The MapTable[36], an interactive instrument for spatial planning design processes

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SUMMARY

The MapTable being a digital design table that is used as an instrument in spatial planning processes. It is used in a collaborative participatory process in which stakeholders are brought together discussing a new spatial design. The MapTable's main purpose is to give insight in the spatial relationships in a certain area by making efficiently use of the knowledge of the participants. This combined with the use of a large spatial database and linked process models will result in a time saving, efficient and effective design process.

This paper presents the design of the MapTable and the results of the case carried out for the Dutch ministry of transport, public works & water Management. In this case the participants had to make a design with measures for the river to accomplish a water level drop in the river of at least 10 cm. In this experiment all the participants were very enthusiastic working with the MapTable and expressed that it would be a great contribution in the process to improve quality in reaching the objectives.

KEYWORDS: *Spatial planning, Interactive design, GIS, Process modeling, Participatory processes, Planning Support System, Hydrology*

INTRODUCTION

In spatial planning processes more and more different actors collaborate in an interactive design process for an area. For sustainable spatial planning, multi functional land use and an increased involvement of civilians a number of interests of stakeholders must be weighted. For this purpose an instrument called 'the digital design table' (MapTable) is a planning support system developed to facilitate the interactive design of spatial plans.

In this paper the design of the MapTable is presented together with the results of a case carried out for the Dutch ministry of Transport, Public Works & Water Management.

Spatial planning process

Modern spatial planning often is organized as an interactive decision making process involving all stakeholders concerned (Mansfeld, 2003). An important driver for this development is the wish to accomplish a spatial planning that is broadly supported by the affected stakeholders. To realize such a planning it is important that participating stakeholders are seriously involved in the planning processes (Arnstein, 1969). In other words: in an interactive spatial planning process, stakeholders are considered actors in the planning process, having a role and certain tasks to fulfill. Interactive planning fits into a

[36] The MapTable is a joint effort of Dutch Ministry of Transport, Public Works & Water Management (RWS), Alterra, Meander & VorTech

development that seeks to replace more traditional sector based spatial planning with an integrated, multi-sectoral one. Increasing pressure on, mainly, rural land use caused by a multitude of demands, claimed by multiple actors necessitates such an approach. Interactive planning is generally focused on regional scales, with boundaries defined by, for example, a common cultural-historical identity, geomorphology, a comparable language etc. (Mansfeld, 2003).

Planning support systems

In spatial planning practice at the end of the 20the century use of geo-information tools are far from widespread and far from being effectively integrated into the planning process (Stillwell, 1999). Geo-information tools are seldom used for those tasks unique to planning, such as visioning, storytelling, forecasting, analysis, sketching and evaluation (Couclelis 2003, Klosterman 1997). Recently, a new generation of geo-information tools entered the scene, focusing directly on support of spatial planning tasks, the so-called planning support systems (PSS) (Vonk, 2005). PSS bring together the functionalities of geographic information systems (GIS), models, and visualization, to gather, structure, analyze, and communicate information in planning. PSS can be considered a subset of geo-information-based instruments that incorporate a suite of components (theories, data, information, knowledge, methods, tools, etc) that collectively support all of, or some part of, a unique planning task (Geertman, 2003).

The Centre for Geo-Information from Wageningen-UR has been developing tools for participatory processes to carry out experiments to prove its effectiveness. Since 2004 the MapTable is developed with the notion that digital available geo-information (the maps) in combination with a sketch tool can accelerate the process of designing spatial plans.

In practice there is a multitude of bottlenecks blocking widespread usage and acceptance of PSS in spatial planning practice (Vonk, 2005); According to Vonk these can be summarized into three main categories. First, the PSS experts questioned see little awareness amongst planners of the existence and use of PSS. Second, they feel there is a lack of experience with PSS, which means that potential users are unaware of the benefits of using PSS and of the conditions under which PSS could best be applied. Third, they feel there is a low intention to start using PSS among possible users. In order to break these barriers you need planners willing start and persevere in using PSS in practice. In 2005 planners of Rijkswaterstaat contacted Wageningen-UR to improve the MapTable and by adding computer process models to integrate sketching and simulating (spatial analysis) in one single environment. Because this PSS would fit in an ongoing process (PKB ‘ruimte voor de rivier’) and a strong belief in the benefits of this PSS with the planners of Rijkswaterstaat the prototype was successful in the case study.

