

Future Illustrative and Participative Urban Planning

Developing Concepts for Co-creation

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Abstract – The starting point of this paper is to develop and experiment with new participatory web-based design services to visualize future urban environments with mixed reality and other content technologies. We have created new visualizations and virtual environments by mixing panoramic imaging and architectural drawings of future urban plans. In order to involve citizens in urban planning projects, we have also implemented user-centred interactions such as questionnaires and commenting tools. In this paper, we discuss how new visual web-based service concepts using mixed reality technologies can be used for future participatory urban planning. To ensure political, economic and social relevance of the developed urban planning service concepts, we have conducted an interview study that clarifies qualitatively, how political decision-makers and other stakeholders perceive the new digital concepts. In addition, we have piloted our participative urban planning demo with users. In the political decision-making processes, the new tools were expected to bring certainty and eliminate uncertainty. New participatory design tools for urban planning should also be efficient at collecting and processing user feedback and other data.

Keywords-visualization; 3D graphics; urban planning; panoramic imaging; co-creation; participatory design

I. INTRODUCTION

In recent years, many cities and communities have started to pay attention to openness and transparency of decision-making for citizens. For instance, when planning new important urban environments, such as public buildings, energy systems and traffic solutions, different kinds of collaborative workshops are organized for residents to share information on the plans and discuss their impact on the environment. Opening complex urban planning processes and using participatory design or open innovation tools can generate new ideas and change the decision-making to make it more interactive and integrate company representatives and citizens [1][2][3].

In this paper, we discuss how new visual web-based service concepts using mixed reality technologies can be used for participatory urban planning. With mixed reality we refer to the merging of real and virtual to produce new environments and visualizations. Our aim is to develop new mixed reality solutions to visualize future urban environments by, for instance, mixing panoramic imaging and architectural drawings and sketches of future city building projects. With these mixed reality services, we aim to make the plans more visual and understandable to different stakeholders. Our aim is to be able to visualize and discuss

the impacts of future building projects and traffic solutions on their environment at the early stages.

Recently several mixed reality technologies including smart phone augmented reality systems have been developed to open up and support stakeholders' participation in urban planning [4][5][6][7][8]. However, mixed reality technologies for urban planning are often developed separately from web-based open innovation and advanced user interaction tools. Our aim is to develop these both under the same service so that up-to-date, visual information should be easy to find and leaving comments would be possible for citizens and other stakeholders. The developed service can be used to promote communication between stakeholders and make decision processes more efficient. By producing easy-to-understand visualizations, it will be possible to view and compare alternative plans and involve citizens and other stakeholders in the planning of the ecology, functionality and quality of their living environments. In addition, we are interested in to find out, what kind of set of participatory concepts support co-creation and stakeholders' participation in urban planning. In what kind of digital environments and public places they should be situated so that users will notice them? What kind of devices and interactive user-interface concepts support participation?

As many new approaches and procedures demand political and social acceptance, in this paper, we will first explore qualitatively how political decision-makers, municipal officials and companies perceive new visual and participatory urban planning service concepts. We interviewed these stakeholders during 2013. The central theme in these interviews was how these new digital tools support decision-making processes and citizen participation in urban planning and how digital urban planning products and services should be developed. In addition, we have conducted preliminary user studies with participation in a small local community in Western Finland, where several environmental urban planning projects are taking place. These projects include, for instance, international airport area development, supplementary construction, green design and planning of noise barriers. Through interviews, queries, demos and case pilots we gained an understanding of how users perceived this kind of participatory mixed reality services in real urban planning projects and how to develop the service further for massive, large-scale participatory projects.

This paper proceeds as follows. In Section II, we discuss the participatory approach to urban planning. In Section III, we describe our research setting. In Section IV, we present

the three different co-creation concepts to urban planning which were used in the interviews of political decision makers. In Section V, we look over the feedback from political decision makers and other stakeholders. In Section VI, we present our participatory urban planning service demo. Section VII describes citizens' feedback on participatory urban planning demo. Section VIII presents our conclusions regarding the role of participatory services in urban planning and we also discuss our future work.

