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Improve public participation in planning processes by using web-based 3D-models for communication platforms

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1 INTRODUCTION

Since people settle in cities, urban areas are always undergoing changes caused by redevelopment, refurbishment and new development. The diversification includes single buildings as well as whole districts. The changes of the urban pattern were growing in time and space over the last decades which means that the urban pattern is transformed often in short periods – considering the life-cycle of real estate. Those alterations of urban areas have great influences onto the people living and working in these areas. For not only the physical environment is changing but also social, ecological and economical alterations will often follow the transformation of urban areas. E.g. the market value will rise which causes diversification in the social composition of the residents, environmental influences will undergo changes like the dissemination of pollution will alter as well as fresh air systems, solar radiation etc.

Due to the multiple influences of urban development onto the residents, public participation (PP) should become an essential part of the planning process. Also, on this account the EU is strengthening public participation and e-democracy by pushing forward the offers in these sectors in its member states, just because “to plan is not enough”. Yet, public participation is not as easy as it sounds like. Effective participation is based on well informed public, whereas lots of non-professionals find it hard to understand the content of plans and therefore have difficulties to see which consequences might be caused by the offered planning alternatives. To improve communication, co-operation and particularly participation, new “planning” tools have to be developed and used in the planning process.

The paper discusses the use of 3D-visualisation to improve the understanding of planning contents and explains how web-based participation platforms might improve public participation in planning processes. The possible use of online participation tools will be explained by describing the EU VEPs project and the web-based 3D participation tool which has been developed for the case study urban redevelopment of the Rosensteinviertel in Stuttgart during the project, respectively which is still under development. Further the special function of a Web 3D Service (W3DS) is discussed regarding online participation systems using 3D-models.

2 HOW TO IMPROVE PUBLIC PARTICIPATION

In most countries of NWE (North West Europe) public participation already is an inherent part of the planning process. Yet, the currently used participation instruments do not at all tap the full potential of modern technologies to support innovative and effective participation methods. Considering the new media sector, a wide range of new possibilities are available to be used in variant ways. Further, most of the participation taking place because it is legally demanded. E.g. in Germany, participation is legally regulated by the “Baugesetzbuch” (German Building Law) and has to take place concerning so-called formal planning processes like Bauleitplanung (land use plans). However, in a lot of cases it makes more sense to participate the public in a very early stage of the planning (“informal planning process, e.g. urban development planning) to get best planning results and highest acceptance of the planning. For these kind of participation the common instruments like workshops, open councils etc. might well be supplemented by tools using the wide range of possibilities of the ICT (Information and Communication Technologies).

Yet, participation should not only be used for legitimisation of and improving the acceptance for the planning projects. Taking the expertise of the residents into account, planning and decision making processes will win quality as well as transparency (cf. Märker, O., 2006). In practice, a new procedure can be seen: online moderated actions. Online moderated actions try to use the variety of knowledge by enabling many

participants to speak out on a defined issue within a time stated. Moderators will coach the process supported by intuitive elements.

It is obvious that the meaning of e-participation is not only to digitalize existing planning and decision making processes but looks for innovative participation possibilities using internet-based information and communication technologies (ICT). E-participation for the public considers those aspects of public participation which enable an active attendance of discourse and decision processes via the internet. On one hand this asks for a broad information offer. Based on the information offerings, instruments on the other hand are necessary to enable active participation (e.g. web forms, fora, chats). Last but not least, the public will turn away from such offerings if the kind of influence of how the participation results are used in the development of the projects is not shown clearly and transparent (cf. Bräuer, M., Biewendt, T., 2005). The user must be able to see what happens with the results of the participation and how the online participation is integrated into the planning or development process.

2.1 ICT to improve information, communication and participation

Information, communication and co-operation are the basics of effective and transparent public participation. Strengthened by demands of the EU to enhance e-democracy and e-participation (cf. Öffentlichkeitsbeteiligungsrichtlinie [Richtlinie2003/35/EG], 2003 and Plan-UP-Richtlinie [2001/42/EG], 2001), new media offers a lot of possibilities to supplement the common participation instruments.

Using GIS and CAD data to generate 3D-urban-models, will utilize already existing planning data in a new way. 3D-visualistion of existing and planned structures will help non-professionals to better understand planning contents and the consequences caused by planning alternatives (improve information level of users). People might be able to evaluate and rate the planning much better as they were able to do by only having 2D maps and reports written by experts. Offering 3D-visualisation via internet, the range of residents achieved by participation measures might grow and also reach people who were not participating before (widen the group of approached people).

