjenigen, die normalerweise in Geoinformationssystemen verarbeitet werden, markant unterscheiden. Sie weisen eine Vielzahl von Eigenschaften auf, die ihre Aufnahme in bestehende Systeme verhindern oder durch eine vorher notwendige – wie auch immer geartete Standardisierung oder Transformation – erheblich erschweren. Eigenschaften, die verdeutlichen, welchen Aufwand die Integration solcher Daten in raumbezogenen Informationssysteme erfordern dürfte, sind zum Beispiel von Reik & Vardar (1999) beschrieben worden. Dazu gehören im wesentlichen

- Inhomogenität der Gebirgskörper und Komplexität der geologischen Strukturen,
- Diskontinuitäten in verschiedenen Größenbereichen und daraus resultierend
- Größen- und Maßstabsabhängigkeiten, etwa von Materialkennwerten,
- Anisotropie und Mehrphasigkeit,
- Unsicherheiten hinsichtlich geologischer Grenzflächen, charakteristischer Eigenschaften, Spannungszustand, bedingt durch Unzugänglichkeit und die geringe Aufschlussdichte, sowie die
- Zeitabhängigkeit der Eigenschaften und Zustandsgrößen.

Zwar ist damit eine Visualisierung der Daten selbst möglich, doch können auf diese Weise keine Aussagen über die meist sehr großen Untergrundbereiche abgegeben werden, aus denen keine Daten vorliegen. Resultierend aus der Unzugänglichkeit sowie der räumlichen Struktur der Objekte wird deshalb eine dreidimensionale Modellierung erforderlich, die möglichst objektiv durchgeführt werden sollte. Im Hinblick auf die unvermeidliche Unzulänglichkeit der Daten – im statistischen Sinne liefert jede noch so umfangreiche geotechnische Untersuchung nur eine verschwindend kleine Stichprobenpopulation verglichen mit der Grundgesamtheit – sowie die natürliche Streuung aller geogenen Daten können die Modellierungen zusätzlich auch zu Simulationen ausgeweitet werden. Eine vollständige Kenntnis des Untergrundes kann daher nie – nicht einmal bei dichtestem Erkundungsraster – erlangt werden. Erst seit Entwicklung der Geostatistik in den 1960er Jahren und ihrer rasanten Fortschritte in den darauf folgenden Jahrzehnten ist es möglich, die unbeprobten Zwischenräume zu interpolieren und das dortige Auftreten bestimmter Lithologien mit Wahrscheinlichkeiten zu belegen. Damit wird eine gewisse Objektivität in der Darstellung erreicht, was einer signifikante Optimierung der sonst nur durch lineare Interpolation gezeichneten Profile gleichkommt.

Die Geostatistik macht sich sämtliche intrinsische Eigenschaften geologischer Daten zu Nutze, so die etwaige Teufenabhängigkeit, eine im allgemeinen vorhandene Anisotropie und die Autokorrelation. Letztere ist Resultat der nicht zufälligen genetischen und postgenetischen Prozesse der jeweiligen Schicht und führt innerhalb eines begrenzten zwei- oder dreidimensionalen Raumes um die Probenlokation zu einer graduellen Abhängigkeit aller anderen Proben. Diese als Reichweite bezeichnete Abhängigkeitsentfernung kann mittels der Variographie erfasst werden und wird im folgenden Schritt des Kriging zur geostatistischen Modellierung benutzt. Diese Abhängigkeit einzelner Proben bewirkt bereits die fehlerhafte Berechnung von Mittelwerten u. ä., was durch andere Faktoren noch verstärkt werden kann. Dabei handelt es sich um die bevorzugte Platzierung von Aufschlüssen an Punkten, an denen man sich bessere oder mehr Informationen erhofft, die also für die Planung von größerem Interesse sein dürften. Hierzu gehören beispielsweise Aufschlussbohrungen, die bevorzugt in der lateralen Nähe eines vermuteten Schichtauskeilens oder direkt in geologische Anomalien abgeteuft werden, wie etwa in die Geschiebemergelfenster, die in Berlin für Grundwasserhaltungsmaßnahmen tief reichender Baugruben von besonderem Interesse sind. Damit ergeben sich zwangsläufig Unterschiede in der Dichte der Aufschlussraster und lokale Cluster. Ebenfalls von zentraler Bedeutung sind die typischerweise vorhandene Heteroskedastizität und die Instationarität der Daten.

4 ARBEITEN AM FACHGEBIET INGENIEURGEOLOGIE DER TU-BERLIN

4.1 Generierung geologischer Modelle

Auf eine Darstellung der theoretischen Grundlagen der Geostatistik muss an dieser Stelle verzichtet werden. Standardwerke sind z. B. Davis 2002 und Deutsch & Journel. Die geostatistischen Modellierungsmethoden nutzen die oben beschriebenen Eigenschaften geologischer Daten und erstellen ein objektives Modell, anhand dessen sich etwa die Auftretenswahrscheinlichkeit bestimmter Lithologien in den nichtbeprobten Stellen quantifizieren lässt. Eine allgemeine Verfahrensweise gibt Abb.2 wieder.

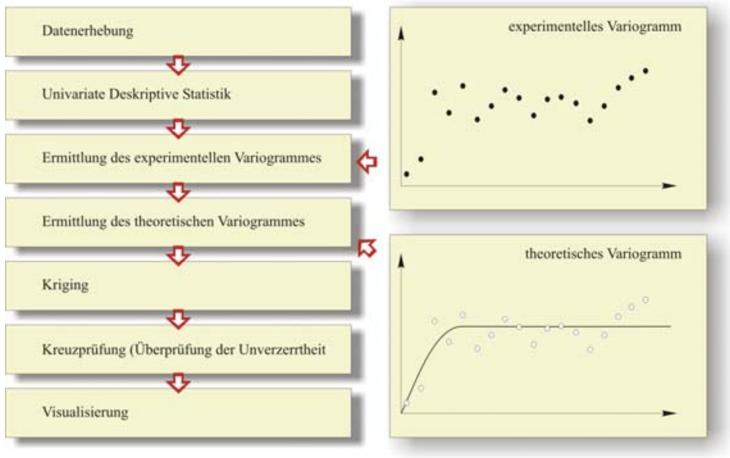

Abb.2: Schematischer Ablauf einer durch Anwendung der Geostatistik objektivierten Untergrundmodellierung

Marinoni (2000) hat solche Modelle für die glazialen Ablagerungen im zentralen Teil Berlins erstellt. Damit ist die Konstruktion von Isohypsenkarten einzelner Schichtober- oder -unterseiten möglich. In gleicher Weise können auch Isopachenkarten einzelner Schichtglieder erstellt werden (Abb.3).

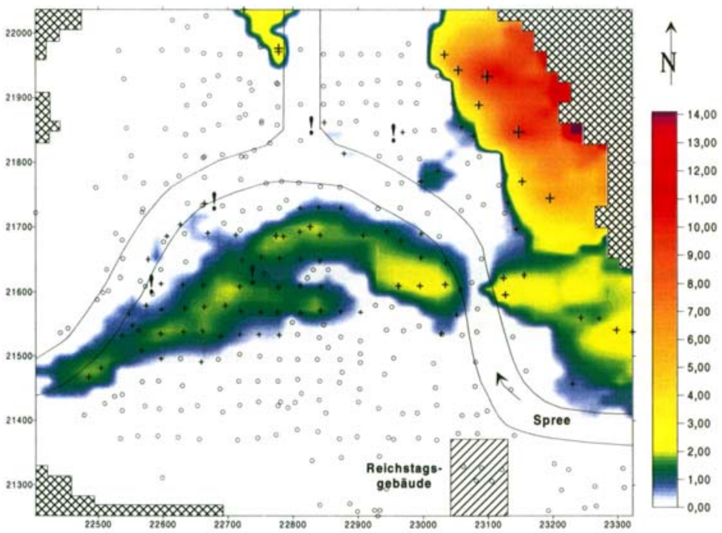

Abb.3: Geostatistisch modellierte Mächtigkeit der organischen Schichtablagerungen holozänen Alters
im zentralen Bereich Berlins als Beispiel eines geologisch-geometrischen Modells (aus Marinoni 2000)

Bei den hier beschriebenen geometrisch-geologischen Modellen handelt es sich im Grunde um 2,5-dimensionale Modelle, die die Oberfläche einer Funktion $z = f(x, y)$ beschreiben. Das bedeutet, dass an jedem Punkt über die Fläche innerhalb einer Schicht nur ein Parameter modelliert wird, hier die Schichtmächtigkeit z an der Stelle (x, y) oder die jeweiligen Schichtober- oder -unterseiten. Dazu werden an den zu modellierenden Rasterpunkten alle benachbarten Bohrungen mit den bekannten erforderlichen Parametern in den Modellierungsprozess eingebracht. Vollständige geometrisch-geologische Modelle ergeben sich durch Stapelung der Mächtigkeiten der einzelnen Schichtglieder in genetischer Reihenfolge. Es können nun Profilschnitte beliebiger Richtung und beliebiger Linienführung abgerufen werden, sofern sich deren Verlauf an den Rasterpunkten des Netzes orientiert.

4.2 Generierung geotechnischer Modelle

Im Unterschied dazu handelt es sich bei der Modellierung gemessener geotechnischer Parameter um echte dreidimensionale Modelle. Die Variographie erfordert somit dreidimensionale Suchbereiche. Der besseren Visualisierung wegen werden sie jedoch durch horizontale Ebenen beliebiger geodätische Höhe geschnitten, die dann separat dargestellt werden. Abb.4 zeigt ein derartiges Beispiel, basierend auf dem Parameter „Spitzendruck“ aus Drucksondierungen. Die mit dem Spitzendruck korrelierbare Lagerungsdichte des Baugrundes kann dann in beliebiger Tiefe unterhalb des Gründungssohle veranschaulicht werden.

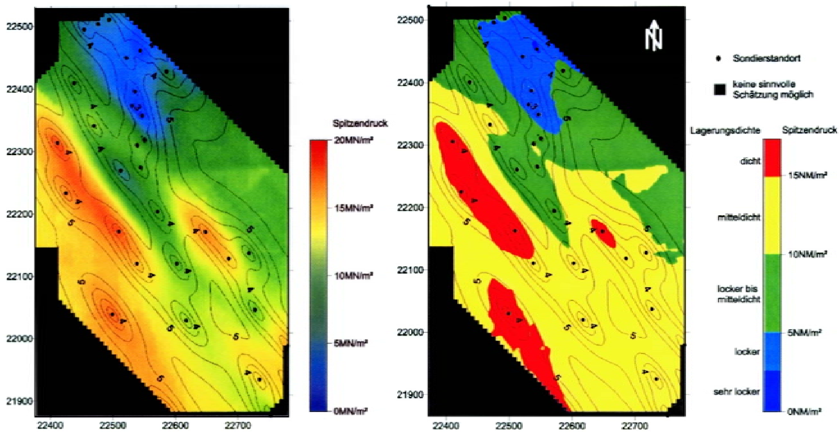

Abb.4: Geostatistisch modellierter Spitzendruck aus Drucksondierungen (CPT) nach DIN 4096 in der Ebene 32 mNN und Ableitung der Lagerungsdichte *D* des Bodens nach DIN 18126 im zentralen Bereich Berlins als Beispiel eines geotechnischen Modells (aus Tiedemann & Grunow 2000)

4.3 Charakteristische Werte

Am Fachgebiet Ingenieurgeologie laufende Forschungen beschäftigen sich u. a. mit der Problematik der charakteristischen Werte (DIN 4020) und der damit in direkter Verbindung stehenden Ermittlung der Teilsicherheitsbeiwerte auf statistischer Basis. Motiviert wurde dies durch die unscharfen Erläuterungen dieser beiden Begriffe in den geotechnischen Normen, die auch nach der Entwicklung und bereits teilweise erfolgten Etablierung der europäischen Normung verblieben sind. Zum Übergang vom globalen Sicherheitskonzept zum Teilsicherheitskonzept siehe z. B. Witt (1998).

Hinsichtlich der Forderungen der Normen nach Festlegung charakteristischer Werte für die projektrelevanten geotechnischen Parameter kann eine Objektivierung nur auf breiter statistischer Basis erfolgen, wie Kruse (2003) anhand von Scherversuchen an Geschiebemergeln zeigt.

4.4 Homogenbereiche

Eine zweite, erst in jüngerer Zeit initiierte Forschungsrichtung am Fachgebiet Ingenieurgeologie beschäftigt sich mit der objektivierten Abgrenzung von Homogenbereichen im Lockergestein. Auch dieser Begriff ist in den entsprechenden Normen nur unscharf definiert. So bleibt es dem Projektbearbeiter überlassen, wie er den Untergrund unter Berücksichtigung seiner Erfahrung und etwaiger aus dem Projekt selbst resultierender Vorgaben in Homogenbereiche einteilt. Im Fels erfolgt die Homogenbereichsabgrenzung meist anhand der Gefügestatistik und der Lithologie. Vereinzelt finden sich Anwendungen von rechnerischen Verfahren auf statistischer Basis, die als Eingangsparameter auch andere Daten, z. B. Werte eines beliebigen geotechnischen Parameters entlang einer Tunnelachse zulassen (z. B. Liu, Brosch, Klima & Riedmüller 1999).

Im Lockergestein zeigen die Häufigkeitsverteilungen von Schichtmächtigkeiten oder geotechnischen Parametern oftmals bi- oder gar multimodalen Charakter. Zudem können Untersuchungen von separaten Bereichen innerhalb des Gesamtgebietes völlig abweichende geostatistische Parameter (Reichweite, Schwellenwert, Anisotropie) erbringen. Beides lässt die Existenz distinkter Subpopulationen und damit unterschiedlicher Homogenbereiche vermuten, sofern die ermittelten Abweichungen statistisch signifikant und also nicht rein zufällig sind. Zusammen mit der Forderung der DIN 4020 bestehen folglich insgesamt drei Gründe, sich mit der Abgrenzung und Definition von Homogenbereichen zu beschäftigen (siehe Abb.5).

Zur Homogenbereichsabgrenzung existieren diverse Verfahren, wie etwa Diskriminanz-, Cluster- oder Korrespondenzanalyse, die sich entweder direkt oder erst nach Modifikation des Datensatzes oder des Verfahrens auch auf geologische und damit räumlich strukturierte Daten anwenden ließen. Dabei könnten sowohl uni- als auch multivariate Datensätze verwendet werden. Zusätzlich sind außerdem bereits Methoden vorhanden, in die die räumlichen Eigenschaften direkt eingehen, wie etwa Split Moving Windows Dissimilarity Analysis.

Künftige Untersuchungen sollen die Frage beantworten, welche dieser Methoden sich in bezug auf geologische Datensätze am besten für die Homogenbereichsabgrenzung in lateraler und vertikaler Richtung eignet und welche Auswirkungen dies auf eine nachfolgende geostatistische Modellierung hat. Dass dies bislang noch nicht stattgefunden hat, lässt sich auf die mit einer Homogenbereichsabgrenzung meist verbundene Reduktion der für Variographie und Kriging zur Verfügung stehenden Datenmenge zurückführen. Es sind folglich schlicht praktische Erwägungen, die den wissenschaftlichen Erfordernissen vorgezogen werden. Es wird jedoch vermutet, dass die Variographie weniger sensibel auf geringe Datenmengen reagiert, wenn alle verwendeten Daten aus einer einzigen Subpopulation stammen. Ein darauf aufbauendes Kriging könnte daher gegenüber herkömmlichen Modellen trotzdem eine Verbesserung darstellen.

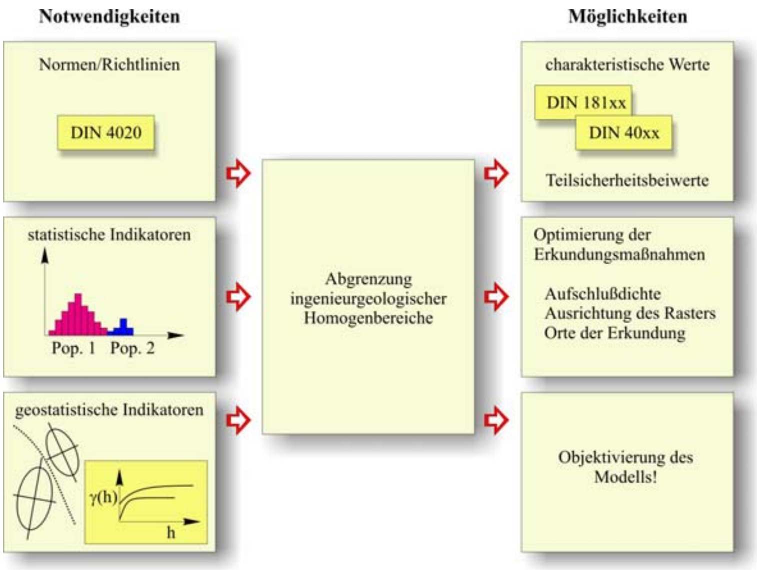

Abb.5: Argumente für die Homogenbereichsabgrenzung

Die solchermaßen generierten Untergrundmodelle müssen schließlich einer Evaluierung unterzogen werden. Dieses sind zunächst *statistische Kriterien*, die den räumlichen Bezug der Daten untereinander unberücksichtigt lassen, und *geostatistische Kriterien*, die den räumlichen Bezug der Daten mit einbeziehen. Sämtliche Modelle sind danach auch hinsichtlich *allgemeiner Kriterien* zu bewerten, die auch zur Bewertung anderer, nicht-geologischer, Modelle geeignet wären, wie etwa Plausibilität, Reliabilität, Portabilität usw.

5 ZUSAMMENFASSUNG UND SCHLUSSFOLGERUNGEN

Die in Berlin für ein städtisches Geoinformationssystem in Betracht kommenden Daten und Datenbanken stellen ein wirtschaftliches Potential dar, das durch die Integration von geotechnischen Daten noch erheblich vergrößert werden könnte. Gelänge es, alle Datenpools miteinander zu verknüpfen, entstünde eine schnell abrufbare, wahrscheinlich auch kostengünstige Grundlage für die Stadtplanung. Die Hindernisse, die der Entwicklung eines solchen komplexen Geoinformationssystems im Wege stehen, sind informationstechnischer und juristischer Art.

Hinsichtlich der geologischen und geotechnischen Datensätze haben Untersuchungen den prinzipiellen Weg zum objektivierten Baugrundmodell aufgezeigt, der über die geostatistischen Verfahren Variographie und Kriging führt. Offen sind bislang die Antworten auf die Fragen nach einer objektivierten Homogenbereichsabgrenzung als Voraussetzung für die Definition statistisch korrekter Grundgesamtheiten sowie deren Auswirkungen auf die Ergebnisse geostatistischer Modellierung.

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$KSI_{Underground}$ – Kommunale Serviceplattform für Abwasser-Infrastrukturen

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1 ABSTRACT

KSI-Underground entwickelt und erprobt ein multimediales Wissensmanagement-System zur Prozessautomatisierung komplexer, zeitintensiver und fehleranfälliger technischer und wirtschaftlicher Entscheidungsprozesse bei Verwaltung und Betrieb kommunaler und privater Abwassernetze.

Aufbauend auf einer umfangreichen Wissensbasis soll das vorhandene Netzmanagement analysiert und zur Generierung von neuen Daten, Informationen, Wissen sowie konkreten Handlungsanweisungen genutzt werden. Hierdurch sollen die Kommunen in die Lage versetzt werden, bedarfsgerechte Investitionsentscheidungen für die Abwassersysteme zu treffen und diese Entscheidungsprozesse kontinuierlich zu optimieren. Die Lösung soll zur Informations- und Dienstleistungsdrehscheibe für Kommunen, private Netzbetreiber, Ingenieurbüros, Bauunternehmen und Lieferanten werden.

Das Konzept der Wissensmanagement Lösung umfasst eine webbasierte Lehr-, Lern- und Arbeitsplattform („UNITRACC“), ein System zum Auf- und Ausbau einer integrierten Wissensbasis, ein Kanalmanagementsystem zur Unterstützung der Entscheidungsprozesse („Status Kanal“) und ein Agentensystem zur personenbezogenen Generierung und Bereitstellung von Wissen.

Die praktische Erprobung von KSI-Underground mit 4 Anwendern in Deutschland soll u.a. den Nachweis über erhebliche Einsparmöglichkeiten bei den hohen Kosten für Bau, Betrieb und Pflege von Kanalinfrastrukturen leisten. Die Erfahrungen können Dritten als praxisorientiertes Know-how zur Verfügung gestellt werden.

2 AUSGANGSSITUATION

Für die Sammlung und Ableitung von Abwasser sorgen die unterirdischen Kanalisationen, die planmäßig seit 1842 errichtet werden und das größte Anlagevermögen im Besitz der Städte und Kommunen in der Bundesrepublik Deutschland bilden. Die Verwaltung der ca. 445.000 km (Stand 2001, Quelle: ATV-DVWK) öffentlichen Abwasserkanäle ist daher ein komplexer und kostenintensiver Prozess. Hinzu kommen etwa 900.000 km privater Grundstücksentwässerungsleitungen.

Der Anteil dringend zu sanierender Schäden beträgt bei den öffentlichen Kanälen ca. 17 % und bei den privaten Abwasserleitungen ca. 40 %. Die Kosten für die Bewirtschaftung (hier Betrieb, Unterhalt und Sanierung) dieser Netze belaufen sich für die nächsten 10 Jahre auf über 100 Mrd. €. Diese Zahl verdeutlicht die enorme Bedeutung der Netzbewirtschaftung in den kommunalen Haushalten.

Die Ressource Wasser als Konsumgut, Produktionsfaktor und Umweltmedium ist (auch aus volkswirtschaftlicher Sicht) der mengenmäßig bedeutendste Stofffluß eines Industriestaates wie Österreich. 81 % der in der Gütekarte 1998 dargestellten Fließgewässer weisen eine biologische Klassifizierung der Güteklasse II oder besser auf. Erreicht wurde dies durch Sanierungsmaßnahmen, die sich in erster Linie auf die Erweiterung der Kanalnetze und den Ausbau der Kläranlagen bezogen. Die hohen Qualitätsanforderungen, die Österreich sowohl an die Trinkwasserver- und Abwasserentsorgung stellt, haben österreichische Unternehmen zu Höchstleistungen motiviert. Im Bereich der Wasserver- und Abwasserentsorgung wird in Österreich für die nächsten zehn Jahre ein Finanzbedarf von über 10,9 Mrd. Euro errechnet. (In: "Water & More", Initiative der IV und des BM für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft, Sept. 2001.)

In Anbetracht dieser gewaltigen Kosten ergibt sich die Notwendigkeit zum verantwortungsvollen Umgang mit den begrenzten Finanzmitteln, welcher aber durch die Komplexität der Entscheidungsprozesse erschwert wird. Denn die in der Bundesrepublik Deutschland vorhandenen Kanalisationen spiegeln aufgrund ihres Alters alle Entwicklungsetappen wieder, so dass man heute insgesamt sehr heterogene Netze mit einer Vielfalt von Querschnittsformen und –abmessungen, Rohrwerkstoffen, Rohrverbindungen, Bettungsarten, Konstruktionsprinzipien, Bauwerken, Leitungsarten, Entwässerungsverfahren usw. vorfindet und damit eine enorme Daten- und Informationsmenge zu berücksichtigen hat.

Die Entwicklung eines multimediabasierten Wissensmanagementsystems, welches diese komplexen Entscheidungsprozesse automatisiert bzw. durch die Verwaltung und Wissensgenerierung aus strukturierten und unstrukturierten Daten unterstützt, hätte für alle Kommunen und Netzbetreiber erhebliche Kosteneinsparpotenziale zur Folge. Die Optimierung der hierfür benötigten betrieblichen, technischen, rechtlichen und kaufmännischen Verwaltungsabläufe ist somit prädestiniert, um auch für andere kommunale Infrastrukturen wie z.B. Straßenverwaltung, Gas- und Wasserversorgung als Referenzmodell fungieren zu können.

3 ZIELSETZUNG

Gesamtziel des Projektes ist die Entwicklung und Erprobung eines 100 % webbasierten und multimedial aufbereiteten Wissensmanagementsystems für **Verwaltung und Betrieb kommunaler und privater Entwässerungsnetze**, nachfolgend **KSI$_{\textbf{Underground}}$** (KSI = Kommunale Serviceplattform für Abwasser Infrastrukturen) genannt.

KSI$_{\textbf{Underground}}$ soll vorrangig die bei Kommunen und Netzbetreibern zur Zeit vorhandenen, erheblichen Kosteneinsparpotenziale bei Verwaltung und Betrieb kommunaler Entwässerungsnetze aktivieren, durch:

- Verknüpfung des Wissens von kleinen und mittelständischen Unternehmen, öffentlichen Verwaltungen, Forschungseinrichtungen und Hochschulen sowie sonstigen Institutionen, Verbänden etc. auf einer zentralen und professionell organisierten und betriebenen Internetplattform
- Konservierung und Sicherung von Wissen
- Wissenstransfer durch effektive und schnelle Verarbeitung, strukturierte Filterung sowie komprimierte zur Verfügung Stellung der vorhandenen Informationsmengen
- Verbesserung von Kundenbeziehungen bzw. des Verhältnisses zwischen Auftraggeber und Auftragnehmer sowie Anbahnung von Kooperationen und Partnerschaften
- Erkennung und Nutzung von Synergiepotenzialen durch Vermeidung von Paralleltätigkeiten und Doppelarbeiten
- Beseitigung der bei den betroffenen Stellen vorherrschenden Wissensdefizite
- Breite Ausnutzung des auf der Plattform vorhandenen Wissensbestandes durch in diesem Bereich Tätige bzw. an diesem Gebiet Interessierte
- Automatisierung komplexer Entscheidungsprozesse
- Neugewinnung von Wissen sowie Akquirierung individueller, noch nicht publik gemachter Wissensbausteine und (Praxis-) Erfahrungen – bei Bedarf in anonymisierter Form.

4 STRUKTUR VON KSI$_{\textbf{UNDERGROUND}}$

Das zu Grunde liegende Gesamtkonzept eines Wissensmanagementsystems basiert auf vier zentralen Säulen:

Webbasierte Lehr-, Lern- und Arbeitsplattform „UNITRACC" (s. Abschnitt 4.1)

Data Management mittels Text-Mining, Sematic Web (s. Abschnitt 4.2.1)

Prozessautomatisierung „Status-Kanal" (s. Abschnitt 4.2.2)

Agentensystem (s. Abschnitt 4.2.3).

KSI$_{\textbf{Underground}}$ wird als Entwicklungsbasis die Ergebnisse des Forschungsprojektes **UNITRACC**, welches im Rahmen von **Lernet** (Go2Learning) vom **BMWA** der Bundesrepublik Deutschland gefördert und durch die **DLR** (Projektträger Multimedia) wissenschaftlich begleitet wird, nutzen. Dadurch verfügt KSI$_{\text{Underground}}$ (Abb. 2) über die umfangreichste Wissensbasis im Bereich des Leitungsbaus und der Leitungsinstandhaltung, die gegenwärtig international zur Verfügung steht. Diese Wissensbasis besteht aus multimedial aufbereiteten Fachbüchern, Baustellendokumentationen, Handlungsanweisungen, Skripten, Vorlesungen, Übungen und dem kompletten Kenn- und Planzahlenwissen, welches der Leitungsbauingenieur benötigt.

Abb. 2: Prinzipieller Aufbau von **KSI$_{\textbf{Underground}}$**

4.1 Webbasierte Lehr-, Lern- und Arbeitsplattform UNITRACC

UNITRACC, Underground Infrastructure Training and Competence Center, ist eine moderne E-Learning-Lösung mit dem Schwerpunkt Leitungsbau und Leitungsinstandhaltung. Die Zielgruppe stellt die gesamte Breite der in diesem Bereich des Tiefbaus tätigen Personenkreise dar: Facharbeiter, Techniker, Ingenieure in Ingenieurbüros und öffentlichen Verwaltungen, Studierende in Universitäten und Fachhochschulen, Teilnehmer in Aus- und Weiterbildungsinstituten sowie Auszubildende in Berufsschulen.

UNITRACC stellt ein komplementäres Angebot dar, das flexibel und individuell einsetzbar ist und im Hinblick auf Zeit und Kosten die Präsenzausbildung optimiert und ergänzt. Die Architektur dieser Plattform umfasst drei Bereiche:

- Informieren/Recherchieren im „Competence Center“
- Lehren/Lernen in der „Akademie“
- Arbeiten mit Softwaretools (ASP)

Ziele von UNITRACC sind:

- die Schaffung von Handlungskompetenz durch Bereitstellung von internationalen, den aktuellen Stand der Technik repräsentierenden Fachinformationen und wirtschaftlichen Daten
- Harmonisierung der Aus- und Weiterbildung durch Bereitstellung von Lehrmaterialien für Berufsschulen, Ausbildungszentren, Fachhochschulen und Universitäten
- die Bereitstellung von Softwaretools für Ingenieurdienstleistungen und Möglichkeiten zur Koordinierung und Abwicklung von Bau- und Forschungsprojekten.

Mit diesem Konzept wird einerseits eine zeitgemäße, betriebliche Kompetenzentwicklung gewährleistet, die den ständig wachsenden Qualifikationsanforderungen und der daraus resultierenden Notwendigkeit zu kontinuierlicher Weiterbildung entspricht. Andererseits helfen die Fachinformationen zur wirtschaftlichen, ökologischen und dem Stand der Technik entsprechenden Lösung aktueller Probleme und Aufgaben.

Die Integration der daten- und informationsverarbeitenden Arbeitsmittel in Ausbildungsinhalte und der effiziente Einsatz multimedialer Lernangebote ist die Herausforderung für eine webbasierte E-Learning und E-Working – Multifunktionsplattform wie UNITRACC. Das Konzept geht über das Angebot einer passiven Informationsaufnahme hinaus durch die Möglichkeiten eine Lernkompetenz zu erwerben, die eine eigenständige Orientierung und Fragestellungen mittels handlungsbezogenen, entdeckenden und selbständigen Lernens beinhaltet. Die größte Bedeutung bei der Schaffung von Handlungskompetenzen besitzen die Medien in Form von Normen und Regelwerken, Fachbüchern und –zeitschriften, Nachschlage- und Tabellenwerken, Dokumentationen, Firmeninformationen, Fachinformations- und Entscheidungshilfesysteme, denen sich der planende oder mit einer speziellen Aufgabe befasste Ingenieur in der Praxis zur Lösung eines Problems bedient.

Das Konzept von UNITRACC basiert auf der Bereitstellung einer zeitlich und räumlich unabhängigen Dienstleistungsplattform, die zielgruppen- und problemsensitiv eine „all in one hand“-Lösung zur Unterstützung des Arbeits- und Lernprozesses liefert.

Zielgruppensensitiv, weil Inhalte und Applikationen individuell auf Lern- und Qualifizierungsniveau des Nutzers angepasst werden. Dies ist wegen der Breite der Zielgruppe erforderlich, in der alle Instanzen von Berufsschulen bis zu Universitäten, Unternehmen und öffentlichen Verwaltungen enthalten sind.

Problemsensitiv, weil Applikationen individuell zur Aufgabenstellung bereitgestellt werden.

„All in one hand“, weil UNITRACC Lernen und Arbeiten verbindet, die erforderlichen Informationen, Daten und Applikationen an einer zentralen Stelle zur Verfügung stellt.

Alle Bereiche und Dienste werden mit Hilfe einer komplett webbasierten Unternehmens- und Projektmanagementsoftware betrieben und verwaltet. Für die Kommunikation zwischen allen Beteiligten stehen alle bekannten Kommunikationsmedien, wie E-Mail, Chat, Foren, etc. zur Verfügung.

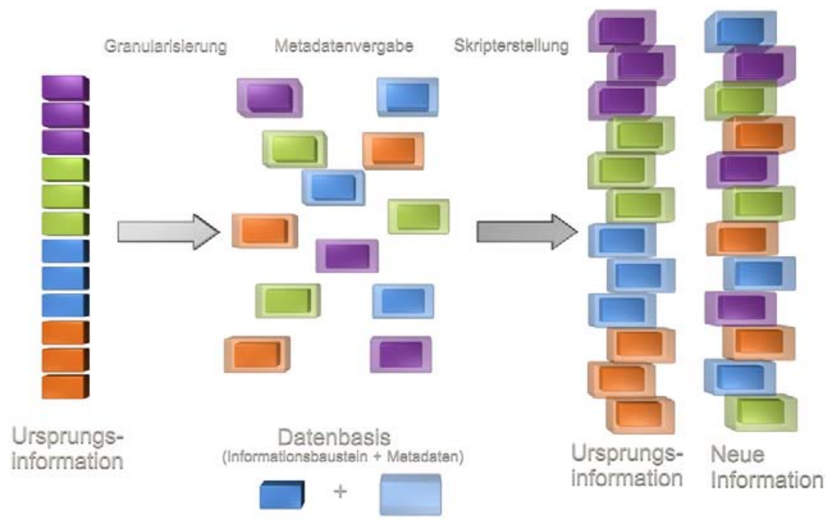

Abb. 3: Prinzip der Granularisierung, Metadatenvergabe und Neukombination von Informationsbausteinen

Die fachlichen Informationen und Applikationen liegen nicht als monolithische Blöcke vor, sondern werden in einem sog. Granularisierungsverfahren in kleinste Datenfragmente (**Informationsbausteine**) zerteilt (Abb. 3). Diese werden zur fachlichen und zielgruppenspezifischen Zuordnung mit Metadaten versehen und in der UNITRACC-Datenbank abgelegt. Anschließend werden die Informationsbausteine über Skripte der Datenbank bedarfsgerecht zu den verschiedensten Informations-, Lehr- und Lernmodulen sowie Applikationen zusammengesetzt und so dem Nutzer auf der Plattform zur Verfügung gestellt. Das Datenbankkonzept gewährleistet hierbei die Vermeidung von Redundanzen, da alle Infobausteine nur einmal vorkommen, aber beliebig oft verwendet werden können.

Ein webbasiertes Content Management System bietet den Nutzern von UNITRACC zusätzlich die Möglichkeit, eigene Inhalte in die Plattform zu integrieren.

4.1.1 Competence Center

Im Competence Center werden vielseitige Handlungskompetenzen in Theorie und Praxis online kombiniert. Den Kern dieses Centers bildet eine umfassende, multimedial aufbereitete Datenbasis, die sich u.a. aus folgenden Modulen zusammensetzt, deren Inhalte in granularisierter Form die Basis für die UNITARCC-Datenbank bilden:

- multimediale Fachinformationssysteme
- Dokumentationen
- Handlungsanweisungen
- Bautabellen.

