SHAPING THE PACE - A DIGITAL DESIGN HEURISTICS TOOL TO SUPPORT CREATION OF URBAN DESIGN BY NON-PROFESSIONNALS

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ABSTRACT:

OVER THE LAST YEARS PARTICIPATION IN URBAN DESIGN AND PLANNING HAS GAINED INTEREST OF RESEARCH INSTITUTIONS, AND MORE PARTICULARLY ICT-MEDIATED CITIZEN PARTICIPATION IN URBAN PROJECTS. THIS PAPER IS EXPLORING A SOLUTION TO FOSTER CIVIC ENGAGEMENT IN URBAN DESIGN PROJECTS THOUGH AN ICT TOOL. WE PROPOSE A FRAMEWORK TO SUPPORT INTERACTIONS BETWEEN NON-PROFESSIONALS AND PROFESSIONALS THAT WILL EASE THE UNDERSTANDING OF URBAN DESIGN AND CREATION OF DESIGN PROPOSALS FOR NON-TRAINED PEOPLE AND, ON THE OTHER HAND, OFFER VALUABLE PROPOSITIONS AND INSPIRATION TO EXPERTS. THE PAPER IS FIRST OFFERING AN OVERVIEW OF THE EXISTING METHODOLOGIES AND TOOLS FOR PARTICIPATORY URBAN DESIGN, FOLLOWED BY A PRESENTATION OF A CASE-STUDY IN MARSEILLE. THEN WE PROPOSE THE DEFINITION OF A SCENARIO ALONG WITH A 3D MODELLING TOOL TO ENGAGE CITIZENS, AND FIRST RESULTS OF IMPLEMENTATION.

KEY WORDS: URBAN DESIGN, PARTICIPATORY DESIGN, CREATIVITY, CO-DESIGN, 3D MODELING, 3D COLLAGE

Introduction

Citizen participation in urban projects has imposed in the last decades as one of the key for success. It is clearly identified there is a lack of communication and collaboration between citizens and urban design experts which can lead to conflictual situations. The stakes of these projects are generally too critical to leave citizens voices apart. Urban designers and local authorities should not forget end users when designing public places in order to respect their quality of life and their 'ownership', in the sense of (De Lange and De Waal 2013), whom define it as "the right to act upon an issue…, a sense of belonging to a collective place". Moreover, regarding the nation legal framework of France (Article L103-2), participatory processes are mandatory for urban projects aiming to modify the living environment of citizens. As a result, a huge number of methodologies and toolkits have been developed lately, applicable to different steps of urban projects whether it is urban planning or urban design. Among these methodologies, an increasing number is focused on ICT-mediated citizen participation in urban issues which are "technology being addressed in such areas as governance, urban planning, information systems and interaction design, geography, citizen activism and community development" (Saad-Sulonen and Horelli 2010). The ambition of ICT tools is to provide a digital interface between urban design experts and citizens to let them collaborate and benefit from each other's knowledge.

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In the first section, we present a non-exhaustive state of the art of interactive and immersive tools for participatory design. We are mainly focusing on ICT tools. Second, we introduce a case-study held in the city of Marseille by Euroméditerranée, from which we have some first observations to share. The first two sections permit us in a third section to define a 3D modeling tool included in a scenario to involve citizens in urban design projects. Finally, we present first results of implementation of the tool and future work planned.

Interactive and Immersive tools for Participatory Urban Design

Urban design is a multidisciplinary process to create places for people and define their interactions with it. The work done is mainly related to public places like plazas, parks, open spaces or streets. Urban designers have to consider the needs, habits and customs of the different kinds of citizens that will use the place and imagine how they will experience it. In the other hand, economical, technical, political and sociological constraints must be considered during a short-range period of approximately five years, to come to a successful solution adapted to needs of everyone. Urban design is a complex process due to the important number of stakeholders, representing different interests: local residents, local authorities, associations, special interest groups, urban planners, urban designers, architects and more. More generally, we can simplify it in two distinct groups, professionals and end-users. Professionals represent urbanism experts and decision makers. End-users represent the people that will live with the newly designed place. On top of it, other issues as ecological challenges, social equity, culture, safety or water supply influence both the choices made by professionals, and the debate or needs risen by end-users.