Using the internet enables the public to participate independently of time and space. Therefore, the information offered via websites has to be unambiguous, detailed and easy to understand. Reports and common 2D maps can be supplemented by 3D models, which may help to understand clearly the statement of planning proposals.

2.1.1 Potentials of ICT for public participation

The internet is no longer an exotic space. Close to 70 % of the German population is already“online” (cf.. (n)onliner Atlas, 2006), which means that the internet became an article of daily use. For “below thirties”, the internet is normality but also the number of onliners in age-group of 50+ is growing steadily:

Alter	2001	2002	2003	2004	2005	2006
14 – 29	63,4%	69,9%	77,2%	80,2%	82,8%	86,5%
30 – 49	48,0%	54,7%	66,3%	68,2%	71,2%	74,1%
50 +	15,6%	18,3%	25,0%	28,2%	30,5%	33,7%

Graph 1: use of the Internet according to age-groups (cf. (n)onliner Atlas 2006)

People use the internet for online banking, to search for job offers or a new partner, for information and communication (news, emails), to book holidays, to shop onlone, etc. The internet is not longer an alien instrument. To many, the use of the web is as naturally as reading newspapers or listening to the radio. Therefore, e-participation is timely and, considering the above listed circumstances, it is appropriate to allow residents to participate in planning processes online. (cf. Bräuer, M., Biewendt, T., 2005)

One of the biggest advantages offered by eParticipation is the independence of space and time: the user is free to choose, when and where he will join the project to get himself informed, and to participate in the process. This aspect could widen the range of people already participating in planning processes, because also those people can get involved who, until now, did not have the opportunity to, due to handicaps,

inconvenient working times, personal timidity, etc. The internet is available 24 hours a day, 365 days a year. Therefore, information can be offered, discussion can take place, and participation is possible, regardless of any office hours. It is also a chance to involve groups which may not be reached with traditional participation methods but are typical internet users, like e.g. young people. Get more resp. other people involved will also enhance the input of knowledge. Legal authorities will profit from getting input from different stakeholders and a wide variety of user groups. Planning will not longer be a process of making proposals and let them discuss by the public, but could benefit from the wide range of public knowledge, which could now easily be used to improve planning and decision making processes (cf. Bräuer, M., Biewendt, T. 2005).

Another point is the possibility of interactive communication, also, or even with high number of participation. Participants are able to link their comments interactively and time lapsed (asynchrony), different from face-to-face discussion (synchrony) where the comments are directly linked to the earlier statement.

The internet allows representing continuously profound information of all relevant planning data which is accessible to whoever is interested in. But not only common information, like textual and map based input, might be offered via internet. One of the big potentials of the web is the interactivity and the special visualisation possibilities. People can look at planning proposals in a 3- dimensional way, walk through 3D-urban-models and change the view-points as they prefer. Videos and panorama images are further features to make information and participation more interesting and understandable. New visualisation technologies (e.g. Google Earth) and discussion structures may help to improve participation and simplify understanding of development contents for non-professional people.

The internet as a networking instrument could help to improve the communication in participation processes: one-way-communication (download, newsletter, and mailing) is possible as well as two-way (e-mail, online forms, e-voting, chat) and multi-way-communication (collective city and residents' server, internet conference, online mediation, online working, discussion forum). This is a very important aspect by developing participation as co-operation between partners, not only as top-down involvement of local authorities.

Another important issue is the improvement of transparency in planning and participation processes which might come with ePlanning and eParticipation. But there is also the risk of anonymity and quasi-participation. Using the web for participation demands a careful handling of data and input of the participants. Contact persons have to be announced and fast feed-back provided. Also the use of the engagement and the influence of the planning process have to be defined clearly. Results have to be displayed and timelines have to be named. Anyway, if online participation is handled carefully and earnestly, the planning and participation process will become much more transparent. (cf. Märker 2007; Sinning, Selle, Pflüger 2003)

2.1.2 Potentials of online 3D-visualisation

As already mentioned in 2.1.1, the ICT offer a big potential regarding visualisation technologies. Information about space does not longer have to be 2-dimensional. With the upcoming possibilities of using 3D-data online, 3D-urban and terrestrial models could play an important issue in future online content. As Google Earth is demonstrating, 3D-urban-models improve the understanding of the space. Orientation is much easier because the user is able to identify landmarks in 3D – like he is used to do in reality, too.

