ANALYSIS OF ONLINE PUBLIC PARTICIPATORY GIS APPLICATIONS WITH RESPECT TO THE DIFFERENCES BETWEEN THE US AND EUROPE

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ABSTRACT

Public Participatory Geographical Information Systems (PP GIS) is a field of research that focuses on the use of GIS by the general public and aims at involving citizens in a decision-making processes. PP GIS applications increasingly use the Internet as a platform for communication and dissemination of information. They link community participation and geographic information in a diversity of social and environmental contexts. In this paper we compare twelve online PP GIS applications and evaluate them according to their usability, interactivity and visualisation. A qualitative expert analysis shows that a highly interactive citizen information exchange platform is the exception rather than the rule. After presenting first results of the study we discuss some directions for ongoing and future work including suggestions for PPGIS evaluation by non-expert users.

1 INTRODUCTION

Realizing changes in public space and sustainable development strongly depends on involvement and responsibility of citizens, social organizations and private enterprises in a city or a region. Therefore, governments at different administrative levels strive to engage such stakeholders in participatory spatial planning. At the local level, public participation has long been recognized as an important component of the community planning process. There is a wide consensus that participation in planning processes is generally considered as positive and should be supported by new technologies (*Craig, 2000; Kingston, 1999; Milovanovic, 2003*). Due to its spatial nature, planning today uses Geographical Information Systems (GIS) almost at all administrative levels from local to national - and supra-national, e.g. within the European Union commission. Over the last thirty years, considerable effort has been devoted to improve GIS technically, methodologically and, more recently, integrating it in mainstream IT software.

Public Participatory Geographical Information Systems (PP GIS) is a field of research that focuses on the use of GIS by the general public and aims at involving the citizen in a decision-making processes. PP GIS is an abbreviation which indicates that public needs to be supported when addressing community based problems, since a variety of perspectives are common in different planning processes. Such recognition does not necessarily enhance the capabilities of a conventional GIS. PP GIS seeks to expand the use of GIS to the general

public and non-governmental organizations that are not usually represented in traditional top-down GIS projects (*Talen, 2000; Ghose & Elwood, 2003*).

In recent years, applications supporting PP GIS increasingly use the web as a platform for communication and dissemination of information (*Kingston, 2002; Hawthorne, 2004*). These applications range from Internet-based spatial multimedia systems to conventional field-based participatory development methods with a modest GIS component. Technically and conceptually, these systems allow for novel approaches, for example to organize an online forum where citizens have the possibility to express their opinions, the usage of new image generation systems or augmented reality systems so that the users can be immerged in a "planned city". Some of them enable the users to express their opinions about their desirable future living environment, or the usage of argumaps in order to locate opinions, suggestions and criticisms of citizens (*Laurini, 2004*).

These applications have the linking of community participation and geographic information systems in a diversity of social and environmental contexts in common. Still, applications exhibit huge differences concerning the level of interactivity and the way in which the users communicate with the system and, finally, their functionality. In this paper we compare and evaluate several examples of online PP GIS applications according to their usability, interactivity and spatial visualisation. We present the first results of the analysis at the expert level, discuss some strengths and weaknesses of the examined American und European studies and describe objectives for our further work.

2 COMPARISON STUDY

In this chapter we present the method and material used for the comparison study for which we selected twelve online PP GIS applications. Our first hypothesis was that there are substantial differences between the European and American applications, which are due to the different planning processes, different degree of freedom of information, and differences in computer literacy. The first goal of the comparison study was to prove the hypothesis through the analysis of the existing online PP GIS applications. The comparison study is based on a qualitative evaluation of the selected PP GIS applications by expert users, namely experienced researchers from Salzburg Research and the University of Salzburg. We mainly concentrate on the evaluation of interactivity, spatial visualization, and usability criteria.

