Interactive Visualization Tool (InViTo)

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Background

The instrument developed by SiTI, called InViTo (acronym of Interactive Visualization Tool), aims to provide a visual interactive support to large scale planning processes. The tool is intended to provide an effective basis for sharing information and enabling discussion among different actors such as planners, stakeholders and, in general, non-expert people within focus groups, workshops, participative and collaborative processes.

The decision to develop this instrument stems from the need to analyse the relations between urban development and spatial elements, such as transport facilities or landscape issues. Since accessibility is one of the factors which most influence location choices, a specific study has been dedicated for its investigation.

The main strength of InViTo is represented by the possibility of managing interactive and dynamic scenarios, in order to visualize in real time the effects of decision making on urban form and to support the planning processes. Due to its flexibility, the tool can be used for several applications and in different fields of research which need to visualize geo-referenced data on maps. In this COST Action, InViTo is presented as a tool for calculating and visualizing accessibility in real time during participated planning processes.

Conceptual framework and theoretical underpinnings

InViTo has been designed to support urban planning processes. It aims to improve the cognitive process through an interactive framework, which combines different data in a complex structure of relations and connections. A specific spatial behaviour can be assigned to each data. Each behaviour can be described through a mathematical function, providing a spatial effect on settlements. For example, a new subway line interacts with the suitability of residential zones as well as the localization of a railway station modifies the perception of the area (Pensa *et al.,* 2011).

All the mathematical functions can be activated and modified in real time during the participatory process by the participating actors, who can operate on the following elements:

Mathematical functions. For instance, if experts do not agree on the catchment area of a railway station, they can change the values assigned to the specific element.

Weights among the spatial elements. Users can define the singular weights which correlate to different spatial elements.

Outlines of routes. For example, it is possible to change the path of a public transport line in the project.

Due to its characteristics, the tool is particularly suitable for measuring accessibility, here intended as the walking time to the nearest public transport access points (e.g. bus stops or railway stations). Walk distances are calculated on the pedestrian network, as shown in Figure 1, and then divided on the average walking speed.

Operational aspects

Nowadays technology provides different solutions to visualize data and relate them to specific features of the object of study. For this reason, existing software have been investigated in order to find the most useful and appropriate for the specific tasks. In particular, this software should be a single tool able to manage and display data, variables and outputs with the possibility to customize it. Furthermore, it should be able to work in real-time relating choices and areas of interest and creating immediate outputs. Finally, it should allow the construction of a method replicable and easily fitting to different sorts of case studies.

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[1] SiTI – Higher Institute on Territorial Systems for Innovation - is a non-profit association, set up by the Turin Polytechnic and the Compagnia di San Paolo in order to produce research and training orientated towards innovation and socio-economic growth.

The chosen software has been Rhinoceros combined with its free plug-in Grasshopper. The former is a commercial 3D modelling tool developed by McNeel & Associates, while the latter, Grasshopper, is a plug-in that allows users to create shapes using generative algorithms that can contain different kind of input including numeric, textual, audiovisual and so on.

Normally this software is used at the furniture or building scale in industrial design and in the architectural field, but Rhino and Grasshopper are here used in an innovative way to study and analyzing spatial issues in large area decision processes.

First of all the combined use of these two pieces of software creates a generative instrument, that allow the drawing of shapes without modelling. Other benefits are related to their parametric features, which allow each data to be associated with one or more mathematical equations and create relationships among them for defining shapes and their behaviours. It is dynamic, so that the choices of users modify outputs in real time according to rules described with algorithms. Furthermore, it is easy to customize using common scripting languages like C#, Python or VB.

The availability and costs of databases depend on the specific case study. Road networks are freely available from open source web sites as "Open Street Maps", but InViTo can use different kind of sources.

Finally, taking advantage of the possibility to describe feature behaviours in a parametric way, the tool can be also used for reproducing the dynamics of various assessment methods, providing interactive visualizations for different purposes. For example, the tool has been applied to reproduce the ANP assessment technique and support collaborative processes (Lami *et al.*, 2011). In this case, it has been used to build dynamic maps showing costs and benefits of different scenarios concerning the improvement of railway infrastructure in three different areas along the corridor 24: Rotterdam - Genoa.

