Spatial planning and electronic democracy: Technologies to support citizens' participation in spatial decision making – DeltaM DSS

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1 INTRODUCTION

In recent decades many attempts were made to employ modeling and computer technology to help understand the complexity of spatial problems. This resulted in the development of information systems and decision support systems (DSS), which range from very simple data collections to complicated assembles of various systems. Most of the time these are internally used applications with limited flexibility and accessibility for users other than their owners.

Recent trends towards democratization and decentralization of decision-making stimulated research in DSS aimed at citizens' participation in policy forming and decision-making. Those systems have an open character and are mostly, if not already then in the future, available via the Internet.

In discussing spatial decision-making in the Netherlands, we can say that frustration is growing in society with contemporary plans and the way planning and decision-making are organized . There is a need to find more flexible ways of planning than those that are centralist and deeply rooted in practice since the first Spatial Planning Act (from 1962). The need to plan the future, though, is in the nature of humans, however uncertain the plans may be, and they concern either private or social life. People simply need to have some 'frame of reference', which will give direction to their actions. In that sense, long-term plans are unavoidable and whatever character (rigid or flexible) they may take on, they will remain a permanent human activity. Nevertheless, between the incident and anarchy that characterizes market-driven spatial developments, and centralized governmental planning, a new solution has to be found which is flexible but has enough structure and foundation in society to be trusted.

PROBLEM DEFINITION

The aim of this research is to develop a tool that will enable designers, decision-makers and citizens to jointly shape the physical environments they inhabit, by interaction and communication through electronic networks. In the scope of this research, designing is no longer seen as the competence of an architectural or urban planning office which develops plans on the assignment of authorities or investors. The designing of physical environments has to move to the foundations – to integrate all interested societal actors, including citizens, into the planning process. In that sense we would extend the statement of Schön and Rein (1994) that 'design is a social process in which the action of design is distributed among multiple actors – designers, recipients of the designed object, and other stakeholders'. Contrary to Schön and Rein who further explain that once design is completed it is 'put into external context where gallery of public opinion may change its meaning', we plea for a design process in which this 'external context' is an actor in the planning process as well, and then on an equal level. We adopt the term 'designing system' which Schön and Rein define as 'a coalition of actors, individual or institutional'. However, instead of confronting the designing system with a 'larger environment' - in Schön's and Rein's opinion the larger environment consists of 'other' actors who see, interpret and react to the design - we consider the larger environment an inseparable part of the 'designing system'.

Although it is based on certain theoretical premises, the aim of this research is not to develop a new design or decision theory. This research is rather empirical, and directed to the practical development of a computational tool, which can be directly implemented in spatial planning practice and used by a 'designing system'. As the tool is meant to help people to come to decisions, it can be considered to be a decision support system (DSS). Because we have used the projects of graduate students of the "Deltametropolis" design studio to fill the database of the prototype of the DSS, it is named DeltaM.

The DeltaM system has two forms: the first, complete one is expressed in the conceptual model of the tool. The second, incomplete one is developed as an operational prototype.

DEVELOPMENT OF THE CONCEPTUAL MODEL OF DELTAM DSS

Development of the conceptual model of the DeltaM DSS started with a definition of requirements, and then the model was designed. Due to a lack of time, only a part of the conceptual model was developed as a prototype. The prototype was then tested and the whole model evaluated.

1.1 Definition of requirements

The first set of requirements was based on a critique of already existing decision support systems in the field of urban design and planning. Looking at the practice of the design of decision support systems, we could find a large number of examples of systems which are either too complex, too specialized, expert-oriented and therefore unsuitable for non-professionals, or systems that are too simple or too general, and therefore unreliable. "The result of poor design is a world filled with frustration, with objects that cannot be understood, with devices that lead to error," says Donald Norman (1999) in his book *The design of everyday things*. Therefore the first requirement for the system was to avoid making a frustrating system that is complicated, user-unfriendly, unreliable and ultimately useless.

The following generic requirements are set up for the system:

- DeltaM should help the user to select alternative solutions among many possibilities in an easy and fast way.
- DeltaM should be sensitive to the needs and responsibilities of a decision-maker and provide assistance based on his cognitive style and personal characteristics.
- The systems should support and enfold human decision-makers rather than replace or automate them.
- Transparency of the system is necessary to make it more trustable, and therefore the reasoning logic of the system has to be displayed to the user.
- As one of the functions of the system is to provide information, the data should be represented in a realistic way so that the history of events can be recorded and relationships between elements can be displayed to clarify the structure.