2.1 Evaluation criteria for PP GIS applications

2.1.1 Interactivity

Interactivity implies that some action of the user generates a response either from another human being at the other end of the connection or from a program or application residing on a computer. PP GIS applications shall enable user interaction with the system (*Kingston, 1999; Chua, 2002*), which represents a substantial improvement compared to paper maps. Paper maps offer only a static representation of the selected situation of the environment produced by a cartographer with specific skills for a specific purpose. This presentation is valid at the time when the map is produced, for a specific scale and with some specific assumptions in mind. On the contrary, GIS provides a more flexible view even though GIS data are not scale independent. The dichotomy of flexible views and selected data combination leads to new tasks of user guidance especially for the non-expert users.

Generally, PP GIS applications include operations like zoom, pan, copy and paste themes between views, spatial queries like area calculations, location and number of

occurrences of an entity, attributes of an entity, shortest path, etc. Such operations allow for 'personalized views' of the data sets and enable the user to access information about specific topics of local day-to-day interest. The design of a sophisticated interface shall support personal interests and preferences, the exploration of planned alternatives, assessment of these alternatives, expression of a personal opinion about the environment and voting for the personal favourite planning alternative.

In our analysis, we partially refer to the e-participation ladder after Smyth (*2001*) that provides a structured overview of different forms of online participation. It focuses particularly on the degree of interactivity aspect (see figure 1). At the bottom stage of the ladder, participation exists in an entirely passive mode as "the public right to know", while full interactivity is present at the top as "participation in the final decision" with the adoption of online decision support systems (*Carver, 2001b*). The level of communication rises up from one-way at the bottom stage to two-way communication on the top rung of the ladder. The bottom stage represents only the delivery of online services such as access to government information. It has some sort of informative status. Further up the ladder, the communication becomes bi-directional making participation more interactive through the sharing of information, ideas and feedback.

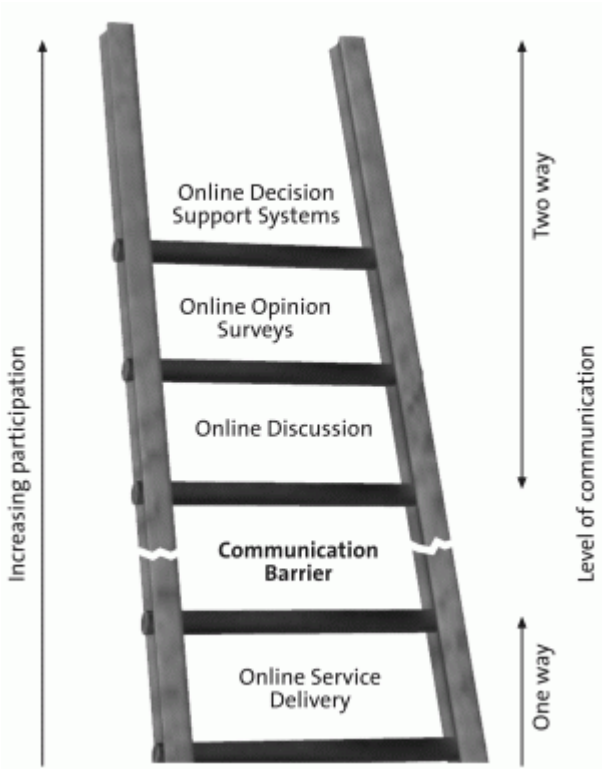

Figure 1: e-participation ladder (modified after Smyth 2001(found in Carver, 2001b))

2.1.2 Visualization

Visualization is a powerful method for the representation of spatial data such as streets, buildings, parks, or rivers. These data sets can be further combined with digital elevation models (DEM), orthophotos, satellite images, pictures, video, sound or other documents. Only the structured utilisation of these different types of media in combination with the existence of a 3D model allows for a virtual reality model. The 3D model has to incorporate also the

planned changes of the reality. Usually, images are created from the model at the same time, which corresponds to the change of viewpoint. This requirement sets up conditions for the hardware and software to be used as well as for the modelling itself. The most affordable system is the screen of the PC as 'window' to virtual reality. The user himself is not present in the system, but it is possible to present an image of the first-person on the screen. By offering nearly simultaneously an image for the left and the right eye through shutter glasses, the e human brain is capable to reconstruct a 3D-image.