To tackle the complex situation of urban design, many people worked on solutions to enhance stakeholder's collaboration. (Sanoff 2000) divided participation methodologies in urban planning and design into six main categories:

- Awareness methods: Inform people about the ongoing project and the main issues through exhibits, medias or walking tours.
- Group interaction methods: Better known as workshops, whether it is a focus group of meticulously selected people or an open session, it aims to solve a particular problem through series of working sessions mixing professionals and end-users.
- Gaming methods: Gaming methodologies places participants into a real-life context in order to solve an identified problem. The context is composed of participants, rules, constraints and methodologies. It can act as an educative process for citizens (and professionals), or as a way to solve issues between multiple stakeholders.
- Indirect methods: Questionnaires and interviews to grasp citizen's opinions and needs;
- Open-ended methods: Methodologies where participants have the less constraints to express themselves.
- Brainstorming methods

(Salter et al. 2009), (Saad-Sulonen and Horelli 2010) and (van Heeswijk 2017) demonstrate in case-studies that the usage of interactive and immersive tools in participatory planning is greatly approved by citizen. It helps to better understand the environment and issues for non-professionals but it also helps with connecting urban planning, community development and local governance. Interactive and immersive tools for participatory urban design can be defined as a group interaction method as well as a gaming method since from one side it connects experts and citizens whom can share experience and knowledge, and from another side it is a constrained environment with rules aiming to solve an identified problem. The gamification also enables an educative process regarding the local community. Digital tools are also a great support for co-creation and permit bottom-up (local) initiatives

supervised by top-down (institutions) rules to end with comprehensive and high-quality design propositions.

The following list presents a few existing interactive and immersive tools for participatory urban design:

- Interactor from (van Heeswijk 2017): A software assisting users in creating their own world in 3D for urban renewal, graphic art or design. It permits manipulation of 3D objects and textures. Objects can also be reworked through a 2D drawing mode where users can cut, paint or draw.
- Terf (3D Immersive Collaboration 2014): A multi-user virtual world used for long-distance collaboration of multiple stakeholders in companies, and more particularly construction management. It offers several points of view (first person, bird view, …) to manipulate 3D models (from a database or imported) or 2D images. Additional features are available like voice and text chat, webcam video, placement of 360 audio sources and in-game usage of programs like excel or word. It is also linked with external programs as SketchUp or ArcGis.
- The Betaville Project (Skelton 2013) offers a "massive participatory online environment for distributed 3D design and development of proposals for changes to the built environment". Multiple actors can be connected to the same virtual city and 'fly through it', model new structures, leave comments and engage a real-time discussion.
- (Westerberg and Von Heland 2015) promoted the use of the Mojang AB's video game Minecraft to build propositions in a virtual city using the Minecraft tools. Feedback tools such as commenting produced design proposals are also available.
- City I/O ("Changing Places" 2017) proposes a table with an urban model on top build out of Lego pieces. One can see the representation of the urban model in 3D on a screen that is directly linked to the physical model with extra textures added like trees and building shapes. Two modes of interaction are possible: one by adding/removing Lego blocks on the table and seeing the change on the screen; or by interacting with the virtual model for softer actions like changing building colors or adding a comment. The virtual scene can be visualized either on a TV screen or on a mobile device using an AR application.

Case Study: Euroméditerranée in Marseille, the Bougainville Park

1.1. Context

Euroméditerranée is a consequential project held in Marseille, France, focusing on urban planning and economic development since 1995. It has been initiated by French government, the city of Marseille, the region Provence-Alpes-Côte d'Azur and is financed by Europe. Euroméditerranée is the contracting authority responsible for urban planning, project management and funding of the different urban projects included in a 480 hectares area. Currently in the second phase of the global project, Euroméditerranée started working on the construction of an urban park, so called Bougainville Park, which is a 4 hectares terrain at a central position of the city: it is surrounded by a metro station, residential districts, joint ownership properties, an elementary school and a social housing building. It aims to be the "green lung" of the district which is more or less an industrial wasteland for the moment. The main desire of the team is to offer a high level of involvement of the different stakeholders and more particularly the citizens and local associations representing residents in order to get a consensus of opinion, and consequently a successful and cost-effective project that is representative of the local needs. The next section will present the participatory methodology used by Euroméditerranée to involve citizens in urban design.

Methodology

The project started in Mars 2016 with a clear view of the methodological approach, that is oriented on co-designing the park with workshop's participants and local residents, three years before the construction work starts. From this point, inputs data where already identified such as: a budget, existing infrastructures, a soil survey, flooding risks, pollution, topological information and social context. Two major objectives have been defined:

- The definition of temporary infrastructures in order to provide quickly some elements of the future park.
- The definition of a pre-planning in dialogue with participants and local residents, which will act as a recommendation list for the prime contract, a landscape specialist company. The objective is to define the features and uses of the park.