Multimediale Fachinformationssysteme stellen das Fachwissen didaktisch aufbereitet mit Hilfe multimedialer Elemente wie Videos, Computeranimationen und –simulationen dar. Durch diese Darstellungsformen bieten sie einen großen Spielraum für die Präsentation der Informationen. Beispielsweise werden die multimedial aufbereiteten Bilder als technische und als fotorealistische Darstellung präsentiert (Abb. 4).

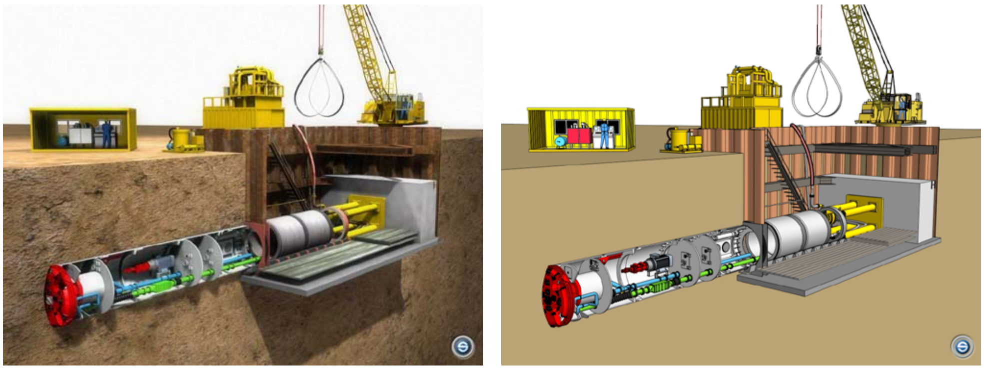

Abb. 4: Prinzip der Bilddarstellung (links: fotorealistisch, rechts: technisch)

Die Fachinformationssysteme basieren auf den aktuellen Auflagen der Fachbücher von Prof. Dr.-Ing. Dietrich Stein. **Instandhaltung von Kanalisationen**, 941 Buchseiten, ist eine umfassende Bestandsaufnahme über die technische Entwicklung und Normung auf dem Gebiet der Instandhaltung von Kanalisationen mit den Schwerpunkten Wartung, Reinigung, Inspektion und Sanierung.

Ziel des Fachbuches **Grabenloser Leitungsbau**, 1000 Seiten, 1500 Einzelabbildungen und 329 Tabellen ist es, die Durchsetzung des grabenlosen Leitungsbaus durch eine fachlich fundierte und auf dem neuesten Stand der Technik basierende Wissensvermittlung zu unterstützen. Angesichts der zahlreichen Nachteile, welche durch die Verlegung in offener Bauweise verursacht werden, und des wachsenden Umweltbewusstseins der Bevölkerung ist es zwingend notwendig, in Zukunft viel stärker als bisher den grabenlosen Leitungsbau als Alternative bei der Planung und Bauausführung von Leitungen und Leitungsnetzen bzw. -netzbereichen zu berücksichtigen.

Der begehbare Leitungsgang, 497 Seiten, 292 Abbildungen und 97 Tabellen behandelt den begehbaren Leitungsgang aus bautechnischer, sicherheitstechnischer, ökologischer, ökonomischer und juristischer Sicht unter Nutzung internationaler Erfahrung der Praxis.

Durch Aufbau von Partnerschaften, national wie international, wird die Bildung von Kompetenznetzwerken mit Instituten und Weiterbildungseinrichtungen mit dem gemeinsamen Ziel der Bildungsförderung angestrebt.

Die englischen Übersetzungen dieser anerkannten Standardwerke bilden die Grundlage für die Wissensbasis der internationalen Plattform.

4.1.2 Lehren und Lernen in der Akademie

Im Bereich Akademie steht die Authentizität der Daten im Vordergrund. Alle Lehrinhalte für die Zielgruppen werden in Abhängigkeit des Nutzerprofils, d.h. von Lernniveau, Lernzielen, Lernstrategien, dynamisch aus der Datenbank generiert und können mit Hilfe eines Redaktionssystems je nach Bedarf vom Lehrenden an die aktuelle Lernsituation angepasst und ergänzt werden. Damit wird nicht nur die Wissensvermittlung, sondern auch die Wissensdokumentation für den Lehrenden erleichtert.

Alle Lerninhalte für die Zielgruppen werden in Abhängigkeit zum Nutzerprofil, d.h. von **Lernniveau, Lernzielen, Lernstrategien,** dynamisch aus der Datenbank generiert und können mit Hilfe eines Redaktionssystems beliebig vom **Lehrenden** an aktuelle Lernsituationen angepasst und ergänzt werden. Damit wird nicht nur die Wissensvermittlung, sondern auch die Wissensdokumentation für den Lehrenden erleichtert. Für die Lerninhalte werden Skripte, dokumentierte Foliensammlungen sowie Übungen und Tests zur Verfügung gestellt. Virtuelle Vorlesungen und E-Seminare sind weitere Modelle zur Veranschaulichung der Lerninhalte.

Das Kursmanagement als Bestandteil der Akademie ist ein profil- und kontextbasiertes Serviceangebot für die Kursverwaltung und -erstellung. Der Lehrende kann über die Kursverwaltung die Kurse für seine Schüler sowohl steuern und verwalten als auch die möglichen Lernwege und die Art und Weise des Kursverlaufs bestimmen.

Der Kurseditor dient der Entwicklung von Lernmodulen, die alle Komponenten eines Kurses wie Textpräsentation, Grafiken, Links, Fragen, Bilder, Animationen usw. vereinen und unterstützt somit die Lehrenden bei der Erstellung von Content und dessen Beschreibung mit Metadaten (Daten über den erstellten Content, z.B. Länge, Inhalt, verwendete Medien etc.). Die Lernmodule können mit eigenen Inhalten kombiniert und/oder als Infobausteine aus dem gesamten Datenbestand von UNITRACC gewonnen werden.

UNITRACC bietet für die Erstellung eines Kurses verschiedene Suchmöglichkeiten an, so dass der Lehrende mit minimalem Zeitaufwand die Kurse optimal nach Länge, Inhalten, Eigenschaften, Schwierigkeitslevel zusammenstellen kann. Alle Inhalte können auf das Profil der Lernenden abgestimmt und über Evaluationstools kann für jeden einzelnen Schüler der Lernerfolg festgehalten werden.

Die über diese Form des Wissensaustausch erzeugten Informationen werden gesichert, archiviert und für die User im Zusammenhang mit dem betreffenden Content zugänglich gemacht – insofern ein Autor seine Freigabe erteilt hat.

Alle in UNITRACC verwendeten Medientypen wie Bilder, Animationen, Virtuelle Baustellen, Videos, Simulationen und Streaming Media stehen dem Lehrenden hierfür zur Verfügung und können über die Mediengallerie schnell und gezielt gefunden und in die Kurse integriert werden.

Eine besondere Darstellungsform sind die „**Virtuellen Baustellen**“, diese stellen mit hohem Animationsgrad und realitätsnah Verfahrensabläufe vom Aufbau einer Baustelle bis zu deren Räumung dar.

Die „**Interaktiven Baustellen**“ stellen mit Hilfe umfangreicher 3D-Szenarien Praxissituationen nach und gewähren dem Anwender virtuelle Übungsräume. Durch den hohen Freiheitsgrad der Interaktion wird vom Anwender ein hohes Maß an Entscheidungskompetenz gefordert bzw. geschult. Falsche Entscheidungen führen wie in der Praxis oft erst später zu Fehlern. Die „Interaktiven Baustellen“ sind modular aufgebaut, so dass neben der Variation von Parametern (z.B. Durchmesser der Leitung, Tiefenlage, Grundwasserstand) auch die Anzahl und Reihenfolge der Module durch den Ausbilder bestimmt werden können. Die hier beschriebenen Medientypen stellen nur einen Teil der in UNITRACC verwendeten dar.

4.2 KSI$_{Underground}$ als Wissensmanagementsystem

Auf **UNITRACC** aufbauend, wird **KSI$_{Underground}$** um drei wesentliche Prozesse erweitert werden:

- **Management strukturierter und unstrukturierter Daten**: Upload von unstrukturierten Daten und deren Umwandlung in Infobausteine zum Ausbau der Wissensbasis sowie zur Optimierung der Kontextbezüge und Kategorien aller Infobausteine
- **Automatisierung von Prozessen („Status-Kanal“)**: Prozessautomatisierung komplexer, zeitintensiver und fehleranfälliger technischer und wirtschaftlicher Entscheidungsprozesse bei Verwaltung und Betrieb kommunaler und privater Entwässerungsnetze durch Überführung, Visualisierung, Nachführung und Editierung der vorhandenen Daten in Kombination mit Fremddaten (amtliche Vermessung etc.) und die Generierung von neuen Daten, Informationen, Wissen sowie konkreten Handlungsanweisungen
- **„Agentensystem“**: Generierung von verhaltensbezogenen Wissensstrukturen durch Evaluierung der Art und Weise, wie der User das System benutzt, mit dem Ziel der aktiven Wissensbereitstellung.

4.2.1 Data Management: Management strukturierter und unstrukturierter Daten

Dieser Prozess beinhaltet die Erweiterung der bestehenden Wissensbasis durch allgemeine oder persönliche Dokumente in diversen Formaten (Word, PowerPoint, PDF, TXT) sowie deren Umwandlung in Infobausteine. Es sollen zwei Varianten betrachtet werden, wobei nur Variante A nachfolgend erläutert wird.:

Variante A: Verwendung von Text-Mining zum Analysieren und Aufbereiten der unstrukturierten Daten aus den externen Dateien und Transformation zum Infobit.

Variante B: Erstellung eines vereinfachten *Semantic Web* zur Nutzung aller unstrukturierten Informationen. Dabei werden die strukturierten Informationen nicht direkt berücksichtigt.

Variante A: Nutzung Text-Mining (Abb. 5)

Upload: Externe Dateien werden vom Benutzer auf die Plattform abgelegt

Analyse von Einzeltexten: Die unstrukturierten Informationen der Datei werden analysiert. Dabei werden die Textbausteine extrahiert und normalisiert, z.B. durch Erkennung des Datenformates oder der Sprache bzw. durch Hinweise auf Dokumentstruktur.

Merkmalsextraktion: Ziel ist die Hervorhebung wichtiger Ausdrücke sowie die Extraktion von repräsentativen Wörtern und Sätzen. Die Textbausteine werden dabei in Worte zerlegt. Aufgrund von Regeln (beispielsweise aus Wörterbüchern) können verschiedene Formen der Wörter auf eine Stammform zurückgeführt und eine Merkmalmatrix aufgebaut werden. Spalten dieser Matrix sind beispielsweise die

Wortklasse und die Häufigkeit des Vorkommens eines Wortes. Die Häufigkeit wird mit dem Textumfang normalisiert, damit ein Vergleich von Zeilen verschiedener Matrizen stattfinden kann.

Analyse von Textkollektionen bzw. Textklassifikation: Ziel dieser Analyse ist die Aufbereitung von Zusammenhängen (oder ggf. Unterschieden) von Textbausteinen, um die Dokumente in ein vorgegebenes Schema einzuordnen. Ein System zur Textklassifikation besteht aus Komponenten zum Wissenserwerb und zur Klassifikation. Der Wissenserwerb kann dabei vom Experten manuell durchgeführt oder mit lernenden Systemen teilautomatisch anhand von Trainingsbeispielen realisiert werden. Im zweiten Beispiel werden von Experten Regeln aufgestellt und über intelligente Algorithmen (Fuzzy-Logik, Neuronale Netze oder eine entsprechende Kombination der Neuronalen Fuzzy-Systeme) optimiert.

Informationsextraktion: Ziel dieser Extraktion ist das Erwerben und Strukturieren von Informationen aus den Texten. Die Relevanz wird dabei vom Experten und/oder System in Form von Regeln vorgegeben. Die Eingabe dieser Extraktion ist dabei die Menge von Merkmalen und von freien Textdokumenten; die Ausgabe sind die Werte für diese Merkmale.

Textzusammenfassung: Nach der Extraktion werden die Werte der Merkmale auf die wichtigsten Punkte reduziert. Als Ergebnis bekommt man die reduzierte Repräsentation, aus der die externe Zusammenfassung produziert wird.

Transformation zum Infobit/Skript: Abschließend werden die reduzierten Informationen inklusive einer Kategorisierung zum Informationsbaustein bzw. Skript zusammengesetzt und stehen im System als neue Information zur Verfügung.

4.2.2 Prozessautomatisierung

Betrieb und Unterhalt der unterirdischen Entsorgungsnetze gehören zu den komplexesten kommunalen Aufgabengebieten. Die historisch gewachsenen Netze spiegeln die technische Entwicklung der letzten 100 Jahre wieder. Diese Situation und die geringe Datenbasis zur Beschreibung der baulichen Verhältnisse erschweren die bedarfsorientierte, fachlich richtige betriebliche Steuerung der Entwässerungsnetze.

Das „**Status-Kanal**"-Modul (Abb. 6) soll daher die Automatisierung dieser komplexen, zeitintensiven und fehleranfälligen technischen und wirtschaftlichen Entscheidungsprozesse für Inspektion und Sanierung, die Überführung, Visualisierung, Nachführung und Editierung der vorhandenen Daten in Kombination mit Fremddaten (z.B. amtliche Vermessung) und die Generierung von Informationen und Wissen, z.B. in Form von Handlungs- und Dienstanweisungen, ermöglichen. Dieser Output wird der Wissensbasis zugeführt. Betriebsabläufe werden dadurch wiederholbar und über die Zeit optimierungsfähig. Bei ausreichender Anzahl an evaluierten Entwässerungsnetzen wird davon ausgegangen, dass mit Hilfe der Wissensmanagement-Komponenten die Übertragbarkeit auf andere Netzstrukturen auch **ohne** ausreichende Datenbasis möglich wird. **$KSI_{Underground}$** wird somit das „Betreiberwissen" **automatisch ergänzen und übertragbar machen** und damit eine Konservierung und Fortschreibung von Erfahrungswissen gewährleisten.

Beispiel für die Optimierung bzw. Kalibrierung von Informationen und Wissensgenerierung am Beispiel der Prognose von Schadensentwicklungen:

Der bauliche Zustand von Abwasserleitungen wird mittels TV-Inspektion erfasst und in einem Datenblatt niedergeschrieben. Auftretende Schäden werden mithilfe eines standardisierten Kürzelsystems beschrieben. Bestandteil von **Status-Kanal** sind Modelle, welche die Veränderung von Schäden durch Alterung oder äußere Einflüsse beschreiben (Veränderungsmodelle). Dadurch wird es möglich, die Veränderung eines Schadens basierend auf einem vorliegenden Schadensbericht für einen zu wählenden Zeithorizont zu prognostizieren. Wird in einem Abstand von n Jahren die Abwasserleitung neu inspiziert, können diese Informationen zur Kalibrierung der Alterungsmodelle genutzt werden. Je mehr Wiederholungsinspektionen nun mit dem System verglichen werden, desto genauer wird die Prognose.

Somit wird aus der Information über den Schaden Wissen über das Verhalten der Abwasserleitung in der Zukunft gewonnen.

Mit diesem Wertschöpfungsprozess ist dieses Konzept insbesondere für alle Städte und Kommunen national und international interessant, die über keine qualifizierte Datenbasis verfügen. Zur Realisierung sollen im Rahmen des Forschungsprojektes Fuzzy-Entscheidungssysteme und künstliche Neuronale Netze mit dem Ziel kombiniert werden, ein Verfahren zu entwickeln, mit dem Fuzzy-Entscheidungssysteme optimiert werden können, ohne dass zusätzliches Expertenwissen notwendig wird.

Die konsequente webbasierte Umsetzung realisiert darüber hinaus die Forderung, kommunale Prozesse mittels eGovernment-lösungen zu optimieren. Durch die Bereitstellung in Form des „Application Service Providing" werden die Dienstleistungen für alle Kommunen und Ingenieurbüros, unabhängig von ihrer Größe, individuell angepasst und zugänglich gemacht.

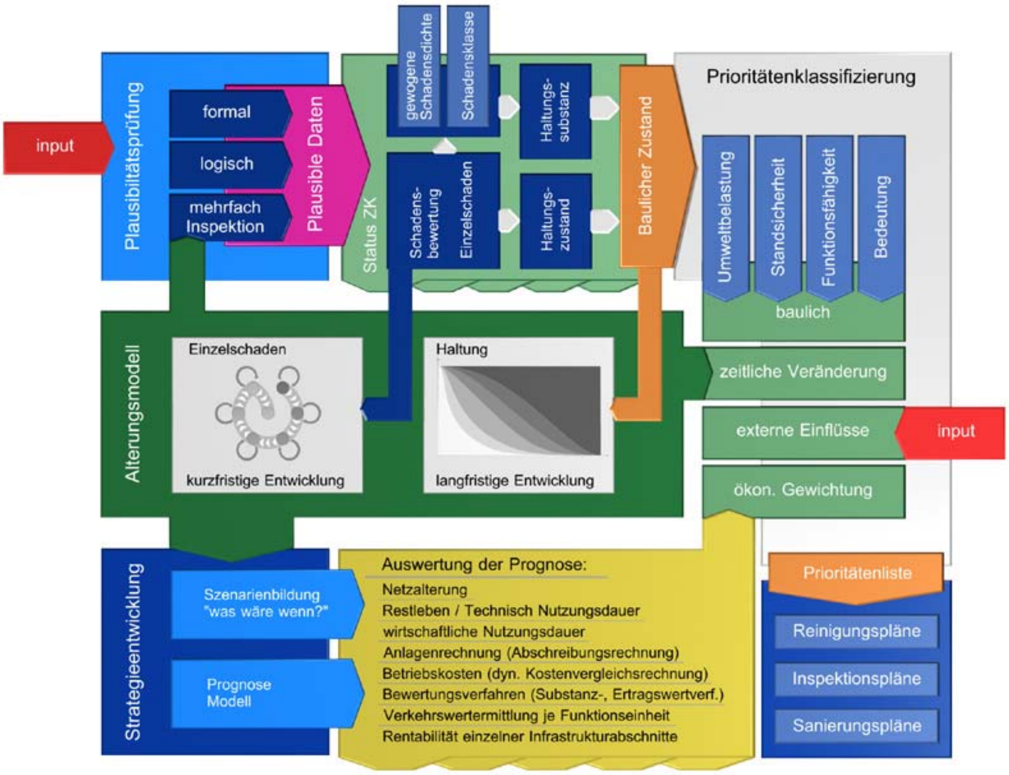

Abb. 6: Schematischer Aufbau von Status Kanal

4.2.3 Agentensystem

Die Integration des Agentensystems (Abb. 7) in KSI$_{Underground}$ verfolgt mehrere Ziele.

Dem Nutzer sollen je nach aktuellem Arbeitskontext weiterführende Informationen aus anderen Bereichen der Plattform angeboten werden. Dadurch soll seine Arbeit unterstützt oder einfach nur seine Aufmerksamkeit auf andere relevante Aspekte gelenkt werden.

Weiterhin werden KSI$_{Underground}$ durch das statistische Auswerten der Nutzeraktionen („Usage Mining“) und seiner Reaktionen auf die vom Agentensystem aktiv bereitgestellten Informationen zusätzliche, neue Informationen zugeführt und damit eine autonome Erweiterung der Wissensbasis erreicht.

Die Erweiterung der Wissensbasis basiert dabei auf der Tatsache, dass die Verknüpfung von Informationen selbst einen neuen Informationsgehalt in sich trägt. Die Verknüpfung kann kausale oder parallele Zusammenhänge aufdecken oder auch Präferenzen oder Trends erkennbar machen.

Zur Steigerung der Qualität der Informationen werden automatische und nutzeraktive Maßnahmen ergriffen. Zunächst wird versucht zufällige Verknüpfungen ohne Informationsgehalt durch Schwellwerte zu eliminieren. Verknüpfungen, die keinen Sinn machen, werden von Nutzern nicht verfolgt und werden per Verfallsdatum gelöscht.

Andererseits hat jeder Nutzer die Möglichkeit, die Ergebnisse des Agentensystems zu bewerten und zu kommentieren. Dieses "demokratische" System sollte bei Überschreitung einer kritischen Nutzermasse die Qualität der Informationen ebenfalls verbessern.

Neben der passiven Arbeitsweise des Systems (Nutzer arbeitet in seinem Kontext und bekommt an einer festen Bildschirmposition weiterführende Informationen), kann man auch direkte Anfragen an das Agentensystem stellen. Ohne einen konkreten Vorgang in der Plattform kann das System zur Recherche oder zum offenen "Browsing" benutzt werden. Die Arbeitsweise der Anfragenbearbeitung ist analog zu der oben beschriebenen.

Zusammenfassend lässt sich das geplante Agentensystem als eine Komponente von KSI$_{Underground}$ beschreiben, welche die Arbeit der Nutzer aktiv unterstützt und die ohne redaktionellen Aufwand die Quantität und Qualität der Wissensbasis erhöht.

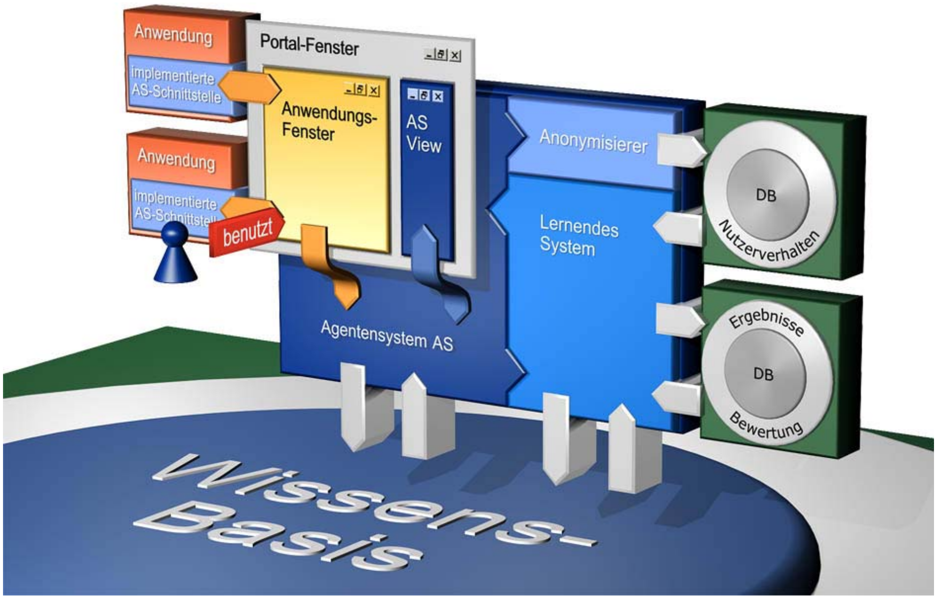

Abb. 7: Prinzipdarstellung der Wirkungsweise des Agentensystems

5 ZUSAMMENFASSUNG

Eine funktions- und leistungsfähige Infrastruktur ist ein wesentlicher Standortfaktor im nationalen und internationalen Wettbewerb der Regionen. Mit dem gestiegenen Umweltbewusstsein und den damit einhergehenden Verschärfungen der gesetzlichen Bestimmungen sind auch die Anlagen zur Sammlung und Ableitung (Kanalisationen) sowie zur Behandlung von Abwasser (Kläranlagen) als ein diesbezüglich wichtiger Faktor identifiziert worden.

Unter diesen Aspekten und der besonderen Bedeutung der Entwässerungsnetze als standortrelevanter Faktor erfüllt **$\text{KSI}_{\text{Underground}}$** im ausnehmenden Maße Forderungen nach Referenzmodellen und Steigerung der Wertschöpfung von mittelständischen Unternehmen und öffentlichen Verwaltungen. Dies wird im Besonderen darin deutlich, dass angesichts des Anlagevermögens (Wiederbeschaffungswert) von Entwässerungsnetzen es dringend geboten ist, diese mit modernen Methoden effizient und gesetzeskonform zu verwalten, zu betreiben und instand zu halten. Ziele sind daher einerseits die Sicherung des Anlagevermögens, d.h. mindestens Ausgleich des Werteverzehrs infolge Betrieb und Abnutzung durch Maßnahmen der Instandhaltung, sowie Sicherstellung der Einhaltung der vom Gesetzgeber vorgeschriebenen ökologischen Randbedingungen und Anforderungen. Die darüber hinaus verfolgte Zielstellung der Prozessautomatisierung der komplexen Verwaltungs- und Betriebsabläufe einerseits und der Konservierung, Ergänzung, Fortschreibung und Distribution des gesammelten Betreiber-Know-hows andererseits ermöglicht die Integration der o.g. Aspekte in betriebliche Abläufe.

Die wesentlichen Vorteile von $\text{KSI}_{\text{Underground}}$ – auf der Basis des bereits mit UNITRACC Erreichten – liegen in ihrer struktur-relevanten Bedeutung, dadurch dass $\text{KSI}_{\text{Underground}}$ als eGovernmentlösung in Form des application service providing für alle Kommunen, unabhängig von ihrer Größe, individuell angepasst und zugänglich gemacht wird. Durch die Schaffung einer eGovernmentsoftware zum Management der Entwässerungsnetze unterstützt $\text{KSI}_{\text{Underground}}$ somit maßgeblich die Entwicklung der Kommunen zu modernen, effizienten Dienstleistungsstandorten.

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Räumliche Disaggregation statistischer Daten unter Verwendung Geographischer Informationssysteme – erste Ergebnisse

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ZUSAMMENFASSUNG

In Geographischen Informationssystemen (GIS) werden häufig Daten unterschiedlichster Quellen verwendet. Bevor sie miteinander verarbeitet werden können, müssen sie meist jedoch räumlich einheitlich aufgelöst werden. Am Beispiel der räumlichen Disaggregation Landkreis-basierter Daten aus der Landwirtschaftsstatistik wird am Institut für Landwirtschaftliche Betriebslehre der Universität Hohenheim ein GIS-basiertes Tool entwickelt. Der Disaggregation liegt dabei ein Regelwerk-basierter Ansatz zugrunde. Mithilfe höher aufgelöster Zusatzinformationen werden hierfür im GIS die Landkreise in Gebiete unterschiedlicher Standortgüte untergliedert und jedem Pixel für den Anbau einzelner Kulturarten eine bestimmte Eignung zugewiesen, anhand derer die Ackerfrüchte auf die Rasterzellen verteilt werden. Bereits erste Ergebnisse der Disaggregation spiegeln näherungsweise das reale Anbaumuster wider. Ebenso zeigt ein Vergleich der Disaggregationsergebnisse mit der Landwirtschaftsstatistik auf Gemeindebasis für die verschiedenen Kulturarten eine räumliche Übereinstimmung. Das Tool ist bisher nur halbautomatisch realisiert; an einer vollautomatisierten Version wird gearbeitet. Es soll zukünftig auch in anderen Disziplinen zur Disaggregation räumlicher Daten verwendet werden können.

1 EINFÜHRUNG

Räumliche Daten werden heute in den unterschiedlichsten Planungs- und Forschungsbereichen genutzt. Vielfach liegen sie jedoch in verschiedenen Maßstabskalen vor. Um sie adäquat miteinander vergleichen bzw. verarbeiten zu können, müssen sie häufig räumlich gleich aufgelöst werden.

Im Forschungsprojekt GLOWA-Danube (IGGF 2001-2003), das die zukünftige Wassernutzung im Einzugsgebiet der oberen Donau in einem interdisziplinären Modellverbund untersucht, werden vom agrarökonomischen Modellteil die Ergebnisse auf Landkreisebene berechnet (KRIMLY et al. 2003). Ein direkter Austausch von Daten aller Teilmodelle erfordert allerdings eine einheitliche Skala. Diese wird im Modellverbund GLOWA-Danube durch ein Raster mit einer Auflösung von 1 km beschrieben. Die landkreisbasierten agrarökonomischen Daten müssen daher disaggregiert werden, bevor sie in andere Teilmodelle einfließen. Hierfür wird am Institut für Landwirtschaftliche Betriebslehre der Universität Hohenheim ein GIS-basiertes Tool entwickelt.

2 DAS ENTSCHEIDUNGS-UNTERSTÜTZUNGSSYSTEM DANUBIA

Im Rahmen von GLOWA-Danube wird ein Entscheidungs-Unterstützungssystem (DANUBIA) entwickelt, um Aspekte einer „nachhaltigen Bewirtschaftung von Wasserressourcen sowohl in Bezug auf die Wasserverfügbarkeit als auch die Wasserqualität" zu analysieren (MAUSER et al. 2001). In DANUBIA sind hierfür sowohl natur- wie auch wirtschafts- und sozialwissenschaftliche Teilmodelle integriert.

Gegenstand der Untersuchung ist das Einzugsgebiet der Donau bis Passau. Dies umfasst mit einer Größe von über 75.000 km² die unterschiedlichsten Naturräume, vom Hochgebirge und dessen Vorland über Mittelgebirgs- und Gäulandschaften bis hin zu Flussniederungen. Der höchste Punkt im Untersuchungsgebiet ist der Piz Bernina mit 4049 mNN (BFL 1995) im Quellgebiet des Inn und der niedrigste am Donau-Pegel in Achleiten bei Passau mit 288 mNN (HDO 2003).

Im Zusammenhang dieser vielfältigen Landschaftsräume steht auch eine sehr differenzierte Nutzung und Nutzungsmöglichkeiten. Das Untersuchungsgebiet stellt daher eine optimale Basis dar, um Möglichkeiten einer räumlichen Disaggregation landwirtschaftlicher Statistikdaten zu entwickeln und diese zukünftig auch in anderen Regionen anwenden zu können.

3 METHODIK

Der Anbau landwirtschaftlicher Kulturarten ist standortabhängig. Faktoren, die die Entscheidung des Landwirts zur Landnutzung bestimmen, können natürlicher (Klima, Boden, Relief, Topographie), politischer (Subventionen für bestimmte Kulturarten) oder ökonomischer Art (Nähe zu Absatzmärkten und Verarbeitern) sein. Betrachtet man den Anbau in Bezug auf diese Faktoren, so ist zu erkennen, dass er bestimmten Regeln folgt. Für die Disaggregation der agrarökonomischen Daten wurde daher ein Regelwerk-basierter Ansatz gewählt.

3.1 Das Regelwerk

Da die Fläche eines Landkreises meist Anteil an unterschiedlichen Landschaftseinheiten und damit an verschiedenen Anbaugebieten hat, wird ein Landkreis zunächst in homogene Sub-Gebiete untergliedert. Hierzu werden räumlich höher aufgelöste Zusatzinformationen (empirische Erhebungen, landwirtschaftliche Maßzahlen, sowie topographische Merkmale) miteinander verschnitten. Auf diese Weise können im GIS räumliche Einheiten unterschiedlicher Standortgüte (Bonität) gewonnen werden. Die über 75.000 1-km²-Pixel werden anschließend eindeutig diesen Sub-Gebieten zugeordnet (vgl. Abb. 1). In einem darauffolgenden Schritt wird den einzelnen Pixeln in diesen Sub-Gebieten je nach Bonität für jede Kulturart eine Eignung (suitability) zugewiesen. Dabei erhalten für die jeweilige Kulturart Pixel in Sub-Gebieten höchster Eignung den Wert 1, mittlerer Eignung den Wert 2 und in nicht-geeigneten Sub-Gebieten den Wert 0. Da landwirtschaftliche Kulturen nicht jedes Jahr auf derselben Fläche angebaut werden, sondern auf Grund einer bestimmten Fruchtfolge wechseln, wird auf jedem Pixel der Anbau jeder Kulturart maximal beschränkt. Der Maximalwert spiegelt dabei den Anteil der Kulturart an der gesamten Ackerbaufläche wider (vgl. Abb. 1).

Die räumliche Verortung der unterschiedlichen Standorteigenschaften wurde in dem Geographischen Informationssystem ArcGIS™ der Firma ESRI realisiert.

