Digital System Of Tools For Public Participation And Education In Urban Design

Exploring 3D ICC

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Abstract. *This article is a starting point for the development of experiential urban co-design interfaces to enhance public participation in local urban projects and to be also used as a communication and collaboration tool in urban design. It is based on the previous research involving 3D city models utilized as understandable design interfaces for the non-technical public (Jutraz, Zupancic, 2011), where we have already explored different views (pedestrian, intermediate and bird's-eye view), as well as the means by which the information obtained from these different views may be combined by shifting between viewpoints. Previous work was conducted in the "street lab" as well as the Urban Experimental Lab, which was developed specifically for the public's participation in urban planning (Voigt, Kieferle, Wössner, 2009). Presented in this article is the next step that explores the immersive collaboration environment 3D ICC [1], formerly known as Teleplace. The environment was developed for efficient collaboration and remote communication and shifts the research focus towards questions regarding how to employ both labs as interfaces between the non-technical public and design professionals. As we are facing the lack of digital systems for public participation and education in urban design, different digital tools for communication and collaboration should be combined into a new holistic platform for design. A digital system of tools needs to be developed that supports the urban design decision-making process and focuses on improved final solutions and increased satisfaction amongst all participants. In this article the system of digital tools for public participation, which include communication, collaboration and education, will be also defined, with its basic characteristics and its elements.*
Keywords. *Digital system of tools; collaboration; 3D model; public participation; urban design.*

INTRODUCTION

Urban design is a public collective activity and through combining different ideas, opinions, etc, we develop shared urban visions. Schoenwandt (2008) defines the "third generation" planning theory as the next step to the rational model of planning, where "agents" of planning construct a "planning world", which exists in the context of an everyday "life-world". Specific exchange among both "worlds" always happens. The collaboration process with its decision support tools presents an experiential urban co-design interface (technical and social) between "the planning world" and "the life-world". This inter-

face is focused on the experiential mode, wherein lies the most important perception of place/ urban design. The collaboration process could be real or virtual, different according to space and time; real world or digital representation of the real world could be compared to the digital city models or even combined with them and used for simulating potential future developments.

Public participation is a complex process, where different representatives of the non-technical public and experts are engaged. Each participant offers particular knowledge and/or expertise/visual communication ability that can be shared with others and each one could learn something new from the other participants. The general public may learn much through the urban design participation by simply being present and sharing comments and opinions. Collaboration is a more important process than communication alone and can contribute to lifelong learning in urban design.

The previous research (Jutraz, Voigt, Zupancic, 2011) was done in the "street lab" and in the Urban Experimental Lab, developed for public participation in urban planning (Voigt, Kieferle, Wössner, 2009), and it aims at developing visual digital 3D city models to enhance public participation in local urban projects. It also discusses the problem regarding the diversity of city model views (pedestrian, intermediate/mid-, and bird's-eye view) and, consequently, the means by which one can combine information from each view by shifting between different viewpoints. We found that the most suitable way to present the city model is to show the site from different views: the pedestrian, mid-, and bird's-eye views, while recognizing that things that are observable from one view are not seen from another. Shifting between different views can even improve the final results of the participation process. It is really important to shift from the big picture to the small details in both directions, and from the conceptual to the experiential mode of presentation. Mid-view can be seen as an interface between the pedestrian and bird's-eye views.

Based on this research, this article focuses on the interface between the "planning" and "life-world" and presents the communicational and collaborative tools to be used by the different participants (Figure 1). This interface presents a digital system of tools (DST) to facilitate the public's participation in urban design, which is most important for the non-technical publics (politicians, citizens, users, investors), who are the target group of the participation process; experts present their support and source of expertise. DST can help by improving the communicational and collaborative process between different participants, in order to develop a shared urban vision.