Ideally, this leads to the establishment of an urban planning virtual reality system, in which the citizen gets the impression that he or she is present both in the existing and the planned environments. In such systems a strong emphasis is put on interactive three dimensional and photo-realistic online presentations. Such representations support communication between the planners and the public involved in the planning process, and vice versa. Visualization is especially useful and appropriate when little is known about the datasets or technical details. In visualization systems the user's learning process depends greatly on the users' interaction with the software. In many real world applications sophisticated visualization allows greater involvement in the application. Sometimes there is a higher degree of interactivity although there is no direct relationship between visualisation levels and interactivity levels.

2.1.3 Usability

PP GIS applications should be easily usable and understandable by a broad public audience. But what are necessary and sufficient characteristics for the criterion usability? General and rather widely used usability criteria exist in software engineering and computer interface design and testing, but there is a lack of such approach for PP GIS. We need concepts to extend them for PP GIS applications and to defining criteria how such applications and interfaces shall support participatory planning processes.

Usability of an application is usually measured from the user's point of view. It is one of the most important factors in the phases of designing up the product for trade (*Jahn & Frank, 2004*), but also for an operational, non-commercial system as in urban or regional planning. The user of PP GIS application is a general public which implies that this is a very heterogeneous group of users and therefore not easily definable. The potential users have a diverse range of world views, cultural backgrounds and knowledge. These aspects require that the systems are accessible and rather easy to use (*Haklay, 2003*).

Why is usability especially important for online PP GIS? We identified two main reasons: 1. The specialized functionality that supports online GIS increases the complexity of a conventional browser experience, and 2. Geographic information systems are characterized by inherent complexity in the amount of content available and the skills needed to interpret that content. Solutions related to the questions like how complex models and methods for spatial analysis should be made available to non-experts, can be developed from the type of research carried out in PP GIS. For example, research into appropriate visualization or the use of multimedia can be integrated with mainstream GIS research in order to improve the usability of GIS for occasional and non-expert users (*Haklay, 2003*).

The only way to ensure that an online application designed for the public is really usable is through extensive testing of the usability before launching the application. Thus, the usability criteria have to be carefully selected and the evaluator's understanding of these criteria is crucial for the success. Another critical factor is to include the user demands and needs into the process of producing an application. In our approach we focus on the capability of the PP GIS application to be understood, learned, and used by the user, when applied under specified conditions. As some social groups lack basic computer skills it is

important to develop systems that can be set to different levels of skill dependent upon the user's prior knowledge.

2.2 Selected online PP GIS applications

Current online PP GIS applications vary considerably in their general performance and level of sophistication. As a result of an intensive internet survey using search machines like Google and links found in scientific papers we identified twelve web-based PP GIS applications. Seven of the twelve applications were developed in the US and five in Europe (see table 1). Some other application examples which are sometime also called PP GIS or similarly, but with too little interactivity of the users e.g. delivering static maps in forms of snapshots or pdf documents, were not considered in this study.

