

Application of the three dimensional models for the public participation in urban design and spatial planning

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This paper describes an application of three-dimensional (also “3D”) models respectively to selected types of citizen participation. Detailed descriptions of those types are in the beginning of paper, because they are a starting points to consider using 3D models in public participation in urban design and spatial planning. In this paper, the selected software, that supports urban planners in preparing, carrying out and evaluate of participation process, has been discussed. The aim of this paper is to present the application of various tools, which allow generation of 3D models, suitable to selected methods of participation.

Keywords: 3D models, urban design, spatial planning, leader of participation, software, visualizations

Introduction

Public participation, which can be include to spatial planning and urban design, may repeatedly streamline the process of decision making. Well-organized public participation can also prevent protests and local conflicts (Pawlewicz, 2014).

Recently, in the debate on public participation (especially in urban design and spatial planning), we can see increased interest of using visualizations, 3D models, GIS models, as well as tools based on new technologies, such as virtual reality and augmented reality. The use of software, which can present urban projects and spatial plans in three dimensions, allows local community to better understand these projects and their impact on the future urban context. Advantage of using 3D models and visualizations in process of social communications can also lead to increase the number of participants in such a process.

This paper analyzes selected methods of preparing three-dimensions models and their applications in social communication. Conclusions from these researches can be used for basic valuation of selected methods.

Description of citizen participation

Definition of citizen participation

Citizen participation is defined as less or more direct participation of citizens in social, public and political life (Każmierczak, 2011). Participation can be also defined as

a process, in which society actively participates in the development of any unit (Pawlewicz, 2014). We can see the problem of social participation getting more and more attention every year, which may be the result of growing citizens’ awareness about their rights to participate in social communication or the fact that they often have a huge knowledge about analyzed areas.

Levels of citizen participation

There are eight (8) types of citizen participation, which are laid out in a ladder of patterns, in order to illustrate them clearly (Arnstein, 1969). Each of them represents the degree of involvement of citizens in the participation process. The higher the rung on the ladder, the higher the level of social engagement.

The first two rungs are called manipulation and therapy. These are degrees of so-called „no participation” that is often used as a substitute for proper participation. On this rungs, the participants are educated by the authorities.

The third and the fourth rungs are types of „tokenism”. Tokenism is a principle, practice, facade, which aims to make equality in decision-making. It allows people, who are unable to govern, to listen to and be heard by the authorities. Information (third rung) is often presented as a first step of proper participation. At this level, citizens are informed not only about obligations, but also about their rights and possible choices. Usually information goes from the authority to the citizens as a one-way flow of information, in which the residents have no opportunity to provide

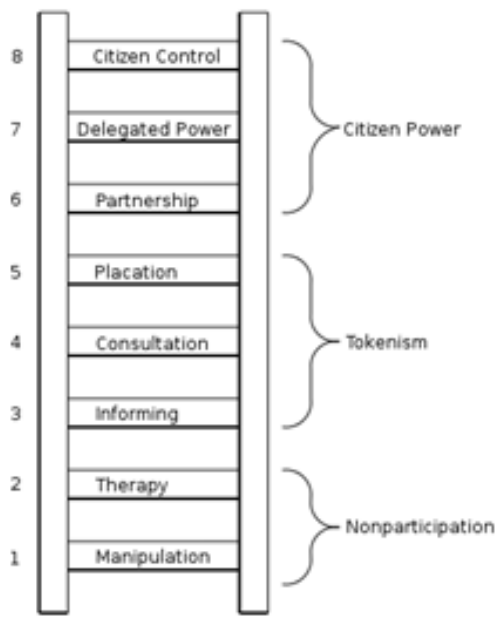


Fig. 1. The ladder of public participation. Source: Arnstein S. R. „Drabina Społecznej Partycypacji”, w: Magazyn Amerykańskiego Instytutu Planistów, 1969