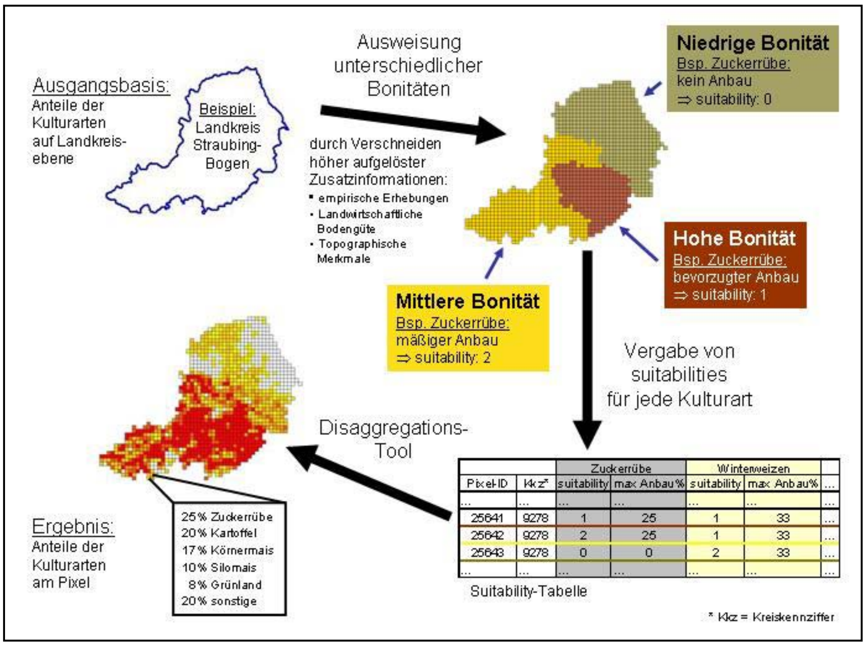

Abb.1: Überblick über Vorgehensweise und Ableitung des Regelwerks

3.2 Technische Umsetzung im Disaggregations-Tool

Um die Disaggregation automatisiert durchführen zu können, wurde in JAVA™ ein Tool programmiert. Der Disaggregationssablauf kann in fünf Schritte gegliedert werden (vgl. Abb. 2):

1. Schritt: Wahl einer Kulturart
2. Schritt: Wahl eines Landkreises
3. Schritt: Wahl aller Pixel in diesem Landkreis mit einem Anteil an Ackerfläche (bzw. Grünland für die Verteilung von Grünland)
4. Schritt: Verteilung der gewählten Kulturart auf Pixel mit bester Eignung
5. Schritt (falls nötig): Verteilung der gewählten Kulturart auf Pixel mit mittlerer Eignung

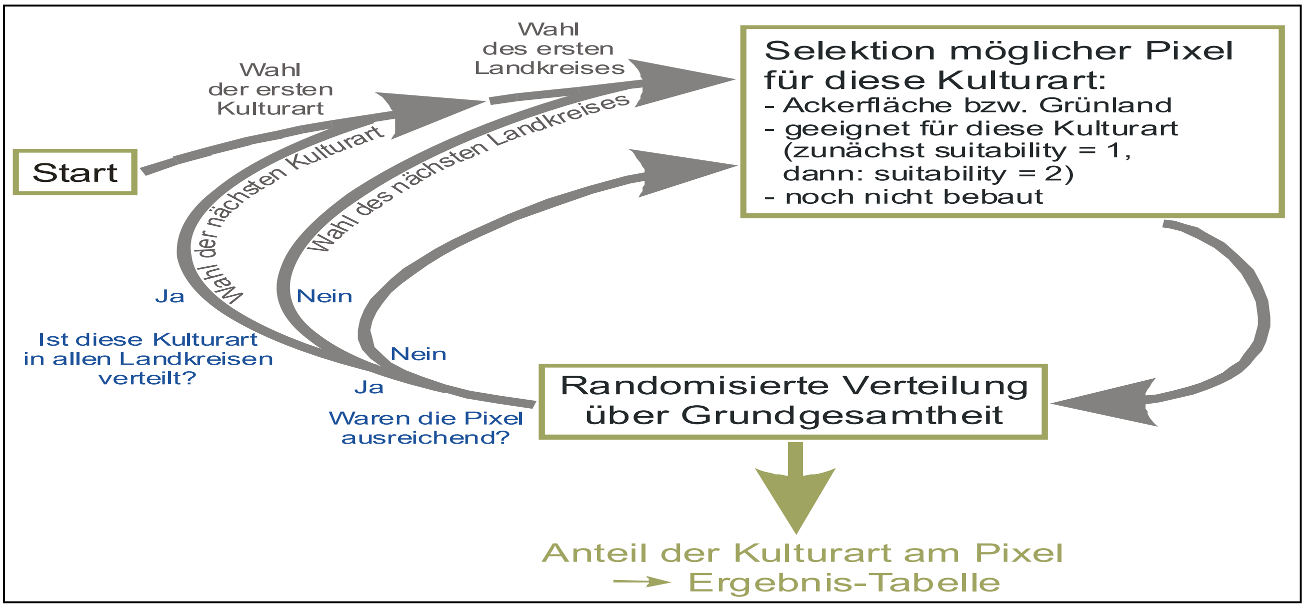

Abb. 2: Programm-Flow des Disaggregations-Tools

Das Disaggregations-Tool verteilt die landkreisbasierten Ergebnisdaten des agrarökonomischen Modells (absoluter Anbau der Kulturarten in ha; KRIMLY et al. 2003) auf die 1-km² großen Pixel (vgl. Kap. 1). Die einzelnen Kulturarten werden dabei nacheinander bearbeitet. Es wird mit der Kulturart begonnen, die bezüglich ihrer Standortbedingungen höhere Ansprüche stellt. Die Kulturart, die dagegen auf jedem Ackerstandort angebaut werden kann, wird als letzte verteilt. Im Einzugsgebiet der oberen Donau wurden Grünland und 15 verschiedene Ackerkulturen unterschieden.

Die einzelnen Landkreise werden in randomisierter Reihenfolge bearbeitet, d.h. unabhängig von inhaltlichen Eigenschaften. Der deutsche Teil des Untersuchungsgebietes untergliedert sich in 57 Landkreise. Stadtkreise werden den jeweils zugehörigen Landkreisen zugeordnet, zum Beispiel wird der Stadtkreis München als ein Teil des Landkreises München betrachtet. Pixel in Landkreisen, die sich im Grenzbereich des Untersuchungsgebietes befinden und nur einen geringen Anteil am Einzugsgebiet der Donau haben, werden benachbarten Landkreisen im Untersuchungsgebiet zugeordnet.

Die einzelnen Kulturarten werden nur auf Pixel mit einem Anteil an Ackerfläche bzw. für Grünland auf Pixel mit Grünlandanteil verteilt. Die jeweiligen Anteile der km²-Pixel an Ackerfläche und Grünland basieren auf CORINE Landcover Daten.

Die Reihenfolge der Verteilung auf die für die jeweilige Kulturart in Betracht gezogenen Pixel erfolgt randomisiert, wobei zunächst nur auf die Pixel bester Eignung (Suitability-Wert = 1) verteilt wird. Sind diese nicht ausreichend, werden zusätzlich noch Pixel mittlerer Eignung (Suitability-Wert = 2) hinzugenommen. Bei der Ermittlung der zu verteilenden Menge für jedes Pixel wird bestimmt, wieviel von der jeweiligen Kulturart maximal auf dem betrachteten Pixel angebaut werden kann (vgl. Kap. 3.1). Ist diese Fläche des Pixels von einer anderen Kulturart noch nicht belegt, wird die ermittelte Menge in vollem Umfang dem Pixel zugewiesen oder ansonsten entsprechend des noch verfügbaren Platzes reduziert. Auf diese Weise wird Pixel für Pixel abgearbeitet bis mit dem nächsten Landkreis bzw. mit der nächsten Kulturart fortgefahren wird (vgl. Abb. 2).

4 ERSTE ERGEBNISSE

Insgesamt zeigen erste Ergebnisse der Disaggregation für das Basisjahr 1995 eine hohe Übereinstimmung mit dem realen Anbaumuster landwirtschaftlicher Kulturen. Exemplarisch soll im Folgenden die Zuckerrübe und der Silomais umfassend betrachtet werden. Erstens bleibt festzuhalten, dass vom Disaggregations-Tool die Zuckerrübe nicht flächendeckend, sondern nur in einigen Teilgebieten verteilt wurde (vgl. Abb. 3). Pixel mit den höchsten Anteilen an Zuckerrübe (> 20 ha) liegen ausschließlich in den Gäulandschaften Bayerns, mit Spitzenwerten (> 25 ha) im Dungau, also in sehr intensiven Ackerbaugebieten. Pixel mit geringeren Anteilen an Zuckerrübe (bis zu 15 ha) liegen im Tertiären Hügelland und anderen Ackerbauregionen mittlerer Intensität. Dagegen ist zweitens festzustellen, dass das Disaggregations-Tool Silomais viel weiträumiger verteilt hat (vgl. Abb. 3). Nur im Grünland-dominanten Alpenvorland, im forstwirtschaftlich geprägten Bayerischen Wald, im südlichen Bereich der Schwäbischen Alb und in den intensivsten Ackerbauregionen findet kein Anbau statt oder ist der Anteil pro Pixel sehr gering (< 5 ha). Als Gebiete mit einem hohen Anteil an Silomais wurden vom Disaggregations-Tools die südlichen Bereiche Niederbayerns und die daran angrenzenden nördlichen Bereiche Oberbayerns ermittelt, also Gebiete mit intensiver Viehwirtschaft.

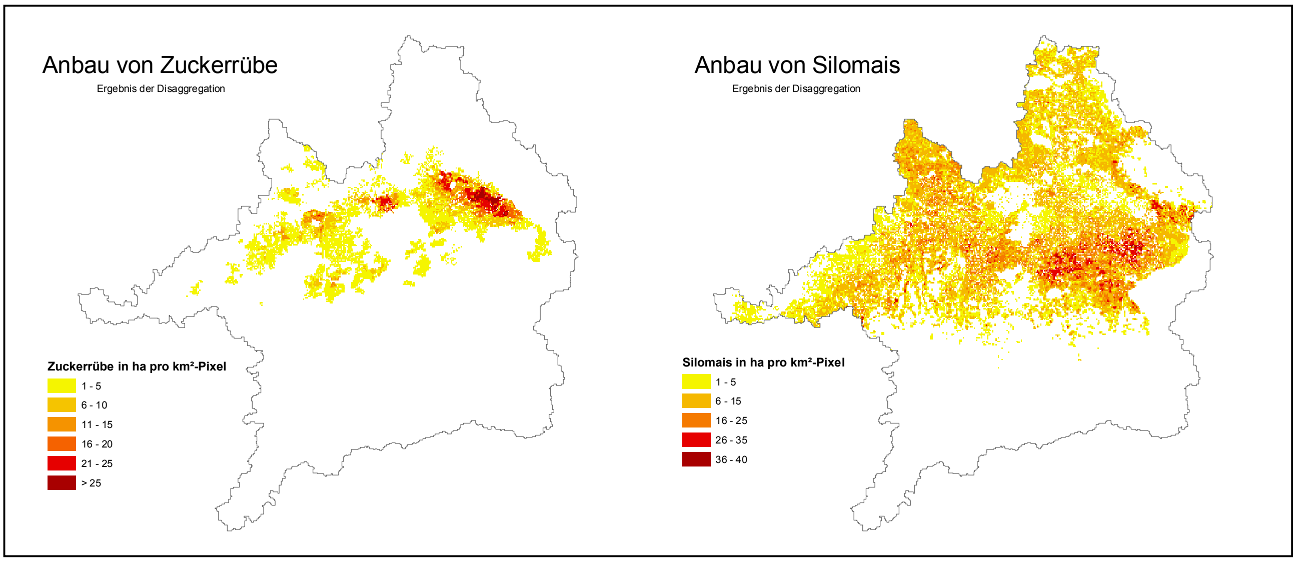

Abb.3: Disaggregationsergebnisse für Zuckerrübe und Silomais

Mit Hilfe des Disaggregations-Tools konnten also räumliche Heterogenitäten des Anbaus, sowie Hot Spots einzelner Kulturen festgestellt werden. Es lassen sich so, ohne dass dabei Ergebnis-Informationen des agrarökonomischen Modells verlorengehen, Nivellierungen der Landkreis-basisierten Daten überwinden und räumlich differenziertere Aussagen bezüglich der landwirtschaftlichen Nutzung treffen. Zum Beispiel können nun intensive Anbaugebiete für einzelne Kulturarten über Landkreisgrenzen hinweg ausgegliedert werden. Abbildung 4 zeigt exemplarisch an der Disaggregation der Zuckerrübe, dass ihr Kernanbaugebiet nur in bestimmten Teilgebieten der Landkreise Deggendorf, Dingolfing-Landau und Straubing-Bogen liegt, jedoch als eine Einheit Landkreis-überschreitend bestimmt werden konnte.

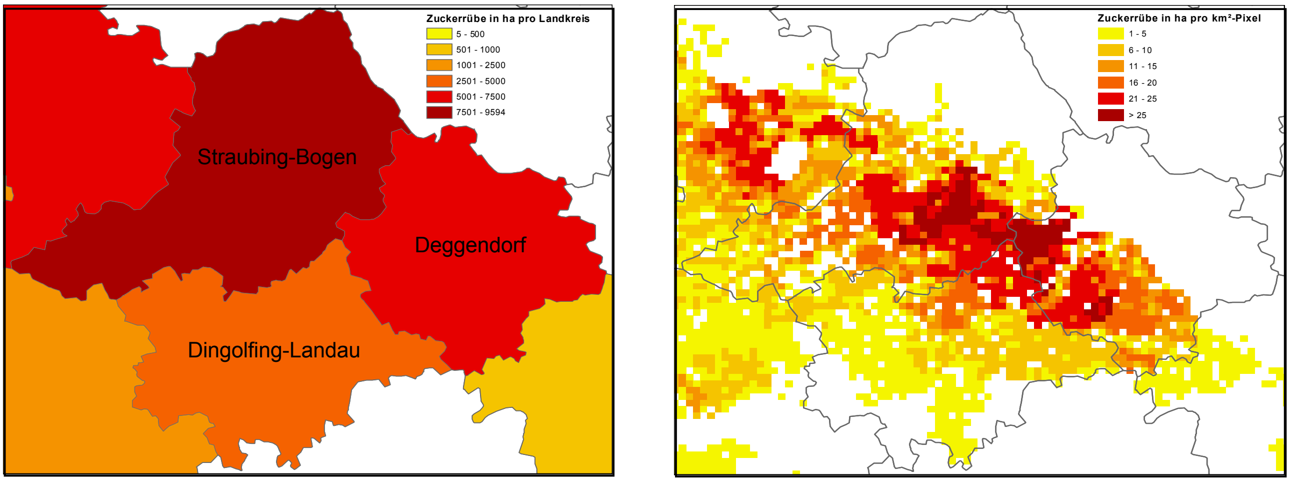

Abb.4: Mithilfe der Disaggregation können Kernanbaugebiete Landkreis-überschreitend bestimmt werden – was auf Landkreisbasis nicht möglich ist.

Eine Möglichkeit, um abschätzen zu können, ob die rasterbasierten Disaggregationsergebnisse tendenziell stimmen, bietet ein Vergleich mit den Gemeindestatistikdaten, die von ihrem Disaggregationsgrad zwischen der Landkreisebene und dem 1-km Raster liegen. Diese Daten stehen im Untersuchungsgebiet flächendeckend für Baden-Württemberg und Bayern zur Verfügung. Ein visueller Vergleich erster Disaggregationsergebnisse mit den Daten der Gemeindestatistik zeigt exemplarisch für das Anbaugebiet der Zuckerrübe eine nahezu räumliche Übereinstimmung in beiden Datenebenen (vgl. Abb. 5 mit Abb. 3). Ebenso decken sich die Gemeinden, in denen flächenmäßig viel Zuckerrüben angebaut werden (> 750 ha) räumlich mit den Pixeln, in denen der Anteil an Zuckerrübe hoch ist (> 20 ha).

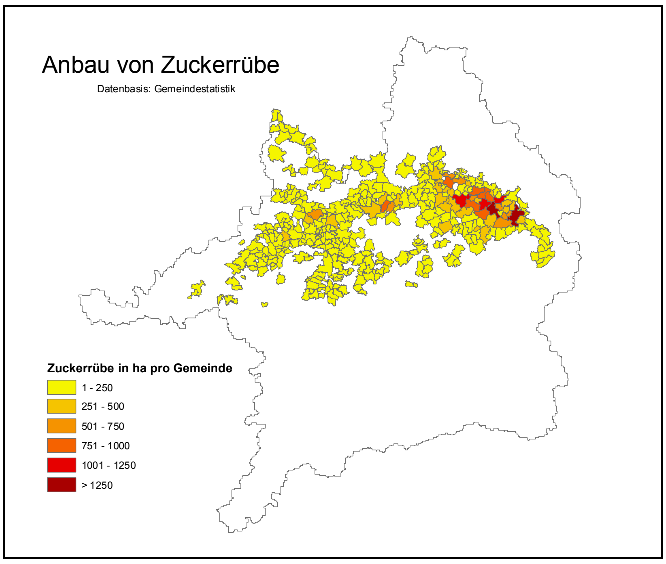

Abb.5: Anbau von Zuckerrübe auf Basis der Gemeindestatistik 1995

Die mit dem Disaggregations-Tool gewonnenen Rater-basierten Daten können in anderen naturwissenschaftlichen Modellen weiter verwendet werden, zum Beispiel zur Ermittlung von Risikogebieten für eine Nitratauswaschung oder erosionsgefährdeter Ackerbaustandorte.

5 AUSBLICK

Zahlreiche Funktionen zur Erstellung des GIS-basierten Regelwerkes sind im Moment nur halbautomatisch verwirklicht; an einem vollautomatischen Ablauf des gesamten Disaggregations-Tools wird gearbeitet, d.h. von der Erstellung des Regelwerkes (Ausweisung von Gebieten unterschiedlicher Standortgüte durch Verschneidung von Zusatzinformationen) bis hin zur Verteilung der Daten.

Das Regelwerk wurde bisher nur für den deutschen Teil des Untersuchungsgebietes erstellt. Die Bearbeitung des österreichischen Teilgebietes folgt. In DANUBIA wird derzeit an der Abbildung des Ist-Zustandes (Basisjahr 1995) gearbeitet. Zukünftig soll das Modell zur Berechnung von Szenarien hinzugezogen werden.

Ein weiteres Ziel ist es, das Tool auf die Disaggregation anderer landwirtschaftlicher Kenngrößen zu erweitern. Das Kernstück der Disaggregation besteht dabei lediglich aus der Erstellung eines Regelwerkes mithilfe jeweils relevanter, höher aufgelöster Zusatzinformation. Daher soll das Tool so gestaltet werden, dass es auch in anderen Disziplinen zur räumlichen Disaggregation statistischer Daten verwendet werden kann.

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Ermittlung der Potentiale für die Ausweisung eines Biosphärenreservates im Naturpark Schwarzwald Mitte/Nord mit Geographischen Informationssystemen

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1 EINFÜHRUNG

Der Schwarzwald gehört zu den größten unzerschnittenen Räumen in Deutschland. Das Mittelgebirge ist durch ausgedehnte Wälder, eingeschnittene Wiesentäler einerseits und Kulturlandschaft mit Streuobstwiesen und Weinbau andererseits geprägt. Diese Mischung und Heterogenität schafft eine hohe Lebensraumvielfalt. So sind etwa ein Drittel des mittleren und nördlichen Schwarzwaldes in unterschiedlicher Weise als Naturschutzgebiet, Landschaftsschutzgebiet oder auch als kartierte Biotope oder Natura 2000-Fläche gesetzlich geschützt.

Gleichzeitig ist dieses Gebiet eine Tourismusdestination und ein Ausflugsgebiet von hoher Bedeutung in Baden-Württemberg und darüber hinaus. 8 Millionen Übernachtungen und 1,7 Millionen Gästeankünfte mit steigender Tendenz belegen den Stellenwert des Tourismus als Wirtschaftszweig in der Region. Diese beiden Aspekte führten im Jahr 2000 zur Entwicklung eines Naturparks, der inzwischen auch durch die zuständigen Behörden etabliert wurde. Derzeit gibt es 92 Naturparke in Deutschland. In ihrer Gesamtheit bedecken Naturparke 24 % der Staatsfläche Deutschlands (STATISTISCHES BUNDESAMT, 2002). Daher entstand im Rahmen der Naturparkplanung rasch die Frage, ob nicht zur Sicherung der ökologischen Qualität, aber auch zur Stärkung der touristischen Destination im Wettbewerb zu anderen Naturparken innerhalb des größten deutschen Naturparks ein Biosphärenreservat eingerichtet werden soll. Im Rahmen einer Forschungsarbeit wurde dieser Fragestellung nachgegangen. Ziel war es zu überprüfen, ob durch den Einsatz von geographischen Informationssystemen dies auf eine nachvollziehbare und effiziente Weise erreicht werden kann. Die hier dargestellte Studie dient als Vorbereitung für den noch ausstehenden Entscheidungsprozess und die Meinungsbildung im Naturpark Schwarzwald Mitte/Nord.

2 BESCHREIBUNG DES BEARBEITUNGSGEBIETES

Der mit ca. 3700 km² größte Naturpark Deutschlands besitzt eine Nord-Süd-Ausdehnung von 90 km sowie ein Ost-West-Ausdehnung von 63 km. Im Naturpark liegen sieben Landkreise mit sehr unterschiedlich großen Flächenanteilen. Als Träger des Naturparks wurde der Naturpark Schwarzwald Mitte / Nord e.V. am 19.12.2000 gegründet. Der Verein umfasst 103 Mitgliedsgemeinden aus insgesamt 7 Land- und 2 Stadtkreisen sowie 13 Verbände. Ebenfalls Mitglied im Verein sind neben dem Land Baden-Württemberg, die für die Gebiete im Naturpark zuständigen Industrie- und Handelskammern. Die Naturparkplanung (AGL et al., 2003) wurde im September 2003 abgeschlossen, die Verordnung durch das Regierungspräsidieum erfolgte im Dezember 2003.

Das Untersuchungsgebiet zählt zu den größten zusammenhängenden Waldgebieten in Europa. Auf rund 2550 km² ist der Wald die vorherrschende Landnutzungsform. Den Kern des Naturparks bildet der Grindenschwarzwald zusammen mit den Enzhöhen. Hier befindet sich auch die mit rd. 1000 m höchste Erhebung des Naturparks; die Hornisgrinde. Der Grindenschwarzwald ist durch eine Vielzahl tief eingeschnittener meist West-Ost gerichteter Bachtäler gekennzeichnet. Die weiter östlich liegenden Enzhöhen sind weniger stark durchTäler eingeschnitten. Hier finden sich ausgedehnte vermoorte Hochflächen. Im Anschluss an die Enztalhöhen bilden die Schwarzwaldrandplatten den Übergang zu den Gäu-Platten im Nordosten und Osten des Naturparkgebietes. Mit tief eingeschnittenen Sohlenkerbtälern besitzt dieser Naturraum ein markantes Landschaftselement. Im Gegensatz zu den Schwarzwaldrandplatten bestehen die nordöstlich und östlich liegenden Gäu-Platten aus Keupermaterial. Aufgrund der besseren Bodenverhältnisse sind die Gäuplatten landwirtschaftlich besser nutzbar. (AGL et al., 2003). Die hohe Bedeutung des Schwarzwaldes aus naturschutzfachlicher Sicht, spiegelt sich in der großen Anzahl an Schutzgebieten wider. Durch Biotopkartierung sind die wichtigsten Lebensräume und Biotope erfasst. Insgesamt sind 32,2% der Naturparkfläche mindestens mit einer gesetzlichen Schutzkategorie belegt.

Die Rahmenbedinbgungen für die Landwirtschaft sind vielerorts aufgrund der Standortbedingungen und des hohen Waldanteils als ungünstig zu beschreiben. Durch eine Zunahme der Betriebsaufgaben sind teilweise auch die touristsch notwendige Offenhaltung der Landschaft und die ökologische Vielfalt des Raums in Gefahr. Der Strukturwandel in der Landnutzung spiegelt sich auch in der Bevölkerungsentwicklung. Der Zunahme der Bevölkerung in den Randbereichen durch Wanderungsgewinne stehen Abwanderungen in den zentralen waldbreichen Bereichen gegenüber. Der wirtschaftliche Schwerpunkt liegt im produzierenden Gewerbe sowie im Dienstleistungssektor. Die zentralen Naturparkgemeinden konzentrieren sich vor allem auf den Ausbau der Angebote für Tourismus Freizeitgestaltung und das Kurwesen.

3 AUFGABEN UND ZIELE DER BIOSPÄRENRESERVATE

Obschon „Naturparke, Biosphärenreservate und Nationalparke sich in ihren unterschiedlichen Aufgabenstellungen darin ergänzen, die Zielsetzungen des deutschen Bundesnaturschutzgesetzes und der Ländernaturschutzgesetze zu erfüllen“ (EUROPARK DEUTSCHLAND, 2003), ist ihre jeweilige Aufgabenstellung doch unterschiedlich. Sowohl bei den Naturparken als auch bei den Biosphärenreservaten handelt es sich um Großschutzgebiete, in denen versucht werden soll, menschliches Wirtschaften und Handeln in Einklang mit der Natur zu realisieren. Die UNESCO definiert Biosphärenreservate wie folgt: „Biosphere reserves are areas of terrestrial and coastal/marine ecosystems or a combination which are internationally recognizes within the framework of UNESCO's programme the Biosphere (MAB), (…)" (UNESCO, 1996). Biosphärenreservate sind Modellregionen, in denen das Zusammenleben von Mensch und Natur beispielhaft entwickelt und erprobt wird. Ziel ist der Aufbau eines weltumspannenden Gebietssystems, um sämtliche Landschaftstypen der Welt zu erfassen. Weltweit gibt es derzeit 408 Biosphärenreservate. Biosphärenreservate gelten weltweit als wichtiges Instrument, eine nachhaltige, d.h. dauerhaft-umweltgerechte Nutzung modellhaft in einem weltweiten Netzwerk zu entwickeln, zu erproben und umzusetzen. Dieser Ansatz gewinnt seit der UN-Konferenz für Umwelt und Entwicklung in Rio de Janeiro (UNCED, 1992) zunehmend an Bedeutung. In den Biosphärenreservaten werden die Ziele und Grundsätze des MAB-Programms konkretisiert und realisiert. Die Biosphärenreservate erfüllen entsprechend den Kriterien der UNESCO folgende wichtige Funktionen:

1. Biosphärenreservate schützen Ökosysteme vor zerstörerischen Eingriffen und erhalten wertvolle Lebensräume für Menschen wie für Pflanzen und Tiere.
2. Biosphärenreservate sind repräsentative Kulturlandschaften, in denen ein ausbalanciertes Verhältnis von Mensch und Natur entwickelt wird.
3. Biosphärenreservate vermitteln Erkenntnisse über die Wechselwirkungen von Nutzung und Entwicklung von natürlichen Lebensräumen.

Im Gegensatz zu den Naturparken werden international anerkannte Biosphärenreservate von der UNESCO beurteilt und anerkannt. Biosphärenreservate dienen vornehmlich der Erhaltung, Entwicklung oder Wiederherstellung einer durch hergebrachte vielfältige Nutzung geprägten Landschaft und der darin historisch gewachsenen Arten- und Biotopvielfalt. Dies schließt den Schutz von Wild - und früheren Kulturformen sowie wirtschaftlich genutzter oder nutzbarer Tier- und Pflanzenarten (EUROPARK DEUTSCHLAND, 2003) mit ein. Die oben beschriebene besondere naturräumliche Situation einerseits und die teilweise kritische Situation im Hinblick auf die Landnutzung andererseits, legen eine potentielle Eignung des Gebietes nahe. Dies gilt um so mehr als in den Gebieten gemeinsam mit den dort lebenden und wirtschaftenden Menschen beispielhafte Konzepte zu Schutz, Pflege und Entwicklung erarbeitet und umgesetzt werden und diese dann als Modell für die jeweilige durch das Biosphärenreservat repräsentierte biogeographische Region verwendet werden können. Hinzu kommen Aufgaben im Bereich der Umweltbeobachtung, Umweltforschung und Umweltbildung. In diesem Zusammenhang hebt das DEUTSCHE NATIONALKOMITEE (1996) in seiner Definition der Biosphärenreservate vor allem die räumliche Ordnung und deren inhaltliche Schwerpunkte hervor: "Biosphärenreservate sind großflächige, repräsentative Ausschnitte von Natur- und Kulturlandschaften. Sie gliedern sich abgestuft nach dem Einfluss menschlicher Tätigkeit in eine Kernzone, eine Pflegezone und eine Entwicklungszone, die gegebenenfalls eine Regenerationszone enthalten kann".
Dem gegenüber steht bei den Naturparken vor allem das Landschaftsbild und die Erholungseigung im Mittelpunkt. Naturparkte moderner Prägung werden zusätzlich als ein Instrument der Regionalentwicklung verstanden. Hier spielt auch die touristische Nutzung vielfach eine nicht unwesentliche Rolle. Die Größe des Naturparkes Schwarzwald Mitte/Nord und die naturräumliche Ausstattung legen die Möglichkeit nahe, dass hier die Zielsetzungen beider Schutzkonzepte überlappend verwirklicht werden könnten.

3.1 Anforderungen und Kriterien zur Auswahl geeigneter Räume

Der große Erfolg der Biosphärenreservate sowie deren große gesellschaftliche Akzeptanz hat die UNESCO dazu veranlasst, weitere Gebiete in das Netz der Biosphärenreservate aufzunehmen. Um zu erreichen, dass die einzelnen Regionen der Erde ausgewogen vertreten sind, ist die Anerkennung an gesteigerte qualitative und quantitative Voraussetzungen geknüpft. Um die Kriterien zu konkretisieren und den neuen Anforderungen anzupassen, wurden diese für die Anerkennung neuer sowie die Überprüfung bereits anerkannter Biosphärenreservate 1995 in Sevilla / Spanien neu erarbeitet. Darüber hinaus wurden alle am Programm beteiligten Staaten aufgefordert, diese internationalen Leitlinien zu konkretisieren und weitergehende an den Natur- und Kulturraum angepasste nationale Kriterien zu erstellen. Um diesen internationalen Verpflichtungen nachzukommen, wurden durch das Deutsche MAB-Nationalkomitee die „Kriterien für Anerkennung und Überprüfung von Biosphärenreservaten der UNESCO in Deutschland" entwickelt. Mit Hilfe dieser Kriterien sollen sowohl Anträge auf Anerkennung neuer Gebiete als auch die Entwicklung bestehender Biosphärenreservate überprüft werden. Die wiederholte Überprüfung von Biosphärenreservaten ist notwendig, da zum Zeitpunkt der Ausweisung nicht immer alle Aufgaben zu Schutz, Pflege und Entwicklung erfüllt sein können. Die Kriterien fußen zum einen auf einschlägigen internationalen Beschlüssen der UNESCO, zum anderen auf fachlichen, wissenschaftlich begründeten Anforderungen und auf Erfahrungen, die in den Biosphärenreservaten in Deutschland gesammelt wurden. Ziel ist die Entwicklung und Etablierung eines Systems gesamtstaatlich repräsentativer Gebiete, in denen einerseits die Ökosystemtypen Deutschlands exemplarisch vertreten sind und andererseits die ökonomischen und soziokulturellen Verhältnisse beispielhaft widergespiegelt werden.

Entsprechend der Vorgaben der UNESCO soll Deutschland in den internationalen Verbund der Biosphärenreservate mit ca. 20 bis 25 Gebieten vertreten sein (ERDMANN, 1999). Die Kriterien wurden 1996 durch die Länderarbeitsgemeinschaft Naturschutz, Landschaftspflege und Erholung angenommen. Damit ist die formale Voraussetzung geschaffen, dass die mit der Anerkennung verbundenen Aufgaben umgesetzt werden.

Die zur Anerkennung und Überprüfung eines Biosphärenreservates relevanten Kriterien lassen sich in strukturelle und funktionelle Kriterien unterteilen. Darüber hinaus wird nochmals innerhalb der Kategorien zwischen Ausschlusskriterien und Bewertungskriterien unterschieden. Anhand der strukturellen Kriterien wird geprüft, ob das vorgeschlagene Gebiet den Richtlinien entspricht. Die funktionellen Kriterien versuchen zu erfassen, inwieweit ein Biosphärenreservat den gestellten Aufgaben nachkommt. Im Folgenden werden nur die strukturellen Kriterien aufgeführt, da nur diese für die Bearbeitung der Aufgabenstellung maßgeblich sind. Die als Ausschlusskriterien eingestuften Punkte sind mit (A) gekennzeichnet und farblich hervorgehoben. Bewertungskriterien sind mit (B) kenntlich gemacht.

Tab. 3 Kriterien für die Ausscheidung eines Gebietes als Biospärenreservat (A= Ausschlusskriterien, B= Bewertungskriterien)

Kriterien	Beitrag durch GIS-analyse möglich?
1Das Biosphärenreservat muss Ökosystemkomplexe aufweisen, die von denBiosphärenreservaten in Deutschland bislang nicht ausreichend repräsentiert werden. (A)	ja
2 Das Biosphärenreservat soll in der Regel mindestens 30000 ha umfassen und nicht größer als 150.000 ha sein. Länderübergreifende Biosphärenreservate dürfen diese Gesamtfläche bei entsprechender Betreuung überschreiten. (A)	ja
3 Das Biosphärenreservat muss in Kern, Pflege- und Entwicklungszone gegliedert sein. (A)	ja
4 Die Kernzone muss mindestens 3 % der Gesamtfläche einnehmen. (A)	ja
5 Die Pflegezone soll mindestens 10 % der Gesamtfläche einnehmen. (A)	ja
6 Kernzone und Pflegezone sollen zusammen mindestens 20 % der Gesamtfläche betragen. Die Kernzone soll von der Pflegezone umgeben sein. (A)	ja
7 Die Entwicklungszone soll mindesten 50 % der Gesamtfläche einnehmen; in marinen Gebieten gilt dies für die Landfläche. (A)	ja
8 Schutzzweck und Ziele für Pflege und Entwicklung des Biosphärenreservates als Ganzes und in den einzelnen Zonen sind durch Rechtsverordnungen oder durch Programme und Pläne der Landes- und Regionalplanungen sowie der Bauleit- und Landschaftsplanung zu sichern. Insgesamt muss der überwiegende Teil der Fläche rechtlich geschützt sein. Bereits ausgewiesene Schutzgebiete dürfen in ihrem Schutzstatus nicht verschlechtert werden. (B)	ja
9 Die Kernzone muss als Nationalpark oder Naturschutzgebiet rechtlich geschützt sein. (A)	ja
10 Die Pflegezone soll als Nationalpark oder Naturschutzgebiet rechtlich geschützt sein. Soweit dies noch nicht erreicht ist, ist eine entsprechende Unterschutzstellung anzustreben. (B)	ja
11 Schutzwürdige Bereiche in der Entwicklungszone sind durch Schutzgebietsausweisungen und die Instrumente der Bauleit- und Landschaftsplanung rechtlich zu sichern. (B)	nein
12 Eine leistungsfähige Verwaltung des Biosphärenreservates muss vorhanden sein bzw. innerhalb von drei Jahren aufgebaut werden. Sie muss mit Fach- und Verwaltungspersonal und Sachmittel für die von ihr zu erfüllenden Aufgaben angemessen ausgestattet werden. Der Antrag muss eine Zusage zur Schaffung der haushaltsmäßigen Voraussetzungen enthalten. (A)	Nein (indirekt)
13 Die Verwaltung des Biosphärenreservates ist der Höheren bzw. Oberen oder Obersten Naturschutzbehörde zuzuordnen. Die Aufgaben der Biosphärenreservatsverwaltung und anderer bestehender Verwaltung und sonstiger Träger sind zu klären und arbeitsteilig abzustimmen. (B)	nein
14 Die hauptamtliche Gebietsbetreuung ist sicherzustellen. (B)	nein
15 Die ansässige Bevölkerung ist in die Gestaltung des Biosphärereservates als ihrem Lebens-, Wirtschafts- und Erholungsraum einzubeziehen. Geeignete Formen der Bürgerbeteiligung sind nachzuweisen. (B)	nein
16 Für teilweise oder vollständig delegierbare Aufgaben sind geeignete Strukturen und Organisationsformen zu entwickeln, die gemeinnützig oder privatwirtschaftlich ausgerichtet sind. (B)	nein
17 Innerhalb von drei Jahren nach Annerkennung des Biosphärenreservates durch die UNESCO muss ein abgestimmtes Rahmenkonzept erstellt werden. Der Antrag muss eine Zusage zur Schaffung der haushaltsmäßigen Voraussetzungen enthalten. (A)	ja
18 Pflege- und Entwicklungspläne, zumindest für besonders schutz- bzw. pflegebedürftige Bereiche der Pflege- und der Entwicklungszone, sollen innerhalb von fünf Jahren auf der Grundlage des Rahmenkonzeptes erarbeitet werden. (B)	nein
19 Die Ziele des Biosphärenreservates bzw. das Rahmenkonzept sollen zum frühestmöglichen Zeitpunkt in die Landes- und Regionalplanung integriert sowie in der Landschafts- und Bauleitplanung umgesetzt werden. (B)	nein
20 Die Ziele zu Schutz, Pflege und Entwicklung des Biosphärenreservates sollen bei der Fortschreibung anderer Fachplanungen berücksichtigt werden. (B)	nein

Wie die Tabelle 1 zeigt, lassen sich innerhalb der strukturellen Kriteren administrative, partizipatorische, ökosystemare bzw. naturschutzfachliche Kriterien unterscheiden, die im Rahmen einer Gebietsauswahl heranzuziehen sind. Die Tabelle zeigt auch, dass zur Aufbereitung einer Entscheidung in vielen Fällen, insbesondere im Hinblick auf ökosystemare und naturschutzfachliche Kriterien eine Zusammenstellung und Analyse geeigneter Datensätze einen wichtigen Beitrag leisten kann. Im Hinblick auf administrative Aspekte kann indirekt ein Beitrag geleistet werden dadurch, dass bei den Abgrenzungen die Strukturen der regionalen Gebietsverwaltung in die Analyse mit aufgenommen werden.

