Dynamic maps for supporting spatial decision processes

DYNAMIC MAPS FOR SUPPORTING SPATIAL DECISION PROCESSES

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Abstract. The research here described aims at supporting decision making processes related to large scale and long term spatial questions. It proposes a method for sharing information and conveying reasoning by the use of dynamic maps. Through the visual localization of costs and benefits, the participants to the spatial decision processes are led to evaluate methods and objectives for a lot of alternative development options. The system has been used in different case studies showing its effectiveness in creating awareness on spatial problems and enabling discussions.

Keywords. geovisualization, dynamic interactive maps, spatial decision support system, grasshopper, ANP.

1 Introduction

The assessment and decision-making of long-term strategies are a process which has to act in uncertain systems involving many actors coming from different disciplines and a large amount of data coming from various sources. Applications in the real world show that a decision process encounters a huge amount of difficulties due to the differences in knowledge, interests and, overall, different languages (Andrienko *et al*. 2007, 2011). The combination of such dissimilar worlds generates a complex problem which asks for an overall framework in order to allow actors to merge and share all the available data, know-how and information.

In the last two decades, different methods and technologies have been realized to support spatial decision processes, but too many times developers and users do not follow the same goals so that analysis tools do not completely fit decision-making requirements. The research here presented describes an effort to overcome some hitches by the use of an Interactive Visualization Tool (InViTo), a customized method for managing data based on McNeel's Rhinoceros and its free plug-in Grasshopper. This study aims to use visualization techniques to support spatial decision processes. This would show the contribution that spatial data visualization and real-time interaction can give to participated design and decision making processes through the creation of a common grammar among involved actors and a shared basis for generating discussion.

2 Methods

InViTo has been used in different applications, with diverse purposes and at various scale. In this case, we would like to introduce its application to visually support the Analytic Network Process (ANP) assessment technique (Saaty 2001, 2005).

The ANP is a multi-criteria analysis technique used to generate a network among different clusters (environment, economic, social, urban planning, transport, etc.) and elements of clusters (air quality, social disease, high speed trains, etc.) for a limited amount of alternative options. Through a pair comparison survey, the ANP provides a method for measuring the weights of each elements and clusters and ranking the alternative scenarios.

InViTo has been set to provide dynamic maps which could display a symbolic localization of the effects of actors' choices. It is used to visualize different steps of ANP procedure. During the discussion among the actors about each pair comparison question of the ANP survey, InViTo visualizes the expected localization of costs or benefits due to actors' choices so that actors can be guided in understanding where their decision may have a considerable effect. After each actor gives his weight to the importance of a cluster or element, InViTo can show the intensity of effects that actors' answers have on the area (fig. 1). The height of displayed hills depends on the amount of costs or benefits all over the area. A slicing plane (displayed in figure 1 as a gray plane) can be used by participants to explore data. It has vertical movements that can be decided by users, so that it can be used as a cursor which visually select the area with more costs and benefits.

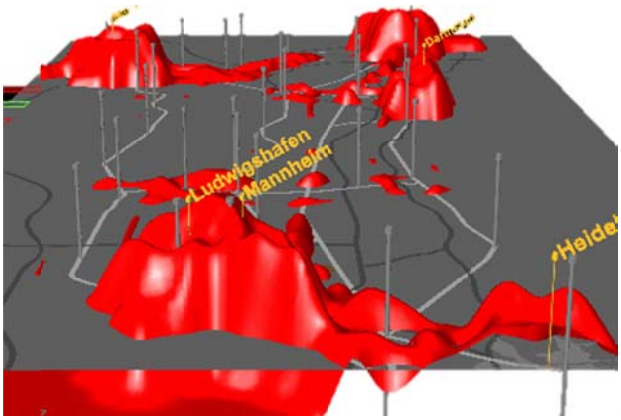

Figure 1. *Example of dynamic maps showing the symbolic localization of costs for an alternative option studied for the area between Frankfurt am Main and Mannheim (D).*

Especially in tiled views (as in fig. 2), this plane allows to intuitively understand where effects are located and their intensity, leading planners and decision-makers to build their personal knowledge and collectively share their ideas.

Once all the ANP survey has been discussed, InViTo combines all the answer and provides in real time the overlapping maps of costs and benefits. In the described case study, InViTo has been set to provide two visualizations for each scenario: a top view and a perspective which describe the amount of benefits (in green) and costs (in red) all over the area (fig. 2).

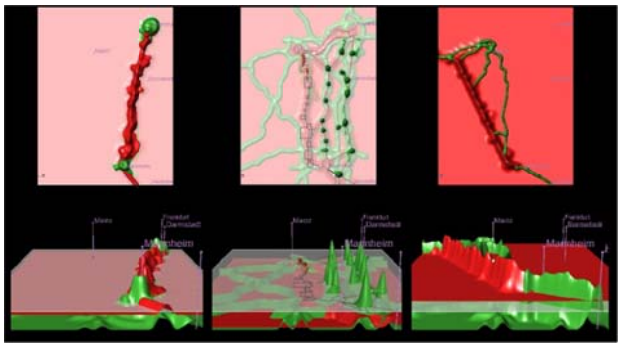

Figure 2. *Simultaneous visualization of dynamic maps showing costs (red) and benefits (green) of each development options for the area between Frankfurt am Main and Mannheim (D). The slicing plane (light gray) highlights the predominance of costs in the third scenario and the high benefits in the second.*

3 Case studies

InViTo has been used during a lot of workshops and focus groups in which a lot of experts have been involved to discuss about some specific sections of Corridor 24 Genoa-Rotterdam (Masala 2012, Lami et al. 2011), part of an Interreg IVB NEW Project called "Code24".

Code24 project opened the discussion on different case studies: two at the metropolitan scale (Wesel, D, and Bellinzona, CH), one at the regional (the region between Frankfurt am Main and Mannheim, D) and one at the trans-national (the whole corridor area). For each case study, three scenarios have been developed to assess the spatial development in relation to three kinds of railway transport strategy: the creation of high speed connections for passengers, the implementation of regional transport for passengers and the building of high capacity infrastructure for freight transport. To assess the development of these areas, InViTo has been set to manage and compare data coming from economic, environmental, transport and urban planning issues through a pair comparison survey as described by the ANP assessment technique.

By the use of GIS data collected among the project partners and freely available on the web, the geographic elements and the networks of railways and motorways have been used as basis to build the maps. In the meanwhile, to generate the maps which localize the effects of actors' choices, the consensus among few experts from different disciplines has been gathered. Then, by the use of Grasshopper, these maps have been turned into dynamic meshes which changes according to actors' evaluations.

Through the use of side by side views, the maps have been displayed during the workshops and focus groups at Value Lab of ETH Zurich. Touch screen tables and walls have been used to enable the discussion among the actors involved in the spatial decision process. The visualization of costs and benefits and their overlapping provided a framework for organizing and sharing all the available information.

4 Conclusions

The use of InViTo during spatial decision process showed to be very effective in sharing information and knowledge building. Maps have been the shared basis for enabling the discussion all over the day. Awareness in actors has been increased so much that many participants declared they had changed their mind on both spatial strategies to adopt and goals to pursue.

The application of InViTo provided a list of elements to be adjusted as well as important improvements for using the system in real environments. In particular, the interaction is still mediated by a technician. This means that a graphic interface for interacting directly with the model is needed. First attempts have already been made by the use of laptops and tablet pc, but never tested in real decisional sessions.

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