	Project	Internet link
US Study Cases		
US1	Pilsen Project – Urban Design Visualization of Pilsen	http://www.evl.uic.edu/sopark/new/RA/#sub1
US2	Orange County Interactive Mapping, developed by the city of Orlando – Florida	http://www.cityoforlando.net/public_works/esd/gis/interactive_mapping.htm
US3	Resource Management Mapping Service – Illinois	http://space1.itcs.uiuc.edu/website/rmms/
US4	Wyoming Oil and Gas Resource Assessment Mapper	http://wogra.wygisc.uwyo.edu/wyoims2/wims2awogra.html
US5	Erie International Airport	http://gis.csengineers.com/erie/viewer.htm
US6	Town of Clover Planning Analyst	http://www.lic.wisc.edu/clover_web/history_bkgrnd.htm
US7	I-map Delaware River Basin	http://bassriver.state.nj.us/imap_delbasin/
European Study Cases		
UK1	Virtual Slaithwaite Project	http://www.ccg.leeds.ac.uk/slaithwaite/
UK2	Bradford Community Statistics Project	http://www.bcsp-web.org/mapguide_site/maingeo.cfm
UK3	"Openspace" of Salford University	http://www.ties.salford.ac.uk/pg/xiao/openspace-main.html
DE1	„Bürgerbeteiligung Online" – landscape plan Königslutter	http://thuja.land.uni-hannover.de/entera/mapserv.phtml
DE2	„Vernetzter Bebauungsplan" – Landkreis Freising	http://fs.mapsailor.de

Table 1: Selected online PP GIS applications

2.2.1 US study cases

The Project Urban **Design Visualization of Pilsen** was developed by the University of Illinois at Chicago and community leaders of the Pilsen community as part of the community planning process. The intention of this project was to provide visualization for the planning and design of the activities that take place in Pilsen. **Orange County Interactive Mapping** was developed by the city of Orlando. It is an online mapping solution, where the users have the possibility to extract different information from the map, leave comments on the map and then send this specific map extent as a pdf file to the Orange County Board of County Commissioners.

The **Resource Management Mapping Service (Illinois)** was created by the College of Agricultural, Consumer and Environmental Sciences. The project area embraces the whole state of Illinois. Users have the possibility to furnish the map with comments and

then mail the map to anybody they want to. The **Wyoming Oil and Gas Resource Assessment (WOGRA)** is an interagency project designed to provide comprehensive, consistent information on oil and gas resources throughout Wyoming. It is an ongoing collaborative effort done by several institutions including among others the Wyoming State Geological Survey. This application offers the users the possibility to send comments to the WOGRA work group which can be related either to the technical architecture or to the content of the application. C&S developed **Erie International Airport** which is a facilitated public involvement approach to environmental and community decision. Among other things the internet site allows users to view maps of proposed projects, letting nearby residents see how their properties might be affected. This means that the users are able to observe different planning scenarios.

The **Town of Clover** project is a PP GIS application enabling local residents to participate online in the planning process. Using web-based tools offered on the site users are able to view planned activities and participate in the planning process. The project is already completed, and the results of the participation process are published on the Internet. **I-Map Delaware River Basin** is an interactive mapping application that provides answers to user's basic questions about recreational activities in the Basin Area. This application enables users to view and perform basic GIS analyses and queries. I-Map Delaware is one of many existing online GIS applications using ArcIMS technology developed by the company ESRI.

2.2.2 European study cases

The most often cited European project **Virtual Slaithwaite** has been developed by the School of Geography, University of Leeds. The emphasis is on decision support systems that increase public access to data and involvement in the decision making process. Application users receive a map of the village Slaithwaite, can work on it and can make suggestions for the future village development. Slaithwaite is one of three online PP GIS applications developed at the University of Leeds (*Waters, 2002; Carver et al., 2003*). The **Bradford Community Statistics Project** provides statistical information to its users. The users can work with the standard GIS functionalities like zoom, pan and address matching. For example, by selecting a neighbourhood area different statistical information about this area can be gained. But the "real" participatory aspect is weak. In the **Openspace** PP GIS application of Salford University the visualization of the city is done with the means of a 3D model. It is created using the virtual reality modelling language (VRML) and Java programming languages. When the users enter the application they have the possibility to either walk or fly through the virtual city. The application enables different viewpoints and exploring speeds. A user can also submit a comment at any spatial location.

One of the two German examples is the **Interactive landscape plan Königslutter** developed by two private companies in cooperation with the University of Hannover. It enables an Internet based communication between the user and the planning authority. Air photography supports the orientation of the users on the map, making the system more accessible to people with limited map reading skills, and providing contextual information about the neighbourhood and the area. The high tech offensive (HTO) of State of Bavaria in Germany enabled the **Landkreis Freising** to publish a set of development plans on the internet. The users are able to have a look at development plans, get information and also to interact with the map.