Allerdings stellt sich sich die Frage welche Daten und Inhalte in Bezug auf die Einzelnen Kriterien einen geeigneten Indikator darstellen.

3.2 Auswahl geeigneter Indikatoren und Abgrenzungsschritte

Durch einen schrittweisen Abgrenzungsvorgang mit Hilfe von geographischen Informationssystemen sollte anhand von festgelegten Kriterien ein Teilgebiet innerhalb des Naturparks Schwarzwald Mitte/Nord gefunden werden, welches sich am besten für die Ausweisung als Biosphärenreservat eignet. Dabei werden zunächst wichtige Kriterien nund Indikatoren festgelegt und anschließend auch ein Modell in 18 Teilschritten ausgearbeitet, wie die Kriterien nacheinander eingesetzt werden.

Allgemein wird bei Planungsvorgängen mangelnde Nachvollziehbarkeit und Transparenz beklagt. Besonders Geo-Informationssysteme sind in der Kritik, weil oftmals nur der Planer weiß, nach welchen Kriterien bzw. Vorgaben und Datengrundlagen der Computer die Ergebnisse berechnet hat. Um diesem Vorwurf bei der Abgrenzung des Biosphärenreservates sowie bei der Festlegung der Zonen vorzubeugen, wird der Prozess anhand von Karten Schritt für Schritt sowie in einem Ablaufschema verdeutlicht und damit transparent gestaltet.

Die im Rahmen der Arbeit verwendeten GIS-Programme stammen alle von der Firma ESRI™ (Enviromental Systems Research Institute). Dabei handelte es sich um die Programme ArcView 3.2a™ mit den Erweiterungen Spatial Analyst™ und 3D Analyst™, Arc/Info™ und ArcGis 8.2™. Die in der Arbeit verwendeten Daten stammen von verschiedenen Institutionen und Einrichtungen. Hierzu zählen die Landesanstalt für Umweltschutz in Baden-Württemberg, das Landesvermessungsamt, das Landratsamt Freudenstadt, die Forstliche Versuchs- und Forschungsanstalt in Freiburg, das Ministerium Ländlicher Raum, die Universität Hohenheim, sowie die Planungsgemeinschaft zu Erstellung des Naturparkplans (AGL et al. 2003).

Naturschutzfachliches und naturräumliches Indikatorenset

Die Lebensräume in Mitteleuropa wurden besonders im Verlauf des letzten Jahrhunderts zunehmend zerteilt und zersplittert mit nachteiligen Auswirkungen auf den Naturhaushalt (BUNDESAMT FÜR NATURSCHUTZ, 1997). Besonders die Auswirkungen von Verkehrsstraßen auf die Tierwelt sind vielfach belegt (MADER, 1979, MADER et al. 1988; GLITZNER, 1999; BUNDESAMT FÜR NATURSCHUTZ, 1997). Als wichtigste Folgen für Populationen sind der Flächenverlust, der Biotopverlust, die Barrierewirkung (Unterbindung von Populationsaustausch), die Unterbrechung von Wildwechseln und Wildwanderwegen und die Störung durch Verlärmung zu nennen. In diesem Punkt kommt den Großschutzgebieten wie Nationalparks und Biosphärenreservate eine besondere Bedeutung zu. Daher zählt der Grad der Zerschneidung in diesem Raum zu den wichtigsten naturschutzfachlichen Indikatoren. Als Grenzwert wurde eine Mindestgröße eines zusammenhängenden Gebietes von 250 ha festgelegt. Dieser Wert wurde aus dem Rahmenkonzept für das Biosphärenreservat Rhön übernommen. Des Weiteren wurden Gebiete kleiner 250 ha, jedoch mit Verbindung zu größeren Gebieten, mit in die Auswahl genommen. Ein zweiter Inidikator leitet sich aus einer der wichtigsten Leitarten dieses Naturraums ab, dem Auerhuhn (tetrao urogallus). Die Schwerpunktvorkommen dieser geschützten und selten gewordenen Leitart für großflächige, störungsarme Wälder mit hohem Tannenanteil (SUCHANT, 2003) werden in die Abgrenzung ebenfalls integriert.

Bei der Abgrenzung wurden darüber hinaus auch bestehende Räume mit hoher naturschutzfachlicher Bedeutung, wie Bannwald, NATURA 2000 Gebiete oder geschützte Biotope berücksichtigt. Ein hoher Anteil dieser Flächen bedeutet eine hohen Stellenwert für die Ausweisung als Schutzgebiet. Nachdem diese Flächen auf einer räumlichen Kartierung beruhen, wurden sie auch zur Ableitung der Außenränder herangezogen. Allerdings wurde zum Schutz diese hochwertigen Lebensräume der Grenzverlauf mit 200 m „gepuffert", um diese Bereiche vor Randeinflüssen zu schützen.

Administratives und strukturelles Indikatorenset

Entscheidend sind weiterhin auch administrative Indikatoren. Hierzu gehören die Verteilung von Grundbesitzstrukturen, die Besitzgrößen, aber auch der Anteil geschützter Lebensräume. Die beabsichtigten Kernzonen haben dann eine größere Chance auf Umsetzung störungsfreier Gebiete, wenn sie überwiegend im Beitz des Staates sind, Maßnahmen in den Entwicklungszonen beziehen sich auf die Entwicklung von nachhaltigen Landnutzungsformen. Hier ist ein hoher Anteil privat genutzter Flächen außerordentlich wünschenswert. Nachdem Biosphärenreservate einen hohen Anteil an geschützten Flächen aufweisen müssen, ist dieser Alspekt und ihre Verteilung im Raum ein weiteres wichtiges administratives Kriterium. Der Großteil der Fläche sollte als Landschaftsschutzgebiet, die späteren Kernzonen bevorzugt als Naturschutzgebiet (oder Nationalpark) ausgewiesen sein. Darüber hinaus gilt es auch die kommunalen Grenzen und die Landkreisgrenzen zu beachten, um das spätere Management, Verantwortlichkeiten und Zuständigkeiten zu erleichtern. Um großflächige Schutzkonzepte umsetzen zu können, sollten weiterhin große Flächenanteile in staatlichem Besitz sein (STÄNDIGE ARBEITSGRUPPE DER BIOSPHÄRENRESERVATE IN DEUTSCHLAND, 1995).

Die nachfolgende Abbildung zeigt, wie die verschiedenen Indikatoren sinnvoll, teilweise zur Kontrolle auch mehrfach (wie der Zusammenhang von unzerschnittenen Lebensräumen) eingesetzt werden können, um durch Auswertung der vorhandenen Daten eine räumliche Abgrenzung schrittweise herbeizuführen.

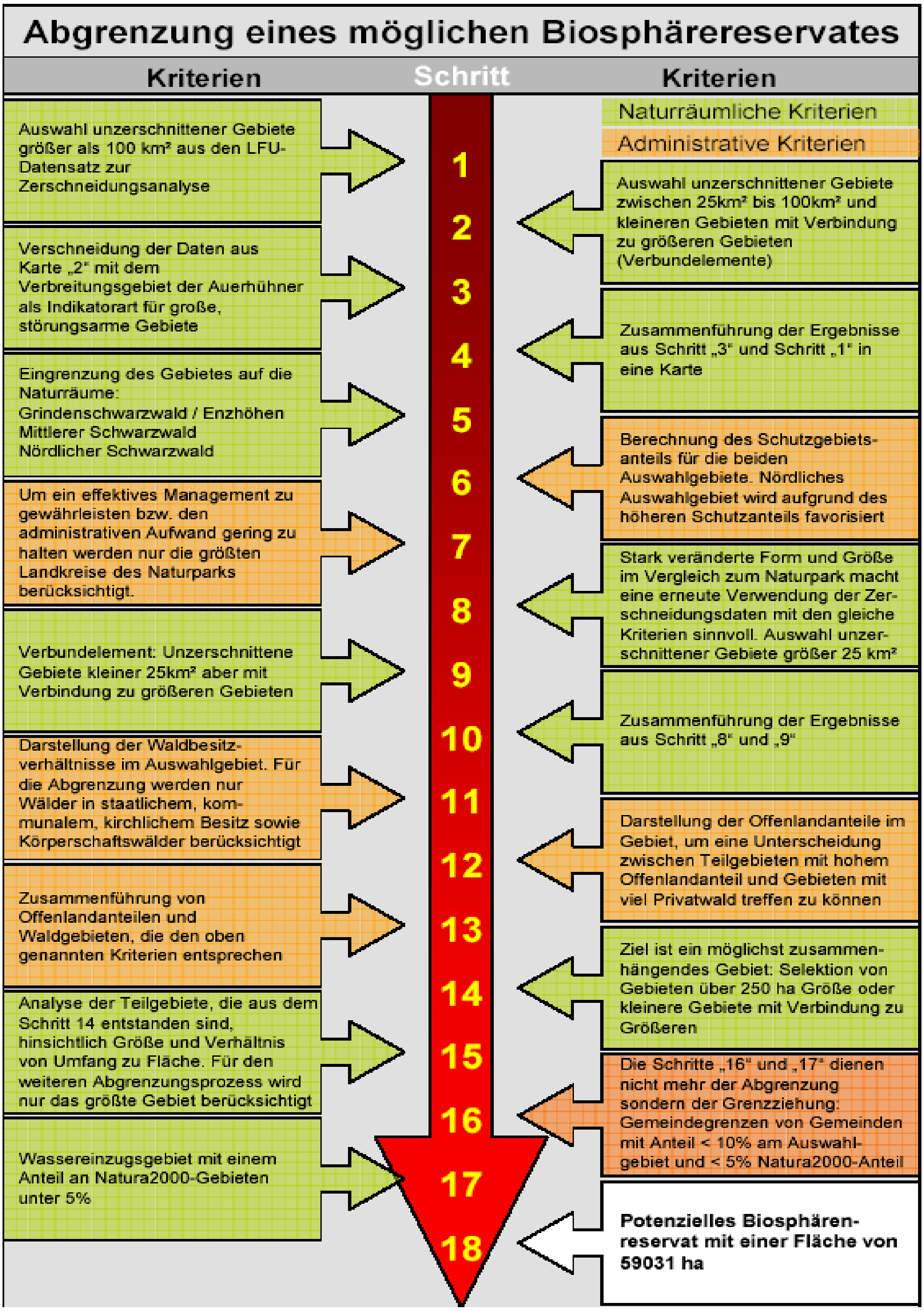

Abb. 18: Inhalte und Ablaufschitte bei der Flächenauswahl

Die nachstehende Abbildung zeigt ein Ausschnitte aus den verschiedenen Analyseschritten und stellt abschließend den ausgewählten Raum vor.

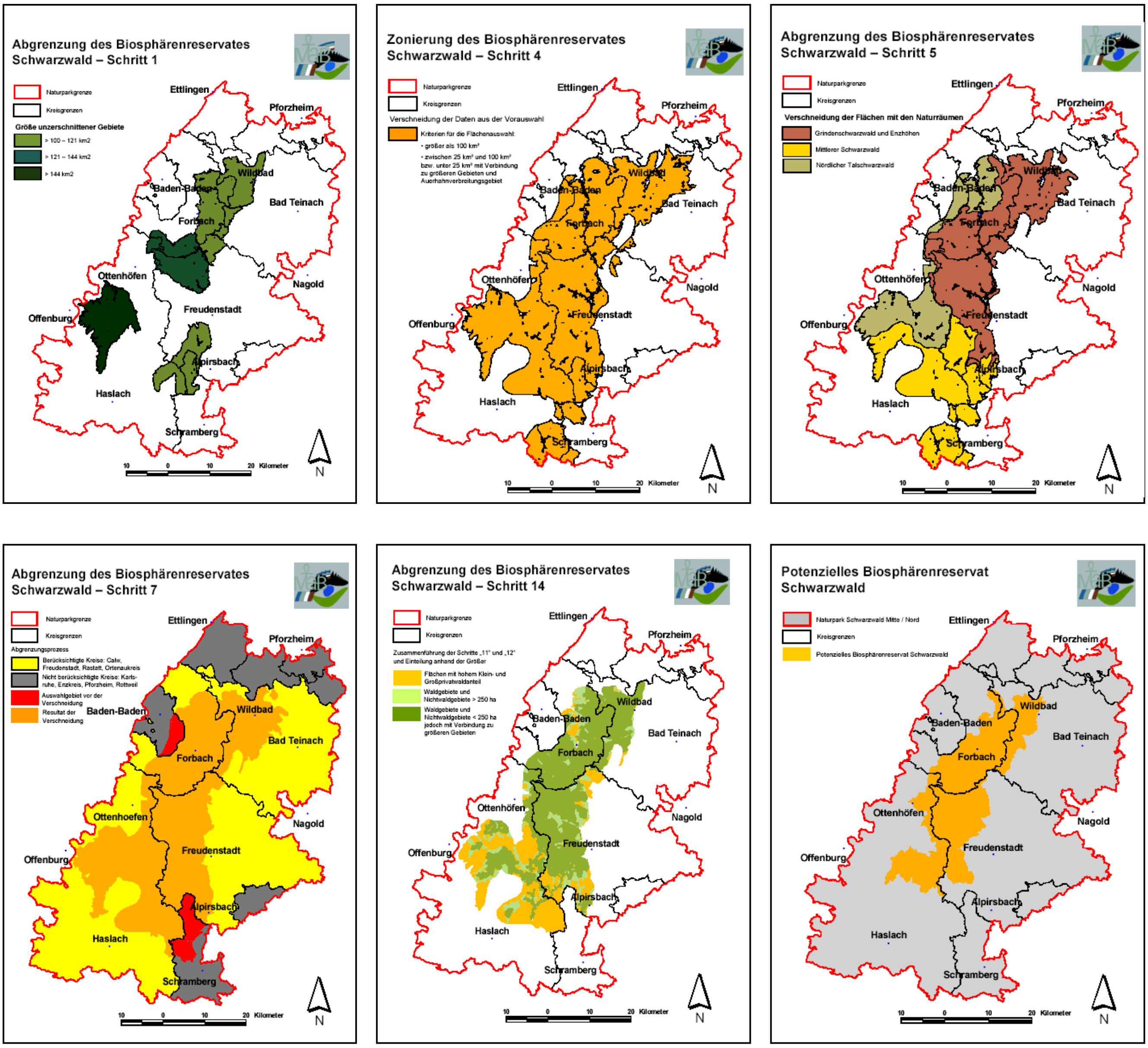

Abb. 19 Auschnitt aus den Bewertungsschritten mit verschiedenen Indikatoren (Unzerschnittene Gebiete über 100 km², Auerwildlebensräume und unzerschnittene Lebensräume über 25 km², naturräumliche Gliederung, Gemeinde und Landkreisgrenzen, Besitzstrukturen)

Differenzierung in Kern-, Pflege- und Entwicklungszone

Nach der Abgrenzung eines möglichen Biosphärenreservates erfolgt die für Biosphärenreservate erforderliche Einteilung in Kernzone, Pflegezone und Entwicklungszone. Die Abgrenzung der Kernzonen, orientierte sich zunächst an den Natura2000 Gebieten des Raums. Die Ableitung dieser Gebiete aus Arten und Lebensraumtypen europaweiter Bedeutung lassen dieses Vorgehen als sinnvoll erscheinen. Zusätzlich zu den Natura 2000-Gebieten wurden Naturschutzgebiete aufgrund ihres hohen Schutzstatus, Schonwälder in räumlicher Nähe zu den ebenfalls als Kernzonen ausgewiesenen Bannwäldern sowie geschützte Biotope und Flächen der Waldbiotopkartierung mit berücksichtigt.

Im zweiten Abschnitt der Gis-Analyse zur Zonierung wurden die Landnutzungsdaten mit denen der Schutzgebiete verschnitten, um die Offenlandflächen herauszuarbeiten. Hierbei zeigte sich, dass eine Reihe naturschutzfachlich hochwertiger Flächen dem Offenland zuzurechnen sind und dringend einer Fortführung der biotoptypengerechten Pflege bedürfen. Diese Flächen wurde im Rahmen der Pflegezone gesondert dargestellt (vgl. Abb.3 Grindenpflegezone). Eine weitere zusätzliche Untergliederung der Pflegezone erschien durch die großen Vogelschutzgebiete zum Schutz der Auerhuhnpopulation im Schwarzwald erforderlich. Die sog. Waldpflegezone nimmt mit über 30 % einen erheblichen Teil des Biosphärenreservates ein. Wichtigestes Ziel ist hier ganz speziell der Schutz der Auerhuhnpopulation im Schwarzwald (vgl. Abb.3 Waldpflegezone, dunkelgrün dargestellt). Die restlichen Pflegezonen dienen vor allem der Offenhaltung und Erhaltung einer artenreichen Kulturlandschaft (hellgrün dargestellt). Die verbleibenden Flächen (in Abb.3 in einem dunklen Gelbton dargestellt) bilden die Entwicklungszone.

Insgesamt umfasst die Kernzone einen Anteil von ca. 10% des ausgewählten Gebietes, die Pflegezone rund 30% und die Entwicklungszone rund 60%. Die Kernzone ist zu 84% in staatlichem Besitz, weitere 10 % sind im Besitz der Kommunen. Damit sind auch die Vorraussetzungen für die Umsetzung des vorgestelleten Konzeptes sehr gut.

Im Hinblick auf die räumliche Verteilung der Zonen, besonders der Kernzonen, finden sich viele Übereinstimmungen mit den Biosphärenreservaten Rhön und Pfälzerwald. Dies gilt vor allem im Hinblick auf die Kombination von größeren, zusammenhängender Kernzonen mit einer Auswahl repräsentativer, kleinflächiger Kernzonen. Die in Tabelle 1 dargestellten Anforderungen an die Flächenanteile und Zuordnungen können mit dem vorgestellten Konzept erfüllt werden.

Im Hinblick auf die Analyse der Repräsentativität erwies sich die vorhandene Bewertung der Biotope durch die Landesanstalt für Umweltschutz als sehr hilfreich. Die Auswertung ergab, dass einige Biotoptypen noch nicht bzw. in keiner so guten Ausprägung in den deutschen Biosphärenreservaten erfasst sind. Zudem zeigt sich in der Vielzahl seltener Biotoptypen die Sonderstellung des Gebietes, so dass die Bedingung hinsichtlich Repräsentativität als erfüllt angesehen werden kann.

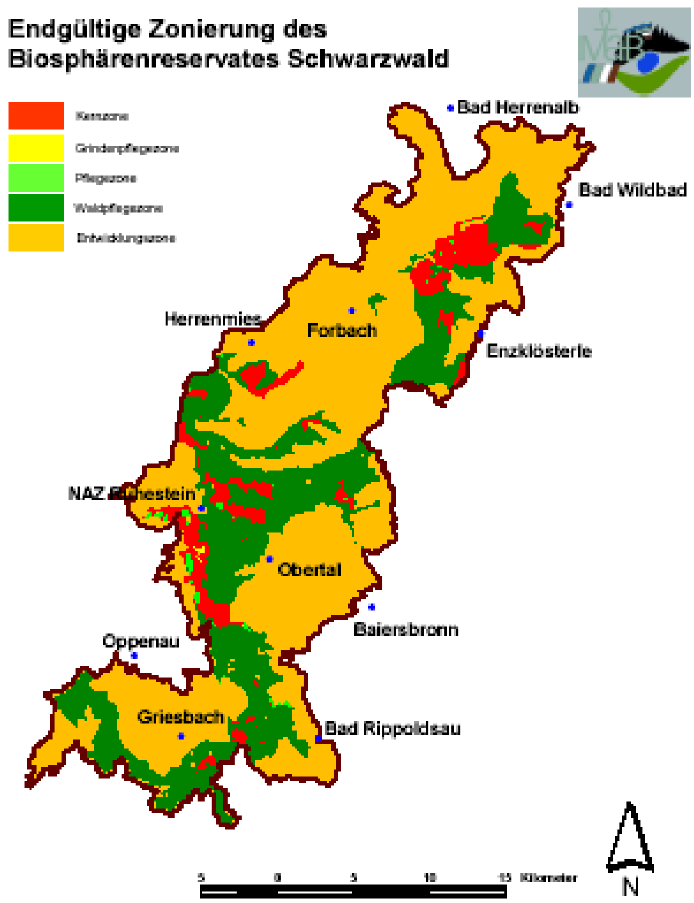

Abb. 20 Endgültiger Vorschlag für ein Biospärenreservat im Naturpark Schwarzwald Mitte/Nord

4 ZUSAMMENFASSUNG

Entsprechend den Kriterien der UNESCO an Biosphärenreservate wurde dargestellt, wie durch eine mehrstufige Gis-Analyse die mögliche Eignung und die Abgrenzung eines entsprechenden Raumes abgeklärt werden kann. Dabei ist es erforderlich, sowohl eine Vielzahl ökologischer als auch adminstrativer und managementbezogener Kriterien auszuscheiden und abzuprüfen. In konsequenter Weise wird dargestellt, wie über naturräumliche Grenzen, Arealansprüche bedrohter Wildtiere, Schutzgebietsgrenzen, Besitzverhältnisse, Verwaltungsgrenzen u. a. ein geeignetes Gebiet abgeleitet werden kann. Es zeigt sich, dass dies mit Geographischen Informationssystemen in objektiver und nachvollziehbarer Weise gelingen kann. Das vorliegende Beispiel verdeutlich die herausragende Eignung geographischer Informationssystem im Bereich der Entscheidungsvorbereitung , insbesondre bei konkurierenden oder schwierigen Fragen der Raumentwicklung. Hierfür ist die Entwicklung eines Biosphärenreservates, das Kulturlandschaft umfassen soll, aber auch hochwertige ungestörte Lebensräume, ein attraktives Beispiel. Der Einsatz von GIS kann gezielt verwendet werden um eine aktive und gleichzeitig transparente bzw. nachvollziehbare Naturschutzpolitik zu betreiben. Der hier vorgestellte Prozess von der Auswahl der Indikatoren über deren Verschneidung und Auflösung in transparente Einzelschritte könnte zu einem Spatial Decission Support Systems (vgl. STAUCH, 2002) weiter entwickelt werden.

5 SUMMARY

The Black Forest is one of the largest contiguous natural areas in Germany. The mountainous natural landscape is dominated by extensive forests and meadows in the valley bottoms, while the cultural landscape is characterized by meadows with disperced fruit trees and vinticulture. This mix provides for a heterogeneous flora and fauna. The northern and middle sections of the Black Forest are protected by various legal means such as protected biotopes and Nature 2000 sites.

The area is also an important tourism destination, and also attracts a large number of local recreationists for the state of Baden-Württemberg and beyond. The region accounts for a total of 8 million bednights and 1,7 million arrivals, with increasing tendencies. The concerns for conservation and the importance of tourism lead to suggesting a nature park for the region by the year 2000. It has been established in the meantime by the local commnities founding the NATURPARK VEREIN EV.

During the planning process for this largest single nature park in Germany, the idea of establishing a biosphere reserve emerged quickly for the purpose of both maintaining ecological integrity, as well as strengthening the competitive position of the region as a tourism destination vis-à-vis other regions with nature parks. According to UNESCO–IUCN specifications, biosphere reserves provide regions with the following benefits:

Biosphere Reserves protect ecosystems from damaging human activities and protect valuable landscapes for humans as well as for flora and fauna.

Biosphere Reserves are representative cultural landscapes in which balanced relationships between humans and nature is developed.

Biosphere Reserves provide additional insights about human uses and development of natural areas.

With the goal of establishing a Biosphere Reserve according to UNESCO specifications in mind, we undertook a multi-layered GIS-analysis to evaluate the suitability of the area and to delineate the appropriate area. The analysis considered many ecological as well as structural administrative as well as socio-economic criteria. The research process started with the identification of suitable data from the many sources available, and relied extensively on the linkage and cross-sectional analysis of the spatial data. We document how our systematic analysis of the habitats of endangered species, land ownership structures, and administrative boundaries lead to the demarkation of an area suitable for a biosphere reserve. The GIS-based analysis provides an objective and comprehensible tool for that purpose. In contrast to the more traditional approach, in which a suitable area is identified by experts and agency managers based on expert knowledge, our analysis makes the complex layers of information transparent, and therefore increased the acceptance of the proposed reserve by the general population.

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GIS-gestützte Analyse von Berggebieten in Europa

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1 ABSTRACT

Dieser Beitrag präsentiert ausgewählte Arbeitschritte und Ergebnisse eines europäischen Forschungsprojektes mit dem Titel "Analysis of mountain areas in the European Union and in the applicant countries", welches von der EU-Kommission (DG Regio) im „Jahr des Berges" (2002) in Auftrag gegeben wurde. Ziel war es, eine tief greifende Analyse von Berggebieten in der Europäischen Union, den Beitrittskandidaten sowie Norwegen und der Schweiz vorzulegen.

In diesem Papier werden insbesondere die Abgrenzung der Berggebiete, die erarbeitete GIS-Datenbank sowie die Indikatoren und ihre Analyse vorgestellt.

2 DIE STUDIE

Das Forschungsprojekt "Analysis of mountain areas in the European Union and in the applicant countries", im Folgenden kurz "Bergstudie" genannt, wurde von August 2002 bis Januar 2004 von einem internatinalen Forscherteam unter Leitung von NORDREGIO in Schweden bearbeitet. Es wurde finanziert durch die EU-Kommission und cofinanziert durch Mittel, die die Regierungen der Schweiz und Norwegens für die Ausweitung des Untersuchungsgebietes um ihre Länder beigetragen haben.

Die Bergstudie hatte die folgenden Ziele:

- Abgrenzung aller europäischen Berggebiete unter Verwendung einer einheitlichen Definition
- Berechnung und Zusammenstellung von statistischen und geografischen Indikatoren auf Gemeindeebene (NUTS 5) in einer umfassenden GIS-Datenbank
- Analyse der sozio-ökonomischen Situation in den betrachteten Berggebieten und Erarbeitung adäquater Indikatoren zur Typologiebildung
- Überprüfung bergbezogener Maßnahmen und Politiken, mit dem Ziel geeignete Politikempfehlungen zu geben

Das Institut für Raumplanung an der Fakultät Raumplanung, Universität Dortmund (IRPUD) war insbesondere für die Punkte zwei und drei verantwortlich. Dies beinhaltete somit die Sammlung statistischer Daten, die Erzeugung von GIS-Daten, quantitative Analysen und die Erarbeitung der GIS-Datenbank.

3 ABGRENZUNG VON BERGGEBIETEN UND ÜBERGANGSGEBIETEN

3.1 Berggebiete

Der Ansatz einer europaweit einheitlichen Abgrenzung von Berggebieten hat gezeigt, dass es nicht ausreichend ist, die Höhe über NN als einziges Kriterium zu verwenden. Dies wurde bereits beim Zusammentragen von nationalen Abgrenzungskriterien deutlich, bei dem man auf eine Vielzahl von Kriterien und dazugehörigen Grenzwerten stößt. Diese spiegeln die lokalen Besonderheiten und die national stark divergierenden Auffassungen von Berggebieten wider, welche durch die kulturellen und historischen Wurzeln der Einwohner geprägt sind. Denn die nationale Abgrenzung von Berggebieten hängt häufig mit deren landwirtschaftlicher Nutzbarkeit für den Menschen zusammen, so dass z.B. Neigung und Klima weitere wichtige Abgrenzungskriterien sind.

So existieren beispielsweise in Norwegen Gebiete mit Fjorden, die sehr steil direkt ins Meer abfallen und somit auf Grund ihrer Neigung und nicht ihrer absoluten Höhe als gebirgig zu bezeichnen sind. Ein anderes Beispiel sind große Gebiete im Norden Schwedens und Finnlands, die auf Grund klimatischer Bedingungen als Berggebiete eingestuft wurden, da ihre klimatischen Einschränkungen (berechnet anhand der Anzahl von Monaten mit einer Durchschnittstemperatur von unter 0°C) ausgeprägter sind als in den Zentralalpen, die innerhalb des Untersuchungsgebietes die höchsten Berggipfel darstellen.

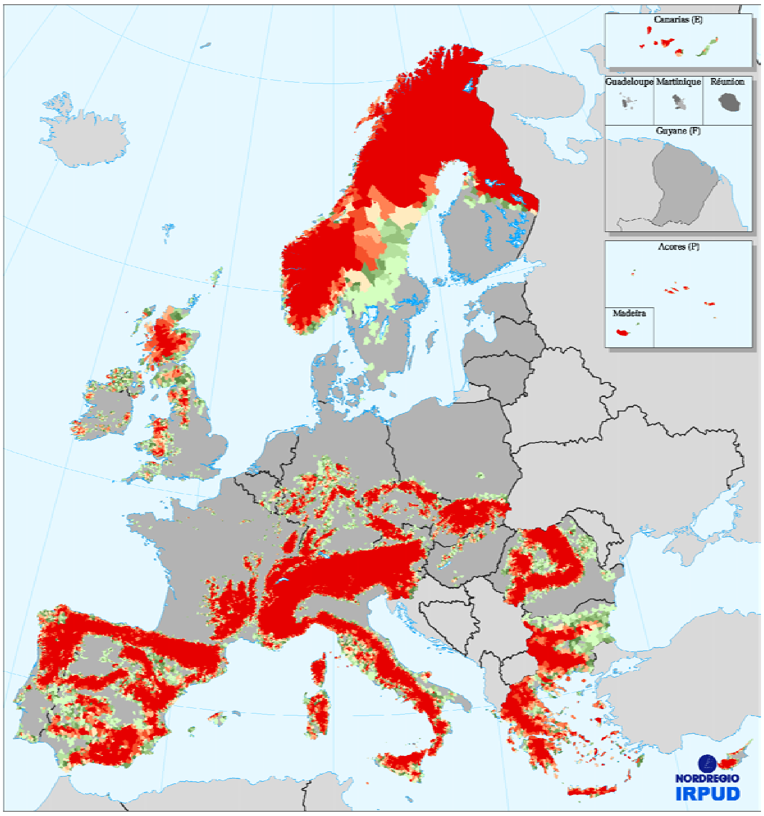
Folglich wurde ein Kriterienkatalog zusammengestellt, anhand dessen 16 Szenarien GIS-gestützt entwickelt und anschließend überprüft wurden, indem ihre quantitativen Grenzwerte stufenweise angepasst wurden, so dass letztlich die bestehenden nationalen Abgrenzungen der Gebirgsregionen weitgehend berücksichtig werden konnten. Das finale Szenario wendet folglich neben absoluten Höhenwerten auch zunehmend restriktive Kriterien bzgl. Höhenunterschieden in niedrigeren Lagen an. Zudem sind die oben beschriebenen klimatischen Faktoren berücksichtigt worden. Zur Abgrenzung von Berggebieten wurde letztlich folgender Kriterienkatalog genutzt:

- alle Gebiete über 2500 m
- zwischen 1500 m und 2500 m: nur Flächen mit einer Neigung > 2º innerhalb von 3 km
- zwischen 1000 m und 1500 m: Neigung innerhalb eines Radius von 3 km > 5º oder Höhenunterschied > 300 m innerhalb von 7 km

- zwischen 300 m und 1000 m: Höhenunterschiede > 300 m innerhalb von 7 km
- unter 300 m: Standardabweichung von > 50 m innerhalb 50 m
- Berggebiete mit einer Größe von < 50 km^2 wurden ausgeschlossen
- Nicht-Berggebiete < 50 km^2, umgeben von Berggebieten wurden mit eingeschlossen
- Gebiete mit einem Temperatur-Kontrast-Indexwert von < 0.25 wurden hinzugefügt

Um statistische Analysen durchführen zu können und Politikrelevanz zu erreichen, musste die Abgrenzung von Berggebieten auf die Gemeindeebene als administrative Einheit heruntergebrochen werden. Voraussetzung hierfür war zunächst ein Gemeindecoverage für das gesamte Untersuchungsgebiet. Eurogeographics (www.eurogeographics.org) hat ein nahtloses Coverage mit den Gemeindegrenzen erzeugt, welches SABE genannt wird. Im Laufe der Studie wurde die Version von 1997 durch die neu erschienene Version von 2001 ersetzt. Leider beinhaltete SABE keine Grenzen für Rumänien und Bulgarien, welche aus seperaten Quellen eingearbeitet wurden. Zudem stellte sich heraus, dass zusätzlich alternative Grenzen für die Schweiz, Slowenien und die Slowakei genutzt werden mussten.

Nach der Überlagerung des Gemeindecoverages mit dem Coverage der Berggebietsabgrenzung wurden die Gemeinden als Berggemeinden identifiziert, welche mindestens 50 % Gebirgsfläche aufwiesen.



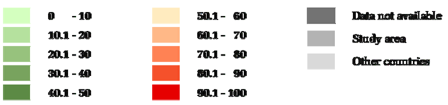


Abb. 1: Anteil der Gebirgsfläche je Gemeinde (in %)

Summiert man die Flächen der letztlich als gebirgig definierten Gemeinden auf, so wird deutlich, dass deren Anteil an der Staatsfläche innerhalb des Untersuchungsgebietes stark variiert (vgl. Tabelle 1).