Due to technical process in data capturing and computer graphics, more and more cities are interested in building up 3D-urban-models, in Germany and other European countries. But still most 3D-models are not available online, even if a lot of cities already possess 3D-data. Usually, the models are used for internal planning processes. With the upcoming popularity of Google Earth, the interest in using 3D-models online grew enourmesly and some cities already started to integrate their models into Google Earth to make them available for the public (e.g. Hamburg, Berlin and Bamberg). However, although the use of 3D-models for public participation offers an improvement of consulation, only very few models are used for this purpose.

Some of the currently existing 3D-urban-models are used in the Google Earth interface. At the beginning of VEPs, we did some test with Google Earth interface and 3D-visualisations. On of the restricitons we had to deal with, is that the buildings are not identifiable which means that a lot of interaction/information is not possible (such as GIS-requests, etc.). That was one of the reasons to decide to develop an own inerface for

the 3D participation tool we had in mind. Google SketchUp also offers a lot of possibilities to enable residents modelling their own buildings. On of the prototypes of VEPs (Master Planner, developed by University of the West of England) is dealing with some of those aspects and will offer a tool for online planning.

The fact of existing 3D-data as well as the missing use of 3D-models for participation have been key aspects for the development of OPPA 3D (Online Public Participation 3D) inside the VEPs project, which are presented below (see 2.2). The aim of the VEPs project is to fill this gap and provide a framework for creating internet-based public participation websites, combining 3D-urban and landscape models with Web 2.0 communication and discussion tools.

Using 3D data, public participation can become much more communicating and interesting: a lot of people still have difficulties to understand the content of planning proposals in 2D, even if they get all necessary information about the proposal. But using 3D to display the existing environment as well as the planning proposals will enable people really to understand the changes in the surrounding which might be caused by a distinguished development. The ability to move through the model interactively will allow the user to see all views of the design not only the preferred aspect of the planners/developers shown as a perspective rendering.

Another important issue for OPPA 3D was the linkage of spatial information to the commenting functionalities. The user will be allowed to set comments either in the commenting platform or directly in the 3D model. Statements of participants will become much clearer in their expression because they exist as visualisation and as written comment.

2.2 OPPA 3D – Online 3D Public Participation tool for Rosenstein area

2.2.1 The EU VEPs Project

The VEPs project aims to improve the knowledge base on the potential of Information and Communication Technologies (ICT) for territorial development in the North West European (NWE) region, specifically on the use of ICT for ePlanning, consultation and communication of citizens' views on planning issues.

The EU VEPs project is funded by InterReg IIIB and is an international project with participating members of UK, France and Germany. VEPs means Virtual Environmental Planning systems and develops a range of 3D visualisation tools used via internet to improve public consultation. VEPs will enable the user not only to download or view 2D-maps and images, but get a real impression of how the planning proposal will change the environment by having the opportunity to move around in the 3D model, to compare proposals and to comment on specific views.The integration of environmental simulations as noise and flooding should give citizens a better knowledge of the environmental impact of the proposed development. Simulations shall people help to view, comment on and understand the environmental issues associated to proposed planning developments, and help them to participate more fully in the planning process.

The state of the art in eParticipation is presently mostly limited on distributing static information to the citizens via the Internet, and sending and receiving (citizen's) comments online. VEPs aims to improve interactivity by trying to integrate interactive 3D-visualisation, to improve the understanding of planning decisions and consequences. Therefore, existing and already used tools, technologies and data shall be used (e.g. 3D city models, digital terrain models, etc.). VEPs will allow a two-way, resp. multi-way consultation process. The stage, at which citizens may view and respond to planned changes, can either be at the Master Plan stage or at a development proposal stage. If 3D-visualisation may (interactively) be used via internet, mutual understanding of planning contents may be improved by exploring what-if scenarios (cf. http://veps3d.org/site/54.asp).

VEPs, therefore, is a step towards an alternative approach to planning consultation. An interactive 3D-visualisation of planning contents allows the viewer to experience highly complex information without the need for training, because they can see the impacts of a planning development and visual as well as environmental consequences in an easily comprehensible format.