2.3 Analysis and discussion of the first results

Our first evaluation criterion is interactivity. Climbing up the e-participation ladder of Smyth (*Carver, 2001b*) the degree of interactivity and participation is rising. Two applications are just providing online information (stage 1: Online Service Delivery) which means that the users interact with the system in only one-way. Five online examples fall into stage 2 and the rest (five applications) provide online Opinion Surveys (stage 3). Landscape plan Königslutter is one of them. It allows the registered user to draw area boundaries into the map, to make comments on defined areas and to mail his or her specific map extent to the town of Königslutter where the planners can work on it. If the user agrees, other users will also have the possibility to respond to these personal comments. None of the evaluated online applications can be regarded as an Online Decision Support System which represents the highest step of the ladder.

In regard to the criteria visualisation and usability, six geographic information systems experts (including the authors of this paper) evaluated the case studies qualitatively. For this expert evaluation, the following criteria were chosen and applied to the applications:

Usability

- Suitability of web application for the task
- Data suitability
- User guidance
- Understandable / intuitive
- Data description / metadata
- Degree of personalization of information

Visualisation

- Quality of visualisation
- 3D functionality

All criteria were explained to the evaluators at first to ensure a common understanding. We used the scale of 1 to 5, where 1 means very good and 5 very bad. A spreadsheet (table 2) served as a common evaluation form while the applications were tested independently on personal computers. Table 2 summarises the results of the individual expert evaluations. Due to the small number of experts only the median and the mean were calculated. The median is less sensitive to outliers than the mean. We did not calculate the mean value of all criteria separately for every application. A direct numeric comparison would be problematic because each application follows specific intentions of the use and are therefore not directly comparable. Table 2 shows that most applications are rather bad in terms of data description except for three examples. For the criterion “generation of a personalized view of information” the grades stretch again over a broad range. The criteria “user guidance” and “quality of visualization” were seen positively by the experts. In general we can state that the grades mainly stretch between two and three point five. 3D visualization is included in only four examples. This fact indicates that the development of a combination of 3D visualization and PP GIS applications is still rather at the beginning.

Evaluation Criteria		US1	US2	US3	US4	US5	US6	US7	UK1	UK2	UK3	DE1	DE2
Suitability of web application for the task	*MEAN*	2,8	2,2	2,3	3	2	3,2	2,5	1,3	2,2	2	1,3	2
	MEDIAN	3	2	2	3	2	4	2,5	1	3	2	1	2
Data suitability	*MEAN*	3,2	2,2	2,1	2,4	2,8	3,8	2	2,5	2,8	3	1,5	2
	MEDIAN	3	2	2	2,25	3	4	2	2,5	2	3	1,5	2
User guidance	*MEAN*	2,5	2,3	2,2	2,6	2,7	2,6	1,5	1,3	2,4	2,5	1,8	2,3
	MEDIAN	2,5	2	2	2,25	2,5	2	1	1	2	3	1,5	2
Understand-ability	*MEAN*	2,3	2,3	2,2	2,8	2,3	2,8	2	1,7	2,4	2,5	2,2	2,3
	MEDIAN	2	2	2	3	2	3	2	1	2	3	2	3
Data description/metadata	*MEAN*	3,8	3,2	1,8	3,2	4	4,6	1,8	4	4	4,5	1,7	2,7
	MEDIAN	4	3	1	3	4	5	1	4	4	4,5	1	3
Generation of a personalized view of information	*MEAN*	4,5	1,8	2	2,6	3	4,5	2,2	3,5	2,25	2,5	2,2	3,8
	MEDIAN	4,5	2	2	3	3	5	2	4	2	2,5	2	4
Quality of visualization	*MEAN*	3	2	2,6	2,5	2,3	3,8	2,2	3,1	2,3	2,5	2	2
	MEDIAN	3	2	2,75	2,5	2	3	2	3	3	2	2	2
3D functionality	*YES OR NO*	YES	NO	NO	YES	NO	YES	NO	NO	NO	YES	NO	NO