On this basis, Euroméditerranée proposed three phases before the start of construction:

- Pre-consultation: Workshops - Choices of the temporary infrastructure and first draft of a pre-planning intended for landscape specialists.
- Selection of the landscape specialist: 5 teams were in competition to gain the project. The citizens were not involved in the selection process, nevertheless, one of the mandatory requirements to win the competition was the acceptance co-design methodology.
- Consultation: Workshops in collaboration with the selected landscape specialists for three consecutive phases of urban design (sketch phase, pre-project phase, project phase).

Workshops

The co-design workshops organized by Euroméditerranée were inspired by the Participatory Prototyping Cycle framework (Sanders 2013). Different stakeholders, professionals or non-professionals, were melted to make and tell on key subjects like security, local culture, history of the district, and finally co-creation of design propositions. Enacting is not part of the current process. During co-creation sessions, several questions have been answered either with the usage of make tools, or through a simple vote. For instance, in order to gather the needs about the open question: 'What features should appear inside the park and where?', participants were working in groups of 5. They were given a 2D map centered on the future area of the park. The animators of the workshop (Euroméditerranée) also gave printed images of the most common features to each group (skate parks, public facilities, playgrounds, trees, …) along with scotch tape and scissors. Then each group had to stick the images on the map, at the position they want it to be. This process of course lead to debates inside each group. At the end of the session, a group by group presentation is made and the animator realizes a synthesis to identify the key needs of the citizens throughout the propositions. After each workshop, outputs are delivered to local authorities so they can identify early the main issues of the project.

Workshops observation

We participated to almost every workshop, hence we had the opportunity to analyze the benefits and limitations. The methodology used by Euroméditerranée confirm the theory that participatory urban design is helping with the acceptance, the ownership, of the project by citizens. The general feeling is positive and the multiple workshops created quality debates and propositions. This will permit professional to work in line with the needs of the inhabitants.

Nevertheless, the audience wasn't fully representative of every kind of inhabitant of the district, which is problematic because their needs aren't heard. Moreover, a huge turnover has been noticed between each workshop, except for a core group of approximately five persons. The overall feelings of the citizens about the participative methodology was mixed, some participants had their trust in the project enhanced, and others were frustrated because it was too long, or because of some political announcements made late that created a feeling of treason. Regarding the co-creation process, we identified some drawbacks that will lead us to the definition of a numeric tool to support participatory urban design:

- Participants have a wrong understanding of spaces and relief,
- Printed images are not convenient when looking for a particular feature/atmosphere,
- Understanding of technical, political and financial constraints could be enhanced,
- Collaboration can be enhanced between professionals and non-professionals

Definition of a 3D Modeling tool to engage citizens and enhance their creativity

To answer the drawbacks listed previously, we propose an interactive and immersive digital tool to help citizens' understanding, enhance their creativity and their knowledge of urban design constraints. Based on (Salter et al. 2009), (Saad-Sulonen and Horelli 2010) and (van Heeswijk 2017) observations concerning the usage of digital tools in urban design, we choose to create a 3D modeling tool in order to support spaces and relief understanding. Alike the participants of Euroméditerranée's workshops, the users of the tool have access to a large digital database of categorized 3D models, meaningful for urban design. Inside the database, one should be able to find models from a complex playground to a basic shape and manipulate it easily: select, move, rotate, scale, deform and delete. Some characteristics of the model could also be changed as the color or the material.

To support creativity, we propose a 3D collage metaphor to support the divergence phase of creation. A user should be able to start from an existing model and create a new one by cutting it, merging it with another model and resize it. Hence, we add 3D cutting and merging metaphors to our tool palette.

Such a tool should provide a friendly user interface for non-professional, as well as background processes producing statistics of usage for professionals and help them in decision making. To support collaboration, we propose the use of an interactive table upon which multiple participants could interact with natural gestures instead of being alone in front of a computer using a keyboard and a mouse.

To enhance spaces and relief understanding, we propose to implement an immersed visualization mode, in a 1-1 scale, thanks to a virtual reality headset. Thus, participants would be able to walk through their design proposition and fully experience the place. For instance, they could realize that a building isn't well positioned because it is hiding a nice sea-view. We can also introduce an audio feature to improve the understanding of the impact of a building regarding an existing noise source, a street with heavy traffic for example. A collaborative aspect is present here as well through the possibility to annotate the proposition and leave audio comments, or emoticons representing a feeling.

