The Role of Virtual City Models in Urban Tissue Evaluation.

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Abstract. The shape of town is the main issue which planners deal with. The function of some buildings and urban facilities is flexible, it changes in time. The appearance of city public areas and, what follows, the life conditions of its inhabitants, depends on elements of the town structure - the surrounding buildings, their density, state and form. All lasting elements of the city form its shape which reflects urban processes which have been taking place over ages. The aim of this paper is to define how latest computer technology can be used as an aid in the evaluation of the town landscape.

***Keywords**: town planning, city models, virtual, GIS, urban analysis*

Introduction

The town – "a whole" in Plato's terms – should be considered holistically. The elements of the system are so complex that it is difficult to define them in an explicit way. Urban planning requires precise information about the current state of the town. The amount of data and rapidly changing life conditions require employing new methods of planning, especially for macro-scale projects which consider the areas of whole cities or big districts.

Use of the GIS (Geographical Information Systems) applications allows automatic creation of the city maps showing space distribution of different processes. The city model based on the GIS system is, in fact, a database connected with a graphic representation. It preserves all the functionality of the databases and enables different types of analysis.

On the other hand there are 3D models which provide the best tool in the dialog with the non-professionals – the local community members and representatives, among others. For urban planners, 3D models may become an easy way to notice some aspects of the urban tissue which are difficult to see when using the 2D drawings only.

The city of Lodz case.

The answer to requirements present in The Urban Planning Law, dealing with the designation of, in Study On The Preconditions And Directions For The Physical Development (the equivalent of English Master Plan), areas needing revitalization and rehabilitation activities, was creating a city model including evaluation of urban tissue. The whole city was divided into morphogenetically uniform areas ranging in size from a few to over a dozen of land plots. The basic criterion was the level of "urbanity" of a given area. The "pattern" was a completed, fully developed with high density, quarter of a 19th century city centre buildings. The division also considered such features of the areas in question as: the spatial structure, its conforming to pattern, the level of land use, architectonic and practical qualities and the relation of the facilities to the surroundings.

The method of evaluation record.

A code enabling the systematization of evaluating particular fragments of space has been used. The number referred to the spatial structure, the series of numbers referred to the level of advancement in urbanization processes of a given area. Specially highlighted were historical elements of urban tissue, including manufacturing plants, modernist housing estates, various types of green areas, empty areas, city transport areas, etc. Letters "a", "b", or "c" depended on the quality of an urban tissue on a given area and its level of "urbanity". It was not connected with the quality of buildings, but rather with the level of completion of urban space. Number "1", "2" or "3" referred to the level of density and completion of urbanization process of a given area. Accepting so clear-cut rules enabled the evaluation of the whole area of the city – basing on visiting the site, the knowledge of authors, airplane photographs and cartographic material (paper and digital maps). The evaluation was partly subjective, taking into consideration that "urbanity" can be to a certain extent measurable. In the course of work appeared areas which went beyond the accepted, and so simple, method of classification. It caused some complications in the system of markings used. As a result of evaluation performed, the whole area of the city was divided into tiny segments of a uniform manner of structure. The drawing showing divisions was made on basis of a cadastral map, treating the borders of properties as the most adequate for dividing different forms of city structure. Every fragment of the city was provided with an appropriate attribute.

The process of map creation.

Basing on a material prepared in this way, which was actually a description of existing city structure in a given moment (the end of 1998), following analyses were carried out. Simple methods of generalization were used for generating maps showing various aspects of city space. A special table assigned various symbols on maps to particular symbols or groups of symbols in the table of attributes. As GIS system is able to use external data, the table prepared in this was gradually joined to the attributes of the theme describing existing state in order to automatically generate consecutive maps. Such a method of work enabled easy update of drawings in the course of working over their content. Each drawing was provided with the table including numerical data which referred to the areas concerning the phenomena described in the legend.

3D Models.

Currently available software provides a number of tools for creating 3D city models. One of these is the use of CAD application (Autocad, Microstation, Archicad, etc.). The models created with the help of these tools can have different level of detail. The number of details responsible for the model's fidelity can be substantially reduced, as long as the models prepared are equipped with textures. Creating such objects is possible due to using software employed to generating photorealistic pictures and animations (3DStudio MAX, Maya). There are also applications enabling the creation of 3D objects with textures, basing on pictures of buildings (Canoma by Metacreation) (City of London example, Batty 2001).

A different method of work characterizes 3D GIS software (e.g. ArcView 3D Analyst) which generates simplified models of buildings using information about the height recorded in database. At the present level of software development tools which would easily handle more complicated, irregular architecture forms (e.g. historical churches) are not available.

3D GIS software enables the presentation of topographic relief on the basis of 3D digital terrain model (DTM, DEM). It also enables using data gained from satellite receivers. An example of this can be data LIDAR, coming from UK National Remote Sensing Centre and used in the model of the City of London (Batty 2001). The precision of

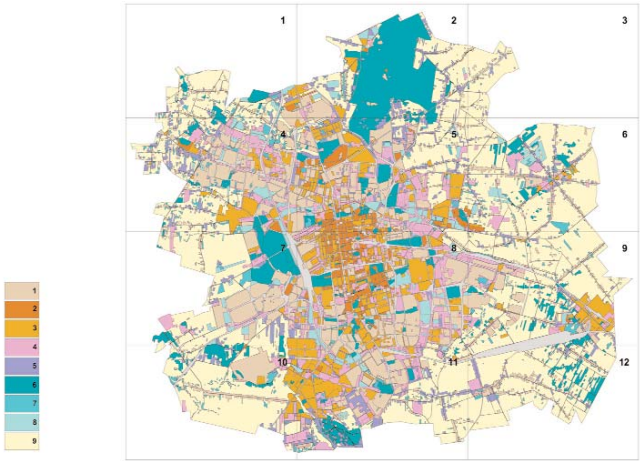

Figure 1. Diagnosis of a city structure state - synthesis (Study, vol. 12, fig. 1, p. 11)

models created in this way is still much below the precision of those made by the use of CAD applications. However, it seems to be a question of time until the development of this software enables remote gaining of 3D city models, as today airplane and satellite photographs are obtained. So far models of this type are used for examining such phenomena as radio signal transmission, the availability of cellular phone operators network, etc.