Usability elements

A critical success factor for the MapTable presented here is Human Computer Interaction (HCI). One basic goal of HCI is to improve interaction between user and computers, by making computers more user-friendly and easier to use. Some more explicit goals can be summarized as ‘to develop or improve the safety, utility, effectiveness, efficiency and usability of systems that include computers’ (Diaper, 1989). In this context the term ‘system’ refers not just to the hardware and software but to the entire environment

that is affected by the computer technology. Usability as key concept in HCI is concerned with making system easy to learn and easy to use. The MapTable design is based on the notion of these usability aspects explained in the next section.

A number of possible definitions of usability are available in the literature. For example, one official definition of usability is given by the ISO 9241-11 standard on Display Screen (VDU) Regulations, Use of Ergonomics for Procurement and Design (ISO, 2002). In this definition, system usability comprises 'the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency, and satisfaction in a specified context of use'.

Usability elements outline the features and characteristics of the product that influence the learnability, effectiveness, efficiency and satisfaction with which users can achieve specified goals in a particular environment. The context of use determines the types of users, tasks, equipment, and the physical and social environments in which a product is used. Therefore, a system consists of users (i.e. the people who interact with the products), equipment (hardware, software and materials), tasks (activities required to achieve a goal) and a physical and social environment, for the purpose of achieving particular goals (Wachowicz, 2005).

Linking to practice

In the development of the MapTable we focused on usability elements of the PSS. We used these elements in designing the interface of the MapTable. The design should address effectiveness, efficiency and satisfaction properly. This PSS is applied in a case study of Rijkswaterstaat (RWS, the Dutch Ministry of Transport, Public Works & Water Management) in the program 'Space for Rivers'. Aim is to enlarge the discharge capacity of the river by taking a variety of measures in order to lower the water level of the River. Possible measures are discussed around the MapTable and directly (digitally) drawn on the map. By calculating the effects of these measures by use of a hydraulic model feed back is given to the participants if the goals are reached. If this is not the case, the design can be adjusted directly and recalculated to be evaluated again. In evaluating the case with the participants of the workshop special attention is paid to the elements of usability in a qualitative way.

THE MAPTABLE

The MapTable is described by its three parts, the hardware, the software and the process. The three parts form a kind of a framework which can be customized and extended when the MapTable is used in a different setting, a different process, and with different stakeholders. The MapTable as is described does not contain any data. But having a standard GIS software package on board it is able to handle all kind of datasets (local or distributed) considered to be relevant for the purpose. This architecture makes the MapTable as a PSS a flexible and powerful tool in spatial planning processes.

The Hardware

The MapTable is a large computer screen embedded in a table. The screen is made interactive to be able to operate the computer by means of a pen (stylus) touching the surface of the MapTable. On the screen maps are shown as layers which can be switched on and off. It is possible to draw on top of these layers using the stylus. All information is stored in the underlying spatial database and can be queried directly afterwards.

The MapTable consists out of:

A horizontal display. We developed two prototypes with different displays

- Projection with the help of a beamer mounted under the table projecting on the bottom of a transparent table surface (figure 1)
- A large LCD screen as a computer display mounted on a supporting leg of a drawing table (figure 2)

An interactive device. We used a Mimio for this purpose. This is a device that is developed to make a whiteboard or flip over interactive (figure 3). By means of a pen (stylus) the position on the screen is determined by infrared and ultrasonic signals. By mounting the Mimio on the surface of the table the surface is changed into a touch screen.

A standard Personal Computer.

Figure 1: MapTable with beamer projection

Figure 2: MapTable with LCD screen

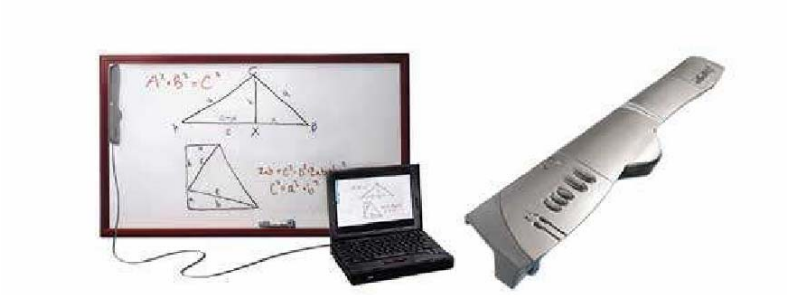

Figure 3: Mimio interactive device

The Software

The software developed for the MapTable consists out of four parts:

A user interface or panel for interaction between the participants and the application. The interface is especially designed for use on the MapTable. Since the participants can stand on all sides of the table the interface can be dragged to each side of the table. We call this the Woosh panel, and all controls are rotated for optimal use at each site of the table (figure 4). The number of controls is as little as possible dedicated to the tasks to be performed in the process. If forms or input windows are necessary for user input these are also rotated to be positioned in an easy way for the active user.