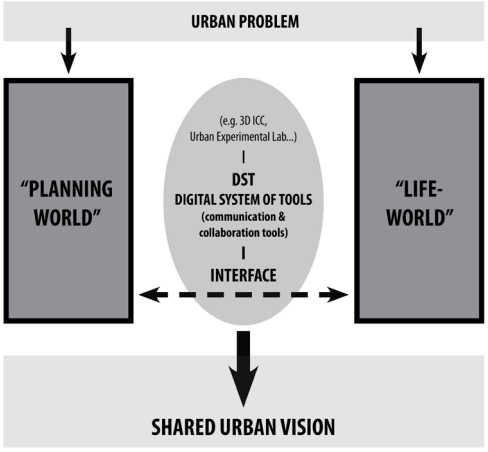
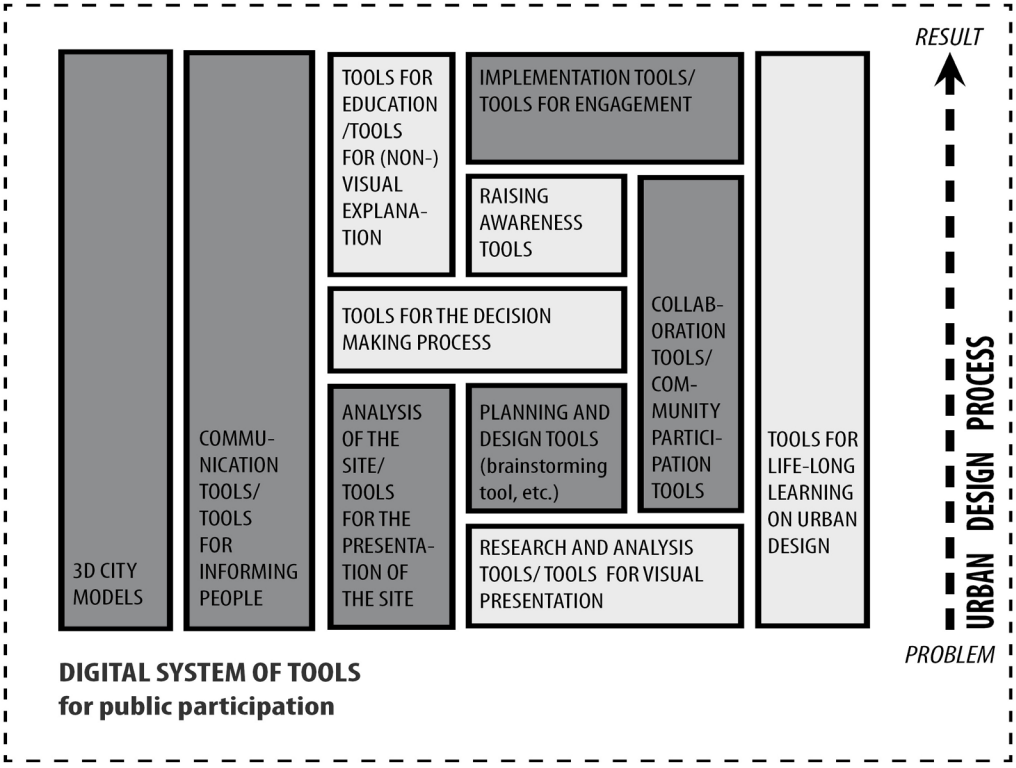


Figure 1
Towards a shared urban vision.

DST should be composed of a set of tools reflecting the needs of the public participation process in urban design. These tools should support public participation in urban design by informing, involving and educating people in urban design. DST should offer to different participants various tools; participants would choose the tools that would be the most appropriate for the selected urban design problem. Only the right combination of various tools will lead to improved final results. These various tools include, among others, tools for the presentation of the site, communication, raising awareness,

Figure 2
*Tools for public participation process in urban design (*3D ICC includes the tools marked darker).*



collaboration, life-long learning in urban design, 3D city models, and implementation. (Figure 2)