Country	*Country area*	*Mountain area*	*% Mountain area*	*Country*	*Country area*	*Mountain area*	*% Mountain area*
AT	83.85	61.51	73.4	BG	101.74	54.18	53.3
BE	30.62	1.29	4.2	CY	9.23	4.40	47.6
DK	43.10	0.00	0.0	CZ	78.79	25.41	32.3
FI	326.76	166.08	50.8	EE	45.23	0.00	0.0
FR	548.64	138.64	25.3	HU	92.48	4.37	4.7
DE	356.77	52.59	14.7	LT	65.30	0.00	0.0
GR	132.22	102.98	77.9	LI	64.59	0.00	0.0
IE	70.14	7.44	10.6	MT	0.22	0.00	0.0
IT	300.59	180.78	60.1	PL	311.44	16.18	5.2
LU	2.59	0.11	4.4	RO	238.40	90.24	37.9
NL	41.20	0.00	0.0	SI	20.27	15.81	78.0
PT	92.36	36.14	39.1	SK	48.99	30.37	62.0
ES	505.21	281.61	55.7	NO	323.90	295.86	91.3
SE	450.00	227.70	50.6	CH	41.30	37.46	90.7
UK	245.49	62.56	25.5	Study area	4,671.42	1,893.71	40.5

Tab. 1: Anteil der Staatsfläche, die von Gebirgsregionen eingenommen wird

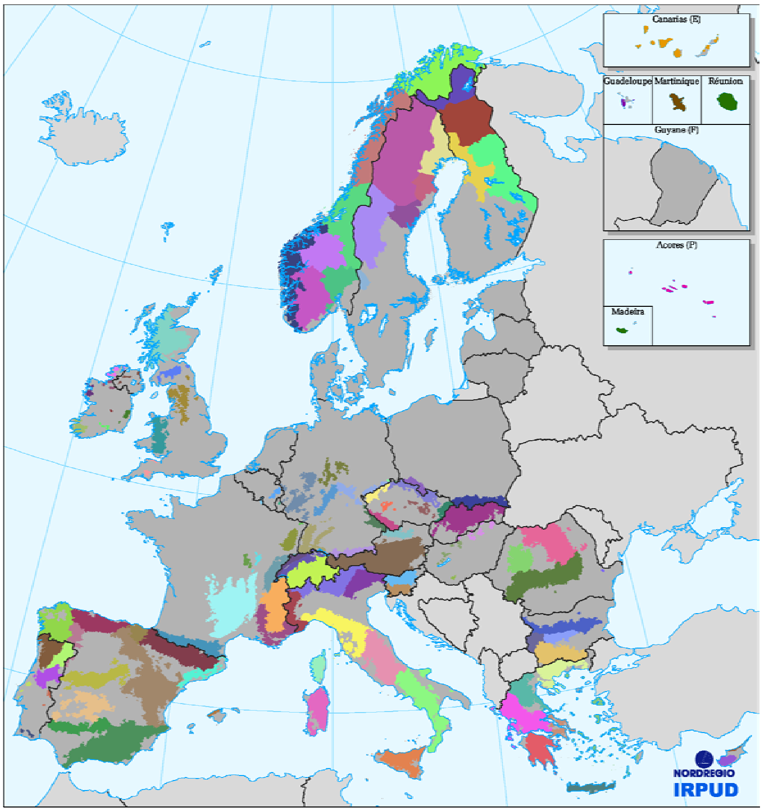


Abb. 2: Massivabgrenzung

Nachdem ca. 33.000 Gemeinden als gebirgig identifiziert wurde, galt es ex-ante Massive zu definieren. Die Vorgehensweise dabei war als qualitativ zu bezeichnen und wurde anhand von Vorschlägen nationaler Experten vorgenommen. Neben den Staatsgrenzen orientieren sich die Massive somit eher an sozialen und kulturellen Kriterien als an geologischen und berücksichtigen somit die innerstaatlichen Aufteilungen und Verständnisse von Bergregionen.

Dieses Vorgehen rechtfertigt sich dadurch, dass eine gemeindebezogene Analyse der einzelnen Berggebiete keine regional zusammenhängenden Gruppierungen hervorgebracht hätte, sondern man eher nach Städten und ländlichen Gebieten hätte unterscheiden können. Zudem werden Massive von sozialen Akteuren weniger als Kategorie verstanden, sonder eher als gebirgige Gebiete oder Regionen, bei denen es in diesem Zusammenhang unbedeutend ist, ob sie in sich homogen, funktional integriert o.ä. sind. Auf diese Weise wurden 127 zusammenhängende, nationale Massive identifiziert, die in Abbildung 2 dargestellt sind.

3.2 Übergangsgebiete

Neben den Berggebieten selbst wurde auch deren räumlicher Kontext, sprich ihre Einbindung und Verknüpfung mit umliegenden Gebieten, untersucht. Hierzu wurden basierend auf der Massivabgrenzung sog. Übergangsgebiete (transition areas) zwischen Gebirgen und dem Flachland abgegrenzt. Mit Hilfe von ArcInfo wurden drei Pufferringe mit den Radien 10, 20 bzw. 50 km um die Berggebiete generiert (vgl. Abbildung 3). Statistische Analysen wurde dementsprechend nun teilweise auch für diese Übergangsgebiete als eigenständige Raumeinheit durchgeführt, wobei sich einige Auffälligkeiten zeigten. Beispielsweise ist die Versorgung mit Universitäten in den Übergangsgebieten vergleichsweise hoch, wie Abbildung 4 am Beispiel des Alpenraumes illustriert. Eine ähnliche Besonderheit lässt sich bei der Bevölkerungsdichte erkennen. Abbildung 5 zeigt, dass diese in den Übergangsgebieten höher ist als in den Berggebieten sowie den Flachlandgebieten. Eine umfassende Untersuchung derartiger Charakteristika und Besonderheiten war allerdings nicht primäres Ziel der Bergstudie und müsste folglich anderweitig ausführlicher untersucht werden.

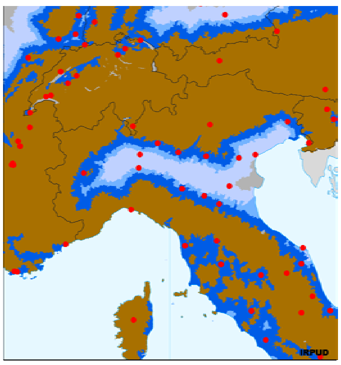


Abb. 4: Universitäten im Alpenraum

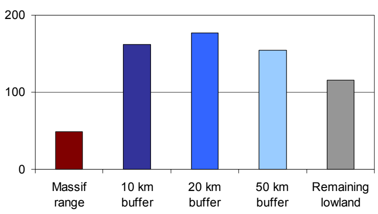


Abb. 5: Bevölkerungsdichte im Untersuchungsgebiet in EW / km^2

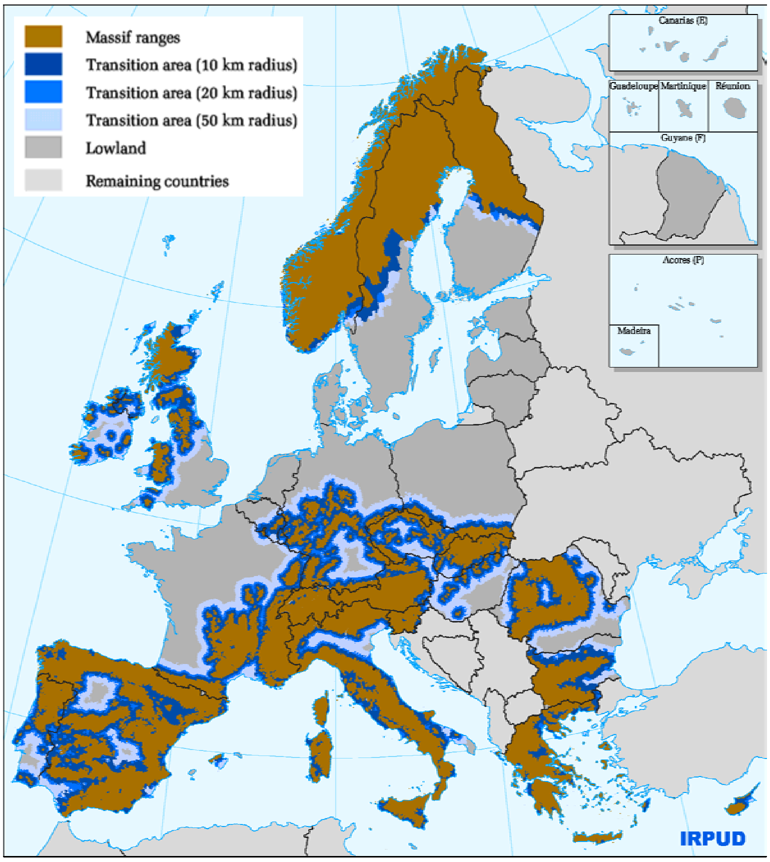


Abb. 3: Übergangsgebiete

4 DATENBANK

4.1 Anforderungen

Einer der grundlegenden Ansprüche an die Datenbank war die Kompatibilität mit der bestehende Eurostat/GISCO GIS-Datenbank. Von Bedeutung waren hierbei insbesondere die unterstützten Datenformate und das genutzte Projektionssystem.

Da die Referenzdatenbank GISCO auf ArcInfo von ESRI in der Version 7.x aufsetzt, bedient sich die Datenbank der Berstudie der folgenden Datenformate:

- ArcInfo Coverages (für Verctordaten wie das Gemeindecoverage)
- ArcInfo Info Tables (für die Indikatoren auf Gemeinde- und Massivebene)

Der Aufbau der Datenbank ist in Abbildung 6 dargestellt. Der workspace MOUNTAINS beinhaltet die Daten organisiert nach Indikatorenbereichen, auf die im weiteren Verlauf dieses Beitrages noch näher eingegangen werden wird.

Das Projektionssystem wurde ebenfalls in Anlehnung an die GISCO-Standards umgesetzt. Verwendet wurde eine Lambert Azimuthal-Projektion, die gut geeignet ist, die Formen großer Flächen möglichst verzerrungsfrei abzubilden. Die Projektion ist durch die in Tabelle 2 gelisteten Parameter charakterisiert.

Units	Meters
Spheroid	Sphere
Radius of sphere of reference	6378388
Longitude of centre of projection	09° 00’ 00’’
Latitude of centre of projection	48° 00’ 00’’
False easting	0.0
False northing	0.0

Tab. 2: Eigenschaften der GISCO-Projektion für Europa

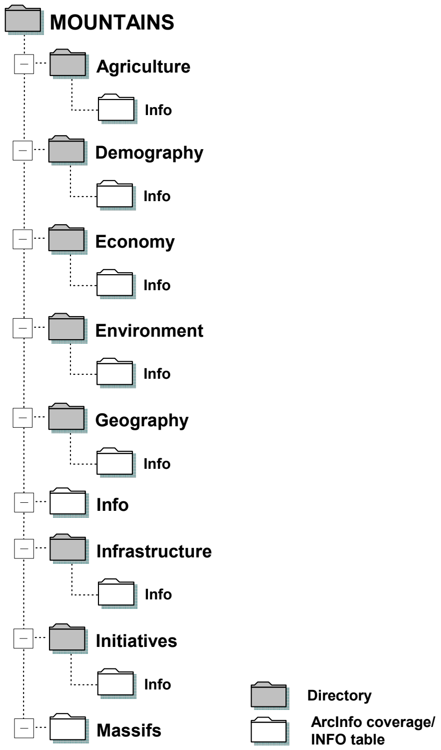


Abb. 6: Die Struktur der GIS-Datenbank der Bergstudie

4.2 Ind ikatoren

Die Sammlung, Erzeugung und Verwaltung von Indikatoren für ca. 115.000 Gemeinden in Europa war Schwerpunkt der Arbeit am IRPUD. Grundsätzlich wurde zwischen statistischen und GIS-Indikatoren unterschieden, wobei sich diese Unterscheidung auf die Erzeugung der Daten bezieht.

Statistische Daten wurden länderweise mit Hilfe nationale Partner gesammelt und später zusammengeführt. Falls Daten nicht auf Gemeindebene für das entsprechende Jahr verfügbar waren, so wurden diese - falls möglich – disaggregiert. Manche Daten lagen allerdings für einige Länder gar nicht vor, weshalb in der Metadatendokumentation darauf hingewiesen wird, für welches Territorium die Daten jeweils verfügbar waren.

Unter dem Begriff GIS-Indikatoren wurden diejenigen Indikatoren zusammengefasst, die mit Hilfe von ArcInfo erzeugt wurden. Die Vorgehensweise folgte dabei immer dem gleichen Prinzip: Das oben bereits erwähnte NUTS 5 Gemeindecoverage wurde mit entsprechenden thematischen Coverages verschnitten und die Indikatoren selbst wurden anschließend unter Nutzung statistischer Methoden in ArcInfo abgeleitet oder unter Kombination mehrerer Datensätze berechnet.

Die Nutzung von GIS-Indikatoren war insbesondere im Kontext der Bergstudie mit den folgenden Vorteilen verbunden:

- GIS-Techniken ermöglichen die Einführung von Indikatoren, die in statischen Datenbasen nur lückenhaft oder gar nicht verhanden sind, wie z.B. Erreichbarkeitsindikatoren, Standorte bestimmter Einrichtungen oder Landnutzungen.
- I.d.R. decken GIS-Layer ganz Europa ab, so dass die Indikatoren lückenlos für das gesamte Untersuchungsgebiet erzeugt werden konnten.
- Den GIS-Layern liegt i.d.R. eine für das gesamte Untersuchungsgebiet einheitliche Datendefinition zugrunde, so dass die Berechnung der Indikatoren für alle Länder auf dieselbe Weise durchgeführt werden konnte, und somit die Verlässlichkeit der Daten sehr hoch war. Diese zwei Punkte waren hingegen bei den statistischen Daten häufig das Hauptproblem.

Auf der anderen Seite war der GIS-Ansatz aber auch mit Hindernissen verbunden:

- Es existiert nur eine begrenzte Zahl an europaweiten GIS-Layern, bei denen die Überseegebiete zudem meist nicht enthalten waren.
- Aufgrund des verwendeten Maßstabs der GIS-Layer ist die räumliche Auflösung häufig unsachgemäß, sprich die Anzahl der Attribute oder die Genauigkeit der Polygone ist unzureichend.

Die Liste der erzeugten Indikatoren umfasst mehr als dreihundert Indikatoren, die zum Teil auf Gemeindeebene und zum Teil auf Massivebene vorliegen (vgl. Tabelle 3). Die Indikatoren sind in die oben bereits erwähnten Bereiche eingeteilt:

- *Landwirtschaft*: umfasst Daten zu landwirtschaftlichen Viehbeständen, landwirtschaftlichen und forstwirtschaftlichen Flächen
- *Demographie*: beinhaltet Informationen zur Gesamtbevölkerung, Alterstruktur und zur räumlichen Verteilung der Bevölkerung
- *Ökonomie*: enthält Beschäftigtenzahlen, Daten zum Bildungswesen und zu Arbeitsplätzen
- *Umwelt*: umfasst Daten zur Siedlung- oder Freifläche, zum Besiedelungsgrad u.ä.
- *Geographie*: fasst Daten zur Flächennutzung, zur geographischen Lage sowie zu klimatischen und topographischen Bedingungen zusammen
- *Infrastruktur*: hält Daten zur Erreichbarkeit, zu Verkehrsnetzen, zum Tourismus sowie zu Gesundheits- und Bildungseinrichtungen vor
- *Initiativen*: beinhaltet Informationen zu Fördergebieten der EU (Strukturfonds)

Bereiche	Gemeindebene		Massifebene		Summe		
	Statistik	GIS	Statistik	GIS	Statistik	GIS	Total
Landwirtschaft	6	4	6	4	12	8	20
Ökonomie	18	0	18	1	36	1	37
Geographie	1	48	1	54	2	102	104
Umwelt	0	2	0	9	0	11	11
Demographie	13	1	13	7	26	8	34
Infrastrucktur	6	22	6	59	12	81	93
Initiativen	0	0	0	10	0	10	10
Summe	44	77	44	94	88	221	311

Tab. 3: Anzahl der Indikatoren nach Bereichen

4.3 Metadaten

Zur Speicherung und Verwaltung der verfügbaren Indikatoren wurde eine auf MS Access basierende Metadatenbank entwickelt. Die Metadaten zu den statistischen Indikatoren, die zunächst durch die nationalen Partner in Form ausgefüllter MS Word Dokumente erhoben wurden, galt es zunächst in die Datenbank zu überführen, wozu eine VBA-Anwendung programmiert wurde, die dies weitgehend automatisiert erledigte. Ein Metadatensatz enthielt pro Land und Indikator u.a. Angaben zu der genauen Datendefinition, den vorliegenden Datenformaten, eventuellen Beschaffungskosten sowie zur Verfügbarkeit und zu Datenquellen. Basierend auf diesen Metadaten wurden dann später die eigentlichen Daten bei den nationalen Partnern angefordert.

Um den Umgang mit den ca. 2.000 Datensätzen so komfortabel wie möglich zu gestalten, wurden zudem auf MS Access basierende Formulare erstellt, die das schnelle und bequeme Auffinden und Manipulieren einzelner Datensätze ermöglichten. Der sog. „DatabaseBrowser“ stellte dabei neben den üblichen Navigationsfunktionen auch Filter- und Sortierfunktionen bereit. Zur Bearbeitung häufig benötigter Abfragen wurde als weiteres Tool mit grafischer Benutzeroberfläche der „QueryBuilder“ entwickelt, der das Erzeugen von Ausgabelisten per Mausklick gestattet und diese bei Bedarf auch nach MS Excel exportiert.

Wie bereits erwähnt, wurden letzendlich auch die Metadaten über die zahlreichen GIS-Indikatoren in die Metadatenbank aufgenommen, so dass sie die Datenbank zum Abschluss der Studie ca. 9.000 Datensätzen enthielt. Um die rechnerübergreifende Kompatibilität der Datenbankanwendung unabhängig von der Version des installierten Windows Betriebssystems sowie der installierten MS Office Version zu gewährleisten, wurde die Datenbank letzlich als MS Access Runtime Anwendung weitergegeben.

5 TYPOLOGIEN

Insbesondere im Hinblick auf die Empfehlung von Politiken war die Betrachtung von Einzelindikatoren nicht ausreichend. Daher galt es, umfassende Multikriterienansätze und Methoden zu entwickeln, um Massive bestimmten Typen zuzuordnen. Da das Projekt erst im Januar 2004 auslief, können an dieser Stelle noch keine endgültigen Ergebnisse präsentiert werden, da zur Zeit der Erstellung dieses Beitrags die Typologien noch überprüft und weiterentwickelt wurden.

Drei verschiedene Typologien wurden entwickelt, die aus drei unterschiedlich zusammengesetzten Blickwinkeln Massive zu kategorisieren versuchen:

- sozio-ökonomisches Kapital
- Umwelt, Flächennutzung und Bodenbedeckung
- Infrastruktur, Erreichbarkeit und Dienstleistungen

Jede Typologie setzte spezifische Methoden ein, daher sei an dieser Stelle exemplarisch nur eine Typologie vorgestellt. Die Typologie zum sozio-ökonomischen Kapital berücksichtigt drei quantitative Indikatoren:

- Bevölkerungsdichte
- Bevölkerungsentwicklung zwischen 1991 und 2001
- Erreichbarkeit von Wirtschaftsräumen

Bei diesen Indikatoren wurden jeweils zwei Klassen gebildet, anhand derer die Einstufung des Massivs zu einem Typus vorgenommen wurde. Die dazugehörige Matrix und die Ergebnisse sind in Abbildung 7 dargestellt.

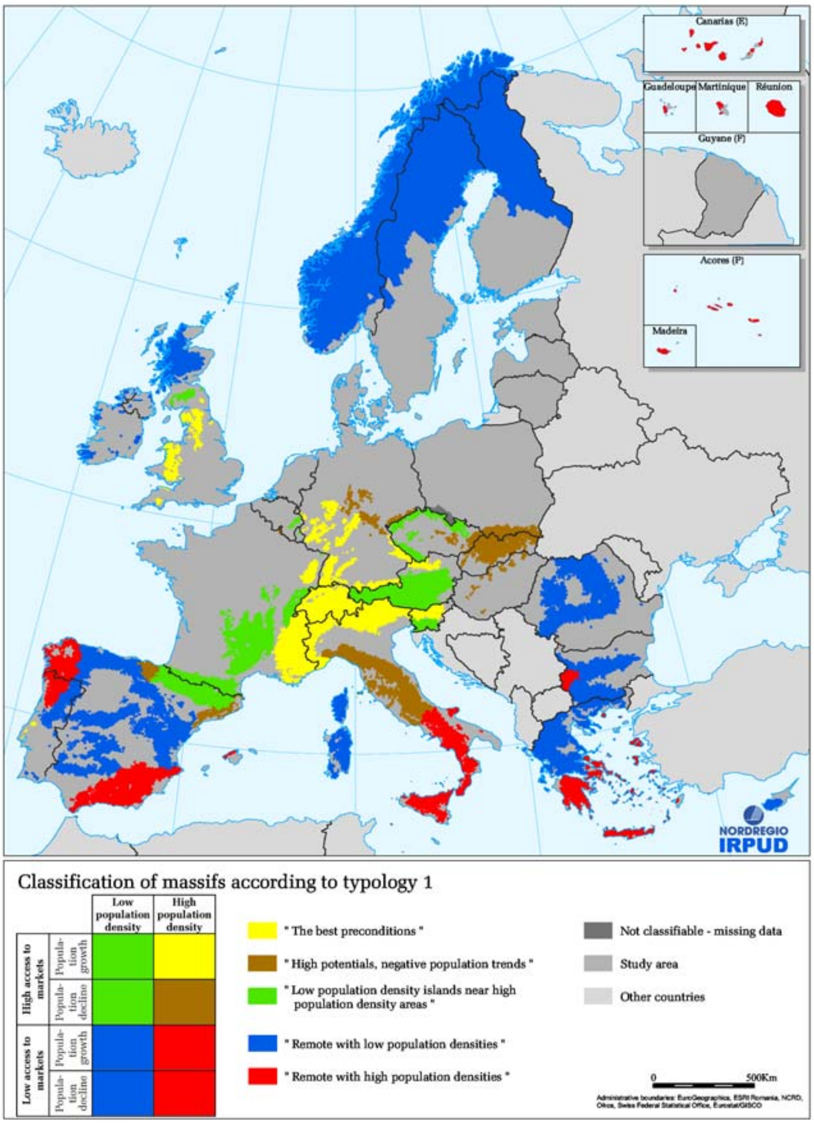


Abb. 7: Klassifikation der Massive bzgl. sozio-ökonomischem Kapital

6 QUELLENANGABEN

Eurogeographics: www.eurogeographics.org

Risikomanagement für IT-Projekte

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1 METHODISCHE GRUNDLAGE

Mehr noch als in anderen Bereichen sind IT-Projekte Risiken unterworfen. "Um erfolgreich zu sein muss die Organisation, die Projekte ausführt, Risikomanagement aktiv unterstützen. Ein Maß für diese Unterstützung ist die Bestimmtheit bei der Sammlung qualitativ hochwertiger Daten zu Projektrisiken und ihren Eigenschaften" (A Guide to the Project Management Body of Knowledge[1] – PMBOK® Guide – des Project Management Institute PMI®[2]).

In diesem Workshop wird der Prozessfluss vorgestellt, den der PMBOK Guide für Risiko-Management vorsieht. Die Zielsetzung ist, über mehrere Schritte Projektrisiken zu identifizieren und zu analysieren, ihre Behandlung zu planen und die Wirksamkeit der Maßnehmen zu beobachten und zu steuern.

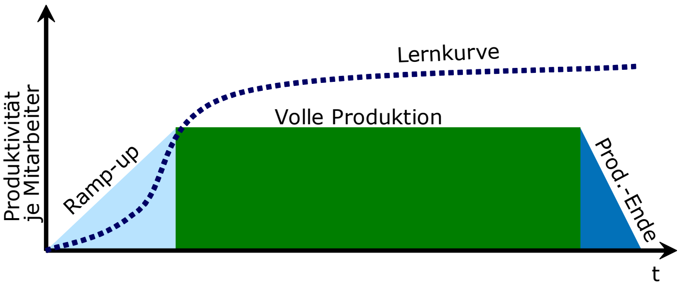
2 PROJEKTE UND IHRE RISIKEN

2.1 Projekte und Operations

Der PMBOK Guide unterscheidet grundsätzlich zwischen Projekten und Operations.

Operations sind die Aktivitäten einer funktionalen Organisation – Unternehmen, Behörde, Verband etc. – die wiederkehrend sind. Meist haben sie gut standardisierbare Abläufe und Ergebnisse. Operations lassen sich normalerweise zuverlässig beschreiben und optimieren. Organisationen bemühen sich oft darum, mit Operations verbundene Lernprozesse frühzeitig stattfinden zu lassen, bevor die vollständigen Anforderungen hinsichtlich Qualität und Produktivität gestellt werden.

Das folgende Diagramm zeigt schematisch die Entwicklung der Produktivität beim Einsatz einer Software für Routineaufgaben und die damit verbundene Lernkurve für die ausführende Organisation und ihre Mitarbeiter:



Zu Beginn des Einsatzes der Software steht oft eine Ramp-up-Phase[3], in der schrittweise die volle Produktivität entwickelt wird. Diese kann beinhalten:

- Teillast-, Pilot- und Testbetrieb
- Mitarbeiterschulung und -coaching
- Weitere Verfahren des Ein- und Hochfahrens auf volle Produktivität

Die reduzierte Produktivität je Mitarbeiter kann auch damit zu tun haben, dass zusätzliche Mitarbeiter für Implementierung, Service, Helpdesk etc. bereitgestellt werden, deren Zahl im Verlauf der Ramp-up-Phase reduziert wird.

Der Produktionsbeginn mit reduzierter Produktivität hat den Vorteil, dass der Anstieg der Lernkurve für die Organisation und die betroffenen Mitarbeiter größtenteils durchlaufen ist, bevor Arbeitsergebnisse in großer Menge erzeugt werden. Damit sollen für diese Phase typische Risiken – insbesondere hinsichtlich Schnittstellen, Steuerung und Qualität – in beherrschbaren Grenzen gehalten werden.

Im Gegensatz zu den wiederkehrenden Prozessen und Ergebnissen, die kennzeichnend für Operations innerhalb einer funktionalen Organisation sind, ist für Projektarbeit eher die Einmalaufgabe typisch. Diese kann durchaus wiederkehrende Elemente haben, in ihrer Gesamt-Konfiguration ist sie aber jedesmal neu.

Es ist eher unüblich, Projekte mit verringerter Produktivität zu beginnen. Projektteams kommen meist zusammen und müssen praktisch sofort auf volle Produktivität gehen. Die Ramp-up-Phase besteht vielleicht aus einem dreistündigen Kickoff-Meeting und ein paar Einzelgesprächen zur Abstimmung, dann geht es los. Daraus ergibt sich folgendes schematische Diagramm:

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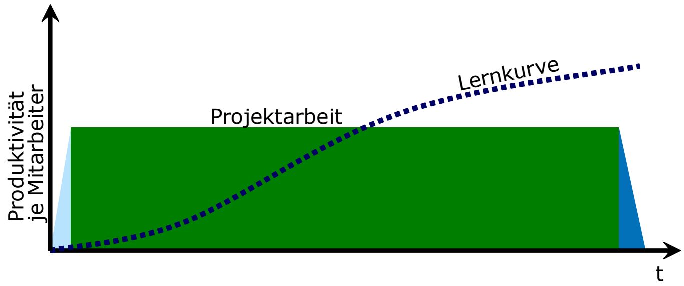
[1] ISBN: 1880410222 erhältlich über das Project Management Institute (www.pmi.org) oder im Buchhandel. Deutsche Version ISBN: 3930894300, erhältlich unter www.pmi-muc.org oder im Buchhandel.

[2] Das Project Management Institute (PMI) ist mit über 120.000 Mitgliedern der weltweit größte Verband im Projektmanagement.

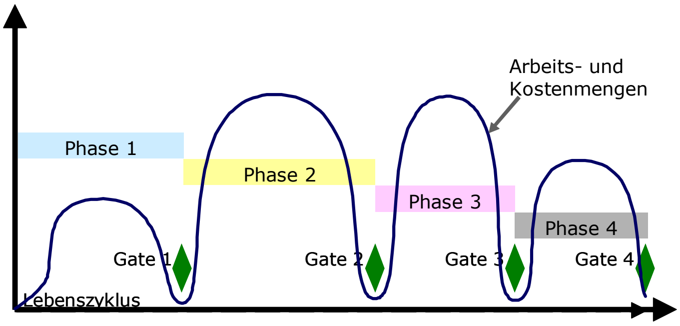
[3] Die Ramp-up-Phase kann selbst Teil eines Entwicklungsprojektes oder sogar ein eigenes Projekt sein.



Projektarbeit beinhaltet Lernprozesse. Eine der wichtigsten Quellen für Risiko ist, dass sich die Lernkurve zeitgleich mit dem Entwicklungsfortschritt nach oben bewegt. Das fehlende Wissen der Beteiligten zu Beginn macht das Projekt unsicher, mit zunehmendem Wissensstand nehmen auch die sich daraus ergebenden Risiken ab.

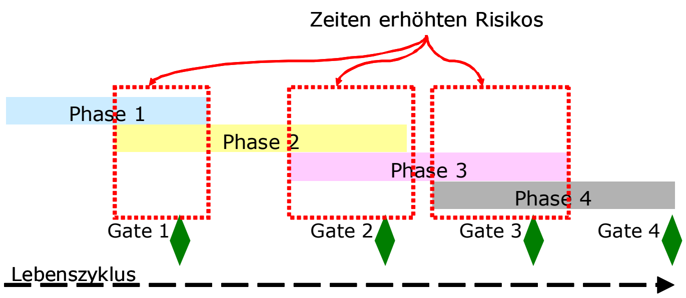
2.2 Phasen

Die meisten traditionellen Projektmanagement-Methoden werden um das Konzept eines Lebenszyklus entwickelt der sich aus aufeinanderfolgenden Phasen – Zeitabschnitten meist mit unterschiedlichen Aufgabenstellungen – aufbaut. Zwischen den Phasen finden Reviews der Ergebnisse statt, die oft mit einer Entscheidung verbunden sind, ob in die nächste Phase eingetreten werden soll. Diese Freigabe-Reviews werden gerne als Quality-Gates oder Killpoints bezeichnet:



Vorteilhaft ist an diesem Konzept, dass die Reviews, während derer die Arbeit im Projekt ruht, zu verschiedenen Aspekten des Projektes Informationen erzeugen können und dabei eine fundierte Betrachtung von Risiken beinhalten können. Tatsächlich gibt es Branchen, in denen dieses Konzept umgesetzt wird, beispielsweise die Entwicklung von Medikamenten, bei denen es vor allem darum geht, Gesundheitsrisiken für die Konsumenten zu minimieren. Dieses Beispiel zeigt allerdings auch, was der Nachteil dieses Ansatzes sein kann: Projekte werden sehr langsam, in der pharmazeutischen Produktentwicklung gelten Projektlaufzeiten von über 10 Jahren nicht als Ausnahme.

In der IT wird auch gerne mit Phasenmodellen geplant. Die Erfahrung zeigt aber, dass diese in der Praxis meist nicht eingehalten werden. Um Projekte zu beschleunigen sind Überlappungen zwischen Phasen Normalität.



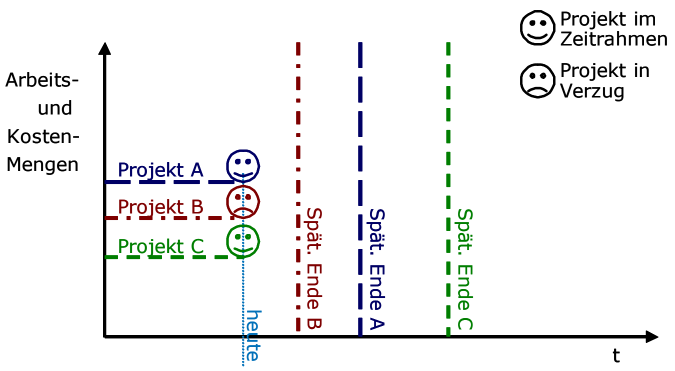
Die Reviews, die auch ein Werkzeug des Risikomanagement darstellen, werden in ihrer Wertigkeit eingeschränkt. Parallell zu ihnen findet Projektarbeit statt, die nicht im gleichen Maß untersucht werden kann wie fertige Ergebnisse.

Es ist daher ein neuer Ansatz notwendig, Risikomanagement während der Projektlaufzeit sicherzustellen.

2.3 Portfolios

Viele Projekte sind Teil eines Projektportfolios. Das bedeutet, die Projekte teilen sich ein gemeinsames Budget, schöpfen aus demselben Ressourcenpool, der Personal, Sachmittel und Material beinhalten kann, und stehen im Wettbewerb die Aufmerksamkeit von Führungskräften.

Es wird häufig unterschätzt, wie sich Probleme in einem Projekt auf andere auswirken können. Im folgenden Beispiel führt eine Organisation parallel 3 Projekte durch, von denen Projekt A und C im Zeitrahmen liegen. Projekt B ist jedoch in Verzug. Der Abgabetermin dieses Projektes liegt allerdings schon recht nahe, die Organisation muss reagieren.



Die Organisation entscheidet sich dafür, in einem Kraftakt mit erhöhtem Einsatz von Geld und Ressourcen Projekt B zeitgerecht zu Ende zu führen, dies wird heute oft als "Crashing" bezeichnet. Woher werden diese Mittel genommen?

Da Geld und Ressourcen für die Organisation begrenzt sind, ist es allgemein üblich,dass diese aus anderen Projekten abgezogen werden. Projekt A und C geraten dadurch in Verzug und müssen ebenfalls mit Crashing beschleunigt werden. Auch andere Projekte des Portfolios werden eventuell betroffen sein, die Organisation hangelt sich von einer Projektkrise zur nächsten:

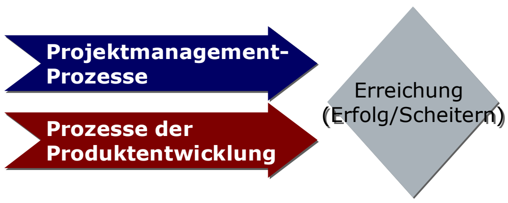
Dieser Zustand kann für die Organisation eine Reihe negativer Konsequenzen haben:

- Effizienzverlust: Um die Produktivität in der Projektarbeit kurzfristig um 50 % zu steigern, müssen zwischen 75% und 100%, vielleicht sogar noch mehr, an zusätzlichen Geldmitteln und Ressourcen bereitgestellt werden. Budgetüberschreitungen werden zur Normalität.
- Burnout: Der andauernde hohe Druck auf den Mitarbeitern kann zu Effekten von Ermüdung, Motivationsverlust und offener oder verborgener Leistungsverweigerung führen.
- Qualitätsprobleme: Die Erfahrung zeigt, dass qualitätsrelevante Arbeitsabläufe besonders leiden. Dazu gehören Erstellung und Pflege des Pflichtenhefts, Dokumentation und Tests.
- Vertrauensverlust bei den Auftraggebern: Diesen bleiben die Fehlleistungen in den Projekten nicht verborgen.