Table 2: Results of the expert evaluation

3 LESSONS LEARNED

3.1 Differences between US and Europe

Haklay and Harrison (*2002*) try to explain how different institutional structures and practices influence public appraisals of Public Participatory Geographic Information Systems. Their study concentrates on differences between the UK and the US planning systems considering elected case studies. These differences have a far-reaching influence on the practice and concepts of PP GIS. In the centralised British planning system the national and local government play important roles. The American planning system is decentralised, based on the interplay among federal, state, local government and other actors. The second important issue, which has an impact on different developments of PP GIS in Europe and US, is access to public information. In the US the access to public information is considered to be the right which is enshrined in numerous state- and federal "freedom of information" acts (*Sieber, 2003*).

Our research indicates that the US does not endue more PP GIS applications in comparison to Europe. The applications found in Europe were mostly developed for the UK citizens. Great

Britain is dealing with this topic intensively for a few years, but processes like the Agenda21 in Germany increase attention significantly in recent years. In general there are just a few applications of truly participatory web based GIS. According to our selected criteria there is no significant difference between the European and the American examples.

3.2 Need for a more precise definition of PP GIS

During our study we observed that most PP GIS applications deal with the first level of the e-participation ladder. Relatively little two-way communication is carried out in which, for example, the users have the possibility to write e-mails according to the specific planning topic and get feedback on them. Such an example is the Virtual Slaithwaite application. Sometimes, applications are also categorised as online PP GIS even when the user has just the possibility to get informed about different processes. This is the case, for example, for the "Town of Clover" and the "Pilsen" projects. Following such a broad definition, the vast amount of online GIS application examples can be counted as PP GIS. Such a broad definition of PP GIS would therefore include almost all web-based GIS applications. We observed the need for a more specific (narrower) definition for PP GIS drawing a clear dividing line between the levels one and two according to Carver 2001 (see figure 1). The users of the first level applications endue interaction functionalities like zoom and pan or have query opportunities. These applications lack "real" interactivity, they lack significant user interaction and chances for individuals to challenge expert knowledge and to include their own accounts of geographic phenomena. The "Bradford Community Statistics project" falls into this category and will consequently not be regarded as PP GIS in further studies.

3.3 Only few operational applications exist

PP GIS research and theoretical publications have developed more rapidly compared to the practical development of real PP GIS applications where users can communicate together on the basis of a map. It is important to explore why web based PP GIS applications have not become more widely implemented, as yet. To better understand why there is a small amount of web based PP GIS, it is important to investigate some of the shortcomings of this approach for the process of public participation. Hawthorne (*2004*) argues that one reason why web based PP GIS are not often implemented is that these systems are difficult to maintain over an extended period of time. In many instances, these systems are developed by academics that are often overworked, they lack funding, or move on to different locations to perform their research. Without money or manpower to maintain these complex systems, it becomes difficult to continue expensive, time-consuming web based PP GIS application. It also becomes quite difficult to justify continual support for expensive web based PP GIS when few members of the community actually participate in such online projects. A second reason for only few operational PP GIS applications is the limited awareness of the planners, planning authorities and potential users about the possibilities of such applications. They are still rather unknown outside the main GIS arena and outside the GIScience research community. The link between the research community and the potential users is weak. Greater and wider communication of the functionalities and methodology is necessary.