2.2.2 OPPA 3D (Online Public Participation 3D)

Stuttgart University of Applied Sciences is working on the 3D Public Participation Tool. This tool consists of a 3D-model, a participation platform and a 2D map, all communicating with each other. Ongoing from the

current prototype, further functions shall be implemented into OPPA 3D until the end of the project, such like comparing planning alternatives, requesting some kind of GIS data, gazetteer service, etc. The 3D public participation tool will be tested in further workshops to improve usability and functionality. For the testing, various user groups shall be addressed to use and rate the tool (professionals, semi-professionals, non-professionals).

Inside the VEPs project, different scenarios have been chosen by the partners. The Stuttgart scenario is the urban redevelopment of the Rosensteinviertel, an urban district located in the city center. In the event of a big urban development project (Stuttgart 21), new areas will be developed, new structures in the existing area will come into being and the transport system will be changed. The Rosenstein scenario was chosen to be the pilot project of VEPs. It was used to develop a common structure and guidelines of how to define user and system requirements.

OPPA 3D shall enable the residents to compare different planning scenarios and the related consequences and enable them to comment those scenarios – in text and map form. To explain difficult planning contents and the relation between different planning issues, as well as to demonstrate the consequences of the different planning alternatives, the illustration using 3D-models will ease the comprehension of the planning contents for all non-planners.

The 3D participation tool aims to improve access to information and public participation in the planning process by allowing anyone interested in planning issues to:

- View information about a planned development in 2D and 3D as part of a consultation process
- Improve their knowledge about the planned development by using 3D-views to help them understand the proposed designs and their environmental impacts
- Make comments on the development in either 2D or 3D
- Safe comments with spatial relation so the specific view to the comment can be seen by others

The participation model for VEPs to be used in this scenario consists of two parts: the scenario's website and the 3D participation tool. The website on one hand gives all necessary information concerning the district, the development plans, the existing data, etc. Also the functionality of the participation tool will be explained. On the other hand, there will be the linkage to the web-based 3D participation tool, consisting of a 3D-model with various visualisation features, a commenting and discussion platform and an optional 2D overview map. Beneath displaying and commenting/discussion functions, the 3D participation tool will offer a variety of optional functionalities which are described below.

The following functionalities of the 3D-viewer have been identified:

- dynamic flight through and turn-around features of 3D-model
- predefined flight-throughs, giving specific information about points of interests, the proposals back-ground, etc.
- predefined view-points in the 3D-model linked to the 2D-map
- display different planning alternatives as layers to allow users to compare proposals and consequences for the environment
- highlight buildings, select buildings to query specific data (GIS data like use, height, historical background, owner ship, etc.)
- set new comments in 3D-model, saving the specific view-point
- display existing comments in 3D-model
- display of environmental impacts, like noise simulation, changes of wind flows and fresh-air streams, flooding scenarios, etc.
- query any kind of GIS data, relevant for the planning area and planning content, e.g. land use, use of buildings, green and public spaces, environmental data (s.a.), height and density, property ownership, etc.
- use a gazetteer service (go to location, go to address, go to zip code)

- display additional data/information (e.g. parking lots, green spaces, public buildings, playgrounds, etc.)

The commenting tool enables all users (public as well as local authoritiy, planners, moderator, etc.) to set new comments, respond to existing comments, choose a topic or create a new one, view all existing topics and comments. The discussion forum is linked to the 3D-viewer and the 2D-map, navigation is possible in all three features. Most important is, to enable discourse oriented discussions – multi-way-communication, and to link the comments to the 3D-model, so that issues can be discussed and displayed in the same time.

The 2D-map will be an optional feature, basically used to give an overview about existing comments, the planning area, view-points, etc. Functions of the 2D-map are predefined view-points, which are linked to the 3D-model as well as displaying existing, spatial related comments, which are also linked to the 3D-model.

Main focus of OPPA 3D is the interaction between 3D-viewer and commenting tool as well as the discourse oriented communication. It allows interested users to query relevant planning data via a web-based system. By visualising the information in 3D, a lot of planning information and planning background can be conveyed in a realistic, clear and understandable manner. The communication platform, linked to the 3D-model, offers the possibility to link written comments to a visual display to explain more detailed the discussed issue. On one hand, the multi-way communication enables the user to view all listed topics and comments, to set new ones and to respond to already existing ones. Also, there is the possibility for every user to send comments or questions via email to a specific contact person. On the other hand, the moderator, resp. the contact person, has the possibility to answer to the comments in public (via the discussion platform) or private via email.