II. PARTICIPATORY APPROACH TO URBAN PLANNING

In many research fields, such as human-centred design, marketing and service design, the emphasis on user involvement has shifted from treating customers, users and citizens only as passive research objects to taking them into the design process as active co-creators, thinkers and partners. This view has been given a different name and a slightly different emphasis in definitions. Two widely adopted perspectives have been *participatory design* and the *user-centred approach*. Participatory design has often been defined as a shift in attitude from designing for users to one of designing with users. However, it is quite difficult to draw the line between user-centred design processes and participatory experiences. Participatory design is not simply a method or set of methodologies but more of a mind-set and attitude to people. The belief is that all people have something to offer to the design process and that they can be both articulate and creative when given the appropriate tools with which to express themselves. Moreover, participatory design is an approach in which potential end-users have a critical role in the outcome [9][10].

According to service business research, organizations and companies can compete through *co-creation*, innovating value with customers or user communities instead of just doing things for customers [11].

In addition, service business is different from simply providing goods or products. In service business, the value comes, especially, from the ability to act in a manner that is beneficial to the other party. "*Value is subjective and always ultimately determined by the beneficiary, who in turn is always a co-creator of value.*" [11]

In urban planning, reaching out and engaging citizens and other stakeholders in making plans is a cornerstone of good practice. Moreover, the collaboration between all the stakeholders in the process – citizens, planners and decision-makers – is the context in which plans are made. The final outcome and plans emerge from the interaction between all the involved stakeholders. The *Open innovation* approach, which comes from the business strategy field, can therefore add valuable insights into service development and enrich a company's or organization's knowledge [12]. In addition, the *crowdsourcing* method can be used with web-based solutions to create the best solution when widespread experimentation and large-scale feedback is needed. Yet, attracting a diverse group of citizen participants can be challenging, since citizen involvement is often a leisure-time activity and competes with other ways of spending time. Developing new visual

tools, such as smart-phone augmented reality for public participation in urban planning, can increase users' willingness to participate in urban planning events. At least new AR visualisations can help people to visualise the intention of the design better than with traditional drawn plans [6][4]. Moreover, digitizing services and publishing them on-line makes them more visible to citizens and allows them to participate any time they want. Participatory services should, above all, provide a shared environment for productive, collaborative development [13].

Social media and social applications have been used for open innovation in land use and urban construction projects. A visualized map enables to collect citizens' comments and development proposals. The growing knowledge and power of end users, sustainability requirements and financial restrictions create challenges for traditional urban planning methods. Many industry examples have demonstrated that open innovation and social media extend the traditional data with citizen participation feedback [14]. Web-based public participation and proper technologies can help to involve new groups of citizens in the planning process [15]. Participatory design approach in urban planning can use different set of technologies and methods to create a shared vision of an urban project. For instance a portable lab, called MT –Tent, using Mixed Reality has been used for participatory design on site [3].

All the above-discussed approaches – participatory design, user-centred approach, co-creation, open innovation and crowdsourcing – are relevant and add value to the development of our web-based participatory urban planning design service. However, it is still unclear how critical numbers of representative citizen groups can be encouraged to participate in urban planning and be motivated to make important contributions.

In the next section, we will discuss in more detail our approach to participatory urban planning and how decision-makers and other stakeholders can acquire these new service models and concepts.

III. THE RESEARCH SETTING

The aim of the interviews was to find out how local political decision-makers, municipal officials and companies perceive the need to develop current urban planning methods. The participating political decision-makers were members of environmental or technical boards with a central role in organizing services related to urban planning. The political decision-makers were selected from all the parties presented at these boards. We selected both genders, as well as experienced and new decision-makers who were in their first term on the Board of Governors. We also interviewed five companies, which represented building, architecture and visual Internet-based services.

We used half-structured theme interview method to discuss and collect feedback from new digital visualization and participatory design tool concepts. The interviews took approximately two hours and they were taped and transcript. At the beginning of the interviews we discussed the recent urban planning practices and their challenges.