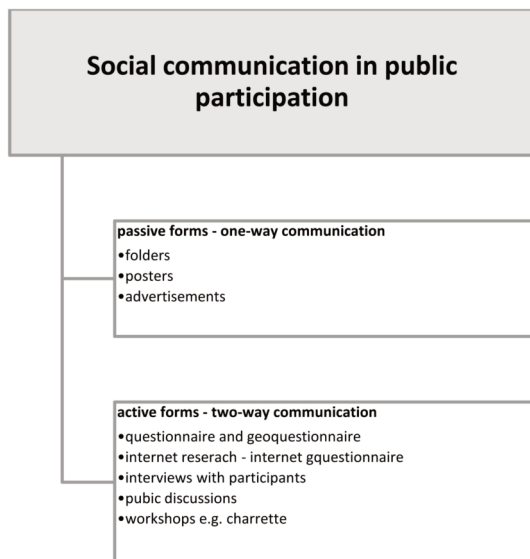


Fig. 2. Forms of the social communication in public participation. Based on Pawlewicz, Alsztyński, 2014

feedback. On the other hand, at the next level of participation ladder – consultations, the opportunity for providing feedback is possible. It consists mostly of listening to the citizens' opinions. However, without the use of additional methods at this level e.g. workshops, the process of participation done in that way may not be complete.

The placation, also called the mitigation, which is the fifth rung, is a higher level of tokenism. It allows smaller

groups, without the legal authority, to provide advice, but decision-making is still in the hands of the managers.

The last three rungs of ladder are called degrees of civil authority. The first one is a partnership (sixth level) that allows citizens to negotiate and discuss with the managers. At the highest levels of the ladder, there are: delegated power (seventh level) and citizen control (eighth level). In both cases, the minority community has a majority of votes or even full power of decision.

The methods mentioned above, which are used in the individual levels of participation, can also be classified into two groups – passive methods (one-way communication) and active methods (bi-directional communication).

The 3D models in static and dynamic form can be used practically in every example from Figure 2. In the following section, the different methods for creating 3D models and their application in participatory planning processes will be presented. The focus was a several selected examples of the use of computer models in bi-directional communication in participatory processes.

3D models in urban design and spatial planning

3D models – definition and types

The term “3D model” (spatial, three dimensional) describes a mathematical representation of an object in three dimensions. In urban design and spatial planning, these models are used to represent the image of real world, but also to show the projects that are supposed to change the state of the city or its parts.

More and more cities in the world have three dimensional city models. They are mainly used for a variety of spatial analyzes, such as visibility analysis, shade analysis or analysis of maximum height for future building investments. The leaders in making available 3D cities models are the metropolitan cities in the United States of America (New York, Chicago) and in South-East Asia (Tokyo, Delhi, Singapore). In Poland, only a few cities have three dimensional model of city (Warsaw, Wrocław, Cracow, Szczecin). The model of the city of Wrocław is the only one, which is currently available to residents online, via the city's geoportal website. Others are only accessible by government employees.

Tabela 1. Types of three-dimensional models. Own study based on Shiode, 2001 and Klejnberg, 2010

Types of models	Main aim	Technical and analytical functionality	Use of GIS technology	Reusability
Aesthetic	Presentation, visualization of results	Low	Not	Small
With limited data	Possibility of making basic spatial analysis	High	Yes	High
Allows for complete spatial analysis	Ability to perform complex spatial analysis	Very high	Yes	Very high
Hybrid	Implementation of spatial analysis and their visualization in real model (e.g. 3D printing)	High	Yes	High

The 3D cities models derive from traditional techniques such as urban mockups and maps. The development of 3D modeling technology has led to the creation of a typology of their division (Shiode, 2001). These models can be divide into the following features:

1. Details of the actual state of the information, that is the amount of contained information,
2. The type of using data, that is the sources from which spatial information originate
3. Functionality.

However, the most important division based on their functionality, degree of usability and their ability to analytically use data from the model (Klejnberg, 2010). This feature is especially important because some of the highly detailed models that do not have spatial information assigned to objects have much less functionality that GIS models, that can be also more generalized (Shiode, 2001). The models highlighted in this typology are summarized in the table below.

In the recent years we can observe increasing interest in using virtual reality and augmented reality to making and presenting 3D city models. Nowadays, in digital society they have a great significance, because they allow to visualize the present and planned city environment in a way that is accessible to general public. Digital applications, which are also available for mobiles and tablets, serve not only to visualize and compare e.g. reality with project, but also allow using additional functions like: adding comments or creating virtual voting. Especially, more and more popular is procedural modeling, which based not on the manual modeling of each building, but on generate models based on defined rules, which are written down in informatical code (Zasina, 2012). This code can be generated by the user, download from the software’s authors or based on codes available online and adapted to ones specific needs.