This paper also investigates the potential of using 3D ICC as an interface between "planning world" and "life-world". 3D ICC combines several tools, which are part of DST (Figure 2). It presents an immersive collaboration platform where one can find different tools for communication and collaboration [1], e.g. content and application sharing, multi-modal communication in one space, realistic interactions such as using whiteboards, sketching, etc. The environment consists of different rooms where various groups of people may meet, share their opinions, and give presentations. Google Sketch Up models may also be imported and users may use their avatars to walk through the 3D models. This platform offers a real-life experience where the user may use his or her avatar to explore a 3D model and gain a real impression of the proposed design. As Murphy (2011) states avatars can *"help you learn to cope with similar situations in the actual world"*. When you move around a 3D city model with your avatar, you are able to adopt this experience and reflect it into everyday life, and you more easily imagine what urban design proposals would mean for real-life.

This article addresses the positive and negative sides of 3D ICC, users' experiences with this tool, compares 3D ICC with Urban experimental Lab, and tries to define the benefits and potentials of both of them for public participation in urban design. Exploring different digital tools for collaboration and communication in the design process helps us to

define the characteristics and elements of optimal DST, as well as to develop appropriate tools for each stage of the participation process.

EXPLORING 3D ICC: METHODOLOGY

The main research of this article is based on the exploration of the immersive collaboration environment 3D ICC [1], formerly known as Teleplace, now Terf, developed for efficient collaboration and remote communication. It consists of several "rooms", generally two types: the meeting place with whiteboards, where participants can work together, share information and applications collaboratively, visualize information, use sticky notes, sketch, modify a document while others wait, and in the other "rooms" you can import a 3D model of a building and walk through the building with other participants at the same time as one would in the real life. It is an online collaborative environment, which offers live/ group chat, video conferencing, and interactive avatars.

In the research presented in this article we wanted to define characteristics and elements of 3D ICC and the links to the DST (which elements of DST are missing in 3D ICC, what could be improved, etc.). At the same time we wanted to evaluate 3D ICC through user experiences; its positive and negative sides were also defined. Moreover, through this research, opportunities for using the tool in urban design were identified.

In the first part of this research, we conducted a survey amongst the students of the AEC Global Teamwork class of 2012 at Stanford University (PBL Lab, 2012), headed by Dr. Renate Fruchter, where the students were asked to use 3D ICC as a support digital tool in their design processes (from January to May 2012). The students used the tool for weekly meetings, instant communication and collaboration and for the exploration of the 3D model with their avatar (walking through the model). The main aim of this research was to find out how the profession is facing the use of the 3D ICC, and on the other hand to evaluate the performance of 3D ICC.

In the second part we were dealing with the process of urban design in 3D ICC, especially with the options of importing larger 3D models, and the level of details, which are still possible to be imported in the 3D ICC.

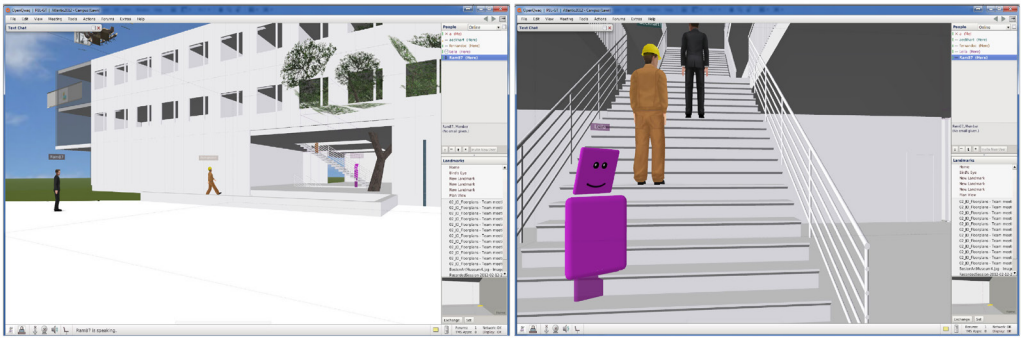
EXPLORING 3D ICC: RESULTS AND DISCUSSION