Finally, to improve citizen's understanding and bring an educative characteristic to the tool, we want the use semantically enriched 3D models, in the manner of (Panagopoulos, Andrade, and Barreira 2009)**.** They made research to embed meaningful data in 3D models such as economic, legal or social data. This methodology is useful for both experts and amateurs. Of course, such a feature should let users enrich information themselves. For example, information relative to the noise approximately generated by a 3D model can help

user to place things wisely, whether it is a highway or a swimming pool. Another interesting extra information would be a categorization of models and newly created (cut and paste) models. By categorization we mean giving an explicit functionality to each model, like 'this is a basketball terrain' or 'this is a bench'. This feature will help professional in decision making thanks to data aggregation. For instance, if every object of the urban design proposal is well categorized, analytics can be made to evaluate, among every proposal, the percentage of citizens interested in a football terrain and where they want it to be. Another example of semantically enriched 3D models is the definition of constraints inside the workspace: we want an admin user to be able to define places where no objects can be dropped by drawing, as it is illustrated in (figure 1). The user can only place objects inside the red grid-pattern. The goal is the creation quality urban propositions by limiting users' possibilities.

To summarize, we define two different workspaces, leading to an iterative process of work-visualize-rework:

- The **creation workspace**: Usage of an interactive table. It is composed of three data layers:
  - Map layer: Geometric data used to generate the workspace.
  - Semantic layer: On top of the previous layer a user can add constraints and useful information.
  - Creation layer: On top of the semantic layer, a user can manipulate and place 3D models and text comments.
- The **immersed visualization workspace**: usage of a virtual reality headset to walkthrough the proposition realized in the creation workspace. Possibility to add comments.

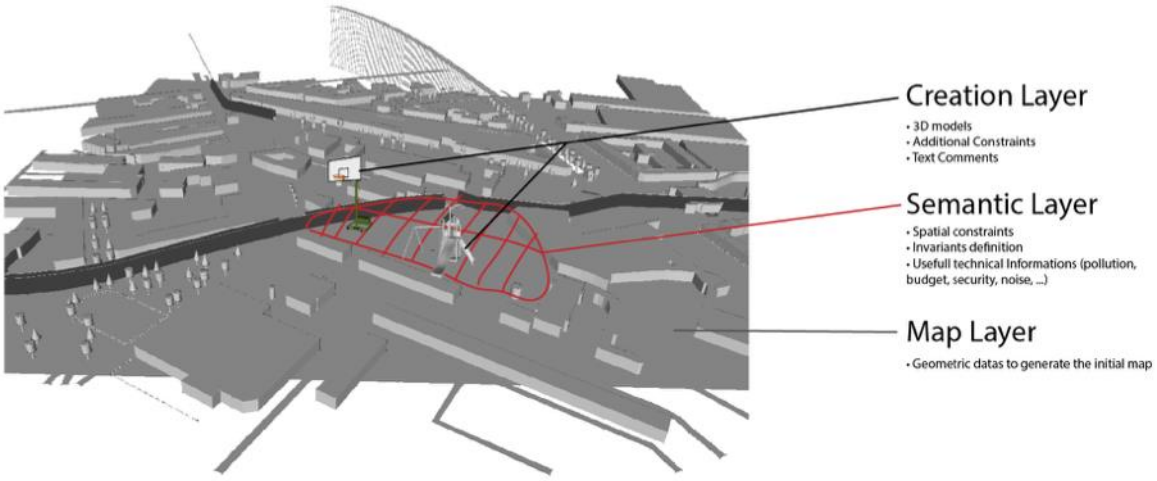

Figure 1: Data layers of the creation workspace

Scenario of usage

The tool is intended for urban design projects accepting participatory design concepts. During the sessions, multiple stakeholders can be involved, this is why we have to define clear roles and responsibilities regarding the usage of the tool. We identified four different roles: the contracting authorities, the project supervisors, the animators; called the professionals; and the citizens. Their responsibilities are detailed in (figure 2). Just like Euroméditerranée's methodology, the tool shall be used along multiple workshops carried out a long while before the start of construction work. The following is a proposition of hypothetical steps that illustrates the usage of the tool for an urban park:

- Step 1: An initial brief is made between professional.