Software and tools supporting urban design and spatial planning

There are currently many available programs or tools for creating three-dimensional models. The most popular tools are the CAD family tools and very popular SketchUP. In the programs mentioned above it is possible to create 3D models, whose main purpose is to visualize and present the project or actual site. These models are aesthetic models with low analytical functionality.

More and more 3D models are being implemented in Building Information Modeling (BIM) software, which provide continuous access to project information, costs, simplifies the design process, and also allow to collected and store information about buildings. This software enables to make very accurate three-dimensional models of buildings. It may be too detailed software, if we want to visualize buildings in a simplified form. Nevertheless, this technology also enables to perform analyzes such as sunlight analysis, shade analysis or air flow simulation between buildings.

Table 2. Summary of software types using for creating and visualizing spatial models. Source: own study based on author’s professional experience

Software	Types of models	Active forms of social communication, in which models can be used	The level of active public participation in the design part of the participation process	Difficulty of creating a model in the software
CAD	Aesthetic	<ul style="list-style-type: none"> • Questionnaire survey, • Works hops, • public discussion, • Internet research 	Low	Medium
SKP	Aesthetic	<ul style="list-style-type: none"> • Works hops, • public discussion 	Medium	Low
BIM	<ul style="list-style-type: none"> • Aesthetic, • With limited data 	<ul style="list-style-type: none"> • Works hops, • public discussion, • Internet research 	Medium	Medium
GIS	<ul style="list-style-type: none"> • With limited data • Allows for complete spatial analysis 	<ul style="list-style-type: none"> • Internet researches, • workshops, • public discussions, • observational research 	High	Medium / High (Depending on the model's required level)
CityEngine	<ul style="list-style-type: none"> • With limited data • Allows for complete spatial analysis 	<ul style="list-style-type: none"> • Internet research, • workshops, • public discussions 	High	High
Virtual Reality/ Augmented Reality	<ul style="list-style-type: none"> • With limited data • Aesthetic 	<ul style="list-style-type: none"> • Internet research, • workshops, • public discussions 	High	High

In spatial and urban planning, where 3D models serve not only for the visualization of the assumption but also to spatial analysis, the most well-know tools are programs based on Geographical Information Systems (GIS). Thanks to them, it is possible to collect, analyze, visualize and share spatial data. Online applications based on GIS systems allow sharing models online and collect input from users about them, e.g. in the geo-questionnaire form.

CityEngine is a program based on GIS systems that was created by a team from ETH Zurich and is used to create 3D city models in efficient way. The program allows for modeling based on rules, parametric modeling, dynamic creation of city composition, reporting, but also to sparing project on the Internet, collecting opinions on them, which is called as e-participation.

The most technologically advanced tools for creating and sharing 3D models are Technologies of Augmented Reality. This technology allows to visualize project in a much more realistic way (Konopacki, 2014). These technologies are based on the principles of overlaying an animated virtual visualization of the project object on the moving image from the camera from e.g. a mobile phone. This method is a very effective way to show and compare the real state and design intension that are presented in the participatory process. The use of this technology also allows to rapid identification of imperfections or mistakes that were made at the design stage (Konopacki, 2014).

Supporting roles of 3D models in citizen participation

Three-dimensional models play a significant role in the process of citizen participation in urban design and spatial planning. Nevertheless, the usefulness of 3D visualization depends on:

1. A software selected to create model,
2. A participatory methods selected in which these models will be used,
3. The target for which the model is executed.

In citizen participation, where the main methods are traditional questionnaires or online questionnaires, the most popular are the aesthetic models, traditionally presented as a picture, an image, a static view from a selected

point. They are often used to show several variants and to show the main differences between them. Based on them, citizens can opt for one of the variants, or they can give any comments on them. Below the pictures show the traditional models of three variants of future local center in Ochota District in Warsaw, which were worked out during the workshops with the habitants, the merchants, the authorities and the network managers. The last image is the visualization of final selected variant for local center.



VARIANT 1.



VARIANT 2.



VARIANT 3.



FINAL VISUALISATION OF SELECTED VARIANT.

Fig. 3. Models of three variant of local center in Warsaw, which were worked out during workshops and final visualization. Source: urzadochota.waw.pl

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In the case of increasingly popular geo-questionnaires, 3D models are created in GIS software. These models allow to perform spatial analyzes also during works hops or discussions, which are the most active methods using in the participatory process. Interactive models in Web applications give more capabilities than the static graphic images. The user of these applications can navigate the model to the same extent as its creator. For the model in the example below, a geo-questionnaires was included, which allows citizens to ask questions about the chosen view (portal GIS-expert).