3D ICC in architectural design in AEC Global Teamwork

The survey amongst the students of AEC Global Teamwork of 2012, based on their experiences with 3D ICC, was answered by 23 students, 15 men and 8 women, mostly between the ages of 18 and 24 years old and not older than 34 years. They came from different universities all around the world (e.g. Stanford University, University of Puerto Rico, Bauhaus University, Warsaw University of Technology, University of Wisconsin-Madison, and University of Ljubljana). They came from a diverse cultural environment: US (10 students), Canada (1), Poland (1), Germany (3), China (2), Iran (1), India (1), Slovenia (2), and Puerto Rico (2). The AEC Global Teamwork is an interdisciplinary class; the students were architects (2 students), construction managers (5), structural engineers (9), life-cycle financial managers (1), MEP (1), apprentice (2) and owners (3). The team consisted of 6 members, each from a different discipline, which was a very important part of the design process. 67% of the students said that 3D ICC helped them by improving the knowledge about the other disciplines. 3D ICC has a huge potential of becoming a really useful tool for interdisciplinary design and collaboration between team members and investors.

Students very poorly knew any other virtual world, only 2 of them have used them before. For most students, this class was their first exposure to a virtual environment. In addition to 3D ICC, they knew of only a few of them: Stadia, Second Life, and Virtual Cube. We could see that virtual worlds are not really popular among the students. The survey is based on determining how the profession is faced with such a tool, how easy it is for using it, does it

Figure 3
Exploring architecture in 3DICC, walking through the model with your avatar.



aid in the design process, with which problems the students were faced, etc.

No one had used 3D ICC before the start of the AEC Global Teamwork class, and also later they used it rarely, averaging twice a month. Before they used it for the first time they were looking forward to using it (50%), they liked it from the first moment they saw it (13%), they didn't want to use it (13%), they thought it was an unnecessary additional tool, and some of them also found it a really difficult tool (8%). It is interesting to watch the change in students' opinion about 3D ICC between the beginnings and end of the AEC Global Teamwork class. At the onset, most of them (50%) were looking forward to using it, 3D ICC has been positively accepted by 63% of students and negatively by 34% of students. After using it 38% of students changed their opinion: 22% liked it more and 16% liked it less. The results of the survey show us that after the AEC Global Teamwork half of the students liked the digital tool and half of them didn't like it. The tool has both positive and negative impressions as expressed in student opinions about the tool shown in (Table 1).

3D ICC has been used for different purposes: 88% of students used it for walking through the model, 59 % used it for weekly meetings, where they shared presentation and information, some of them also for decision-making actions (35%) and real time actions like whiteboards, discussions, sketching (41%). They were exchanging visual- and non-visual information, voice and text, the information were available in 3D ICC all the time, and the team members were able to enter the collaboration space in 3D ICC and check the information they needed. The virtual room was utilized as the collaborative space where whiteboards were located; you could exchange both kind of information: visual and non-visual, e.g. numbers, density, text. It's like a real meeting place, where you walk around with your avatar and synchronously exchange all the information.

Walking through the model in 3DICC

From the architectural and urban design point of view we can conclude that the most valuable characteristic of 3D ICC is the option of walking through the model (88% students used 3D ICC for walking through the model and they liked this function the most).

40% of students used pedestrian view (the elevation from the ground 1.6m) and 40% the combination of all three views (pedestrian, intermediate, bird view) for moving through the 3D model. 20% of students used only intermediate view (the elevation from the ground 10m). These results could be linked with the students' cultural and environmental background: cultural context has a big influence on the students' perception and their way of using 3D models - it is especially important what their background knowledge is, what they are used to, etc. Students didn't use the orientation boards in the 3D model because they didn't know they could use them, and they didn't know exactly how to use them.