?? The design of user interfaces is extremely important in the development of DeltaM as most of the users associate the interface with the system itself.

?? The user interface should establish the common ground between the user and the computer, similar to those that people use in human-to-human conversation.

?? Integration of the models and necessary modeling technology is required for the proper functioning of the system.

The second set of requirements was driven from the theories of pluricentric decision-making (Teisman), neorepublican citizenship (van Gunsteren) and public sphere (Habermas), which form the theoretical framework of this research. The figure below shows the position of our research in relation to the theoretical framework.

As is shown in figure 1, the design of the system implied choices between extreme positions within several technical and social categories:

?? In the design process the system is not aimed at either actors or citizens, but at the 'designing system' which joins both of them;

?? in spatial decision making, between a unicentric and multicentric model of decision making, we choose a pluricentric one;

?? looking at the theories of citizenship, the system is designed for the neorepublican citizen;

?? considering the relationship between citizenship and politics, we have chosen the 'public sphere' and civil society, as a realm which occupies the space between the private and governmental ones;

?? looking at the ways in which cyberdemocracy could be realized, we have chosen a modified representative;

?? and finally this would all result in my own approach to spatial design: a combination of designing and deciding through the involvement of neorepublican citizens in a pluricentric network of independent actors who are – supported by information technology – able to jointly shape their environment.

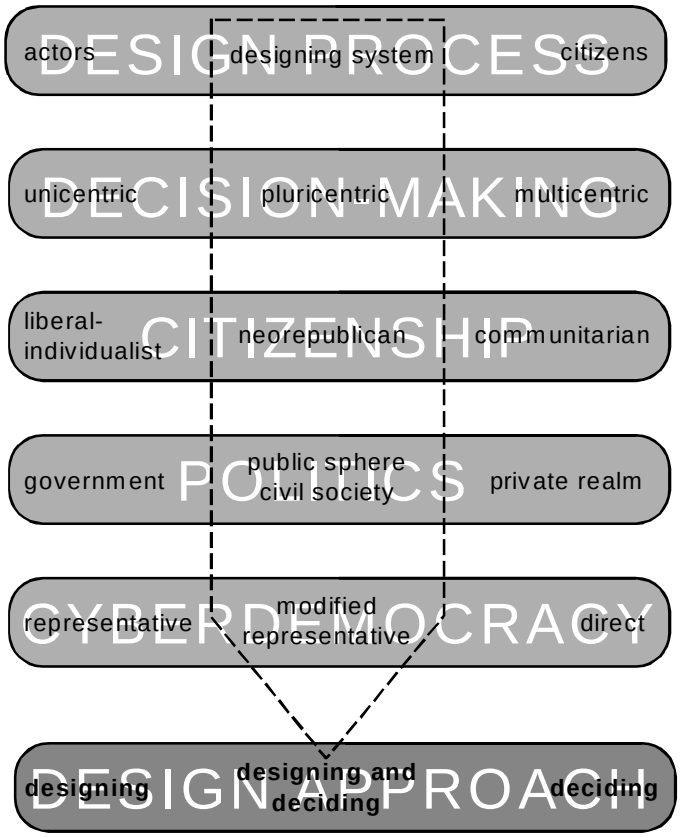

Figure 1. Theoretical framework of the system

The third part of the system requirements is formulated on the basis of the experiences gained through four case studies. The first case was the 'Masterplan Zuidas' in Amsterdam, originally planned to be the only one. Partly because of the difficulties in cooperation with the Projectbureau Zuidas, and partly because of the attractiveness and actuality of new cases that were appearing during the research period, we have extended the number of cases with three more. The most important one was the case of development of a new decision-making method by the foundation 'The Metropolitan Debate' (HMD). The other two, the 'Deltametropolis atelier' web site/database and the 'Open Plek- Niemandslad?' Internet discussion were directly related to the practical development of the prototype of our system.