Standard GIS software for common used navigation tools like zooming panning and so on. For the MapTable we used ESRI ArcGIS 9.1 of which almost all of its controls are hidden except those necessary for this particular process. Of course other functionalities can be linked as well to the Woosh tailor the it for other applications.

A GIS module for editing and storing geographic input from the participants. The GIS contains all geographic visualizing capabilities necessary. Specific automated tasks are programmed within ArcGIS, embedded and linked to the controls on the Woosh panel. The tasks are designed to perform dedicated edits for drawing the measures to be taken in the project area. Other controls take care of the management of possible scenarios, carry out specific queries on the maps, control of the calculating model(s) and there is a set of standard map navigation tools.

A Model module. In this module the effects of all measures drawn on the map are calculated and fed back to the participants. For this case we used a hydrologic model Waqua and the spatial schematization tool Baseline. Time to complete the calculations for one scenario in this case is approx. 10 minutes.

Figure 4: The Woosh panel with all controls

The Process

A typical set up for a session will be as follows. Of all stakeholder groups representatives are invited to participate in the process. Approximately 10 to 15 people will attend. A session will last a full day. As a start the participants will get acquainted with each other but also with the area of interest. Standing around the MapTable with the relevant map layers switched on the participants will share their knowledge of the area by pointing out locations on the map and telling their story. It is also possible to make notes on the map and store them as separate graphics. This also allows the participants to get familiar with the MapTable's interactive interface.

Together with the participants a clear goal for the session is set, to be achieved by the end of the day. During the second phase a first sketch is made. Drawing map features during the discussion directly on the map will result in a first design. Participants will use the pen alternately to sketch their own ideas on the map and discuss the effects of the measures proposed. After an agreement has been reached on a common design the measures drawn on the map will be processed by the linked model (s) to calculate the effects. These effects will be returned to the MapTable and presented to the participants.

This will be evaluated and the design can be modified according to gained new insights in a cyclic process of drawing and calculating.

During the third stage the design is evaluated against the goals set for this session. If the result is satisfactory, this can lead to a first acceptance of the design supported by all stakeholders. If the result is not accepted by the stakeholders a new attempt can be made or the design criteria can be rephrased to be used as a starting point for a new design.

Since everything is stored digitally the session ends by handing out the printed report with the session results of that day to all the participants.

THE CASE

The area chosen is the holm 'Keizers en Stobbenwaarden'. This is an area on the right side of the river the IJssel just between kilometers 948 and 952 which is North of Deventer. The soil is mostly sand partly covered with a deck of clay. It is an area with agriculture, a former stone factory with an occupied dwelling house, and nature areas. In the south eastern part archeological values are present (figure 5).

The area will have nature as a first priority for future development. Besides this also recreation and agriculture is foreseen. The land is owned fore the most of the centre part by the 'Stichting IJssellandschap', the southern part by the city of Deventer and the northern part by SBB (the National Forest Service).

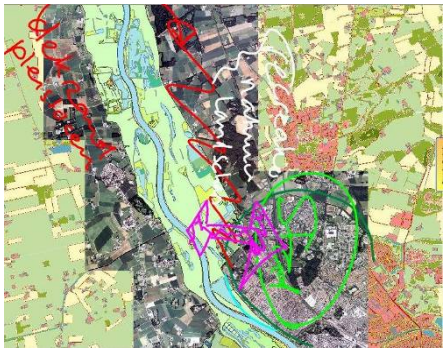

Figure 5: The project area with some annotations made by the participants

The Set Up

The participants are representatives of the 'Stichting IJssellandschap', the city of Deventer, and SBB (the National Forest Service). Also present are RWS (the Dutch Ministry of Transport, Public Works & Water Management), HSRO Landscape architects and the province of Overijssel. The process is facilitated by RWS and technically by the developers oft the MapTable.