3 CITYMODEL ADMINISTRATION TOOLKIT (CAT3D)

In order to realize the major innovation, the integration of a rich 3D model that can be a part of the user interface, it is essential to have an efficient management of 3D geo-data on server side. It is recommended that the data is provided in different layers, which group objects thematically, so that the client can query the appropriate model for its specific needs. Typically, data for planning projects is provided by a variety of city administration departments, planners, architects or other institutions. All these parties have their own specialized software using different data formats. This implies, that the data for the different layers do not necessarily come from one data source. Therefore, the framework must be able to handle different data formats, database management systems (DBMS) and data schemas. It also has to have the capabilities to integrate this information into one database on the one hand, or if necessary, to merge the data “on-the-fly” to built an appropriate model on the other hand. It is also very important for the framework to support a set of output formats to support several platforms on which PP-Tools can be developed (e.g. GoogleEarth, VRML-Plug-Ins, etc.).

In the scope of VEPs, the CAT3D-framework is developed to handle the tasks defined above. The architecture is modular and can be easily extended. It is also possible to combine a subset of modules to solve specific tasks with a lightweight solution. The framework modules can be associated with one of the four groups: data connectors, data format creators, data mapping and utilities (fig.1).

The data connector modules are used to access different kind of data sources and to implement the “logic” of the data schema. For geo data, which is predominately handled by the framework, the use of database management systems (DBMS) with spatial extensions is quite common. These databases have an additional column type that stores the geometry of the object and is used to build a special index on which spatial search algorithms can be performed. All these additional capabilities can be encapsulated in the data connector, and the application developer neither have to know the detailed schema of the data nor the exact syntax of the involved queries.

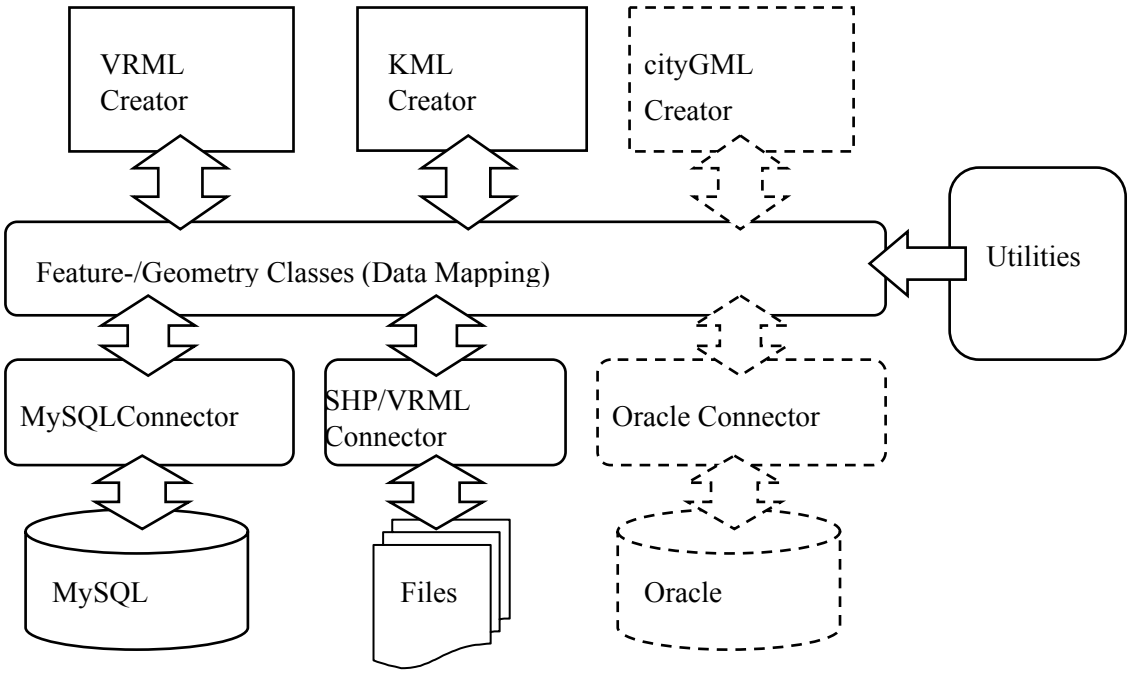

Figure 1: CAT3D architecture

Another advantage of hiding the data access in a module is that there is no direct connection to the data source, in that way the consistency of the data can be tested inside the connector before it is written to the database. In addition, with foreign key constraints within the database this is a very efficient way of avoiding corrupt datasets.