1.2 The conceptual model of the DeltaM DSS

By definition DeltaM is a decision support system, which implies that it consists of a database, a knowledge base with modelling environment and the user interfaces. The aim of the system is to help users (in this case competent citizens) to deal with spatial information overload, to get an insight into alternative solutions, to develop criteria to compare alternatives, to choose solutions according to their preferences and to finally discuss and vote for the solutions in cooperation with their co-citizens. Figure 2

represents the conceptual model of the DeltaM system. The green line shows the path of the system's use: first the database has to be filled with perspectives, projects[1] and data about users. Then the knowledge base has to be established. When this is done, the processing of data can begin, in this case by employing an extra device – the matching system, which retrieves the information according to the user's preferences. As the result of this process a list of alternatives is offered to the user – a suggestion accompanied with information about the alternative solutions and the way they were selected. This is the first stage in the decision-making process – choice at the level of individual user.

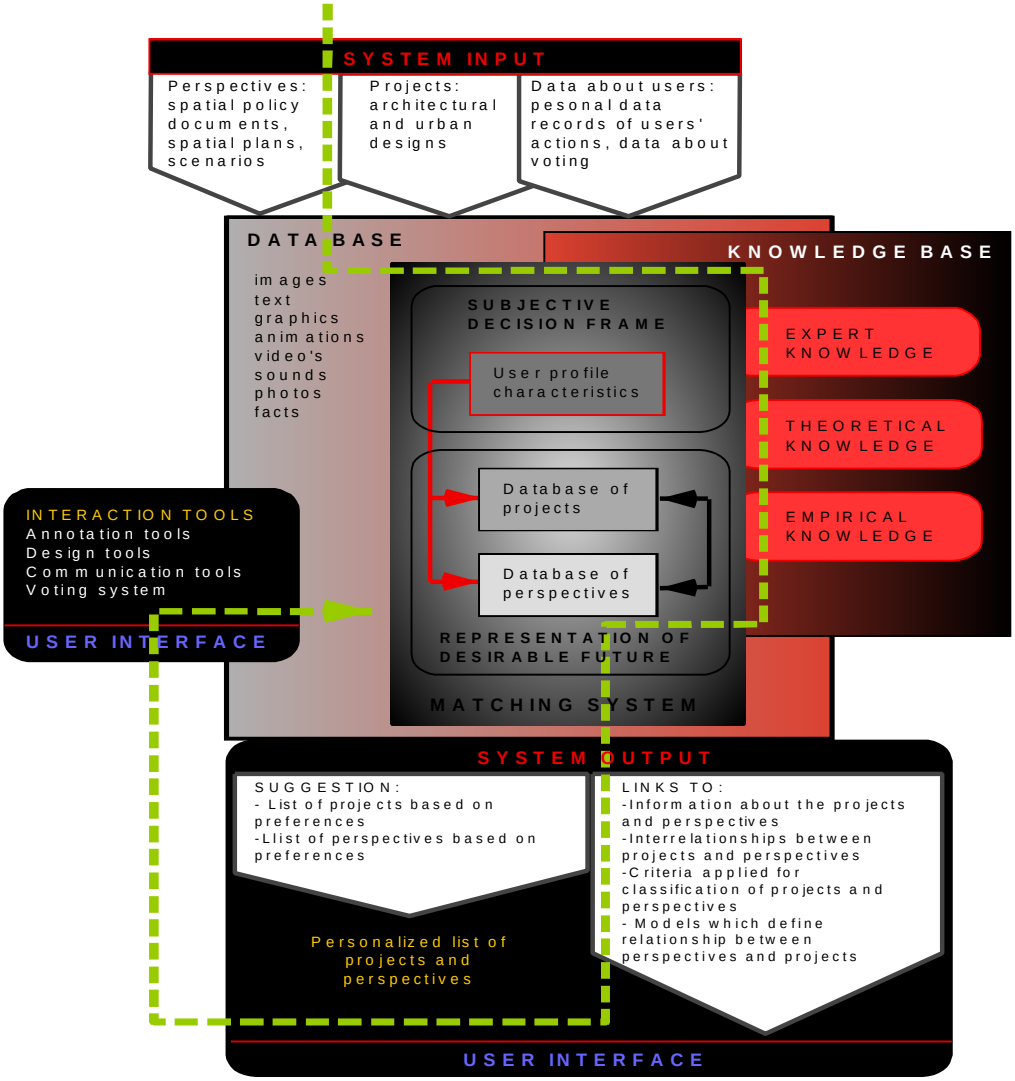

Figure 2. Conceptual model of the DeltaM system

In the second stage, the interaction tools enable direct communication between the participants in the decision-making process, access to the system's database so that users can add their comments or new solutions to the system. Finally, the voting system – a collective decision-making tool - completes the DeltaM system in the sense that it enables decision-making on the community level.