The central question for the session was formulated as follows:
'Make a sketch of measures for the river to fulfill a water level drop in the river of at least 10 cm under the restriction that also improvement of the spatial quality is realized. This should be according to the established regional policy on this matter. Measures are

supplementary riverbeds, (re)placing dikes, changing surface heights and changing land use'.

The Workshop

About 15 participants (including the developers) were present in the workshop. Two MapTables were used. The session lasted all day. After a common exploration of the area two groups were formed to develop a scenario and a design that fulfill the central question. One group should favor nature aspects and the other group should favor river management aspects (figure 6 & 7). Due to some technical constraints the groups designed their scenario only in one cycle.

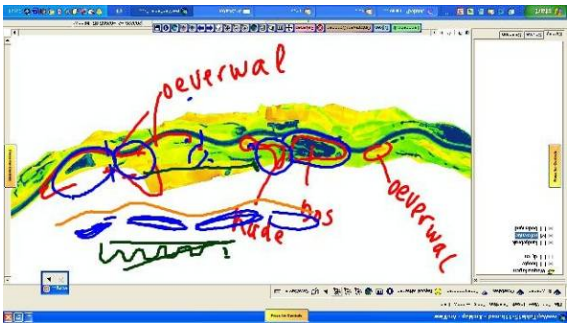

Figure 6: First sketch of the 'river' group

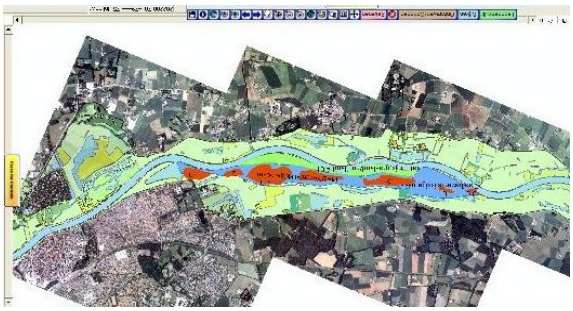

Figure 7: Design with the features drawn in

The Results

After calculating the effects of the measurements neither one of the groups fulfilled the central goal lowering the river water level by 10 cm after one cycle. The most successful was the 'river group' by reaching a decrease in level of about 8 cm (figure 8). In the discussion, in which the results were evaluated the outcome of the calculations could well be reasoned and also ideas for changing in the design in the next cycle were indicated. Because of technical constraints only one cycle is carried out in the workshop.

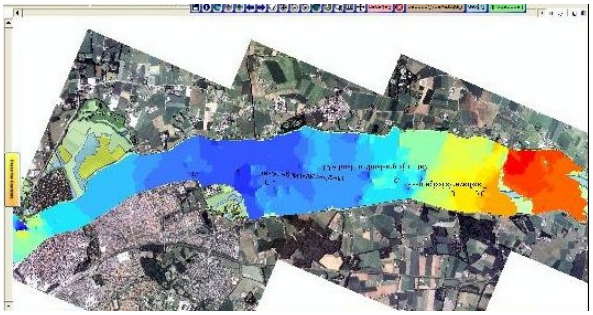

Figure 8: Results after calculations

The participants evaluated the use of the instrument and judged it on three different aspects:

value in a interactive participatory process
- Very suitable in brainstorming
- Quick and easy to present ideas
- Empowers collaboration
- Also useful for visualization and (public) information

ease of use
- Drawing could be improved, it is still not intuitive
- Have to get used to the interactive device (pen/stylus)
- Designing is equally possible for all participants

impact for the design process
- can put information from many sources together
- technique is slowing down the design process
- designing is relatively coarse
- technical (digital) constraints hamper the creative design process
- time benefit by direct calculations enormous
- time efficiency improved a lot by storing all measures directly in the database
- easy way to focus on possible bottlenecks

DISCUSSION & CONCLUSIONS

Many suggestions are brought up to improve the MapTable. The most important one was to improve drawing. Drawing should be more intuitive and comparable with for example a felt-tip pen. Another one was to implement more analysis tools to be used during the design process and means to add comments to the map and store them along with the map features digitally. For this case it was also mentioned that extending the number of types of measures to be taken would improve the flexibility of the PSS. Suggested was to develop different editions of the MapTable. For example: one edition for experts and specialists and another edition for layman. An improvement would be to include more intelligence based on combining information from different layers, like if a soil type is this then a measure like that may not be used. Some recommendation concerned also the use of this instrument in different processes. Like (public) informing, consistency checks, different calculations, etc. Also combining multiple models; for example adding a cost module to calculate project costs and so on.