3.4 Critical social and economic aspects

One preliminary conclusion is that public involvement can in principle be improved by Internet-based PP GIS approaches if the web is used to enhance, but not replace, the current methods of public participation. The crucial point is that this does not happen automatically and we argue that it is not the technology, but the social and economic factors that substantially influence the success and operational use of PP GIS applications. The PP GIS research literature in general exhibits a wide range of sophistication and degree of citizen's integration. However, it is difficult to analyse the real success of public participation since hardly any study critically documents or evaluates the additional efforts retrospectively. In current PP GIS research there has been an extensive debate on whether PP GIS technology represents a tool for empowerment or marginalisation (*Pickles, 1995; Craig et al., 2002; Laituri, 1998; Fox et al., 2003*). Proponents of the technology hope that it will allow citizens to better understand and advocate their concerns, promote the geographic visions of previously unheard people and provide for better involvement of a large group of citizens through the use of information tools (*Sieber, 2003*).

3.5 Rational ignorance of citizens

One of the most important goals of PP GIS is to integrate more citizens and stakeholders into planning processes. With the adoption of GIS into public participation processes the communication between the different persons involved such as citizens, planners and stakeholders shall be increased so that decisions are finally based on a broader public level. Does this really happen? Unfortunately, very little empirical research exists which would testify or falsify this hypothesis.

What we can observe in the process of trying to involve citizens in the planning process is the effect of rational ignorance. Rational ignorance is a term most often found in political science and economics, particularly public choice theory (*Gunning, 2002; Buchanan, J. & T. Gordon, 1962*). Ignorance about an issue is said to be "rational" when the cost of educating oneself about the issue sufficiently to make an informed decision can outweigh any potential benefit one could reasonably expect to gain from that decision, and so it would be irrational to waste time doing so. This has consequences for the quality of decisions made by large numbers of people. One could compare it to political elections, where the probability of a single vote to change the outcome is very small. Since geoinformation is costly, there will always be a limit to support spatial planning activities geographically. For most citizens the personal benefit of getting involved in planning activities and learning how to use a PP GIS application is little and the costs are high. As a result, citizens feel that they cannot really influence the final planning decision and in most cases they really cannot. In this case, they decide to ignore the possibility of involvement and economists say that these poorly informed citizens are rationally ignorant. One of the crucial questions is therefore how to motivate the citizens to invest in learning to use such applications and to participate in decision-making processes.

4 CONCLUSIONS AND FURTHER WORK

Recently, Salzburg Research, the University of Salzburg and Sun Microsystems started cooperation in form of a Centre of Excellence for Map-Based Online Public Participation (MAP^3). The main focus of the centre is research on public participatory issues which aim to

enhance the citizen's contributions to decision-making and public participation in planning as well as in environmental and local policy measures. GIS based applications with proof-of-concept prototypes will be used for the implementation of the concepts in the domain of public participation in planning and decision-making. Based on an ongoing comprehensive state-of-the art study of PP GIS applications partly described in this paper, first empirical studies are underway. This includes a PP GIS application in the province of Salzburg, Austria, and an evaluation study of the acceptance of such an application by the citizens. Specifically, applications of 3D-visualization and innovative spatio-temporal communication approaches will be analysed. Activities comprise the use of dynamic and (semi-) realistic geo-visualizations to communicate interactively in participatory planning processes.

The long term impacts of these ongoing and starting projects shall substantially contribute to the implementation of democratic policy intentions and improve the effectiveness of policies by using new concepts, methodologies and instruments to support participatory spatial planning. Using the MAP[3] research platform bridging academia and industry we will critically evaluate if re-enforcement of community involvement and responsibility of citizens and governments will be realized. Within the framework of this PP GIS lab, applications are going to be tested comprehensively by including a large number of non-expert users in the evaluation phase. Next to technical and methodological issues, we will tackle the inequality problem in computer access and the problem that many social and economic groups are characterised by low levels of computer literacy. Purely internet-based collaborative decision support systems would at least potentially disempower these groups. Future research projects will include combinations of different media such as outdoor touch screen installations, collaborative planning meetings monitored with videos or sketch maps techniques. All in all, we need a result-oriented research agenda, rather than a technical one and we shall directly link research to educational and advocacy initiatives.

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