The central theme in these interviews was how these new digital tools and services should be developed to support decision-making processes and citizen participation in urban planning.

In the interviews, we presented three future urban planning service concepts (described in Section IV). Our aim in the interviews was to place the urban planning concepts in order of importance so that we can choose the kinds of digital urban planning concepts that should be developed in the near future. The services should inspire users and arouse interest in developing better and more versatile living environments. We also aim, through visualizations, to produce better material for decision-making so that it will be possible to view and compare different options.

Moreover, we conducted our first user pilot in a small local community in Western Finland. We wanted to ascertain how to support citizens and other stakeholders in involving them planning of the sustainability and quality of their living environments through digital services. We wanted to find out how our demo service suited this purpose, and how to develop it further, especially trying to understand user values, needs and preferences in participative urban planning. We first conducted a user study in a small village near the highway where a new noise barrier is planned to protect inhabitants from noise pollution. There are only town houses in this area, and residents of the village consisted mainly of families with children and older people. Our aim was to reach residents living near the noise barrier to respond to our inquiry, so we published an online questionnaire link in a municipal community web portal, community Facebook site and in a local newspaper. The query was available over a period of a few weeks in March and in April 2014.

The questionnaire included both multiple choice and qualitative open-ended questions. The survey included basic background information questions, and focused on topics such as clarifying requirements for a future community planning, perceptions on visualisation and participation services, and most preferred places and information channels and devices for utilising a future participatory urban planning service. Users were also asked to try out the web-based pilot service, which mixed panoramic imaging and architectural drawings of the planned noise barrier near their homes. The demo illustrated noise barrier building stages and the area five and twenty years later.

IV. THREE APPROACHES TO PRESENTING FUTURE URBAN PLANS

In the beginning of the interviews, examples of three different ways of demonstrating future urban plans were introduced. The examples helped in figuring out the idea of new visual approaches to community planning and aimed to facilitate feedback and ideas related to the different approaches. Finally, the participants were asked to prioritize the three approaches and state reasons for their preference order.

A. On-site mixed reality mobile tools

We aimed to describe possibilities of visualizing urban planning solutions with smartphones and tablet devices. The idea is for users to be able to move around the surroundings under development and see merged virtual 3D objects and a camera view on a handheld device (Figure 1). The virtual building objects will be located in their intended locations. The demonstrated mobile mixed reality tool for architectural sites has been described and evaluated in earlier studies [4][5].



Figure 1. On-site augmented reality solution

B. Interactive public screens

The other presented approach was interactive public screens with mixed reality features (Figure 2). The screen shows areas under development, and new digital visualizations are embedded into the views. Users can manipulate the views and community plan options using their gestures or the touch screen input method. Gesture recognition would be implemented with the help of depth camera sensors. This kind of public screens can be located next to the area, in shopping centres or in municipal office buildings.



Figure 2. Concept of an interactive public screen with AR features

C. Off-site interactive design tables

Thirdly, the users can explore urban planning solutions using interactive and multiuser design tables (Figure 3). The tables can be a combination of tangible objects or 3D printed building models, projected information and camera recognition systems. The users are able to browse different urban planning options or manipulate objects on a table, and

they can receive more information using, e.g., pointing, touching or gestures.

Dalsgaard and Halskov have developed and studied a tangible 3D table-top system in which physical objects on a table can be recognized [7]. The same kind of table-top systems in urban planning include the Spatial Design Table and the Bionicle Table [8][16]. They both enable 3D visualizations showing how different buildings look in their environments. The user moves and indicates building options using AR markers on the table.