1.3 The Prototype DeltaM

After the conceptual model of the DeltaM system was designed and specified, we started developing the prototype. Because of a lack of time and resources, we have chosen to develop only a part of it. As we consider the matching system the most essential part of our DSS, which makes it different from many other systems, we decided to build this part as a prototype.

We found development of a working prototype extremely important for this research for several reasons. According to Adelman and Riedel (1997), the knowledge requirements needed to build such a system are by definition based on domain-specific knowledge which may exist only in the minds of experts. Prototyping is then a way to understand the problem, access the expert knowledge, and obtain feedback to validate the evolving knowledge requirements for the system.

[1] In this research we deal with the relationship between two kinds of spatial plans: perspectives and projects. Perspectives are descriptions of conceivable developments in the future, which represent desirable policy scenarios. As they are long-term and large-scale spatial plans it is most unlikely that they will ever be fully realized. Nevertheless, perspectives are very important as a recognizable frame of reference for the realization of smaller spatial plans, in this case called projects.
Projects are concrete spatial interventions that are defined in extent and time so that they can be executed by a principal. Projects concern architectural objects (houses, offices, schools, hospitals, factories etc), infrastructure objects (bridge, tunnel, road, railway), landscape objects (park, forest, nature area, tree line etc.) or water management objects (waterway, channel, dike, lake, pond etc.) or a combination of these.
As in reality the interaction between desirable future (perspectives) and concrete proposals (projects) leads to the transformation of space, we can consider the choice of perspective(s) in combination with projects as a way to deal with the future spatial development of a territory. In that sense, when a participant(s) in a decision-making session selects some perspective(s) and/or projects(s) it is considered a final decision.

In the case of DeltaM the operational prototype was developed for the purpose of practically demonstrating the function of the tool. In order to ensure the tool's operational stability it is built with technologies available on the market, although the theoretical model relies on other, more experimental technologies. The expectations were that even though it is so simple it will be enough for users to judge the value of the tool, and if so, the prototyping process will continue until the tool is fully set up in the way the conceptual model proposes.

The prototype DeltaM consists of four modules: database of projects, matching system, user interface and the back office with the database of projects. The matching system enables indirect communication between project maker (planning organisation) and project observer (decision-maker). Figure 3 shows the connections between the modules and the parties responsible for the parts of the system.

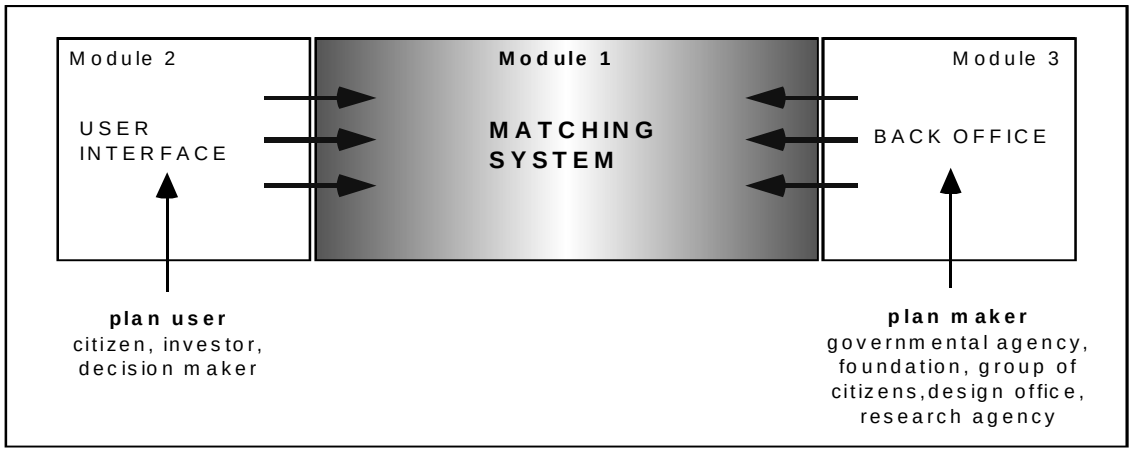

Figure 3. DeltaM prototype. The system enables interaction between plan maker and plan user. Plan maker operates the back office of the system, while the user operates the system via the user interface. The DeltaM system matches preferences of a user with information about the plans stored by a plan maker in the database of the back office.