The advantage of urban models using GIS systems is their connection with database. Similar to 2D systems, each object is linked with the record in the table of attributes, which enables reading the information about the object; performing various analyses, consisting of the selection of objects meeting the given criteria; generalization, choosing a better location, etc.

There are also attempts to connect models made in CAD software with GIS applications, which enables linking the virtues of both systems, that is the precision and the possibility of using information connected with geometrical objects. An example can be a model of virtual Los Angeles created in Urban Simulation Laboratory in the University of California in Los Angeles (Jepson 2001).

The methods of 3D models presentation

3D models are presented as static pictures, animations or VR models. The pictures of the model, as prints or images illustrating WWW pages are the most conventional form of presentation. Animation allows for better reception of the model, it is a faithful representation of a pre-planned events. A form of presentation which has been recently developing dynamically are VR models. There are several file standards, of which VRML is the most popular.

A recent format of 3D files enabling mobility in VR is Shockwave format created by Macromedia. The advantage of this software is its availability: a plug-in for reading Shockwave files is included in the Windows XP package. Shockwave presentation has several advantages not available in earlier formats: it allows incorporation of photorealistic imagery, it has an inbuilt polygons reduction in geometrical models depending on enlargement scale, it enables collision detection. Macromedia Director allows the import of a model created in a few of the most popular programs for 3D modelling. Additionally, the elements can be modified, enriched with interaction.

Another technique developing recently is visual XML programming language (GML – graphic programming language) (Michalak 2002).

Conclusion.

A basic function of 3D models is a possibility of presenting suggested solutions in a way which is accessible to laymen, unlike traditionally used plans. The addressee of the presentation, depending on the requirements of a particular project, can be local community or a city council. Urban simulations are an effective measure used for increasing social participation and design presentation, since their crucial feature is their visual aspect. Communication between the participants of the process is carried out through image. The appropriate understanding of the design by all people involved enables support for a particular project (Bulmer 2001).

3D models are also a tool in a town planner's workshop, enabling the choice of the best solution available and fast access to information. As a city image of a certain level of fidelity, they offer a possibility of watching urbanization processes. For some purposes, 2D models are sufficient, for instance the one created in Lodz. However, they lack the possibility to describe the shape of public spaces. The number of receivers is limited to professionals only. At the present level of software development, 2D models are more practical, easier to update and they engage less effort in preparation.

We may anticipate that the future of urban modelling lies in 3D models with the advantages of GIS databases. The satellite photographs available today offer the resolution of 1m (Brail 2001). Current progress in photogrametry allows predicting that future city models will be remotely created, and thus actualized in the real time. 3D models can be presented to all interested parts via the World Wide Web and thus provide a useful tool in public discussion with an important educational aspect.

References

Batty, M. and others: 2001, Visualising the City, Communicating Urban Design to Planners and Decision Makers, in Brail R.K., Klosterman R.E. (eds), Planning Support Systems: Integrating Geographic Information Systems, Models and Visualization Tools, ESRI Press, Redlands California, pp. 405-443

Brail R.K.: 2001, Introduction in Brail R.K., Klosterman R.E. (eds), Planning Support Systems: Integrating Geographic Information Systems, Models and Visualization Tools, ESRI Press, Redlands California, pp. IX-XXI

Bulmer D.: 2001, How can computer simulated visualizations of the built environment facilitate better public participation in the planning process?; Online Planning Journal; www.onlineplanning.org

Dodge M., Doyle S., Smith A.: 1998, Visual Communication in Urban Planning and Urban Design, Working Paper 2; Centre for Advanced Spatial Analysis Working Papers; London; June 1998; http://www.casa.ucl.ac.uk/working_papers.htm

Evans S., Hudson-Smith A.: 2001, Information Rich 3D Computer Modeling of Urban Environments, Working Paper 35, Centre for Advanced Spatial Analysis Working Papers; London, August 2001; http://www.casa.ucl.ac.uk/working_papers.htm

Hanzl M.:2001, Mo_liwo_ci wykorzystania analiz w systemach CAD i GIS w planowaniu przestrzennym in Systemy CAD w projektowaniu architektury krajobrazu, Walkowska W., Szczecin; pp. 56-76

Jepson W., Ligget R., Friedman S.:2001, An Integrated Environment for Urban Simulation, in Brail R.K., Klosterman R.E. (eds), Planning Support Systems: Integrating Geographic Information Systems, Models and Visualization Tools, ESRI Press, Redlands California, pp. 387-404

Kowal S.: 2001, Komputerowy Model Miasta in Architektura – Murator, 3 (12), pp.12-15

Michalak J.: 2002, Interoperability in domain of geospatial information in Systemy Informacji Przestrzennej, PTiP, Warszawa, pp. 41-50

Wisniewski M. and others 1997-2001, Study On The Preconditions And Directions For The Physical Development of Lodz, 12 volumes, UML Lodz