CRITERIA	3D ICC pros	3D ICC cons
Type of the tool	Online immersive collaboration and communication tool.	Only virtual, no face to face collaboration.
Open source/paying	Closed group of people.	Limited access – it is not free.
Requirements	No time, place limits - you can access it from wherever you want, whenever you want.	Needs a really good internet connection - if one person's connection is less powerful, the whole group suffers it and has to wait. Sound and connection problems.
Team members	Communication with physically co-located team members.	You have to arrange meeting in advance.
Collaboration process	Interdisciplinary collaboration. Anyone can revise and mark up documents interactively. Efficient meeting flow without changing controls.	There is no list of all the members of the collaboration process, you cannot send them message, only online participants are in the list.
Type of information	You can have multiple documents up at once. Combining visual- and non-visual information.	You can get information only if you enter the virtual environment - it requires some time.
Stage of the project	You can access the information whenever you want, through the whole stage of collaboration process.	It is useful only at the beginning of the project.
3D model	The walkthrough helps by making decisions. It helps architects, because they experience their building from the perspective of a user.	3D model has to be prepared in specific program (e.g. Sketch Up)
3D model - navigation	Predefined views.	Problems with navigation, problems with moving around with the avatar.
3D model - details	It helps to experience only conceptual 3D models.	It is good only for the simple building – more detailed models don't work well. Hard to get the real impression of the building if you don't have a lot of details.
3D model - importing models	You can import simple Sketch Up 3D model.	Problems with importing large 3D models, complex architectural forms and files cannot be handled.
Combining different tools	Only one tool at the same time: sharing information or walking through the 3D model.	Hard to switch between "walking through the model" and "sharing information" at the same time.

Table 1
The critical evaluation of the 3D ICC, based on survey and personal experiences.

Students pointed out that avatar mostly helped them to identify scale of building and spaces. 87% of students think that walking through the building with your avatar effects the perception of the space – comparison of avatar size to space.

Evaluation of 3DICC, based on the survey and own experiences

3DICC offers a variety of functions/elements, and the most popular functions among the students were walking through the building (82% students used it), using sticky notes (76%), sharing information (71%) and interactive avatars (71%).

The connection between 2D plans and 3D models was also discussed. 73% of students claimed that 2D plans don't illustrate the building sufficiently and you cannot imagine the place, and that 3D models build upon the 2D plans. 2D and 3D drawings need to be considered concurrently; the 3D model is critical in order to visualize the architectural model.

CONCLUSIONS

The Urban Experimental Lab (developed in previous research work) and 3D ICC both offer many benefits: the Urban Experimental Lab offers a real experiential mode by using 3D glasses; 3D ICC is a virtually based collaborative space for communication, collaboration and designing. The Urban Experimental Lab requires one to be physically located at a specific place (the lab is located in Vienna and a user must be physically present in this lab), whereas 3D ICC is available anywhere a reliable Internet connection

Table 2
The elements of DST and 3D ICC, based on survey and own experiences.

The elements of DST	**The elements of 3D ICC: (+) yes; (o) mid; (-) no**
List of participants: name, purpose of being involved, discipline, …	(-) There is only list of names of online members.
Text, communication tools - e.g. chat - simultaneously	(+) Individual and group chat.
Text, communication tools - forum, blog – non-simultaneously.	(-) You can chat only with the participants who are online at the same time as you are.
Analysis, presentations.	(o) Only if you posted them on the whiteboards.
Aerial photographs with street level imagery.	(-) No direct link between real-life street level and 3D model.
2D maps.	(o) You can post them on the whiteboards.
3D city models, 3D architectural models.	(+) Limits on the size of the model.
Visualizations, a realistic visual simulations.	(o) Conceptual simulations.
Various scenarios.	(o) Only one scenario at the same time, but you could switch between different scenarios.
Planning design aspect.	(+) Available from the bird view and intermediate view.
Experiential design aspect.	(+) You can experience the site with your avatar (pedestrian view).
Educational module.	(o) Learning takes place through direct interaction with other disciplines, there are no special educational modules