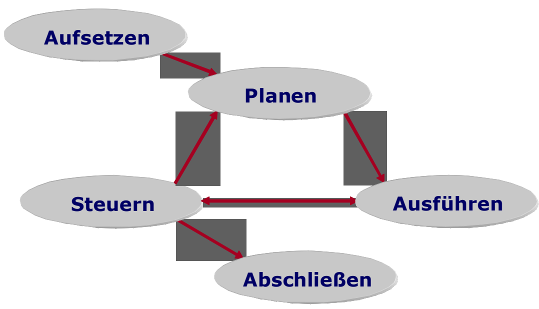
3 PROZESSE DES RISIKOMANAGEMENT

3.1 Prozessgruppen

Der "Guide to the Project Management Body of Knowledge" beschreibt Projektarbeit als aus Prozessen zusammengesetzt. Dabei wird unterschieden zwischen Prozessen, die sich aus den Aufgaben der Produktentwicklung ergeben, und Projektmanagement-bezogenen Aufgaben.

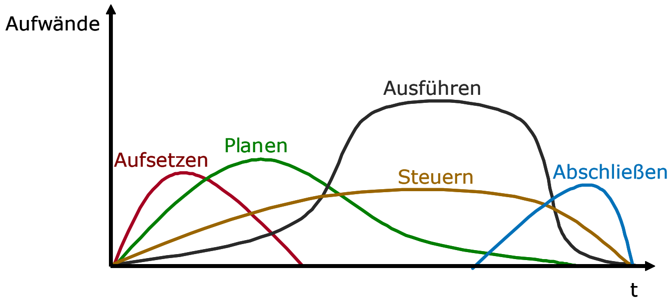


Für die obere, Projektmanagement-bezogene Prozessebene kennt der PMBOK Guide 39 Prozesse, die in 5 Prozessgruppen zusammengefasst werden:



- Aufsetzen-Prozesse: Authorisierung der Projektarbeit (1 Prozess)
- Planen-Prozesse: Entwicklung eines Schemas für Ausführung und Steuerung der Projektarbeit (21 Prozesse)
- Ausführen-Prozesse: Umsetzen des Projektplans (7 Prozesse)
- Steuern-Prozesse: Planabweichungen erkennen und Zielerreichung sicherstellen (8 Prozesse)
- Abschließen-Prozesse: Beendigung der Projektbeauftragung (2 Prozesse)

Im Gegensatz zum schon beschriebenen Phasenmodell geht dieses Prozessmodell von vorneherein davon aus, dass sich die damit verbundenen Aktivitäten überlappen:

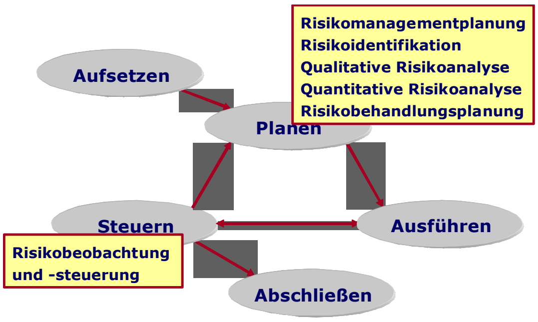


3.2 Risikomanagement-Prozesse

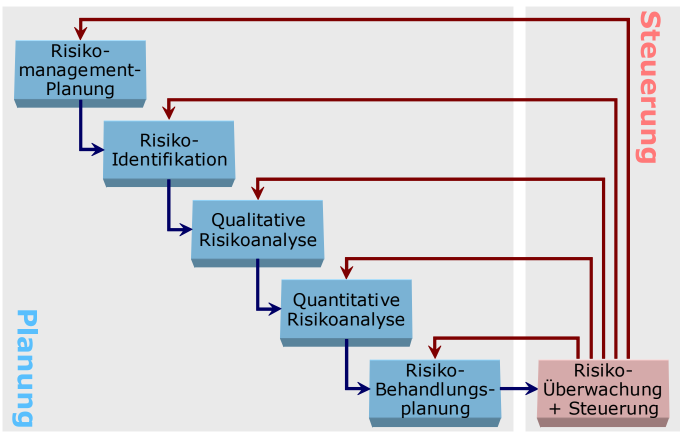
Der PMBOK Guide beschreibt sechs Risikomanagement-Prozesse:

- Risikomanagementplanung
- Risikoidentifikation
- Qualitative Risikoanalyse
- Quantitative Risikoanalyse
- Risikobehandlungsplanung
- Risikobeobachtung und –steuerung

Fünf dieser Prozesse gehören zur Prozessgruppe Planung, ein Prozess gehört zu Steuerung:



Diese Prozesse werden nicht als einmalige Aktivität interpretiert, sondern bilden ein System aus Schleifen, die wiederholt durchlaufen werden sollen:



3.3 Risikomanagementplanung

Ziel des ersten risikobezogenen Prozesses ist die Erstellung eines Risiko-Managementplans. Dieser beschreibt, wie

- Risiko-Identifikation,
- Qualitative und quantitative Analyse,
- Behandlungsplanung,
- Beobachtung + Steuerung

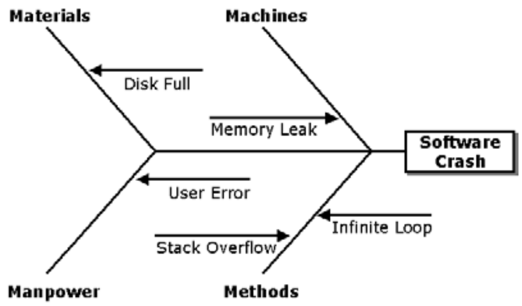
während des Projektlebenszyklus strukturiert und ausgeführt werden. Er beinhaltet Verfahren, Termine und Verantwortlichkeiten, geht jedoch nicht auf Einzelrisiken ein. Für die Erstellung werden häufig Planungsmeetings abgehalten.

3.4 Risikoidentifikation

Während des Prozesses der Risikoidentifikation geht es darum, Risiken zu finden, die das Projekt beeinflussen können, und deren Eigenschaften zu dokumentieren. Dies geschieht typischerweise in Meetings, in denen Planungsdokumente auf erkennbare Risiken überprüft werden, oder durch Interviews. Außerdem können Checklisten ein hilfreiches Werkzeug sein.

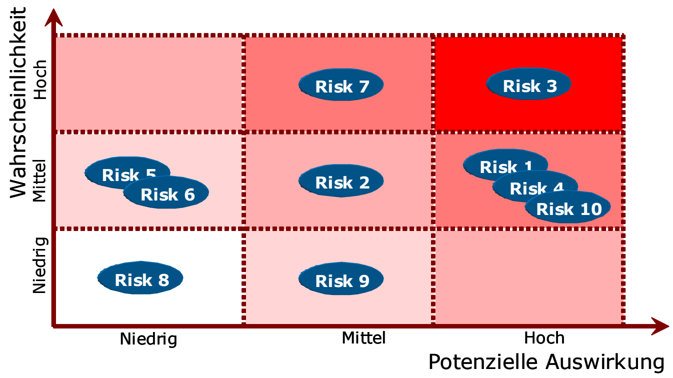
Sinnvoll kann für diesen Prozess außerdem sein, während der Planungsprozesse getroffene Annahmen und Schätzungen zu dokumentieren.

Außerdem lassen sich Diagrammtechniken einsetzen, z.B. Ursache-/Wirkdiagramme (Ishikawa-Diagramme):



3.5 Qualitative Risikoanalyse

Im Rahmen einer qualitativen Analyse werden Projektrisiken nach ihrer Auswirkung auf Projektziele klassifiziert und priorisiert. Häufiges Werkzeug hierfür ist die P/I-Matrix (Probability/Impact):



3.6 Quantitative Risikoanalyse

Bei diesem Prozess geht es darum, die Wahrscheinlichkeit und potenzielle Auswirkungen von Risiken auf Projektziele bestimmen. Die Ergebnisse des Prozesses liegen meist in Form von Zeit oder Geld vor.

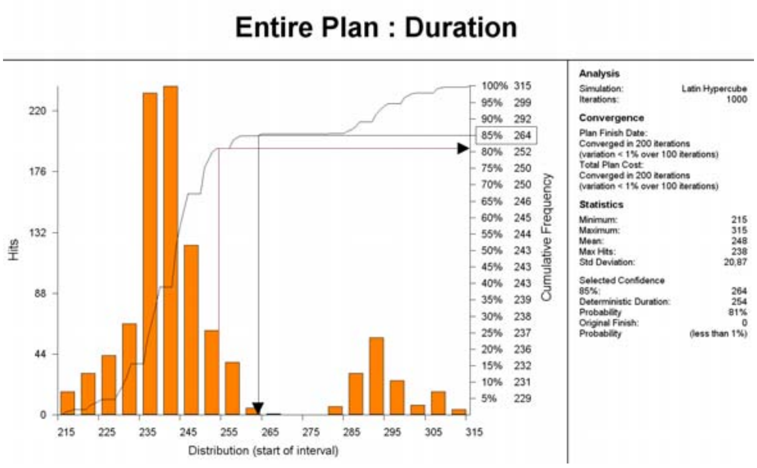
Ein Verfahren ist die Analyse von 3-Punktschätzungen: Statt der traditionellen Einpunktschätzung zu Zeit oder Kosten werden je 3 Schätzungen verwendet – Optimistisch, Wahrscheinlich, Pessimistisch. Daraus werden über die PERT-Formel

$$\frac{(\text{opt.} + 4\ \text{wahrsch.} + \text{pess.})}{6}$$

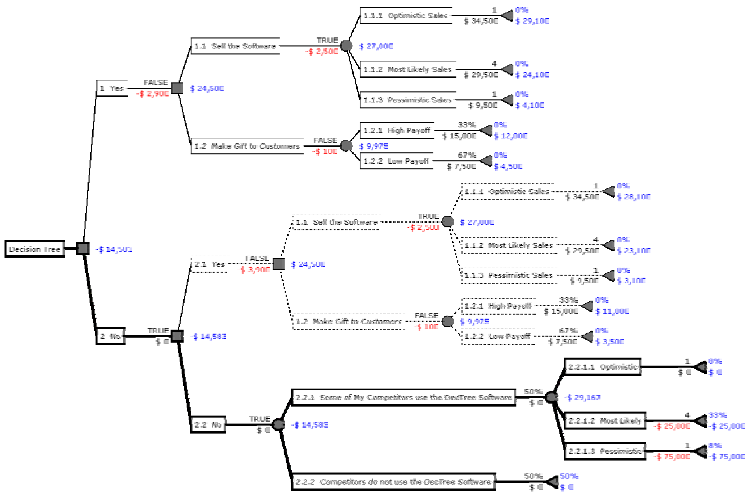
möglichst relevante Schätzwerte und das Ausmaß ihrer Unsicherheit abzuleiten. Im folgenden Beispiel wird aus einzelnen Aufwandsschätzungen, die im 3-Punkt-Verfahren durchgeführt wurden, eine Gesamtschätzung sowie ein "Spielraum" für Abweichungen abgeleitet:

	Optimistisch	Wahrscheinlich	Pessimistisch	PERT
Aufgabe 1	22	43	72	44.3
Aufgabe 2	5	12	33	14.3
Aufgabe 3	24	29	52	32.0
Aufgabe 4	30	38	55	39.5
Aufgabe 5	18	22	32	23.0
Gesamt	**99**	**144**	**244**	**153.2**

Ein weiteres Verfahren ist die Montecarlo-Simulation, die per Zufallsgenerator verschiedene Kombinationen aus Einzeldauern und weiteren Parametern für das Projekt durchspielen. Daraus können sich Verteilungsdiagramme wie das folgende zur Projektdauer ergeben[4]:



Zusätzlich wird für quantitative Risikoanalyse Entscheidungsbaumtechnik eingesetzt, die die Abfolge von Entscheidungen und Risiken darstellt und nummerisch erfassbar macht[5]:



3.7 Risikobehandlungsplanung

Im Rahmen der Risikobehandlungsplanung werden Verfahren und Prozeduren entwickelt, um Bedrohungen für Projektziele zu reduzieren. Der PMBOK Guide kennt dafür 4 Verfahren:

- Vermeidung: Maßnahmen zur Ausschließung der Risikosituation oder zur Vermeidung Ihrer Auswirkung.
- Übertragung: Übertragung der Folgen des Risikozustands auf eine dritte Partei.
- Minderung: Reduktion von Wahrscheinlichkeit oder Auswirkung.
- Hinnahme: Risiken, deren Behandlung nicht möglich oder wirtschaftlich ist, werden oft hingenommen. Aktive Hinnahme kann die Bereitstellung von Ausweichplänen oder Schaffung von Rückstellung beinhalten.

Ergebnis dieses Prozesses ist der Risikobehandlungsplan, in dem festlegt wird, welche Verfahren beim Eintreten bestimmter Risiken eingesetzt werden sollen.

3.8 Risikobeobachtung und –steuerung

Bei dem Prozess Risikobeobachtung und –steuerung werden über den Projektlebenszyklus hinweg Restrisiken beobachtet, neue Risiken identifiziert, Risikobehandlungspläne ausgeführt und deren Effektivität beurteilt.

Maßnahmen können Change Requests sein, aber auch Improvisation kann notwendig werden. Außerdem werden aus diesem Prozess heraus bei Bedarf die anderen Risiko-bezogenen Prozesse erneut aufgerufen, um Analyse und Planung bei Bedarf anzupassen.

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[4] Erstellt mit der Software Pertmaster: www.pertmaster.com

[5] Erstellt mit eigener Software des Autors

4 SYNOPSIS

Die Prozesse des PMBOK Guide zum Risikomanagement bilden einen Kreislauf, der in einer Häufigkeit durchlaufen wird, die dem Projektrisiko angemenessen ist. Neben der Tatsache, dass man sich auf die meisten Risiken vorbereitet hat und bei Bedarf schneller reagieren kann, ist von Vorteil für das Projekt, dass bei allen Beteiligten ein Bewusstsein für Risiken geschaffen wird, die in der IT, aber auch in anderen Bereichen Bestandteil eines jeden Projekts sind.

In der Praxis hat sich gezeigt, dass manche dieser Prozesse zu Projektbeginn mühevoll sein können. Insbesondere für die Identifikation von Risiken und deren Analyse kann viel Zeit notwendig werden.

Diese Investition wird sich im Verlauf des Projektes auszahlen – beim Eintritt eines Problems ist man vorbereitet und kann schneller und besser reagieren. Auch zeigt die Erfahrung, dass Risiko-bezogene Meetings immer kürzer werden. Im Verlauf des Projektes wird man erleben, dass sich diese von ursprünglich mehreren Stunden auf deutlich unter eine halbe Stunde reduzieren.

Ein weiteres wünschenswertes Ergebnis dieser Maßnahmen ist die Entwicklung einer Risiko-bezogenen Projektkultur, die die ganze ausführende Organisation durchdringt und sich im Denken und Handeln der Beteiligten, aber auch in deren Sprache niederschlägt.

Projektdaten für Entscheider – Effektive Nutzung von Geodaten im System GEOhaus

Otmar SCHUSTER & Olaf LUDWIG & Martina BUSCH

Otmar Schuster, Dr. Olaf Ludwig, DI Martina Busch; GEOhaus, Mülheim a. d. Ruhr; Deutschland

1 GEODATEN IN DER WIRTSCHAFT

Die Erwartung an die wirtschaftlichen Wachstumsmöglichkeiten durch die Nutzung von Geodaten sind hoch (Micus – Studie 2002). Es besteht auch kein Zweifel, dass die weltweite Nutzung von Geodaten im Wachsen begriffen ist. Doch andererseits weist die tatsächliche Baisse der Wirtschaft und der durch Geodaten befruchteten Teile der europäischen Wirtschaft wie der Weltwirtschaft das Faktum aus, dass die Nutzung von Geodaten in der Breite keinen selbständigen oder selbsttragenden Wirtschaftsteil darstellt.

Das hängt mit den Eigenschaften der Daten und ihrer Nutzung zusammen. Sie sind nämlich nur kostbar, solange sie zu einer anstehenden, wirtschaftlichen Entscheidung benötigt werden. In vielen Ländern – insbesondere im angelsächsischen Raum ist man es gewohnt, diese Entscheidungen so zu treffen, dass die wirtschaftliche Relevanz der Geodaten – und insbesondere solcher hoher Qualität – niedrig ist. Das ganze Wirtschafts- und Rechtsleben hat sich darauf eingestellt. In Kontinental – Europa – und insbesondere in dem deutschsprachigen Teil – ist die Geodatenwelt weit stärker in das Wirtschafts- und Rechtsleben integriert, eine Folge der konsequenten Installation von Grundbuch und Kataster sowie der amtlichen Kartenwerke über lange Jahrzehnte (Schuster u.a.: Market Report, 2003).

Diese riesigen, über 200 Jahre angesammelten und stets erneuerten Datenquellen und eingeübten Funktionsabläufe und die auf ihnen basierenden Rechts- und Wirtschaftszuständen haben durch die Computerisierung das Laufen gelernt und sind besser verfügbar als bisher. Die allgemeine Erwartung ist, dass der dadurch ausgelöste Wirtschaftsstrom auch die alten Strukturen hinweg spült samt Behörden, Berufen und in einen marktwirtschaftlichen Wirtschaftsraum einmündet, der jedem Bürger die optimale Wertschöpfung aus diesen Daten ermöglicht.

Wer sich in seinem wirtschaftlichen Tun auf diese Erwartung gestützt hat, musste schnell merken, dass ein wirtschaftliches Überleben mit dem allgemeinen Anbieten von Geodaten schwierig ist aus den verschiedensten – hier nicht alle aufzuführenden Gründen.

2 GEOHAUS ERFAHRUNGEN

Auf der Basis einer 50 – jährigen Erfahrung mittelständischer bzw. freiberuflicher Erhebung von Geodaten für die Wirtschaft sind folgende Erfahrungen durchschlagend:

Geodaten entfalten ihre stärkste Kraft, wenn sie für Legal – Entscheidungen zur Verfügung stehen,

Geodaten haben einen wirtschaftlichen Wert, wenn sie für wirtschaftliche Entscheidungen gebraucht werden,

Geodaten haben nur dann einen entscheidungsstrategischen Charakter für den in seinem Wettbewerb stehenden Anwender, wenn sie ihn besser stellen als seine Konkurrenz oder zumindest seine Defizite ausgleichen.

Geodaten benötigen Produkte und Produktnamen als „Carrier zum Kunden"

Der mittelständische Geodatenmarkt entwickelt sich mit der steigenden Nutzung zu solchen Entscheidungen.

Wertschöpfungsmöglichkeiten für den Kunden entstehen durch Datenkombination

Voraussetzung für die Entwicklung dieses Dienstleistungsmarktes in Breite und Tiefe ist aber auch seine Harmonisierung in dem Sinne, dass die Dienstleistungsprodukte als Wirtschaftsprodukte identifizierbar sind und sich so einem breiteren Wettbewerb der Anbieter und einer größeren Nachfrage öffnen können als bisher. Diese Harmonisierung spielt sich sowohl sektoral wie horizontal ab. Die Dienstleistungsprodukte müssen so attraktiv sein, dass sie die Grenzen der lokalen Märkte, der Region und der nationalen Landesgrenzen überspringen können, so wie wir es bei den Industriegütern gewohnt sind. Das notwendige Überspringen von Grenzen gilt auch für die beruflichen Grenzen, in denen es sich die Nationen gemütlich eingerichtet haben. Insofern ist die Erwartung gerechtfertigt, dass die teilweise verzweifelten, regionalen und inhaltlichen Abgrenzungsbemühungen nur Rückzugsgefechte sind.

3 GEOHAUS - SCHLUSSFOLGERUNGEN

Die GEOhaus – Schlussfolgerungen lassen sich konsequenter Weise an der Firmen – Philosophie ablesen:

DIE GEOHAUS-GRUPPE

besteht aus europäischen Experten für alle Eigentumsfragen, Schaffung von Baurecht, Infrastrukturplanung, Boden- und Umwelt, Facility und Land - Management, GPS - und Industrie Vermessung. Wir verstehen uns auf Elektronik und erstellen Software stets eng am Projekt.

Interdisziplinäre Kooperation mit fest gefügter Integration der Ergebnisse, Vielfalt der Produkte in Dienstleistung, Hard- und Software zum Nutzen des privaten und öffentlichen Investors ist die Intention der Gruppe.

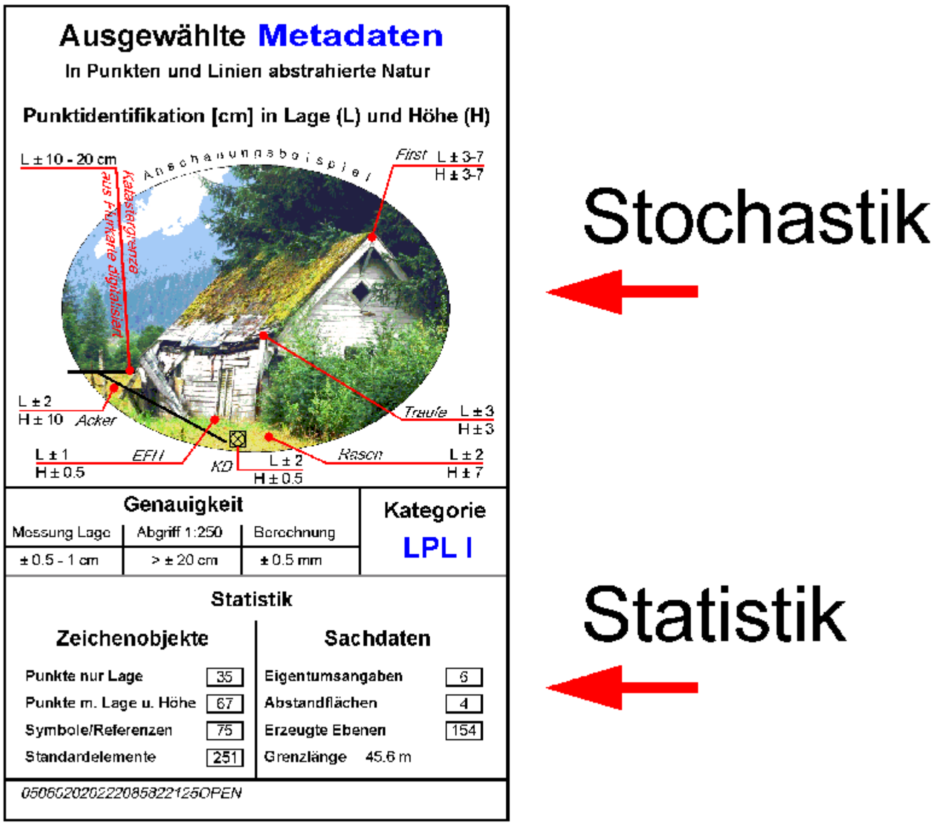
Zentraler Gedanke des Kooperationsmodells ist es, dass alle Arbeiten in ein festes, dreidimensionales, geometrisches Gerüst von Geodaten eingehängt werden. Dadurch werden Fehler und Doppelarbeit vermieden und ein hohes Qualitätsniveau erreicht, weil wir die Stochastik stets verfolgen können

Der systematische Umgang mit Geodaten erzeugt Geoinformation. GEOhaus Online als Internet-Tool der Gruppe bewirkt den entscheidenden Wissens- und Gestaltungsvorsprung seiner Kunden.

DATENQUALITÄT – NACHWEIS DURCH CONTROLLING UND METADATEN

In allen industriellen Prozessen ist es geläufig, dass der Fortschritt mit besserer – sprich feinerer – Unterscheidung und Bearbeitung von Material und Datenstrukturen verbunden ist. Davon sind wir im Bereich von Geodaten weit entfernt. Die Bauzeichnungen und Lagepläne sind der Fortschritt zum Ende des 19. Jahrhunderts und unsere CAD – Softwarehersteller produzieren entsprechende Software, weil die Vorschriften für staatliche Genehmigungen gleich welcher Art sich noch auf dieser veralteten Stufe bewegen.

Die Lagepläne zum Baugesuch in Europa stellen die Datenqualität der Planung und der Geodatengrundlage als identisch dar, obwohl beide Sorten von Information völlig unterschiedliche Herstellungsprozesse und stochastische Eigenschaften aufweisen. Die Folgerungen in GEOhaus sind: dokumentiertes, stufenweises Controlling und Darstellung durch die „Metadaten" (Schuster, O, „Rationalisierung...", 2003):



Die konsequente Anwendung der Metadaten seit zwei Jahren hat einen von uns anvisierten, durchschlagenden Erfolg: Die Behörden und Gerichte nehmen bei ihren Entscheidungen plötzlich die Datenqualität wahr und die Entscheidungen dieser Institutionen über Bauabstände, rechtliche Abgrenzung von Rechten, die Lage von Eigentumsgrenzen etc. erhalten eine weitaus höhere Qualität.

Daneben gibt die Statistik dem Kostenträger eine weit bessere Information über den Aufwand als etwa manch unbeholfene Beschreibung überkommener Abrechnungstatbestände. Die Software bearbeitet die Plangrundlage in kaum einer Sekunde, sodass der Aufwand für den Kunden klein ist, aber eine erhebliche Besserstellung bedeutet.

QUALITÄTSPRODUKTE ALS MATRIX

Diese Ergebnisse sind nur wirtschaftlich erreichbar durch konsequente Normierung der Dienstleistungsprodukte. Sie müssen darüber hinaus aufeinander aufbauen, sodass keine Doppelarbeit zu befürchten ist. Der Blickwinkel des Dienstleisters muss zu jedem Zeitpunkt jener des Kunden sein. Als Beispiel soll die Dienstleistungsmatrix für Bau- und Grundstücksleistungen dienen:

Leistungen am Grundstück	4 LEISTUNGEN ZUM BAUVORHABEN	**4.1 Leistungen eines ÖbVI Ihrer Wahl**[1]
5 BODENRECHTLICHE ERHEBUNG	Bodenrechtliche Erhebung	Grenzangabe
6 GRUNDSTÜCKSDIAGNOSE	Lageplan zu Planungszwecken LPL 1: einfach LPL 2: mittel LPL 3: schwierig	Amtliche Grenzanzeige
Strategische Eigentumsanalyse	Lageplan zum Baugesuch Freiflächenberechnung Abstandflächenberechnung	Teilungsantrag (bau- u. planungsrechtlich) Teilungsantrag (grundbuchlich)
Liegenschaftsbewertung	Absteckungen	Fortführungsvermessung
Baurechtschaffung mit Begleitung, Lenkung des kommunalen Verfahrens Steuerung der Gutachten B-Plan-Urkunde Städtebauliche Verträge Erschließungsverträge	Abnahmebescheinigungen 1. Atteste	Grundbuch- und Kataster-Analysen (Herkunft von Grundstücken, Flurstücken, Bestehen von Rechten etc)
Analysen	Gebäudeeinmessungen	Gebäudeeinmessungen
Gutachten zu Bau-, Planungs- und Bodenrecht	Liegenschaftsgutachten: Verkehrswert, Versicherungswert, steuerlicher Wert	Gutachten zu Grenzen und Rechten an Grund- und Boden

„Dienstleistungsprodukt“ bedeutet auch: vorweg festlegbarer, möglichst pauschaler Preis. Das ist für ein Dienstleistungsprodukt oder besser für den Anbieter eine große Herausforderung, denn Aufwand und Aussagekraft liegen miteinander in Fehde. Das gelingt aber umso besser, je fortgeschrittener die Normierung der Abläufe und Ergebnisse ist.

Solche Dienstleistungsmatrizen gibt es für verschiedene Bereiche, als jüngste ist sie für den wichtigen Bereich des Bodenschutzes in der Entwicklung.

HARD- UND SOFTWARETOOLS

Je unbedeutender die wirtschaftliche Entscheidung, je kleiner der wirtschaftliche Spielraum für das Dienstleistungsprodukt. Hohe Qualität bedeutet aber auch hohe Qualität der Mitarbeiter, auskömmliche Gehälter und Sicherheit für die Mitarbeiter – also eine schwierige Position im Wettbewerb. Der Versuch, die Qualität zu steigern, wird oft im Wettbewerb des Weglassens bestraft und von der nachträglichen Erkenntnis des Auftraggebers kann kein Dienstleister leben, denn die Versuchung, beim nächsten Projekt mit weniger Kapitaleinsatz im Vorfeld zurecht zu kommen, ist für die Investoren zu groß. Deshalb müssen Hard- und Softwaretools her, die es dem Investor ermöglichen, die teure Datenerhebung vor Ort und die Planbearbeitung insbesondere im Vorfeld der Entscheidungen ohne teure Fachleute aber mit der nötigen Sicherheit durchzuführen.

7 GEOMETER, GEOBOX, DATENLOGGER[2]

Die Entwicklungen der GEOsat® GmbH als Teil des GEOhauses bedienen sich des DGPS[3] und gestatten es dem Anwender, auf einfache Weise Daten zu sammeln, diese mit anderen Daten zu verschneiden und dem Ergebnis zuzuführen. Ursprünglich für die Landwirtschaft entwickelt, gestattet es das GEOMETER 24 pro dem Grundstücksentwickler, selbst kosten- oder planungsrelevante Daten zu erheben und sie auf einfache Weise zu verwerten. Die GEObox macht die Positionierung direkt im Laptop im Felde sichtbar und der Datenlogger wird in z.B. Fahrzeuge installiert und sammelt die Fahrdaten gemeinsam mit anderen Entscheidungsdaten (z.B. für die Kontrolle und Abrechnung straßenbezogener oder auf landwirtschaftliche Flächen bezogene Dienstleistung).

BAILIFF, DIE SOFTWARE FÜR ENTSCHEIDER[4]

Die Software ist das eigentliche Tool, das dem Entscheider in seinem Netz oder seinem PC zur Verfügung steht. Er kann damit alle graphischen Vektor- und Pixeldaten sowie alle alphanumerischen Daten mittels WORD- / EXCEL- / PPT-/ ADOBE-/ o.ä. selbst

[1] ÖbVI = Öffentlich bestellte Vermessungsingenieure in Deutschland. Sie können sie über www.bdvi.de abrufen

[2] Abzurufen unter www.geosat.de

[3] Differential GPS – Methode

[4] www.bailiff.de

ohne Hilfe von CAD – Fachleuten bearbeiten und seinen eigenen Datenbestand sammeln. Es hat sich gezeigt, dass die Nutzer in 95 % aller Fälle keine vollständigen Pläne benötigen, sondern die auf ihrem eigenen Drucker erzeugten Ausschnitte viel angemessener finden. Vielmehr liegt der besondere Reiz darin, dass der Nutzer sämtliche Darstellungen in seine Briefe, Exposés hineinkomponiert. Die Software wird in drei Ausführungen geliefert, ***BAiliFF, BAiliFF***-Infobase, bei dem man beliebige Datenfiles an beliebige Stellen in den Karten heften kann und ***BAiliFF*** – Editor, mit dem man ***BAiliFF's*** erzeugen kann.

7.1 GEOhaus – onLINE® als Rückgrat[5]

Die Internet – Plattform GEOhaus – onLINE bildet das Rückgrat aller Dienstleistungsprodukte, denn diese werden dem Nutzer über dieses Medium geschützt zur Verfügung gestellt. Das Update des lokalen Tools ***BAiliFF*** geschieht per Knopfdruck. Außerdem kann der Nutzer eine Task-Management – Software **GEO-notice** in Gang setzen, mit der er verschiedene Rechte an seine Gruppen vergeben kann. Die Erfahrung ist, dass die downloads unter bestimmten Voraussetzungen wasserfallartig zunehmen. Die dazu notwendigen Voraussetzungen sind die eigentliche wirtschaftliche Herausforderung für die Zukunft. In jedem Fall gehören dazu:

- Vertrautheit mit dem Internet
- Vertrautheit mit dem Produkt
- Vertrauen in Qualität und Kostentreue.

DIE NUTZUNG DER GEODATEN

Die Nutzung der Geodaten ist naturgemäß vielfältig. Als Projektdaten im weitesten Sinne sind sie für den Investor, den Entscheider dann von großem Wert, wenn er sie selbst im eigenen Fertigkeits- und Erfahrungsbereich einsetzen kann. Gerade bei Vorentscheidungen über anstehende Investitionen haben solche Daten einen besonderen Wert, wenn sie wirklich strategische Information beinhalten. Die beschriebene, in langjähriger Praxis entwickelte Vorgehensweise verschiebt die bisherige Schnittstelle zwischen Dienstleister und Abnehmer der Geodaten. Sie ermöglicht dem fachfremden Anwender, ohne zusätzliches Knowhow, selbst Daten zu erheben, zu verarbeiten und ein eigenes Entscheidungslabor einzurichten. Sie vertraut darauf, dass Nutzung und Bedarf an entscheidungsrelevanten, qualitativ hochwertigen Unterlagen auf diese Weise im volkswirtschaftlich besten Sinne steigt.

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[5] www.geohaus-online.de

Regionale Innovation und dauerhafte Entwicklung in Europa
Das Beispiel der spanischen "ciudades del conocimiento"

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Die Kartographie Europas, in deren Rahmen unsere Association heute arbeitet, ermöglicht uns die semantischen Veränderungen auf diesem Feld besser zu sehen und durch die Analyse der Programme lokale Kollektivitäten zu entwickeln.

Gemeinschaftsprogramme, die in Spanien als „**Städten des Wissens**" bekannt sind, erscheinen uns als sehr wichtig in der Entwicklung der Verwaltung digitaler Bilddaten.

1 EIN NEUER RAHMEN FÜR EIN NEUES KONZEPT

Was wir heute digitale Stadt nennen sind Kollektivitäten, in denen die Innovation sich durch Polarität und Attraktivität charakterisiert.

Wie Nicos Komninos, Professor auf der Aristotle Universität von Thessalonique, sagt, stehen wir neuen Prozessen gegenüber, nämlich dem Mechanismus der Wechselwirkung zwischen digitalen Räumen und Wissenssystem.