1.3.1 Database of projects

In the case of the prototype, for simplicity, we decided to fill the database only with projects. We used the graduate projects of the students of the 'Deltametropolis' studio, one of several graduate students' studios of the Faculty of Architecture in Delft. The studio is named after the area in the Netherlands, formerly called Randstad and actually renamed because of the new concept for its development which the leaders of the studio propose.

The Deltametropolis is the area between the coast of the North Sea, North Sea channel, Nieuwe Waterweg/Oude Maas, and the 'Nieuwe Hollandse Waterline' (Figure 4).

Deltametropolis has about 6.4 million inhabitants and 2.7 million jobs. The inhabitants of the Deltametropolis constitute about 2.5 million households, while jobs are within 250.000 businesses and institutions. Inhabitants and businesses are also joined around hundreds of organizations that represent their goals and intentions. Land in the Deltametropolis belongs to the millions of small and thousands of big owners. The authorities of the Deltametropolis include about a hundred municipalities, tens of water management organizations and five water management boards. Within this metropolis, about 20 billion guilders per year are invested in spatial development projects, usually for thousands of projects.

We used this territory and the projects made by students of the Deltametropolis design studio as a test case for the development of the prototype of the DeltaM DSS.

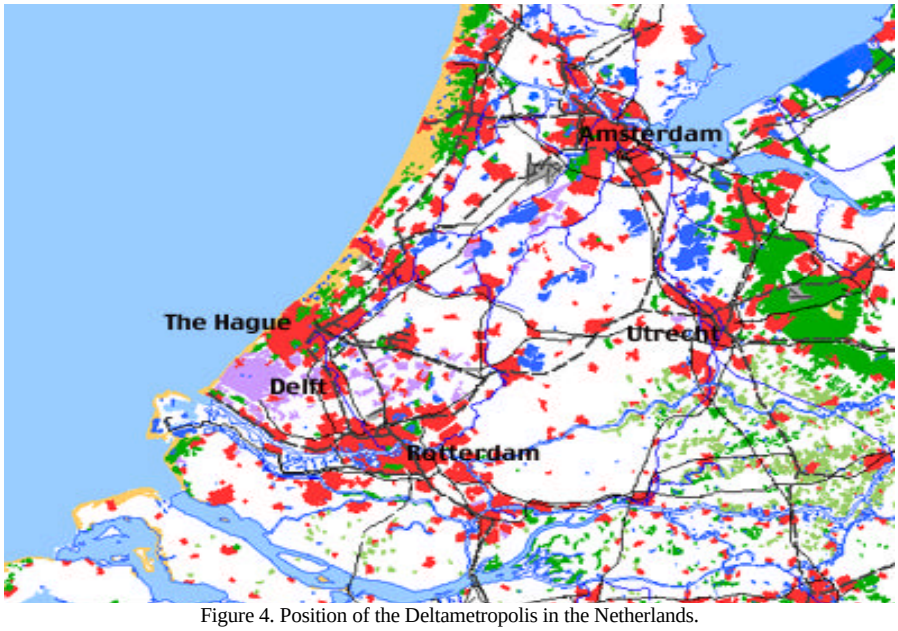

Figure 4. Position of the Deltametropolis in the Netherlands.

Deltametropolis is an excellent example to show how DSS can help deal with an enormous amount of projects because it is a metaphor of spatial planning in Netherlands as:

?? hundreds of spatial projects and plans are made per year

?? they overlap in place, time and scope

?? they are incomparable to a decision-maker because:
  ?? they are not compared to the existing situation, some kind of 'reality' map
  ?? their contents are not uniform
  ?? requirements for a minimum of quantitative indicators do not exist
  ?? there are no conventions about graphical presentation (like common legend;
  ?? fixed colors, or symbols)

In this situation it is very hard to imagine that a decision-maker will be able to collect the proper information and make a comparison between alternatives, making choices in a short period of time. Yet, as there are more plans than financial resources to realize them, the choices have to be made. The prototype DeltaM has the task of helping participants in the decision-making process, the 'designing system' which joins actors and citizens, to make a selection of projects which they would like to carry out in reality.