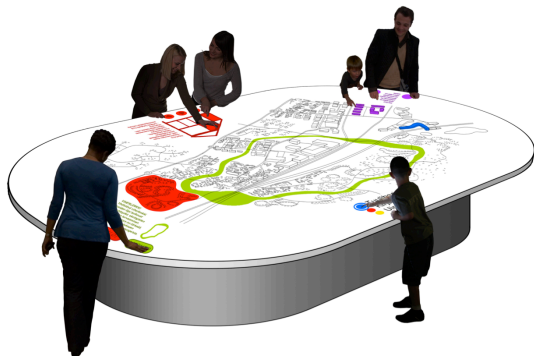


Figure 3. Visualization on an interactive design table

V. FEEDBACK FROM POLITICAL DECISION-MAKERS

Altogether, 13 political decision-makers and municipal officials took part in the interviews. All the interviewed decision-makers attached great importance to developing methods to illustrate urban plans and support citizen participation in future urban planning. According to the interviews, the recent urban planning approaches could be improved by paying more attention to the availability of information and inclusion of citizens at the right time in the urban planning processes.

Recent participatory methods in urban planning projects cannot be applied to all citizens as such. For instance, public workshops are connected to a certain time and place, and busy working families and younger age groups, in particular, are often left out. Young segments have showed more interest in on-line surveys, but reaching younger age groups and getting them to become actively involved and to participate in urban planning presents a clear challenge.

The interviewed politicians perceived the development of information processes and increasing awareness of on-going projects and statements as especially important so that all citizens would have the opportunity to obtain up-to-date information on important projects if they wanted to. The information on on-going urban planning projects is usually available on the city net portal or in paper format at the municipal office. However, not all citizens are capable of acquiring the necessary information. Participation requires personal interest, activity and information seeking to be possible. Versatile information channels can support

information seeking, sharpen communication and lower the threshold for participation.

Presenting alternative plans through visualizations would also be important, and plans that are too detailed and complete should be avoided. Overall, the proliferation of new technologies in participatory urban planning is affected by, among other things, the maturity of the technological solutions, implementation expenses, acceptability and ease of use.

When citizens and other stakeholders are asked for feedback and comments on urban plans through, for instance, on-line surveys, the response material needs to be processed, analysed and reported carefully to urban planning officers, planners, decision-makers and citizens. Through on-line surveys, it is easy to access large populations. However, analysing large-scale survey material takes time, work and recourses. Processing large-scale material also demands good and suitable tools.

Of the three presented technology approaches, the decision-makers appeared to prioritize lightweight, web-based mobile solutions, which are suited to illustrating different alternative options in urban planning. Other presented solutions, such as the interactive design table and public screens, were also seen as viable in the long run. They were seen as suitable for large urban planning projects and as tools for both decision-makers and citizens. Public screens were seen as effective attention grabbers and information channels: they were considered a good way of spreading knowledge of urban planning projects. However, screens were seen as less suitable for collecting feedback and ideas from the general public. It was assumed that people would be hesitant to use a technical device that was for public use. The actual participation and feedback would happen via a personal mobile or other personal device, or in a more closed facility organized by the city or community. User interfaces that recognize gestures were seen as better suited to public spaces than touch screens. The interactive design table was thought suitable for concretizing urban plans by decision-makers and active citizens who wanted to participate in urban planning.

VI. PARTICIPATORY URBAN VISUALIZATION SERVICE: ILCO CITIES

Based on the interview results and concept design outcomes, two demonstrators were developed. These ILCO Cities demonstrations illustrated different community plans.

Encouraging residents and other stakeholders to participate in urban planning is a fruitful approach in many ways. When the architectural sketches are presented in illustrative and visual ways, the projects are especially likely to proceed fluently with fewer complaints to slow down the processes. When possible problems can be detected at an early stage and costly changes avoided, the final outcome of the urban planning is usually of better quality.

The stakeholders in urban planning and the users of the new community planning approach can be categorized into three groups: 1) decision-makers, 2) companies, and 3)