The characteristics of DST	The characteristics of 3D ICC: (+) yes; (o) mid; (-) no
Online, virtually based, with no geographic / location or time constraints.	(+) It needs a really good internet connection.
Easy to use.	(+) It needs some basic computer skills (move around with the avatar, import something on the whiteboards, share presentations,…). We didn't test the lay public.
Easy to navigate 3D models.	(o) Participants could have some minor problems, depending on previous experiences with navigation in 3D models.
Real-time information sharing and multiuser application.	(+) Easy to share information with other participants, simultaneously.
Understandable for different users with different knowledge background.	(+) We tested only professionals; we haven't tested lay public yet.
Cost-effective.	(-) It's not free, you have to pay for using it; limited number of participants, only invited participants can use it.
Reliable.	(o) There could be internet connection problems, also problems with larger number of participants and with larger 3D models
Transparent.	(o) Only registered participants could see and access all the information.
Save participants' time.	(+) Participants should have more time to express their opinion.
Interdisciplinary collaboration.	(+) Different disciplines (architects, CM, psychologist etc.) collaborate together.

Table 3
The characteristics of DST and 3D ICC, based on survey and personal experiences.

is available. As face to face collaboration and virtual collaboration are both really important and strongly connected, these labs could be seen as support for effective public participation in urban design. Moreover, urban planning, which has already been explored in the Urban Experimental Lab, could be combined with urban design, as planning is always connected with design and vice versa.

Positive sides of both Labs should be combined in a distributed lab. By using both labs, each for a specific purpose, their weaknesses and potentials should be improved. Both of these labs should represent a part of the DST and each can offer specific functions for the larger, overarching DST. These labs, combined with other tools from DST, are essential for establishing effective public participation in urban design.

FUTURE WORK

Many opportunities are seen for future development and research of DST for public participation in urban design, such as determining which tools are the most appropriate for the "life world", interdisciplinary collaboration between "life-world" and "planning world", etc. Future work will be focused especially on the context of countries with no strong tradition in public participation, and to the development of DST with the following characteristics:

Table 4
The comparison of Urban Experimental Lab and 3D ICC.

	Functions	Space/time limits	Avatar	Weaknesses	Potentials
Urban Experimental Lab	Public participation tool, offers a real experiential mode by using 3D glasses.	Physically situated in Vienna, you cannot use it wherever you want.	No avatar, 3D glasses, experiencing 3D model.	Physically located in one place.	Shifting between urban planning and urban design.
3D ICC	Virtually based collaborative space for communication, collaboration and designing.	No space limits, you can use it with good internet connection wherever you want.	With your avatar you can walk through 3D models.	Needs good internet connection and good software.	Using for urban design projects, not only architecture.

- Low-budget development of DST
- Free for using (no participation cost)
- Understandable for the general public
- Easy to use for non-technical users
- Available for everyone with regular internet connection
- No special hardware/ software requirements

The development of DST will be divided into the following steps:

- Development of the primary DST: based on the determination of the stages of the public participation process and urban design process, and specific digital tools, suitable for general public use at each stage.
- The research/ survey among the general public on different digital tools as part of DST: the survey will be made among three different groups of the general public, where different levels of information will be presented - first group: DST with little information, only final solution will be presented without additional explanation; second group: DST with some information, some proposals and final solution, without additional explanation; third group: DST with detailed information, different proposals and final solution with major additional explanation (causes and consequences).
- Based on this survey, we will define which tools are better/easier to use/more understandable for the general public, and how much information should be presented for effective public participation in urban design. Each digital tool will be analyzed and the importance of the tools will be also defined.
- The optimal DST will be developed: it will present the way of simplification of complex situations in modest economic systems with no tradition of participation.

ACKNOWLEDGMENTS

This research project is supported by the Slovenian Research Agency (ARRS) – the research is part of PhD studies at University of Ljubljana, Faculty of Architecture. It has been conducted in cooperation with the PBL Lab at Stanford University, AEC Global Teamwork class. We would like to thank Dr. Renate Fruchter for her assistance and for the opportunity to explore and work with 3D ICC, as well as to work with the students of the AEC Global Teamwork class.

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