1.3.2 Back office

The back office is an application program which is under the control of an operator who can set it up for the purpose of a decision-making process. The operator can be any initiator of a decision-making process. Controlling the back office of the DeltaM system means that the operator selects the database input, defines the questions that will be put to users, and the criteria for the classification of projects.

1.3.3 Matching system: How the prototype works?

By entering the DeltaM web site http://www.bk.tudelft.nl/ai/deltametropool/DeltaM.htm the user is asked whether he/she would like to use the system or not. If the answer is no, he/she is connected to the database of projects where he/she can browse as he/she chooses. If the answer is yes, the system starts by asking a set of 7 questions (see table 1).

1. Our system has information about 8 topics. Four are about the space, and other four about activities and use of time. Click on the topics that interest you the most.
?? Urban spaces
?? Landscape and greenery
?? Water
?? Connections
2. Which activities are interesting for you?
?? Care: sleeping, eating, cleaning, washing, health
?? Work: earning money, creating, helping
?? Learning: educating, culture
?? Sport, play, recreation
3. Which kind of cities do you prefer?
?? I like big cities.
?? I like towns.
?? I like villages.
?? I like rural areas and landscape.
4. How important is greenery for you?
?? I like to have it in my direct surrounding
?? I like to have it in the neighborhood
?? Greenery is not too important to me.
?? Greenery is not at all important to me.
5. Are you interested in having water (like channels, ponds, moats, fountains or recreational water) in your surroundings?
?? I like to have water in my direct surrounding.
?? I like to have water nearby.
?? Water is not too important to me.
?? Water is not at all important to me.
6. Please choose the values that are the most important to you.
?? Economic efficiency
?? Ecological sustainability
?? Cultural diversity
?? Social equality
7. How important is accessibility to you?
?? Good accessibility by car is important.
?? Accessibility by public transport is important.
?? Not important, I prefer quiet surroundings.

Table 1. Questions and options which are used to determine users' preferences

When the last question is answered it takes about one minute and then the result is displayed: a list of projects from the database that best correspond with the preferences of the user.

From the list there are two links: the red one is to the 'back office' of the system showing the scores of the project and the yellow one is to information about the project. The scores actually show how one project scores according the criteria that are used for the ranking of projects. They are displayed to the user in order to make the system transparent. The other, much more important link is to information about the project. All the projects in the DeltaM system are presented in a uniform way, following the approach that we developed for this case.

Figure 5. The screen with the end result DeltaM: the list of projects with links to information about projects and scores of projects in the back office

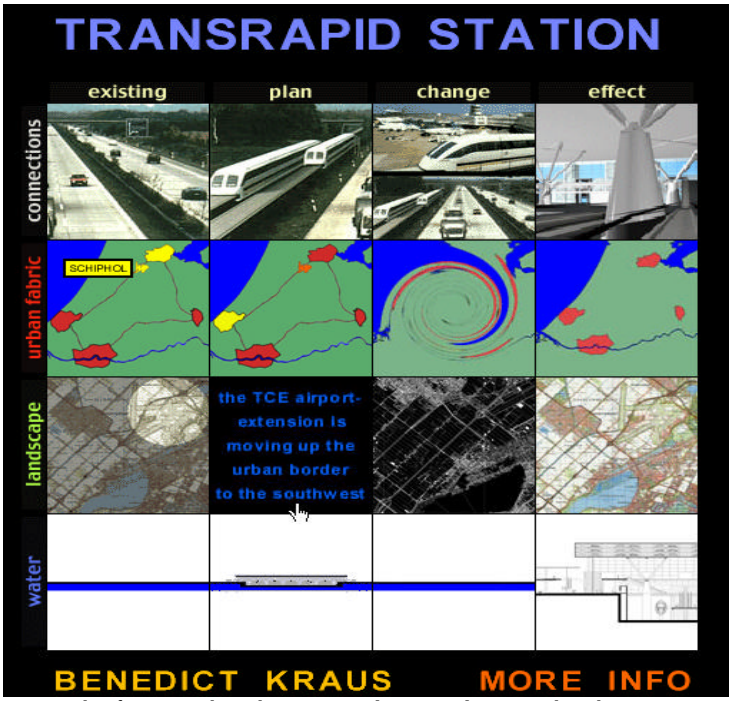

Figure 6. Matrix with information about the project: Deltametropolis approach to the presentation of projects

1.3.4 User interfaces: Information about projects

The example of information on the project 'Transrapid station' is shown in Figure 6. The design of this interface was influenced by findings from the case study of the Masterplan Zuidas. Although designers believe that visualization of urban plans in the form of maps, plans, 2D or 3D drawings, computer animation etc. has a big advantage over textual presentation, our survey showed that both kinds of information are equally important to citizens. We have therefore chosen to use both kinds of presentations for the DeltaM system's information interface , giving just slight priority to visual information.