Eine solche Definition ermöglicht besser zu erkennen, was eine Region heute tun muss. Es ist für unsere Philosophie wichtig zu verstehen:

- wie *Orte* das Wissen bearbeiten und auch wie sie, als Institutionen, helfen können eine bessere Struktur der Kenntnisse zu erarbeiten
- wie Wissensvermittlung solche Polaritäten gründen kann
- und auch – als eine sehr wichtige Frage für uns - wie eine Stadt das besser ermöglicht, als andere

Jeder wird natürlich eine andere Antwort finden - es hängt klar mit seiner Kultur und seiner geographischen Herkunft zusammen - aber wir können einige wichtige Leitlinien geben:

- die zwei Leistungen der digitalen Stadt sind: eine Innovations-Ökologie gründen und auch Wissen vermitteln, Formation organisieren. In unseren Augen ist es zum Beispiel wichtig, dass das Internet hinsichtlich Identität und Erbe der Region ein richtiges Werkzeug wird.

- die digitale Stadt muss zuerst eine Wissens-Umwelt lehren und entdecken: ohne diese nützen natürlich keine Seminare und keine Marketing Angebote, *Innovations - Inseln* zu gründen.

- Was kollektives Lernen angeht, sind wir wenn wir lokalen Akteuren zuhören immer erstaunt zu sehen, wie (zum Beispiel im letzten CEBIT von Hannover), trotz der Arbeit von so vielen *Innovations - Netzen*, die „guten Beispiele" - wie man in Brüssel sagt - so wenig bekannt sind. Im Alltag, arbeiten die europäischen Städte wenig miteinander. Aus diesen Gründen haben wir dieses Jahr die Gründung einer europaïsche Stiftung. zum Ziel.

- die Werkzeuge für die Gründung einer solcher *Wissens-Umwelt* fehlen auf fast allen Websites der europäische Gemeinschaften (mit Ausnahme deutscher Regionen und der spanischen Städte).

2 DAS SPANISCHE BEISPIEL

Anhand der spanischen Städte können wir ein Beispiel für einen strategischen Plan geben.

So will **Burgos** im Jahr **2015** eine Stadt der Kenntnis sein, besonders mit seinem Technopark. Bildung muss Heute und Morgen ein Leitmotiv für die Gemeinden und Regionen sein. „**Burgos Ciudad XXI"** soll ein Beispiel sein von „integracion sociolaboral" und „**Ciudad Real : Ciudad empressarial virtual**".

Bilbao 2010 geht mit dem Programm vom Lebenslangen Lernen in dieselbe Richtung**,** er sieht in der Gründung in Zorrozaurre einen Raum der Zukunft innerhalb einer „Stadt der Innovation und der Kenntnis".

Der Plan „**Coruna**, Ciudad del Conocimiento" zielt mehr auf die Dimension der elektronische Verwaltung.

„**Sevilla** 2010" nennt sich auch „Stadt der Innovation und der Kenntnis", zeigt sich aber viel ehrgeiziger: sein historisches Zentrum soll schon dieses Jahr mit der Wiederherstellung von fünfzehn Gebäuden ein Quartier „der neuen Ökonomie des Wissens" werden.

Man findet denselben Ehrgeiz in **Huelva**, das sich in die „Stadt des Wissens, Stadt der Kenntnis" verwandeln will.

In **Saragossa**, mit dem Plan „Zaragoz@ccessible", kann man denselben Willen einer Entwicklung als „ciudad del conocimiento" erkennen.

Dasselbe in **Sabadell**, bei Barcelona, mit seinem „Plan für die Gesellschaft der Information und der Kenntnis": die Gemeinde hat eine „Stiftung der Informationindustrien" für die Entstehung der Unternehmer der Zukunft gegründet und gleichzeitig ein Institut für Studium und Forschung für Neuerungen eingeführt. Für den Plan „Sabadell 2010", ist die digitale Stadt überhaupt eine konkurrenzfähige Stadt.

Getafe, bei Madrid, hofft durch eine solche Philosophie einen Qualitätsplan für die Verwaltung der Gemeinde erstellen zu können.

Mit „eDonosti.net", setzt sich **San Sebastian** in ein Urban Projekt ein, mit dem Hauptziel die Kreativität zu fördern. **Elche** versucht auf seiner Seite die elektronische Verwaltung als Instrument für die Stadtplanung zu ändern.

Grenada will sein städtisches Institut mit einem Center für neue Technologien bilden.

Jerez de la Frontera, bei Cadix, hat eine virtuelle Arbeitsbörse gegründet, aber auch ein virtuelles Amphitheater für Fernbildung.

„**Leon Ciudad Digital**" will die Planung seiner Entwicklung in dieselbe Richtung führen.

ZUSAMMENFASSUNG

Dieses Panorama müssen wir natürlich für eine Publikation über dieses Thema in den nächsten Monaten konkretisieren.

Unsere italienischen Kollegen haben schon viel an dem Konzept gearbeitet, vor allem in Mailand. Das ist aber auch in Spanien der Fall, wo vor einigen Monaten ein Workshop in Villafranca stattgefunden hat. Es fehlt allerdings noch eine globale Vision für Europa.

Die territoriale Intelligenz soll nicht nur ein Wort, sondern ein ganz konkretes Arbeitsfeld für die Geschichte wie auch die Zukunft unserer Stadtplanung sein.

Congo:Deux
Ein kongolesisch-österreichisches Gemeinschaftsprojekt setzt auf OpenSource Software in der Schulbildung

Frank TENDAY LUABA & Ingo LANTSCHNER

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1 ENTSTEHUNGSGESCHICHTE

Der Verein VUM (Verein für die Unterstützung von Menschen), hatte es sich zum Ziel gemacht, die Vernetzung und den Austausch von zwischenmenschlichen und kulturellen Ideen zwischen Afrika und Europa zu verbessern. Hierfür sammeln und adaptierten wir gebrauchte, aber brauchbare Computer, transportierten diese nach Afrika und schulen die Menschen vor Ort im Umgang mit den Rechnern und dem Internet.
Im Sommer 2002 wurde das Projekt **congo:project** (Cooperation Congo-Autriche) in Kinshasa, Hauptstadt der Demokratische Republik Kongo, sehr erfolgreich durchgeführt. Es wurden 100 Computer in Österreich gesammelt und mit einem LKW über Belgien mit dem Schiff in den Kongo transportiert.
Dort wurden nach dem Prinzip des TTT (Train The Trainers) KongolesInnen als Computer-TrainerInnen ausgebildet, um weitere Schulungen machen zu können.
Desweiteren wurden 2 Computerräume in Schulen aufgebaut, um den Jugendlichen den Zugang zu Computern zu ermöglichen. Das Projekt wurde bei Siemens „Spin The Globe2003" mit dem 4. Platz
ausgezeichnet. Weiters haben wir bei der CORP 2003 erstmals über dieses Projekt berichtet.

Links:
http://www.vum.at
Video vom „congo:project": http://www.vum.at/video/congoweb.ram (Video)
Falter-Bericht: http://www.vum.at/content/vernetzung/falter.pdf

Das Projekt war so erfolgreich, dass im Sommer 2003 das nachfolgende Projekt **congo:deux** in Angriff genommen wurde, um noch mehr Jugendlichen die Chance auf Weiterbildung und Benutzung moderner Kommunikationsmittel zu ermöglichen.

2 ZIELE&AUFGABEN VON CONGO:DEUX

- Land: Demokratische Republik Congo
- Region/Ort: Kinshasa
- Laufzeit: August-Dezember 2003

2.1 Beschreibung von Zielgruppe, Partner/Innen:

Schülerinnen und Schüler zwischen 10 und 18 Jahren in den folgenden Schulen:

- Institut St. Esprit Elimosantu (Kinshasa/Livulu, "Institut Commercial" für Knaben und Mädchen im Alter 10 bis 18 Jahren)
- Lycé Maman Ndiankeba (Kinshasa/Limeté, Sport- und Tourismusschule für Mädchen im Alter von 13 bis 20 Jahren)
- ISAM, Lycé Technique de la Gombe (Kinshasa/Gombe, Schneiderinnen und Modeschule für Mädchen im Alter von 13 bis 20 Jahren)
- College Abbé Loya (Kinshasa/Ngiri-Ngiri, Wirtschaftsschule für Knaben und
- Mädchen im Alter von 13 bis 20 Jahren)

Der Eingang von St. Esprit, mit 1500 Schülerinnen und Schülern das grösste der vier bishrigen Institute.

Ausladen der Geräte im Schulhof des ISAM, die Schülerinnen halten sich noch im Hintergrund.

Eröffnung des Kursraumes in Abbe Loya

2.2 Oberziel des Projektes:

Die Jugend des Congo verfügt über das Wissen und die Kommunikationsmittel um mit der übrigen Welt Wissen und Ansichten auszutauschen.

2.3 Projektziele:

- Die Schülerinnen und Schüler von 4 Schulen in Kinshasa sind informationstechnisch ausgebildet.
- Die Schülerinnen und Schüler von 4 Schulen können dieses Wissen in einem jeweils schuleigenen Computerlabor praktisch vertiefen und anwenden.
- Die Schülerinnen und Schüler können mittels Email und Webbrowser Informationen einholen, versenden und so den Kontakt mit der Aussenwelt pflegen.
- Der Einsatz von Software, deren Quellcode offen liegt (Open Source Software) sorgt für informationstechnische Unabhängigkeit.

2.4 Kurzbeschreibung/Zielsetzung/geplante Maßnahmen

- Ausstattung von 2 Schulen mit je einem Computerraum und Internetzugang.
- TTT (Train-the-Trainer-Seminar) für je 2 Lehrkräfte pro Schule
- Nachrüstung von 2 Schulen (die bereits einen Computerraum haben) mit Internetzugang
- Software mit offenem Quellcode wird bevorzugt eingesetzt

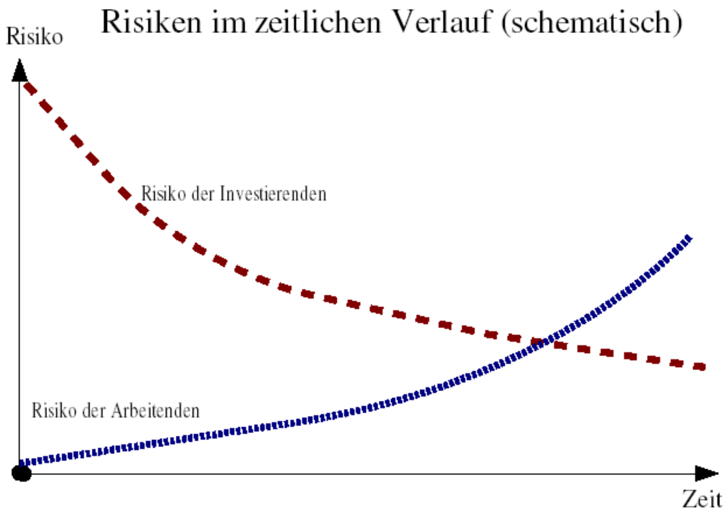
3 GESCHÄFTSMODELL, EIGENTUMSVERHÄLTNISSE: INVESTORINNEN-ARBEITENDE

3.1 Grundlegende Betrachtungen – die humanistische Kooperative

Auf der Basis des von der Humanistischen Partei Ende der 80er Jahre entwickelten Vorschlags der Humanistischen Kooperative gestalten sich die Eigentümerverhältnis dynamisch und in Relation zu den realen Risiken der InvestorInnen bzw. der Mitarbeitenden. Im Gegensatz zu dem kapitalistischen Modell, welches davon ausgeht, dass lediglich die InvestorInnen ein Risiko zu tragen hätten, anerkennt der humanistische Ansatz auch die Risiken der Mitarbeitenden.

- • Risiko der Investoren: Verlust des eingesetzten Kapitals
- • Risiko der ArbeitnehmerInnen: Verlust des Arbeitsplatzes

Im zeitlichen Verlauf eines Wirtschaftsunternehmens sind die Risiken der Mitarbeitenden und die der InvestorInnen gegenläufig. D.h. die Risiken der ArbeitnehmerInnen (Mitarbeitenden) steigen mit der Zeit, da sich mit zunehmender Dauer des Arbeitsverhältnisses die Abhängigkeiten von einem bestimmten Arbeitsplatz erhöhen: Die Lebensumstände, werden mehr und mehr an dem Arbeitsplatz orientiert, für ältere ArbeitnehmerInnen ist es schwieriger einen neuen Arbeitsplatz zu finden, falls der alte auf Grund eines Konkures o. ä. verloren gegangen ist. Im Gegensatz dazu, sind die Risiken der InvestorInnen am Anfang hoch, da von dem eingesetzten Kapital noch nichts retourniert wurde. Nach Jahren des hoffentlich erfolgreichen Wirtschaftens ist das Kapital jedoch mehrfach retourniert und somit das hohe Risiko des Unternehmers mehr ein Märchen, um die im Vergleich zu den Löhnen unverhältnismässig hohen Gewinnausschüttungen an die einstmaligen InvestorInnen zu rechtfertigen.
In Relation zu dem solcherart realistisch betrachteten Risiko, gestalten sich sowohl die Ausschüttungen der Unternehmensgewinne als auch die Mitbestimmungsrechte. Am Beginn des Unternehmens entscheiden letztendlich immer die InvestorInnen was mit ihrem Geld geschieht. Ebenso werden zu nächst einmal die Unternehmensgewinne vor allem zur Rückzahlung der Investitionen verwendet. Zu einem späteren Zeitpunkt, bekommen die Investoren weniger, während die Löhne, Sozialleistungen, etc. für die Mitarbeitenenden ausgebaut werden.



Risiken im zeitlichen Verlauf (schematisch)

3.2 Rückzahlung der Investionen

Eine der entscheidenden Fragen wird sein, wann die getätigten Investionen als zurückgezahlt betrachtet werden. Es wäre zu einfach, einen Investor, der den Betrag **I** in ein Unternehmen investiert hat, diesen Betrag **I** nach zwei Jahren zurück zu zahlen. Bei dieser Sichtweise würde das Risiko des Investors nicht abgegolten werden. Um dieses Risiko zu quantifizieren, muss abgeschätzt werden, wie wahrscheinlich ein Teil- oder Totalverlust des eingesetzten Kapitals zum Zeitpunkt der Investition gewesen ist. Diese Wahrscheinlichkeit kann am ehesten mittels Erfahrungswerten festgestellt werden, indem zu Grunde gelegt wird, wieviele in etwa gleichartige Unternehmungen erfogreich sein würden und wieviele scheitern. Folgende Formel bringt diese Überlegung auf den Punkt:

$$Rz = \frac{I}{E}$$

Rz....................Rückzahlung an InvestorIn [€}
I...................... .Investition durch den/die InvestorIn [€]
E.......................Wahrscheinlichkeit d. Erfolgs [0-1; 0=Erfolg ausgeschlossen, 1=garantierter Erfolg]

Am Beispiel des Projektes Congo:Deux würde sich die folgende Berechnung ergeben:

$$Rz = \frac{€\ 10.000}{0,25} = €\ 40.000$$

In dieses Projekt wurden von 2 Personen jeweils ca. € 5.000,-, also insbesamt € 10.000,- investiert.
Zum Zeitpunkt der Investition, hätten wir die Erfolgschancen auf ca. 1:3 geschätzt. Anders gesagt, hätten wir insgesamt vier Versuche starten müssen, um einmal erfolgreich zu sein. Dies ergibt eine Wahrscheinlichkeit von 0,25 bzw. ¼.

Die obige Formel geht davon aus, dass es sich bei dieser Investition um eine hochriskante handelt, deren Risiko den Totalverlust des eingesetzte Kapitals einschliesst. Konkret hätte dies vor allem im Zuge des Transportes der Hardware passieren können, durch Unfall, Diebstahl, Zollprobleme oder politisch/ ökonomische Katastrophen in der DRC. Bei weniger riskanten Unternehmungen müsste berücksichtigt werden, dass oft nur ein geringer Teil des Kapitals verloren gehen kann. Die Rückzahlungen (Rz) würde sich in diesen Fällen verringern.

$$Rz = \frac{(I - G)}{E}$$

Rz.....................Rückzahlung an InvestorIn [€]
I.........................Investition durch den/die InvestorIn [€]
E.......................Wahrscheinlichkeit d. Erfolgs [0-1; 0=Erfog ausgeschlossen, 1=garantierter Erfolg]
G.......................Gesicherter (nicht-riskierter) Kapitalanteil

Beispiel: Wäre in dem gegenständlichen Projekt Congo:Deux das Risiko auf 50% des Kapitals beschränkt gewesen, weil z.B. die Hälfte der Investitionen in jedem Fall, also auch bei Scheitern des Projektes, noch verkäuflich gewesen wären, müsste folgendermassen berechnet werden:

$$Rz = \frac{(€\ 10.000 - €\ 5.000)}{0,25} = €\ 20.000$$

Faktisch war es so, dass es sich bei dem Projekt Congo:Deux um unseren dritten Versuch handelte: Vorausgegangen war ein EDV-Projekt, welches erst nach 2 Jahren begonnen hat Gewinne abzuwerfen, mit denen die Investitionen nun schön langsam zurückgezahlt werden können. Ein weiters Unternehmen, das wir komplett einstellen mussten, weil es sich nicht rechnete, war ein Versuch Fair-Trade mit Edelsteinen zu betreiben.

3.3 Mitbestimmung

Zum jetzigen Zeitpunkt haben in allen Belangen der Geschäftsführung die Investoren das letzte Wort. Selbstverständlich werden die Anliegen und Vorschläge der Mitarbeitenden ernsthaft in Betracht gezogen und nach Möglichkeit berücksichtigt. Mit zunehmender Rückzahlung des Investitionen wandeln sich die Mit*sprachemöglichkeiten* der ArbeitnehmerInnen mehr und mehr zu Mit*bestimmungsrechten*. Die konkrete Umsetzung wird man im Laufe der Zeit entwickeln müssen. Von basisdemokratischen Plenas bis hin zur Wahl der Geschäftsführung durch die Miarbeitenden ist alles denk- und diskutierbar.

4 OFFENE ZUKUNFT

Im Sinne einer prozessbezogenen Sicht der Dinge sind alle oben festgehaltenen Sichtweisen und Vorgangsweisen diskutier- und veränderbar. Insbesondere ist zu berücksichtigen, dass ein Wirtschaftsunternehmen vor allem von Menschen getragen und betrieben wird, deren komplexe Struktur nicht mit den relativ einfachen Konstrukten denen sich die Naturwissenschaften im allgemeinen widmen, vergleichbar sind. Alle obigen Berechnungen und Formeln sind daher nur grobe Richtlinien. Insbesondere sollte die hier bisher als klar und eindeutig betrachtete Trennung von InvestorInnen und Mitarbeitenden in Frage gestellt werden, da sowhl InvestorInnen in einem Unternehmen arbeiten können als auch MitarbeiterInnen angehalten sein sollten, in das eigenen Unternehmen zu investieren.

5 KOOPERATIONEN UND VERNETZUNG

Das diesem Papier zugrunde liegende Projekt Congo:Deux, sowie die dieses Projekt tragende Organisation Bino na Biso arbeiten erklärter Weise im Kontext freier Software mit offenem Quellcode. Der kooperative Ansatz dieses Softwareentwicklungsmodelles harmoniert naturgemäss dem kooperativen Wirtschaftsmodell, wie hier vorgeschlagen. Die Zusammenarbeit mit gleichgesinnten Organisationen bietet sich an und wir sind für diesbezügiche Vorschläge jederzeit offen.

6 VERLAUF UND AKTUELLER STAND

Die Implementierung von Kursräumen in den ersten vier Schulen hat sich als durchaus anspruchsvolle aber dann doch schaffbare Projektphase erwiesen. Inzwischen konnten wir noch eine fünfte Schule ausstatten. Damit sind unsere Reserven and Hardware in Kinshasa restlos belegt. Wir warten nun auf den hoffentlich wieder erfolgreichen Transport im Aprill 2004.
Das Ziel eine Internetanbindung für alle Schulen zu ermöglichen musste aus technischen wie finanziellen Gründen aufgeschoben werden und ist nun für Mitte 2005 geplant. Finanziell wurden die Ziele im ersten Trimester nur teilweise erreicht: BnB war zwar bereits finanziell unabhängig in dem Sinne, dass mit den Einnahmen die Löhne des kongolesichen Personals bezahlt werden konnten. Die Geschäftsführung musste in dieser Zeit jedoch auf ihren Lohn noch verzichten und auch die Investoren gingen leer aus. Seit dem Beginn des zweiten Trimesters (Jänner 2004) sind diese Anlaufschwierigkeiten jedoch überwunden und es können nun alle Projektbeteiligten zunehmend mit der Abgeltung ihrer Leistungen rechnen.
Sehr erfolgreich waren wir in der Umsetzung des Zieles, ausschliesslich offenen Quellcode einzusetzen. Bisher konnten alle Anforderungen mit OpenSource Software abgedeckt werden.

7 ZUKUNFTSPLÄNE

7.1 Erwachsenenbildung

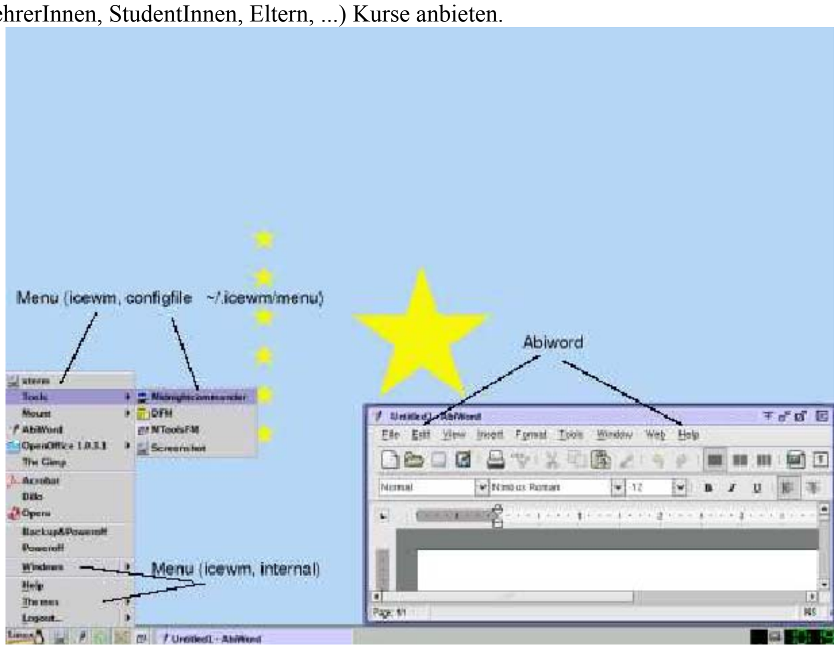
Zunehmend werden wir auch Erwachsenen (LehrerInnen, StudentInnen, Eltern, ...) Kurse anbieten.

7.2 Firmenkunden

Im Sinne einer Diversifizierung unseres Geschäftsfeldes wollen wir beginnend mit Q2/2005 Beratung und Implementierung von OpenSource basierenden Lösungen für Burautiques, einer Mischung aus Internetcafe und Bürodienstleister, und andere Klein- und Mittelbetriebe anbieten. Dies soll u.a. den von uns auf OpenSource-SW ausgebildeten SchülerInnen spätere Berufschancen in der IT-Branche ermöglichen.

7.3 Liboke ya Congo

Die Lokalisierung von iceWM und AbiWord, vor allem deren Übersetzung in die Sprache Lingala ist eines unserer Vorhaben für das Q2/2004.
Speziell bei der Lokalisierung, also der Anpassung einer Software an lokale Gegebenheiten, ist die Offenheit des Quellcodes von unschätzbarem Vorteil.



Erste Designstudie der LyC

8 BINO NA BISO – KONTAKT

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Zeitzone Kinshasa ident mit MEZ (=GMT+1h); keine Sommerzeit

BnB-MitarbeiterInnen vor ihrem Büro (Abb. links). Der Garten des BnB-Hauses wird vielfältig genützt: Ausruhen, Meetings, Wäschsalon, Obst- und Gemüsegarten. Demnächst ziehen dann auch eine Ziege und Hühner ein (Abb. rechts).

Stand Februar 2004

Das Verkehrsmodell Wien

Roman RIEDEL & Paul HOLZAPFEL

(DI Roman Riedel, rie@m18.magwien.gv.at, Ing. Paul Holzapfel, hol@m18.magwien.gv.at,
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1 EINLEITUNG

Die Stadtplanung Wien hat Ende der 90er Jahre mit dem Aufbau eines eigenen Verkehrsmodells begonnen. Das Verkehrsmodell Wien basiert auf der Software der Firma PTV in Karlsruhe und ist in mehrjähriger Eigenleistung aufgebaut worden. Es umfasst 390 Verkehrszellen in Wien, Niederösterreich und Nordburgenland sowie 26 Außenzellen.

2 FUNKTIONSWEISE

Das Verkehrsmodell verwendet **ursachengerechte Aktivitätsmodelle**. So lassen sich im Vergleich zu vereinfachenden Regressionsmodellen äußerst detaillierte Analysen der Verkehrsnachfrage erstellen. Der Untersuchungsraum ist in Verkehrszellen eingeteilt, denen Struktur- und Verhaltensdaten der Bevölkerung sowie die räumlichen Nutzungsstrukturen und Verkehrsangebote zugeordnet werden.

Die Berechnungsmethode des Verkehrsmodells beruht auf der Nachbildung des Verhaltens aller Verkehrsteilnehmer nach Marktsegmenten (verhaltenshomogene Bevölkerungsgruppen). Dabei wird auf alle Aspekte des Verkehrsverhaltens eingegangen:

Wer? ► Marksegmente
Warum? ► Wegezweck
Wohin? ► Zielwahl
Wie? ► Routenwahl
Womit? ► Verkehrsmittelwahl

2.1 Wer? (Marktsegmente)

Das Verkehrsmodell Wien basiert auf elf verhaltenshomogenen Bevölkerungsgruppen:

- Kinder bis 6 Jahre
- Volksschulkinder
- Unterstufenschüler
- Oberstufenschüler
- Studenten
- Erwerbstätige mit Pkw
- Erwerbstätige ohne Pkw
- Nicht-Erwerbstätige mit Pkw
- Nicht-Erwerbstätige ohne Pkw
- Senioren mit Pkw
- Senioren ohne Pkw

2.2 Warum? (Wegezweck)

Es werden 5 Hauptzwecke unterschieden:

a) Freizeit
b) Arbeit
c) Einkauf (weiter untergliedert in täglicher Bedarf, Auswahlgüter und Möbel)
d) Bildung (weiter untergliedert in Kindergarten, Volksschule, Unterstufe, Oberstufe, Universität)
e) Dienstleistung

2.3 Wohin? (Zielwahl)

Die Zielwahl erfolgt auf Basis der Verkehrszellen und deren Ausstattung mit Schul- und Arbeitsplätzen, Freizeiteinrichtungen und Einkaufsmöglichkeiten.

2.4 Wie? (Routenwahl) und Womit? (Verkehrsmittelwahl)

Bestandteile des Verkehrsangebots (Verkehrsnetz) sind:

ÖV-Liniennetz und Fahrplan

Bewegungs- und Fahrmöglichkeiten für Fußgänger, Radfahrer und Autofahrer im Straßen- und Wegenetz

3 NUTZUNGSMÖGLICHKEITEN:

Die umfangreiche Datenbasis und die zahlreichen Analyse- und Darstellungsinstrumente ermöglichen vielfältige Anwendungsmöglichkeiten. Der Hauptanwendungszweck besteht in der Prognose von verkehrsplanerischen und städtebaulichen Maßnahmen: **Was wäre wenn?**

Die Prognoseinstrumente basieren auf einem Modell der Wirklichkeit, das die **Wirkung** von **Änderungen des Verkehrsangebotes und der Siedlungs- und Nutzungsstruktur** abbildet und **erklärt**. Mit diesem Ansatz kann nicht nur die Wirkung von Veränderungen im Verkehrsangebot auf den ÖV, Pkw-, Fußgänger- und den Fahrradverkehr untersucht werden, sondern auch die Wirkungen von städtebaulichen Entwicklungen.

ABSTRACTS / KURZFASSUNGEN, WORKSHOPS

Workshop: IT-Security & Safety

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1 KURZBESCHREIBUNG

Fragen der IT-Sicherheit, der Datenintegrität und Vertraulichkeit der zu verarbeitenden Daten im Planungs- und Vermessungsbereich sollen nach einem kurzen einführenden Vortrag aufgezeigt und ausführlich diskutiert werden.

2 MOTIVATION

Es ist erstaunlich, daß unsere Rechner bereits mehr als 15 Jahre lang durch periodische Wellen von Vireninfektionen lahmgelegt werden. Trotz unablässiger Anstrengungen gegen diese Plage mit zum Beispiel Anti-Virus Software, Trojan-Scannern, Firewalls, Intrusion Detection Systemen, etc. gelingt es immer mehr, mittlerweile nicht nur tausende, sondern Millionen von Computern weltweit innerhalb weniger Stunden zu sabotieren – wie kann es dazu kommen, wie kann man sich schützen?

Auch moderne Planungs- und Vermessungsbüros müssen sich immer häufiger mit dieser Problematik beschäftigen; vielmehr, daß solche Unternehmen bereits fast vollständig von der EDV abhängig sind. Ein Rückschritt zwecks Problemvermeidung in die Zeiten ohne EDV kommt aus wettbewerbstechnischen Gründen nicht in Frage; zusätzlich könnte eine erfolgreiche Attacke auf die Computer so eines Büros existenzbedrohend werden – welche Maßnahmen sind nun zu treffen?

Über die Konsequenzen nicht rechtzeitig eingeführter, dem Stand der Technik entsprechender Schutzmaßnahmen, sollte sich jeder Inhaber eines Büros als auch der EDV-Verantwortliche im Klaren sein: Haftungsfragen, Wettbewerbsnachteile, oder sogar Strafbarkeit können zu den unangenehmsten Begleiterscheinungen zählen.

Computer-Security definiert die EDV-Sicherheit im vorher beschriebenen Sinn. Unter Computer-Safety versteht man unter anderem den Datenschutz, wie zum Beispiel Sicherung und Archivierung der Daten. Gerade diese Archvierungsproblematik, welche die Wahl von geeigneten Datenformaten und Speichermedien umfaßt, kombiniert mit einer gerade im Bau- und Vermessungswesen geltenden dreißigjährigen Aufbewahrungspflicht, stellen Inhaber von Planungsbüros vor nahezu unlösbare Probleme. Nachdem sich Haftpflichtversicherungen bei grober Fahrlässigkeit gerne leistungsfrei sehen, kann diese Problematik ein unkalkulierbares Risiko für jedes Unternehmens in der Zukunft bedeuten.

Ein weitere in diesem Zusammenhang nicht zu unterschätzende Problematik ist die Frage der Datenintegrität. Es ist, wie schon erwähnt, durchaus wichtig und zweckmäßig die Nettodaten zu sichern und zu archivieren, jedoch müssen diese interpretierbar bleiben. Wesentlich ist hier, daß sowohl der logische Zusammenhang der Datensätze erhalten bleibt, und daß die sogenannten Metadaten, die für die korrekte Interpretation dieser Daten zuständig sind, ebenfalls in die Zukunft gerettet werden.

Zum Schluß, nachdem viele technische und organisatorische Fragen, die im Zusammenhang mit der IT-Sicherheit stehen, angerissen worden sind, bleibt nur noch ein Restrisiko zu diskutieren: der Mensch. Da das Ausspähen von Informationen im Geschäftsleben immer lukrativer, und vor allem durch die hohe Datenkonzentration und Systemvernetzung, immer einfacher wird, müssen hier ebenfalls technische und organisatorische Maßnahmen getroffen werden, um die Vertraulichkeit der Daten zu gewährleisten.

In der Folge werden drei Themenschwerpunkte des Workshops genauer behandelt, um vorab einen Überblick in die Marterie zu erhalten.

3 IT-SICHERHEIT

Der etwas undeutliche Begriff der IT-Sicherheit umfaßt im Wesentlichen die beiden englischen Begriffe IT-Security und IT-Safety. Die IT-Security behandelt Fragen des Schutzes vor unberechtigtem Zugriff, Veränderung oder Löschung von Daten, somit Sicherheit vor beabsichtigten Störungen. Die IT-Safety definiert hingegen die Fragen der Sicherung und Archivierung, also Sicherheit vor unbeabsichtigten Schäden, wie Headcrashes, Übertragungsfehler oder defekten Geräten.

Angriffsziele von absichtlichen Störungen sind im grundsätzlich Hardware, Software und die Daten, wobei nicht vernetzte Systeme in der Regel weniger gefährdet sind, als vernetzte. Um eine höchstmögliche Netzwerksicherheit, genauer Kommunikationssicherheit, zu erreichen, wie dem Schutz vor Manipulationen und Abhören, hat die schon seit der Antike übliche Kryptographie in den letzten Jahrzehnten wesentliche Forschritte erzielt, und nahezu perfekte Konzepte entwickelt. Zusätzlich müssen rein technisch-organisatorische Konzepte vorgesehen werden, um Sicherheit vor Eindringlingen zu gewährleisten; hier leisten eine Art elektronischer Portier (Firewalls), elektronische Schlösser (Authentication Systems) als auch Alarmanlagen (Intrusion Detection Systems) wertvolle Dienste. In weiterer Folge erkennen und beseitigen elektronische Schnüffelprogramme die trotz der Sicherheitsvorkehrungen eingedrungenen Spezies, wie Viren, Trojanische Pferde oder Würmer.

Computerviren sind Programme, die sich selbst reproduzieren, indem sie sich an andere Programme anhängen. Sie brauchen also einen ausführbaren Wirt. Ein Wurm ist ein eigenständiges Programm, das sich selbständig übers Internet oder per Email wie ein Virus ausbreitet. Wie bei einer menschlichen Krankheit, treten deshalb vergleichbare krankhafte Symptome bei Computern auf. Häufig wird dagegen mit Selbstmedikation angekämpft, zum Beispiel Firewall Software einfach dem Anwender überlassen, die dann nicht den gewünschten Effekt erzielen kann. Genauso könnte man plakativ vergleichen, daß man einem Kranken auf dem OP das chirurgische Besteck reicht. Das Problem benötigt einen ganzheitlichen Lösungsansatz, denn der schlichte Einsatz einer Firewall und ziellose Installation von Schutzsoftware ist vom heutigen Stand der Technik einfach zu wenig – vielmehr führen präventive organisatorische Maßnahmen zu einer raschen Reduktion des Infektionsrisikos.