Data, that is read by the connector modules, is stored in memory to be processed by other components of the framework. In order to have a general format, which can be handled by all modules, the data mapping layer defines several classes to model features and geometries. These class definitions build a general structure for geo-spatial data that is used by all components in the framework. They also enable the exchange of modules due to special requirements and the extension of the framework with new components without interfering with existing parts of the framework. Utility modules can also process data that is stored in the data mapping layer. An example would be to read 2D building footprints and extrude them to build a LoD 1 (Level of Detail 1) block model. In addition, these building blocks can be intersected with the terrain model, so that they stand on the terrain surface. It is also possible to merge data from different sources in the mapping level in order to build a suitable model. For example, the terrain information can not only be used to give the buildings an elevation, it can also be integrated into the dataset, so that buildings and terrain surface build a 3D-model. All this processing is done in the mapping level, before the data is handed over to the appropriate format creator.

The format creators are modules to generate output formats. For the framework, it is quite important to support several external formats so that it can be used with many applications. Yet, for the online PP-Tools it is necessary too, to support different formats, because the front-ends can be implemented, using different technologies (e.g. X3D/VRML-Viewer, Google Earth, etc.). The format creator just provides the reverse transformation as the connector module. It translates the internal mapping format into the external format. In some cases, the external formats can be restricted compared to the internal, or features are modelled in a different way. These constraints and restrictions can be handled inside the format creator. And because of the mapping level between creator and connector, the modules for different formats can be exchanged quite easily and any combination of data connectors and format creators can be used to build a suitable dataset.

4 3D-MODEL TRANSMISSION

The CAT3D technology, described in the previous chapter, can access, manage and merge 3D data, but the data transmission and the interface for client requests is another part of the server side application that is built on top of this framework. Because we want to support different PP-Tool implementations and to be able to exchange client side modules, it is inevitable to use open standard interfaces and data exchange formats. As VEPs mainly handles geo-spatial objects, we also extended the definition of a textual comment by a

point-geometry, Open Geospatial Consortium (OGC) standards seem most appropriate. Besides an OGC Web Feature Service (WFS) for the transmission and management of comments, we decided to use the Web 3D Service (W3DS) interface to provide 3D city models over the internet. The W3DS is a discussion paper of the OGC and is currently in the standardization process. The interface is quite similar to the existing Web map Service (WMS) and the Web Terrain Service (WTS), though the type of the response is quite different. The W3DS returns a scene-graph, a tree-structured representation of a 3D scene. This structure cannot be displayed straight away; the client needs a viewer to render the information given in the scene graph. Supported formats, describing scene graphs, are the Virtual Reality Modelling Language (VRML), the Keyhole Mark-up Language (KML), X3D, and others. The VEPs implementation takes advantage of the CAT3D capabilities to access different data sources. A W3DS provides data in different layers, like CAD systems, to thematically group objects. By using a XML file, it is possible to link different data sources to specific 'W3DS layers', the connection to the data is realized by the different CAT3D connector modules. In that way the W3DS can provide different thematically organized object sets from different sources. This is extremely helpful when integrating the whole system into an existing geo-data infrastructure with distributed data stores. These distributed datasets are updated by the responsible department and it is impossible or not desired to transfer all the data to one central database. In that case, the W3DS, respectively the CAT3D framework has to build the 3D model on-the-fly.

5 CLIENT SIDE MODULE INTEGRATION

The PP-Tool client (OPPA 3D), as described in chapter 2.2.2, consists of a 3D viewer, a 2D map and a communication platform. All of these client side components are more or less individual applications, sharing one screen (fig 2). These applications are specialized in their field and provide a specific functionality that is useful and required in the PP-Tool. Yet, to show information about the same object or comment in all three modules, the applications have to be synchronized. In order to be flexible on client side in terms of exchanging modules, we mainly use standard interfaces (OGC) to communicate with the server, but there is also a need to have a flexible communication procedure among the client components.