Such tools as geo-questionnaires do increase the participation of the local community, especially of the part that, for various reasons, cannot participate in traditional participatory methods such as workshops and discussions. The results of such geo-questionnaires may be converted in the software to diagrams and displayed to contributors in real time.

One of the example of this participatory method was the „Geoconsultation” project carried out by the MPRW Office in Warsaw for Vistula River Valley area. The authors of the application evaluated those as tools that help in presenting the plans and also in facilitating the required legal consultation. The tool has increased the transparency of the planning and consultation process. The high price of necessary software is a significance disadvantage of using this method of participation (UNEG/ GRID, Warsaw, 2010).

Online research in social participation have not just to rely on community responses to the questions that were asked by the authorities. They may also rely on collecting comments available on the Internet 3D models. Such actions are allowed, for example, by Esri CityEngine software.

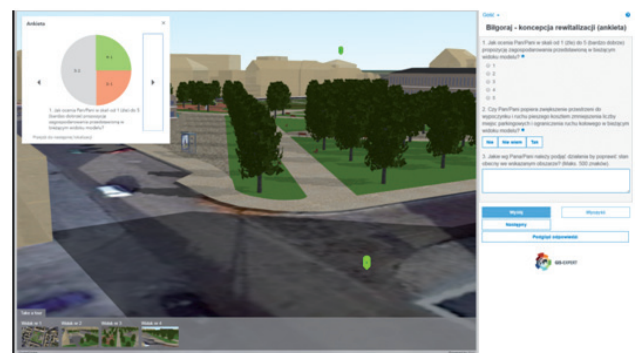


Fig. 4. Questionnaire combined with 3D model
Source: <http://gis-expert.pl/blog/modele-3d-w-konsultacjach-spoecznych/>



Fig. 5. Example of using CityEngine in participatory process
 Source: <http://www.esri.com/software/cityengine/industries>



Fig. 6. Example of using CityEngine in participatory process
 Source: <http://www.esri.com/software/cityengine/industries>

Available models can be opened in the browser and based on them can be make some simple spatial analysis. To this analysis it is also possible to send comments or suggestions to model's creators. Below is a graphic showing the idea of sharing 3D models on the Internet. The slider allows to make a smooth comparison between the existing state and the designer one. In the panel on the right, it is possible to select the layers which we want to be displayed. On the model, we can see the symbols that indicate the comments, which can be also viewed. In the Information tab we can view the spatial data that is assigned to the object. For example, Figure 4 shows the information for the designer building, including: density, footprint area, GFA, GLA, lot area.

CityEngine helps to decision-making that are benefit to the further development of cities. This software enhances the attractiveness of the process of citizen participation and increases people's interest in this process. Undoubtedly, the added value of using this participatory technique is the development of the ability to use the new Technologies by society. However, the use of such programs is always associated with high costs.

Conclusion and future research

The three-dimensional models are increasingly used in the process of citizen participation in urban design and spatial

planning. They serve to improve the conditions of discussion between authorities, residents and other actors.

Selected examples of 3D models and applications, in which they have been made, show the multiple possibilities of use of such models in various participatory methods – from questionnaires, discussions, geo-questionnaires to design workshops. It should be remembered that the model which was created for the participation process, can also be used in the further stages of the project, e.g. to monitoring the process of changes in the selected area.

Undoubtedly, three-dimensional models enhance the attractiveness of the social participation process. They also help designers at the early stage in preparing, conducting and evaluating the process. Nevertheless, the creation of models in GIS, CityEngine or in Augmented Reality, which are the technology that bring the most appealing 3D models to the community, remains very expensive. For this reason, not all of the entities are capable to order that models for consultations. However, it is difficult to overlook the fact that the costs incurred for these model are also beneficial for the city authorities. For example this kind of 3D model can as increase the interest in participatory processes. This is particularly important in urban design and spatial planning, because the effects are usually long-term, which will have also impact for future generations.

The above considerations do not discuss all possible ways of using computer models in participatory processes. In further consideration and research, it is worthwhile to try to implement these more advanced 3D modeling techniques to use them in the process of participation for agglomerations' areas e.g. Warsaw.

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