Trojanische Pferde sind im Gegensatz zu vielen Viren eigenständige Programme mit mehr oder weniger bösartigen Funktionen. Ihre schädigende Komponente ist in ein Programm eingebaut, das eine nützliche Funktion vortäuscht. Ein Trojaner gibt sich als Spiel oder anderes nützliches Tool aus, um im Hintergrund sein bösartiges Handwerk zu betreiben. Mit Hilfe eines Trojaners gelingt es, die vollständige Kontrolle über einen infizierten Rechner zu erhalten, was äußerst unangenehme Folgen für das oft ahnungslose Opfer haben kann.

Schutzziele vor diesem ungebetenen bösen Zoo, als auch vor Hackern und Crackern können wie folgt definiert werden:

- Vertraulichkeit: Nachrichteninhalte dürfen niemandem außer dem Kommunikationspartner bekannt werden
  Der Sender und Empfänger sollen die Möglichkeit haben, unbeobachtet und anonym zu kommunizieren
- Integrität: Fälschungen sollen erkannt werden

  Der Empfänger soll nachweisen können, daß eine Nachricht vom Sender, womöglich zu einem bestimmten Zeitpunkt, geschickt worden ist.

  Der Absender soll das Absenden einer Nachricht mit korrektem Inhalt, womöglich zu einem bestimmten Zeitpunkt, nachweisen können.
- Mehrseitige Sicherheit: Jeder wird gegen andere weitgehend geschützt

  Erfordernis des Einsatzes bestimmter Verfahren, die auch genutzt werden können

Für all die oben genannte Ziele bietet die Kryptographie interessante Lösungsmöglichkeiten. Das nachfolgende Schutzziel kann nicht mit deren Hilfe gelöst werden, sondern muß sowohl technisch-organisatorisch als auch mittels redundanten Back-up oder Stand-by Systemen erreicht werden.

- Verfügbarkeit: Zuverlässige Kommunikation zwischen allen Teilnehmern, die es wünschen, und denen es nicht verboten ist.

Die Folgen erfolgreich sabotierter Systeme können durchaus dramatisch ausfallen, wie zum Beispiel:

Ausspähen privater Daten oder Firmendaten, Verlust der Privatsphäre, Wettbewerbsnachteile, Fernsteuerung des Rechners, Mißbrauch des Rechners für kriminelle Zwecke im Namen des Opfers, Zerstörung oder Veränderung von Daten und Programmen, Kosten der Wiederherstellung, Haftungsfragen in Folge Regreßforderungen, Existenzbedrohung, strafrechtliche Verfolgung, ...

Um solchen Bedrohungsszenarien zu begegnen, müßte zu allererst die Büroinfrastruktur als auch benachbarte Systeme dokumentiert werden, um danach eine Risikoanalyse durchzuführen zu können. Danach wären geeignete Schutzmaßnahmen und Schutzpläne zu entwerfen, die in regelmäßigen Abständen auditiert und angepaßt werden.

Man muß sich jedoch bewußt sein, daß eine 100%-ige Sicherheit nie erreichbar ist. Letztendlich ist es ein betriebswirtschaftliches Kalkül, welchen Wert an Daten und Systemen man schützen muß, und in Relation dazu die Kosten die nötig sind aufstellt, um diese Daten und Systeme zu schützen.

4 DATENINTEGRITÄT

Gerade im Planungs- und Vermessungsbereich ist schon vor Jahrzehnten Pionierarbeit geleistet worden, was den Einsatz der Datenverarbeitung betrifft. Aus diesem Grund gibt es in diesem Bereich ein hohes Maß an Wissen, wie Daten über lange Zeiträume integer und dauerhaft gehalten werden können, aber auch das Bewußtsein für die Begleiterscheinungen solch, zwar einfach klingender, aber dennoch komplexer Anforderungen.

Fragen der Datensicherung und der Archivierung sind schon im vorherigen Kapitel der IT-Sicherheit eine Rolle gespielt, haben aber gerade hier eine zentrale Rolle. Als erstes fällt hier die Problematik des zu wählenden Mediums auf. Es ist nicht nur eine Frage, ob die Daten auf diesem Medium dauerhaft gespeichert, also auch in Zukunft fehlerfrei lesbar sind, sondern auch, ob in der Zukunft noch Geräte, Schnittstellen und Software verfügbar sein werden, die diese gespeicherten Daten lesen und korrekt interpretieren können. Es ist in diesem Zusammenhang ein berühmter Fall zu erwähnen, wo die Daten der Apollo-13 Mission weitgehend verloren sind. Aus diesem Grund kauft die NASA seit Jahren ausgediente Rechner und Medien auf, um dieser Problematik in der Zukunft rechtzeitig begegnen zu können. Eine Notwendigkeit in diesem Zusammenhang ist das Umkopieren und Umformatieren der gespeicherten Daten auf neue, dauerhafte, auch in der Zukunft absehbar unterstützte Medien und Geräte, da gerade im Planungs- und Vermessungsbereich die dreißigjährige Haftungsdauer für Bau-, Bestands- und Vermessungspläne als „Damoklesschwert“ über den Planungsbüros hängt. Diese Problematik erhält eine noch größere Tragweite, da die Daten immer mehr und vielfältiger werden.

In diesem Zusammenhang wäre auch kurz die Geschichte als Beispiel heranzuziehen, um diesem Thema eine allgemeine, schon seit Jahrtausenden, bestehende Wichtigkeit hervorzuheben. Viele antike Werke wären nie ohne die Kopierarbeit im arabischen Raum, als auch in den mittelalterlichen Klöstern, erhalten geblieben. Durch die Weitsichtigkeit der alten Ägypter, der Wahl von dauerhaften Speichermedien wie Stein und Papyrus, wird uns eine seit Jahrtausenden vergangene Epoche lebendig erhalten; und trotzdem ist genau hier die Problematik der Interpretation gespeicherter Daten aufgetreten, die inzwischen durch die Entzifferung der Hieroglyphen gelöst ist:

Die Datenformate stellen eine immer mehr komplexere Herausforderungen an das moderne Büro dar. Die zu speichernden Formate sind vielfältig, wie zum Beispiel für Textverarbeitung, Tabellenkalkulation, Plandaten, Bilddaten, Datenbanken, u.v.m. Diese Situation wird noch dadurch verschäft, daß sich die Versionen der eingesetzten Formate immer rascher ändern, mit der Folge, der Inkompatibilität, auch nur teilweise. Der schlimmste einzutretende Fall ist, wenn ein Datenformat nicht mehr lesbar wird, da ein Softwareprodukt nicht mehr unterstützt wird, oder dessen Hersteller nicht mehr existiert. Um dieser Herausforderung möglichst zu begegnen, sollte man sich folgende Anforderungskriterien an eine Software und dem Datenformat überlegen:

- Muß eine exakte oder möglichst authentische Reproduktion gewährleistet sein?

- Was ist der Zweck der Datenverarbeitung? Sind Vektor-, Raster- oder Textdaten zu verarbeiten?
- Wie ist die Politik und Liquidität des Herstellers? Ist eine möglichst langjährige Unterstützung absehbar?
- Existieren Import- und Exportschnittstellen zu anderen Anwendungen? Wie authentisch ist dann die Kopie?

An dieser Stelle kann man über die Sinnhaftigkeit proprietärer Formate von Softwareherstellern diskutieren, aber auch über die Zweckmäßigkeit von offenen Standards, wie XML und GML oder möglicherweise etablierter Formate wie Postscript. Auch für die Frage bestehender oder noch zu schaffender Normen wäre hier ein Platz. Weiters sind Fragen des Datenaustausches, der Wichtigkeit der Metadaten, und von Weiterverarbeitungsmöglichkeiten genau zu klären, bevor man sich auf Anwendungen und Datenformate festlegt.

Letztendlich ist der Erhalt der Datenintegrität, das heißt, die Erhaltung der Zugehörigkeit von Daten und deren Interpretierbarkeit, besonders bei Planungs- und Vermessungsbüros von besonderer Bedeutung. Würden zum Beispiel die Strichstärke von Plandaten bei Umwandlung in ein Rasterformaten verändert, oder bei der Speicherung mit verlustbehafteten Kompressionsverfahren ganze Flächen, wäre eine authentische Reproduktion des Originals anhand der Kopie unmöglich.

Letztendlich gilt es zu bedenken, daß beim Erstellen von Urkunden, auf das spätere Reproduzieren einer authentischen Kopie Bedacht genommen werden muß, auch im Zusammenhang einer 30-jährigen Aufbewahrungsdauer. Diese Aufgabenstellung wird den Büros nicht erspart bleiben, im Gegenteil, die elektronisierung von Urkundenarchiven schreitet in rasanten Schritten voran.

5 VERTRAULICHKEIT

Zum Schluß soll noch ein kurzer Einblick auf die Probleme, die im Zusammenhang mit der Vertraulichkeit der Daten stehen, hingewiesen werden. Auf der einen Seite wird dieser Schutz juristisch erreicht, wie zum Beispiel dem Datenschutzgesetz, Signaturgesetz oder dem Strafgesetzbuch. Bei Verstoß drohen dem Deliquenten Konsequenzen, wie Strafen. Auf der anderen Seite ist es auch technisch und organisatorisch möglich, sich vor unberechtigter Weitergabe und Ausspähen von Daten zu schützen; hier sei auf das Kapitel IT-Sicherheit verwiesen.

Computerkriminalität ist ein deliktisches Handeln, bei dem der Computer das Werkzeug oder das Ziel der Tat ist. „Deliktisch“ ist ein Begriff aus dem Strafgesetzbuch (StGB); damit meint man ein strafbares Handeln. Dabei kann der Computer das Werkzeug oder das Ziel sein, und zwar für Manipulation, Sabotage und Spionage.

In diesem Kapitel beschäftigen wir uns mit der Spionage. Trotz aller Gesetze und Strafbestimmungen ist es sinnvoll, sich vor Angriffen zu schützen; denn auch wenn man den Täter ausfindig macht, der Schaden läßt sich nur selten wieder gut machen. Bei Schadenersatzansprüchen wird oft ein Vergleich gesucht, um längere Prozesse zu vermeiden. Das bedeutet, daß der Geschädigte nur einen Teil des Schadens ersetzt bekommen wird. Ist trotzdem ein Vergleich nicht möglich, so ziehen sich solche Verfahren doch jahrelang hin, was zusätzlich einen bedeutenden Zeit und Kostenaufwand für den Geschädigten darstellt. Sich zu schützen hat auch einen weiteren Aspekt: Versicherungen halten sich gerne leistungsfrei bei Vorsatz und grober Fahrlässigkeit.

Einige Maßnahmen zur Erhöhung der Vertraulichkeit der Daten könnten so aussehen:

- Verschlüsselung der Daten, eventuell der Software und Freigabe mittels Schlüssel
- Authentifizierung der User und Paßworteinsatz
- Ein Paßwort muß regelmäßig geändert werden, und absolut geheim bleiben
- Vorsicht vor Erspähung von Paßworten
- Kathodenstrahlröhren (Cathode Ray Tube, CRT), Geräte und Kupferkabel erzeugen eine Strahlung die mittels speziellen Geräten empfangen werden kann, wobei der z.B. dargestellte Bildschirminhalt dann sichtbar wird.
- Überprüfung des Programmcodes eines Programmierers durch andere Programmierer
- Vernichten nicht mehr benötigter Festplatten, Disketten oder Ausdrucken (Mistkübel sind oft eine interessante Informationsquelle)

Ein letzter Aspekt: all diese Maßnahmen sind wirkungslos, wenn der Spion im eigenen Unternehmen steckt; Untersuchungen haben ergeben, daß die meisten Angriffe von eigenen zugangsberechtigten Mitarbeitern durchgeführt werden, oder daß Geheimnisse von diesen nach außen getragen werden. Umso wichtiger ist es Maßnahmen zu setzen, damit Zugangsberechtigte zu sensiblen Daten erst gar nicht in Versuchung geraten, solche Handlungen zu setzen; das wären zum Beispiel Mitarbeiterzufriedenheit, Gehalt, Kontrolle, Strafandrohungen, Aufklärung, u.v.m.

Antiker Wohnkomfort - Moderne Bedürfnisse
Eine progressive Analyse zwischen Architektur des Altertums und zeitgenössische Raumplanung

Zsolt VASAROS

TU Budapest, Fakultät für Architektur

ZUSAMMENFASSUNG

Ich habe es versucht das Thema “Wohnkultur-Wohnluxus” über Epochen des Altertums hinweg zu verfolgen. Der folgende Vortrag beschäftigt sich mit der Rezeption historischer Architektur und Wohnkultur, wie sie im Nostalgie-Boom der 70-er 80-er Jahren und in der postmodernen Architektur zutage tritt. Auffallend ist das Zusammentreffen mit entsprechenden Problemen der modernen Architektur. Hier wie dort die Suche nach Theorien, Versuche von Standortbestimmungen und Bereitschaft, der Vergangenheit und ästhetischen Kategorien grösseren Raum zu geben. Nicht nur eine überdachte Rämlichkeit soll man sich als bebauten Raum vorstellen. Jeder künstliche Eingriff, der an einem gegebenem Ort eine qualitative und in gewissem Sinne eine quantitative Änderung mit sich bringt, ergibt einen bebauten Raum einen gegebenen Punkt definiert.. einen gegebenen Punkt definiert. In den Arbeiten des rumänisches Starphilosophes Mircea Eliade werden diese Begriffe aufgrund verschiedene Mythen ausführlich dargelegt und definiert. In der Bauforschung ist man sich bewusst, dass nur mit der Rekonstruktion der Entwürfe das Ursprünglichste und das eigentliche Bau-Wollen wiedergewonnen werden können. Das Ziel dieser Forschungen ist es, die Harmonie und hohe Qualität der antiken architektonischen Räume und die zweifache Relation von Funktionalität und Ästhetik zu untersuchen.

ABSTRACT

Examining the living conditions of any historical era, housing culture and city planning may play an important and interesting role during the process. The influence of historical architecture is clearly observable, recently in the postmodern trend of the past few decades. By adopting the appropriate analysis, methodics and the way of thinking of certain eras is to be explored – thus the spirit of the age opens up. A built-up area, or one single point in space indeed means a level of higher quality, serving as a peculiar derivative of the universe. During the designing process certain coordinates forecast the duality of functionality and aesthetics. Structure, as the third determining factor prevents the system from disintegration thus examinations must be carried out in a complex way. This could be followed by the comprehension of architectural structures at a higher level. Still the search for antiquity in modern European trends leaves several questions unanswered, each of either material or of intellectual levels.

Wissens-KulturLandschaften
Wie Nachhaltigkeit durch Kultivieren wissensbasierter Wertschöpfungen – aller Nutzungen + Körnungen erreicht werden kann

Jürgen PIETSCH

Prof. Dr—Ing. Jürgen Pietsch, TU Hamburg-Harburg, FSP 1: Stadt, Umwelt und Technik

Die Wissensgesellschaft eröffnet nachhaltige Potentiale für neue Kulturlandschaften.

An Beispielen wie Wissensmilieus als neuer, nahezu zwangsläufig nachhaltiger Nutzungsmischung, der Transformation traditioneller Kulturlandschaften, etwa durch Weinbau geprägt, in zukunftsfähige Nutzungskulturen wird aufgezeigt, dass zukunftsfähige (Stadt)Regionen durch wissensbasierte Wertschöpfungen geprägt sein werden. IT-Werkzeuge und Infrastrukturen stellen dabei nur die Basis dar, wesentlicher wird die die Bildung von kulturellem und Wissenskapital sein.

Welche, vor allem positven Veränderungen im Übergang von Industriegesellschaftlichen Landnutzungen und Nutzungsstrukturen zu Wissens-KulturLandschaften bereits eingetreten und noch zu erwarten sind, wird mit ausgewählten Beispielen illustriert.

Benchmarking regionaler Innovationsdaten: Der Nutzen für die regionale Planung

Hansjörg BLÖCHLIGER

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Nachhaltiges Wirtschaftswachstum hängt immer mehr von der Fähigkeit zur Innovation ab. Für eine Region ist Innovationsfähigkeit ein zentraler Standortfaktor, um ihre internationale Wettbewerbsfähigkeit zu bewahren oder zu verbessern. Detaillierte und international vergleichende Informationen zur Innovationsfähigkeit sind deshalb eine strategische Grundlage der Regional- und Raumordnungspolitik.

Für das „Benchmarking regionaler Innovationsdaten" stehen fünf Fragen im Vordergrund. Diese Fragen sollen im folgenden behandelt werden.

Warum benchmarking auf regionaler Ebene?

Innovation ist ein regionales Phänomen. Innovation konzentriert sich oft auf wenige Regionen eines Landes. Regionale Cluster können Treiber einer ganzen Volkswirtschaft sein. Regionen können einen beträchtlichen Einfluss auf die Innovationsfähigkeit ihrer Unternehmen ausüben.

Welche Modelle gibt es zur Innovationsforschung?

Die Modelle, wie sie von der OECD und anderen internationalen Forschungs- und Politikberatungsorganisationen verwendet werden, unterteilen Innovationsfähigkeit in der Regel in drei Bereiche: Innovationsressourcen, Innovationsprozesse und Innovationsergebnisse. Die Zuteilung der Daten auf die drei Kategorien erfolgt manchmal sehr pragmatisch.

Welche Daten zur innovationsfähigkeit gibt es auf der regionalen Ebene?

Während für die nationale Ebene vielfältige und differenzierte Innovationsdaten zur Verfügung stehen, sind Daten für die regionale Ebene oft rar und unvollständig. In vielen Fällen müssen Daten aus verschiedenen Quellen kombiniert und aufbereitet werden.

Wie sieht die Innovationsfähigkeit europäischer Regionen aus?

(siehe nachfolgende Powerpoint-Präsentation)

Welchen Nutzen schaffen regional vergleichende Innovationsdaten

Regionen stehen im internationalen Standortwettbewerb, und Innovation ist ein regionales Phänomen. Innovationsbenchmarking kann deshalb der regionalen Planung für das Bestehen nicht nur im nationalen, sondern auch im internationalen Wettbewerb wertvolle Informationen bereitstellen:

- wie ist unsere Innovationskapazität im internationalen Vergleich zu beurteilen
- welche Innovationsfaktoren sind gut entwickelt, welche weniger
- welche Aspekte im Innovationsprozess (Ausbildung, Forschung und Entwicklung, Wissens- und Technologietransfer etc.) bedürfen besonderer Förderung
- sind die einzelnen Akteure im Innovationsprozess gut miteinander verknüpft
- führt die Innovationskapazität zu einer hohen wirtschaftlichen Performance

Wirtschaftsförderung, regionale Wirtschaftspolitik, aber auch die Raumplanung können Innovations-Benchmarkdaten direkt für die Entwicklung regionalwirtschaftlicher und raumplanerischer Strategien verwenden.

Praxisbericht OpenSource-Software für Projektmanagement: www.projektstrukturplan.net

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Wir sind seit rund 15 Jahren in der Software-Industrie tätig und haben uns dabei auch auf das Gebiet des Projektmanagement spezialisiert. Dabei sind wir vor etwa vier Jahren auf die Herausforderung gestoßen, Software für Projektmanagement zu erzeugen, und wir haben das mit verschiedenen Mitteln probiert. Erfolglos: die Software war – wie fast jede Software - zu komplex, zu instabil, zu starr, zu wartungsaufwändig, zu mühsam zu implementieren, zu unfreundlich zu bedienen.

Im Winter 2002/2003 haben wir uns dann intensiv mit dem weltweiten Phänomen der „Softwarekrise" auseinandergesetzt und daraus mehrere Anforderungen für eine vollkommen neue Projektmanagement-Software entwickelt:

- diese Software muss ganz einfach mit wenig Aufwand herzustellen sein,
- sie muss sich selbst erklären,
- sie muss aus dem Internet downloadbar und leicht weiter-vermailbar sein,
- sie darf keine Installation erfordern,
- sie muss ohne Datenbank auskommen,
- sie darf keine Mehrfacheingabe von ohnehin vorhandenen Daten erfordern,
- sie muss bei der Erstellung und bei der Verwendung Spaß machen.

Wir haben uns daher entschieden, all das, was ein normaler Projektleiter und seine Projektmitarbeiter mit hoher Wahrscheinlichkeit zur Verfügung haben, zu nutzen, und ansonsten keine Anforderungen zu stellen. Ein durchschnittlicher PC oder Laptop mit einem Tabellenkalkulationsprogramm, einem E-Mailsystem und einem Kalender mit Aufgaben- und Terminverwaltung und unserer installationsfreien, selbsterklärenden, Download-Software musste genügen, um damit vor allem Projektstrukturplanung, Kostenplanung, Terminplanung, Aufwandsplanung, Ressourcenplanung, Projektcontrolling und Multiprojektmanagement zu verwirklichen.

Das Ergebnis ist ein Programm, das seit Juli 2003 völlig „open source" als freeware unter www.projektstrukturplan.net für jeden Menschen frei erhältlich ist, das in rund 15 Manntagen (!) Programmieraufwand entstanden ist und alle geschilderten Anforderungen auf verblüffende Weise abdeckt. Die Downloadraten steigen zur Zeit mit plus 80 % pro Monat. Ungefähr jeden Monat entsteht mit wenigen Tagen Programmieraufwand ein neues Produktrelease. Zur Zeit beginnen mehrere Betriebe, die Software flächendeckend für ihre Projekte einzusetzen.

Die Erfahrungen, die wir dabei gemacht haben, und die Erkenntnisse, die wir daraus durch unseren Vortrag bei der CORP2004 für andere nutzbar machen wollen, beziehen sich auf:

- die Wahl der Programmiersprache für solche Projekte,
- die Nutzung vorhandener Software,
- das Fachwissen zur Aufgabenstellung der Software,
- die Wahl der Anwender-Zielgruppe und die Vermarktung,
- die Möglichkeiten, mit solcher Software Geld zu verdienen,
- die Erkenntnisse auf die Teamzusammensetzung für solche Projekte.

KUALA LUMPUR TOWARD A SUSTAINABLE AND COMPETITIVE GLOBALIZING CITY-REGION: CAN MULTIMEDIA SUPER CORRIDOR (MSC) BE A DRIVING FORCE?

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MALAYSIA

ABSTRACT

Kuala Lumpur is one of the globalizing cities in Asia Pacific region. Competing with Singapore, Seoul, Hong Kong, Sydney, Jakarta and Bangkok, Kuala Lumpur has sought to reposition herself as a potential centre for global capital by implimenting various strategies and developments. The repositioning of Kuala Lumpur in this global system of cities has brought about changes and adjustments of her city-region. Prior to the era of globalisation, the Klang Valley as a city region of Kuala Lumpur, has been recognized as a coherent urban planning region, covering four districts of Selangor state; Gombak, Klang, Petaling and Hulu Langat as well as the Federal Territory of Kuala Lumpur. However, from the late 1980s, Kuala Lumpur has strategisted policies what might be understood as a “global shift of development”. Through the development of mega projects, i.e., Kuala Lumpur City Centre (KLCC), Kuala Lumpur International Airport (KLIA) and Multimedia Super Corridor (MSC), the city-region of Kuala Lumpur had been transformed, restructured and now become a high-tech city-region, known as Kuala Lumpur Metropolitan Area (KLMA), incorporating the districts of Sepang and Kuala Langat in addition to the existing Klang Valley region. In this context, the city-region of Kuala Lumpur played a key role to the future economic success of Malaysia within the context of the highly globalized economy, providing Kuala Lumpur a new dynamic and driving force of competitiveness toward achieving a status of global city. However, this has rise a question of, to what extent these forces have been transforming Kuala Lumpur particularly in the process of restructuring the functional landscapes of the city-region, in order to be more competitive and sustainable in the near future. Hence, it is the purpose of this paper to deal with the above question.

I-City: Information and Communication Technologies for Urban Planners:

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ABSTRACT

ICT is becoming a new specialization in the field of urban planning, alongside well-established specialties such as transport planning, land use planning, the planning of housing, or the more recent specialty of planning for sustainable development. It is today impossible to imagine any viable urban development plan that does not integrate ICT in one way or another.

The Urban Planning Program at Columbia University is at the forefront of the emerging field of "Social Communication Planning". This Spring Columbia will be the first American University to offer a planning course focusing on the urban impact of ICT. We suggest that:

> *Social Communication Planning should address the closely interrelated issues of the technological infrastructure and the cultural infrastructure needed for the more effective functioning of a democratic, collaborative social communication process that supports a high quality of life within an open society.*

Much of the drive to open this field of study has steamed from students' initiatives such as the Trading Places Network and the Urban Image Network. Both are projects undertaken by Columbia University Urban Planning students aiming at exchanging ideas and information with other students globally. Trading Places uses the Internet to coordinate traveling conferences in cities around the world (including Shanghai, Hong Kong, Seoul, Tokyo, New York, Toronto, Mexico City, Bogotá, Berlin, Amsterdam, Paris, and Lisbon), promoting physical exchange and networking. The Urban Image Network is a free gallery of images of cities around the world to be launched this fall.

About myself: I recently graduated from the Masters Program in Urban Planning. As a student I was an active member of the Trading Places Network. I am currently working as a researcher and assistant instructor in the Program. My research areas are communication planning, and the informal economy. I maintain the website on the Urban Planning Program, manage the Urban Image Network project, and work on the new Social Communication Planning course with Professor Thomas Vietorisz.

Finding the "institutional space" for democratic e-governance: Information and Community Technology (ICT) and Area-based Management (ABM) in Durban, South Africa

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ABSTACT

The notion that Information and Communication Technology (ICT) can assist effective local governance is an exciting one to explore in developing countries. Given that urbanites in developing countries suffer from the indignities of poverty, inequality and resource scarcity, the onus is increasingly on local governments to enable more effective service delivery and economic empowerment. The role of ICT in this regard is underpinned by technological and human resource capacity as well as social and cultural networks. Given the uncertain terrain that is governed by many municipalities in developing cities, a number of questions emerge when examining the interface between local government and ICT within this context. Firstly, how well are local governments placed to harness digital technology towards more effective service delivery? Secondly, how well is it placed to understand the civil society networks that underpin urban life in poor communities? Furthermore, does the institutional make-up of local governments in developing (and developed) countries allow for the use of ICT in a truly empowering manner?

This paper will engage with these questions by investigating the prospects for enhanced democratic governance using ICT in Durban. The eThekwini Metropolitan Council, has recently embarked on a system of Area-Based Management (ABM) to enable decentralised governance within the city. The paper will attempt to understand whether the inclusion of ICT in ABM can promote the community networks and institutional learning necessary to achieve democratic governance. Can it contribute to regeneration and development in Metropolitan Durban? The research will be based on interviews with key community and institutional stakeholders implicated in these initiatives as well as perusal of relevant policy documentation.

City and Information Technology: Theoretical Challenge

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ABSTRACT

Since the mid-1970s, new information technologies have increasingly become the means of interactive communication among people scattered throughout the world. The fundamental changes that have occurred created new realities of how socioeconomic activities, and essentially cities, behave. The commonly established planning theories have since challenged.

This paper is an attempt to analyze these theories which could be looked at in three perspectives: the Physicalist; the Urban Economist ; and The Social Meaning perspectives.

The physicalist perspective tends to minimize the significance of social relations, and concentrate on the physical elements of the city such as schools, hospitals public spaces and street patterns. It is the process of manifesting social structures into symbolic expressions. (Hyper space and virtual spatial patterns are immanent challenges.)

The economist perspective perceives the city as a practical machine. It emphasizes efficiency. Activities are located according to their relative cost of reaching labor, materials, markets, and services. These competitions result in the arrangement of land uses and cityscape (low cost telecommunication challenges the bases of accessibility.)

The social meaning perspective is concerned on the reflection of the society's dominant culture. To understand the city, analysis of the population, institutions, and political structure, is necessary. (grass root movements, new sense of spatial arrangements are true challenges.)

This paper will explain these perspectives and suggest the most likely changes in their assumptions and the emergence of new propositions. The, this study will attempt to establish a theoretical framework to construct a conceptual model to deal with these challenges.

Biography:

Tarik A. Fathy, Ph.D., is a planner and architect. He holds a doctorate in planning from the University of Southern California (USC), Los Angeles, California in 1988. His research work emphasizes on the transformation of cities into a new era. He is considered one of the first researchers on this subject. He has published few papers and he authored: "TELECITY: Information Technology and its impact on City Form." Praeger, New York, 1991. He is a member of many academic and professional organizations. He is a founder member of T.H.E. Architects, Planners, and Civil Engineers in both Los Angeles and Cairo, Egypt. He was born 1955.

SUSTAINABLE USE OF IT IN URBAN PLANNING

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ABSTRACT

Information technology changing the contemporary society with its widespread distribution all over the world, in addition to its turning of traditional ways of interactions between people at all activities, which lead to urban changes to fulfill its new requirements as a hope to cope most urban problems. But without considering sustainability, these urban changes will lead to more urban problems.

Problem

Information Technology is not only a type of infrastructure, but also it becomes a main tool to work, learn and many other activities day over day, So it must be included in urban studies in right way to show how we could deal with it to achieve sustainable urban growth.

Hypothesis

1-Information technology becomes one of major factors affecting urban future, and it could be more useful with good urban arrangements.

2-Information technology could be used to achieve intelligent sustainable urban growth, especially in developing countries as Egypt.

Objectives

Main objective is to study urban future in information technology age from sustainable vision, through these secondary objectives: -

1-To draw conclusions about how communications technology participates in society and urban development.

2-To show future urban indicators in information technology age, and applying it on developing countries and Egypt.

Methodology

Research relies mainly on Inductive methodology, to exploit of available theoretical tools to achieve its objectives.

It uses secondary Comparative Analysis methodology, to evaluate different ideas in this field, and draw final conclusions.

The influence of e-supply chain in the transformation of urban space.

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ABSTRACT

Supply chain plays crucial role in the business process as far transportation and store are the most costly business, that add the value of "place" and "time" in product value.

The change of functional structure of a business to become **e-business**, under the use of technologies of Informatics and Telecommunications Systems, has consequences upon the transition of urban space from polis to e-polis.

E- supply chain and its management, logistics, are the systems inside business that create the necessary connections -nods between data, communication network and the effectiveness of business network (supply chain network).

Three steps development of e- supply chain are referred.

In first step, advanced techniques are used to create the suitable electronic network to meet the client /consumer.

A step forward, departments of a business appear as network members begin sharing resources and utilizing joint assets to enhance the network.

Finally, full network connectivity is achieved as use of the Internet is pervasive and the network is prepared to do business in a digital economy.

In this work, we will try to figure out the consequences of the above changes upon the spatial organization of business, focusing on warehouse and distribution network and the following effects upon urban space transformation to become e-polis.

Understanding and modelling the challenges of information technology in urban and regional development

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ABSTRACT

In the last decade advances in information technology and the fast-growing stock of digital information became an important resource and driving force for successful development in urban regions in numerous locations all over the world. The instant and global availability of information and knowledge over the Internet enables not only the development of information-based economies; it also contributes to manifold social, cultural and environmental opportunities to improve current conditions. The pace of technological change in the IT-sector and the complexity of modern societies bear both opportunities and risks on the path of transformation of regional economies and the social and environmental quality of life. Nevertheless, it is not well understood how the combination of information, information technology, and know-how can actively be used to support the successful revitalisation of declining urban regions. Planning and decision-making in this domain are confronted with complexity and uncertainty because many aspects of human systems are involved, e.g. from the economic, social and ecological spheres, which are interacting simultaneously. Therefore integrated approaches are needed to build up an interdisciplinary understanding of the complex relationships and the dynamics that is driving urban regional development in current times. System thinking and systems modelling provide means to analyse the key relationships between structure and long-term behaviour in regional development in an integrative way. It uses tools to represent the cause-effect structures and the underlying feedback loops, which govern growth and decline processes. System simulation models allow calculating the consequences of specific feedback structures and experiencing the possible long-term behaviour of regional systems considering aspects like economic development, jobs, regional population, land use patterns and regional quality of life. Additionally, computer models support the search for policy options and testing their feasibility under alternative conditions. This approach can be used as a consulting tool for managers and public authorities in planning possible sustainable futures of urban regions with regard of the emerging information und communication technology.

The role of space technologies in territorial management

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ABSTRACT

Territorial planning is still a field where space technologies do not enter easily and are not used extensively. However, in recent years earth observation, geopositioning, and satellite communications have evolved to a stage where they are not anymore a privilege only a few can afford, but they have effectively became extremely competitive with the traditional tools supporting urban and regional planning. In some cases, they're irreplaceable and provide services unthinkable until a few years ago. Some, such as Digital Elevation Models, topographic surveys and aerial views of the intervention sites have been eased and became standard operations. Others, such as acquiring and comparing images from a specific date in the past, geopositioning or collaborative planning using data sharing to and from virtually any place on the planet would not be possible at all without space technologies. This paper explores the usefulness of Space in urban and regional development and planning, and the reasons why its use is still not generalised in some fields. The presentation associated with the paper uses mainly images to show results of many real applications such as sealing maps, urban growth, land use change, subsidence maps, low to very-high resolution images, lava flow path prediction, World Heritage monitoring, traffic management, oil spills and river pollution monitoring, greenhouse gases measurement, digital elevation models, 3D fly-throughs and locationbased services.

GIS Supports Planning and the Public Participation Process With Planning Support Systems

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Advances in GIS and supporting technologies have led to the development of decision support systems that facilitate the community planning process. There are several planning support systems (PSS) available on the market today to GIS users. PSS uses indicators and alternative development scenarios to measure the attributes and performance of communities and their plans. Planning support systems are instrumental to successful community planning and public participation processes because they focus on the needs and the know-how of users as opposed to focusing on or requiring a high degree of GIS expertise. Planning support systems can measure and compare performances of different planning scenarios according to planner- or citizen-defined indicators for land use, transportation, natural resources, and employment, to name a few. The ultimate goal is to bring together all potential players to work collaboratively on a common vision for their community. GIS-based planning support systems allow planners and citizens to quickly and efficiently create and test alternative development scenarios and determine their likely impacts on future land use patterns and associated population and employment trends, thus allowing public officials to make informed planning decisions.

Furthermore, software developers are increasingly using 3D visualization tools as an integral part of their Decision (Planning) Support Systems. Community planners, architects, urban designers and land use planners are increasingly using 3D visualization tools to give citizens and public officials the ability to visualize the impact, or probable result, of urban design projects, proposed land use and zoning changes, or to envision the results of smart growth initiatives. 3D GIS tools facilitate public participation by communicating both complex and simple geographic and man-made phenomena. 3D visualization tools combined with Planning Support Systems allow the public and decision makers to interactively change or simulate existing and proposed modeled environments or scenarios.

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