The VEPs project team decided to implement a broadcast module that sends event messages to all registered listeners. This technique seemed to be more flexible and allows fast integration of existing components and applications. It also makes it unnecessary to update the broadcast module whenever new functionality is added to the system. In contrast to a fixed set of API methods that must be implemented by every module, the broadcast module only calls one function to transmit the event message. When integrating a new module, it only has to implement this single function and not a large set of functions. Instead, the 'API' on client side consists of a set of event messages. These messages can be analyzed by the receiver and the execution of the required action can be delegated to existing module methods. In that way the existing module interface does not have to be changed to fit the API, the message handling method is just put on top to read the message and trigger the appropriate action. Another advantage is, that not all other components have to be informed manually by a module with a separate function call. The module just passes the message to the broadcast that handles the message delivery to the involved components. This method is recommended when more and more modules are embedded into the system to provide additional functionality (e.g. web service front-ends), and more than the three basic modules are in use.

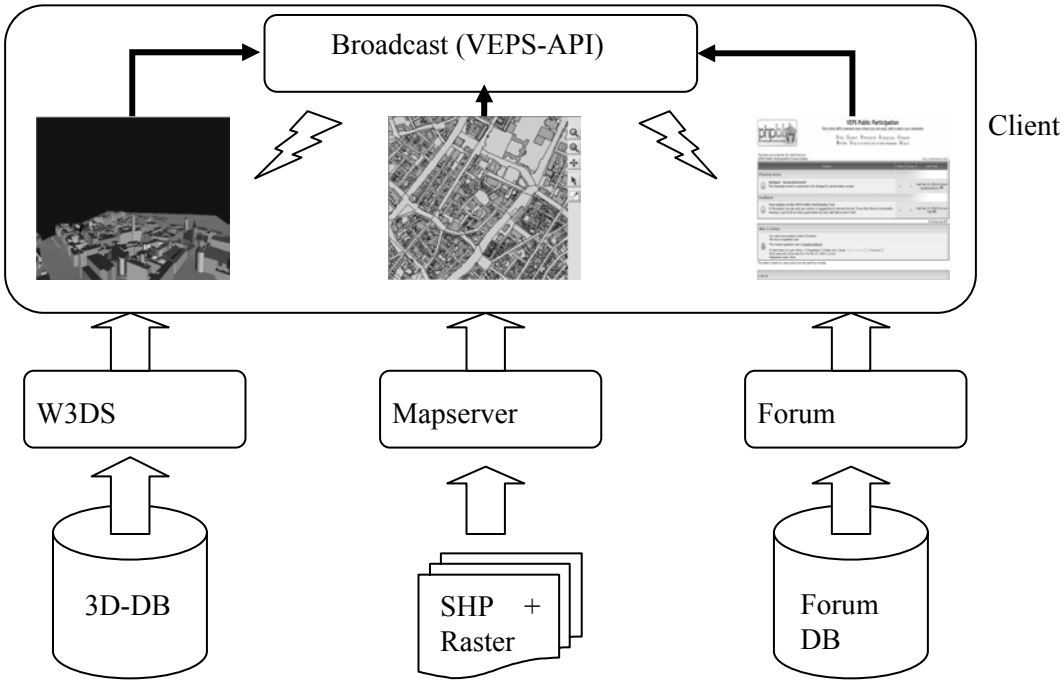

Figure 2: PP-Tool architecture

6 PROSPECTS

To evaluate the tools developed during the VEPs project, a new organisation joined the project team. Groundwork is a federation of Trusts in England, Wales and Northern Ireland, each working with their partners to improve the quality of the local environment, the lives of local people and the success of local businesses in areas in need of investment and support. Due to their work, Groundwork UK is very experienced in operating and evaluating all kind of public participation. For the evaluation of the VEPs tools, Groundwork will test them in a special scenario developing an evaluation concept to test the tools with different user groups (professionals, semi-professionals, public/non-professionals).

The statement of our paper, "improve public participation in planning processes by using web-based 3D-models for communication platforms", is an assumption and consciously has been chosen kind of provocative. As there are still not enough research studies considering this issue, the main aims of the evaluation are firstly to test, if people could think of using this tool as part of a participation process (executional office as well as the applying users), and if they think this tool helpful to improve the participation process. Secondly, we will gain some indicators wether 3D-visualisation really will improve the understanding of planning contents in public participation.

7 ACKNOWLEDGEMENT

The VEPs project is partially funded by European Regional Development Funding through INTERREG IIIB NWE Community initiative.

Special thanks to the City of Stuttgart for making available the 3D city model and very inspiring discussions as well as to the Stuttgart planning offices "OrPlan" and "Auer + Weber + Assoziierte" for the planning proposal data.

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