During the evaluation it was clear that this instrument offers a lot of benefits. Despite the technical constraints of the prototype all the participants were very enthusiastic working with it. Participants who were still hesitant to use the pen and draw on the table in the morning did overcome their fear and used it later on in the workshop easily. Also it was clear that the MapTable is valuable for specific tasks as in this case. The results indicated that the MapTable could be used in an operational way by Rijkswaterstaat in other projects areas.

BIBLIOGRAPHY

Arnstein, S. R. (1969). A ladder of citizens participation, AIP Journal: 216-224.

Beyer D., Brink, N.G.M van den, en M.M. Scholten, (2004), Onderbouwing hydraulische randvoorwaarden HR2001, Concept mei 2004, RWS-RIZA.

Brink ir N.G.M van den, (2005), Hydraulische effectbepaling in Keizers en Stobbenwaarden, voorontwerp, RWS-RIZA.

Carjens, J. G., R. Lammeren van , et al. (2003). STEPP: A strategic Tool for Integrating Environmental Aspects into Planning Procedures. Planning Support Systems in Practice. S. Geertman and J. Stillwell. Berlin, Springer [etc.]: 139-154.

Couclelis H, (2003), Where has the future gone? Rethinking the role of integrated land use models in spatial planning, in Framing Land Use Dynamics: Reviewed Abstracts International Conference, 16 - 18 April 2003 Faculty of Geographical Sciences, Utrecht University, Utrecht: 27 - 28

Diaper, Dan (1989) The Discipline of HCI. 3-5 Interacting with Computers: The Interdisciplinary Journal of Human-Computer Interaction. 1: 3

Duijn, M., L. H. Immers, et al. (2003). Gaming Approach Route 26: a combination of computer simulation, design tools and social interaction. Journal of Artificial Societies and Social Simulation (JASS) 6(3).

Geertman S, Stillwell J (Eds), (2003) Planning Support Systems in Practice (Springer, Berlin)

Hilverink, M. and P. Rietveld (1999). LAND USE SCANNER: An integrated GIS based model for long term projections of land use in urban and rural areas. Journal of Geographical Systems 1: 155-177.

ISO (2002) ISO 9241-11. Retrieved 27 March, 2002, from The South African Human Computer Interaction Special Interest Group Web Site website: http://www.chisa.org.za/usability.htm

Jankowski, P., T. L. Nyerges, et al. (1997). Spatial group choice: a SDSS tool for collaborative spatial decisionmaking, Int, J. Geographical Information Science 11(6): 577-602.

Klosterman R, (1997), Planning support systems: a new perspective on computer-aided planning, Journal of Planning Education and Research 17 45 - 54

Ligtenberg, (Arend), Jandirk Bulens, Michel Uiterwijk, Rob Knapen, (2005), MapTable, Tekenen en Rekenen in de Rivier, Alterra, Wageningen.

Mansfeld, M. J. M. (2003). Interactive planning as a way to sustainable land use: A case study from the Netherlands. Conserving biodiversity in agricultural landscapes. R. K. Swihart and J. E. Moore. West Lafayette, Indianna, USA, Purdue University Press.Mansfeld, M. v., A. Wintjes, et al. (2003). Regiodialoog: naar een systeeminnovatie in de praktijk. Wageningen, Alterra Research Instituut voor de Groene Ruimte.

PKB, Ruimte voor de Rivier, (2005), Tweede Kamer, vergaderjaar 2004-2005: 29-435, nr 154, SDU uitgevers, 's-Gravenhage.

Stillwell J, Geertman S, Openshaw S (Eds), (1999), Developments in geographical information and planning, in Geographical Information and Planning (Springer, Berlin): 3 - 22

Vonk, Guido, Stan Geertman, Paul Schot (2005), Bottlenecks blocking widespread usage of planning support systems, Environment and Planning A 2005, volume 37: 909 – 924

Wachowicz, (Monica),Wies Vullings, Jandirk Bulens, Hugo de Groot, Machteld van den Broek, (2005), Uncovering the main elements of Geo-web usability , Centre for Geo-Information, Wageningen-UR, conference proceedings AGILE 2005 8th conference on Geographic Information Science F. Toppen, M. Painho (editors)