In the application of InViTo to accessibility, the main purpose is the evaluation of planning options, which concern the localization of new public transport lines. Therefore, accessibility is calculated as walk time from the nearest public transport access points with reference to the pedestrian road network . The output of this calculation is a map which defines point by point the level of accessibility to different public transport modes (Figure 2) such as bus, subway and railway or all of them (without considering, at this step of the research, different weights associated to different modes depending on their level of service).

Results can be displayed in different ways, according to audience and level of expertise. To simplify the understanding of the output, we chose to work on bi-dimensional maps which lay on the studied area directly in Google Earth virtual globe. Each map shows point by point the level of accessibility through a colour gradient based on a red-yellow-green scale: red corresponds to worst value while green represents the best one.

Relevance for planning practice

The first application has been a pilot study on Northern area of Turin (IT). The test intended to investigate the transformation effects of the new subway network on the redevelopment of areas of interest.

In particular, the first application concerns the study of the relationship between facilities and settlements, in order to define how public transport facilities influence the localization of new settlements as a consequence of accessibility. This relation is useful for the definition of the route of the new subway line, mapping the difference between existing and future accessibility to public transport and defining the area which could be advantaged or disadvantaged from the realization of a project option. The comparison among different scenarios and the possibility to modify some element of the project as well as their influence, provide data which can be used to build a discussion on a shared basis of information.

A second application concerns new settlements on dismissed brownfields in the city of Asti (IT) as a part of the European project "CircUse" (Circular Flow Land Use Management), a Central Europe Programme co-financed by the ERDF. The tool has been used for analyzing the suitability of different possible new functions for these former industrial areas on the basis of reclamation costs, landscape issues, accessibility, localization of green areas, transport and commercial facilities. As for the Turin case study, the tool has shown to be useful in the evaluation of alternative planning options.

Strengths and limitations

This tool's main strength lies in its possibility of being adapted to different uses and purposes, which can act on different scales. Each component of the model can be evaluated and changed in real time on the basis of the considerations of experts, thus providing scientific validation to the functioning of the model.

This tool facilitates the communication of information, providing a shared basis for enabling discussions. Relations among data and their weights can be modified by users and displayed in real time, allowing a full interaction between users and needed information.

Another interesting aspect is represented by the possibility of visualizing the effects in Google Earth. It, thus, allows non-expert users the possibility to visualize outputs in a well-known environment, and with a user-friendly interface.

Further developments can be carried out.

First of all, the use of public transport changes city by city. In literature, different studies can be found, but usually the peculiarity of each case makes complicated the identification of the real behaviour of people. The next step will concern the definition of the weights related to the different transport modes in order to obtain a general accessibility to public transport. A further step will be the definition of accessibility as perceived by people, which could be investigated and defined through specific studies or surveys. This information will be useful to understand the quantity of people who will potentially use the new transport line.

Secondly, the interface for changing the input values are not so user-friendly, so the presence of a technician for the tool managing is required.

Future improvements concern the updating of the tool on the basis of feedback received during workshops and focus groups, especially on the choice of the visualization modality. The interface will be modified in order to be more user friendly.

References

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Pensa, S., E. Masala, C. Marietta (2011). *The effects of decision-making on urban form: A tool for supporting planning processes*. Proceedings of the 7th international conference on virtual cities and territories, Lisbon, October 11th to 13th, 2011, Coimbra: Department of Civil Engineering of the University of Coimbra and e-GEO, Research Centre in Geography and Regional Planning of the Faculty of Social Sciences and Humanities of the Nova University of Lisbon, N.N. Pinto, J.A. Tenedorio, M. Santos, R. Deus (Eds),

Figures

Figure 1 Northern metropolitan area of Turin: Pedestrian road network (white lines) and the new subway line in project (grey lines) with new access points (black and white dots)
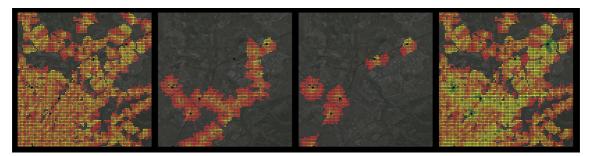
Figure 2 Accessibility on the Northern Turin area visualized through a Green-Yellow-Red Gradient Map.

(Note: From left to right the figure illustrates the accessibility to bus stops in the first image, to subway stations in the second and to railway stations in the third. The fourth one is the sum of the three, considering all the different transport modes with the same weight.)