- Step 2: Pre-configuration of the tool between professional. Here, the initial map would be imported as well as the identified constraints/information. The database shall be filtered at this step if necessary, to avoid unrealistic proposition.
- Step 3: Definition of additional constraints and rules thanks to local residents' knowledge and culture.
- Step 4: Functionality definition workshop, what functionality should appear and where? People are divided in multiple groups and make 3D propositions with the interactive table. Each group can use the immersed visualization workspace the validate the proposition or refine it if necessary. At the end of the session, participants can use the tool to present, debate and choose the final proposition.
- Step 5: Zoom-in workshop on each functionality to work on their shape in collaboration with project supervisors. Example themes: "The shape of the trash bins", "The shape of the fountains".

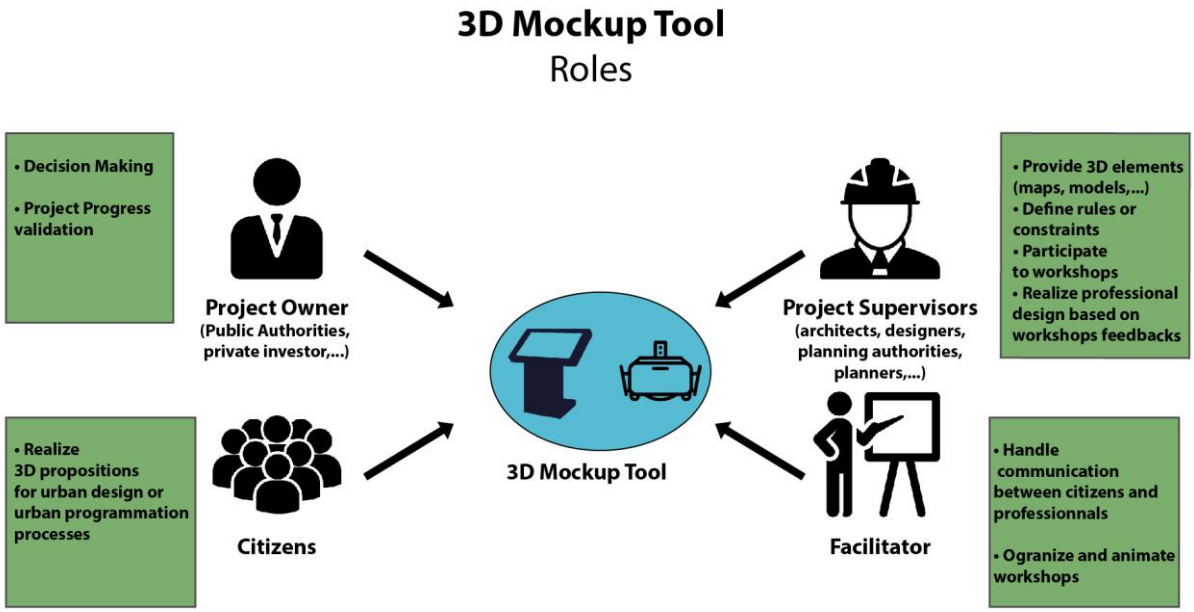

Figure 2: User roles

First results of implementation

Implementation effort has already been made regarding the tool. We are using the cross-platform game engine Unity to create an interface that will suit for both interactive table and VR Headset. We implemented a draft version of the interface (figure 3) which permit to navigate in the virtual world, zoom, rotate and tilt the camera. We also imported a 3D City model (.obj file) generated from OpenStreetMap data (.osm file) with the use the open-source third party software OSM2World (http://osm2world.org/). We also implemented an interface to drag and drop 3D objects from a carrousel menu accessible in the virtual world. First test with immersive view has already been made with a Google CardBoard, using Google's VR SDK for Unity. It clearly appears that mobile phones are not powerful enough in terms of graphic rendering to provide a fluid and pleasant experience to users: the video is not fluid gazing around, which can lead to motion sickness.