Bearing in mind the findings about information overload and that the average time a visitor spends on a web-site is not longer than a few minutes, we decided to rank the information **hierarchically**, going from shorter and illustrative to longer and descriptive. The user is initially shown a matrix with sixteen small images, the title of the project, the name of the author and the 'more info' link. Behind each of the sixteen images, just by dragging the mouse over them, a very short text appears. Behind the title of the project is a new window with a short summary about that project. By clicking on a small image, a bigger image and more text about the same issue appear, opening the next page in the browser. For those who want to know about the project in full detail, the link 'more info' leads to the complete text about the project. The link behind the author's name is to his/her home page, and it is meant to offer even more information about the project and the authors' other works.

In the design of the information interface we used the principle of **ordering of information** in the same way for all the projects. On the one hand this is done to ensure that each project will tackle the same spatial problems. On the other hand, this is also a way to make projects comparable.

In the case of DeltaM, as it is set up now, we based the ordering of the information on the approach of the 'Deltametropolis' design studio. Within the studio we started from the proposition that the Deltametropolis area is a synergy between four systems: urban, connections, landscape, and water. This approach to understanding space was followed in the design of the matrix for the presentation of information about the projects. The rows in the matrix describe the four systems - connections, urban, landscape and water. The columns carry information about the time dimension and the consequences of the proposed spatial interventions: existing – shows the existing situation in this place and in this system at the moment the intervention occurs; plan - what the project is proposing for the future; change - what is going to change by this intervention; and effect - what the effect will be of the proposed change on that system.

The design of the user interface for information about projects is not built on traditional knowledge about the usability of web sites. The reason was that we believe that the attractiveness of a web site can stimulate citizens' participation in decision-making. Making a web site that is not stereotypical, we believe, can attract the attention of citizens and stimulate not only their interest in the information, but also their will to participate in the decision-making processes.

EVALUATION OF THE DELTAM PROTOTYPE

The prototype of DeltaM is at the moment the subject of a four-level evaluation, specially developed for this case:

At the first level, DeltaM successfully passed the technical evaluation which assumed validity, reliability, effectiveness, efficiency and robustness testing.

At the second level, the system's usability is to be tested by exploring its general ease of use, consistency, attractiveness, control, efficiency, and learnability.

The third level of evaluation gives an insight into process quality, product quality and overall confidence in the system. These two evaluations are currently ongoing. About 500 people were invited to evaluate DeltaM via its web site http://www.bk.tudelft.nl/ai/deltametropool/DeltaM.htm. The response is very low, though, which is delaying the completion of the research.

At the fourth level, the effectiveness of the social program of the conceptual model of the DeltaM tool will be evaluated by experts' judgement. The questions of whether DeltaM could become a valuable tool for the improvement of citizens' information, citizens' participation in the designing and deciding process, insight for authorities into public opinion, interaction between the actors in decision-making, and democratization of spatial decision-making, will be considered. This most important part of the evaluation should answer the main question of this research: whether the DeltaM tool has the potential to improve and reinforce the involvement of citizens in spatial decision-making in the Netherlands.

CONCLUSIONS

Through this research we are trying to find ways to improve the quality of decision-making in the Netherlands. We consider a formation of a 'designing system' which involves both actors and citizens in the decision-making process to be a possible solution. The function of 'designing system' can be, in our opinion, reinforced by the employment of spatial decision support systems. Therefore we developed a prototype of a spatial DSS called DeltaM.

Although we have not yet completed the evaluation of the first prototype of the DeltaM system, the first tests of the technical quality of the system are excellent. The preliminary results of usability testing and system content appreciation show that for most of the people interviewed it has potential as a really applicable tool. But it is still too early to report the final findings of the evaluation and therefore we can only speculate about the future of these kinds of systems and their value for really becoming imbedded in society and political decision-making procedures.

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