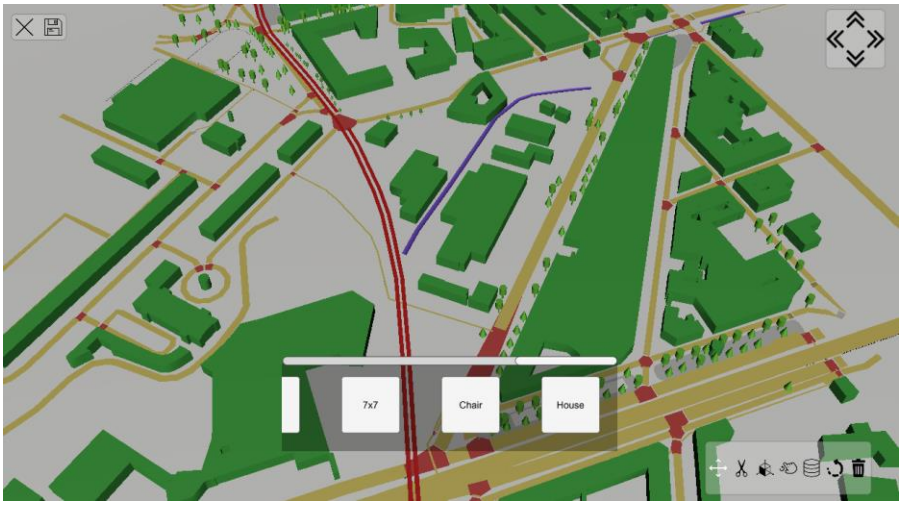

Figure 3: Draft user interface of the tool

Finally, we worked on a virtual mesh cutting algorithm, necessary to implement the 3D collage metaphor. We are relying on an open-source library called CGAL (http://www.cgal.org/) written in C++, which is communicating with Unity as an external plugin. CGAL permit us to manipulate 3D models as triangulated meshes and apply mathematical operation on it, and then send it back to Unity when the computation work is finished. We decided to implement the cutting metaphor as follow: a user draws a line on the desired element to cut, then a triangulated surface is generated from this drawing that intersects the shape with its current position. Finally, the cut is computed by looking for the intersection points between the target model and the surface. Then two different models are sent back to Unity.

Future work and conclusion

This paper presented the definition of a 3D Modeling tool to engage citizens in urban design projects and foster collaboration between experts and amateurs. The tool has been defined on the basis of observations taken during Euroméditerranée's workshops, our case-study. More observation opportunities will come in the next 2 years until the construction work starts. It will permit us to realize tests and refinements of our tool. To do so we intend to organize workshops mixing citizens and professional to challenge the functionalities we specified, but also to work with test groups on subjects such as the interaction metaphors of the interactive table. Specific workshops will be realized focusing either on experts' benefits or citizens'. Moreover, we intend to realize questionnaires to grasp users' feelings about the experience we propose. Finally, huge effort will be made on implementation to provide all the functionalities described in this paper and offer a collaborative, intuitive, interactive and educative experience in urban design.

REFERENCES

1. 3D Immersive Collaboration. 2014. "Immersive Terf." http://3dicc.com/.
2. "Changing Places." 2017. Accessed July 1. http://cp.media.mit.edu/cityio/.
3. Heeswijk, Jeanne van. 2017. "Face Your World." Accessed July 11. http://www.faceyourworld.net.
4. Lange, Michiel De, and Martijn De Waal. 2013. "Owning the City: New Media and Citizen Engagement in Urban Design." *First Monday* 18 (11).
5. Panagopoulos, Thomas, Rita dos Reis Andrade, and Ana Paula Barreira. 2009. "Citizen Participation in City Planning and Public Decision Assisted with Ontologies and 3D

Semantics." *CISTI 2009 - 4ª Conferência Ibérica de Sistemas E Tecnologias de Informação*. Associação Ibérica de Sistemas e Tecnologias de Informação, 167–72. http://sapientia.ualg.pt/handle/10400.1/3982.

6. Saad-Sulonen, Joanna Catherine, and Liisa Horelli. 2010. "The Value of Community Informatics to Participatory Urban Planning and Design: A Case-Study in Helsinki." *The Journal of Community Informatics* 6 (2). http://ci-journal.net/index.php/ciej/article/view/579/603.
7. Salter, Jonathan D, Cam Campbell, Murray Journeay, and Stephen R J Sheppard. 2009. "The Digital Workshop: Exploring the Use of Interactive and Immersive Visualisation Tools in Participatory Planning." *Journal of Environmental Management* 90 (6): 2090–2101. doi:http://dx.doi.org/10.1016/j.jenvman.2007.08.023.
8. Sanders, E.B.-N. 2013. "Prototyping for the Design Spaces of the Future." Valentine, L.
9. Sanoff, Henry. 2000. *Community Participation Methods in Design and Planning*. John Wiley & Sons.
10. Skelton, Carl. 2013. "Soft City Culture and Technology." In . Springer.
11. Westerberg, Pontus, and Fanny Von Heland. 2015. "Using Minecraft for Youth Participation in Urban Design and Governance."