citizens (Figure 4). Companies are counted as actors in the building industry, e.g., architectural and construction business. Local politicians and city officials are decision-makers who prepare initial plans and processes of community development programmes and activities. Citizens can be called end-users of local community plans. They live and work in the planned environments. All these groups should have transparent, real-time and equal communication of commonly shared living environment design solutions. We have divided the process into three main areas that should be taken into account when creating and implementing the future community plan. The first phase is visualization. The citizens and decision-makers are not usually urban planning business professionals and do not have the capabilities to perceive 2D architectural community or building plans and conceive their effects on the surroundings. On the other hand, building industry actors need to have impressive, cost-effective and easy-to-use tools to represent their plans or ideas. The participation step should offer equal and real-time ways to analyse, prioritize and comment on plans. Citizens, in particular, need to be encouraged and motivated to give their feedback, which requires open information sharing via commonly used media channels and technologies. The final outcome, influence, meaning democratic decisions and diverse possibilities to affect plans, can be achieved. It may enable or demand changes to existing community plan processes. In an ideal case, this kind of advanced operational model can streamline ways to consider, effectively and transparently, the needs and feedback of different stakeholders, and in this case officials proceed faster in municipal decision phases.

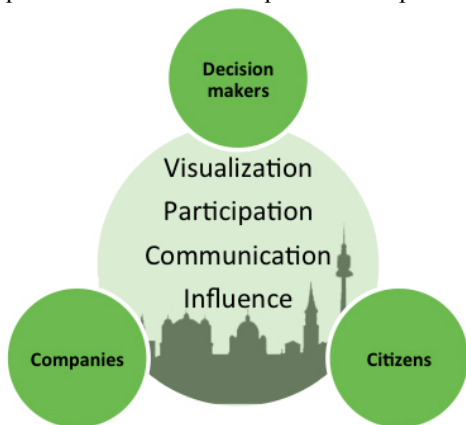


Figure 4. The ILCO Cities service model shows collaboration between different stakeholders in participatory urban planning processes

Two ILCO Cities service demonstrators were developed to concretize the presented service concept. Both demonstrators are related to real on-going community planning cases in two municipalities in Finland. Technically, the demos run on web browsers of different devices such as tablet devices and PCs.

First, the ILCO Cities demo included options for a new congregation building in a small municipality, Lempäälä in Western Finland (Figure 5). The original building was a flat single-layered white building from the 70s, and the future options included two modern, higher and multi-layered architectural plans. The users were able to investigate the following alternatives:

- Current building
- Building model with dark wooden walls and a copper roof
- Building model with white plastered walls and a painted roof

The building models are integrated into the panoramic images of the surroundings close to the congregation building and the user can change view freely in panoramic images. Overall, three panoramic images were taken and used in the demo.

The users change building options by selecting the required model from the menu on the right (see Figure 5). Panoramic image viewpoints can be changed using the eye icons on the screen. Questionnaires are available on the left side, and the user can show or hide the on-line questionnaire. The existing congregation building is architecturally protected, and ILCO Cities aims to generate a discussion on alternatives for the current situation.

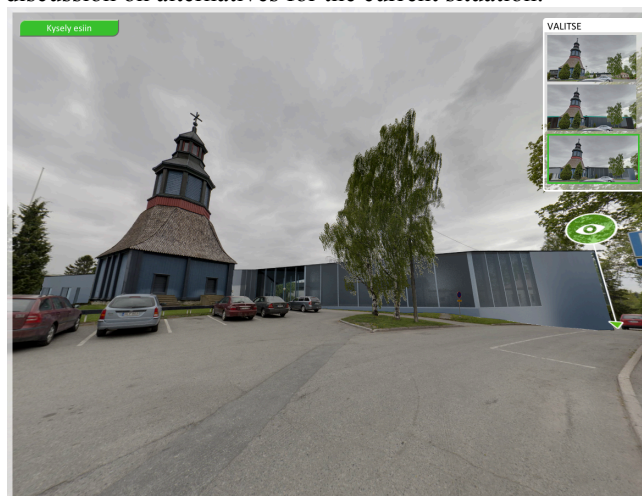


Figure 5. ILCO Cities building options visualization

The second, ILCO Cities demo visualized noise barrier plans between a highway and a field in Pirkkala municipality in Western Finland (Figure 6). The main goal of the demo is to illustrate the following phases of the upcoming work:

- Recent surroundings
- Drawings of noise barriers
- Computer graphics of ready-made noise barriers
- Situation after twenty years when plants such as trees have grown up

The panoramic views were taken from four locations around the planned noise barrier, and the user can change the viewpoints.

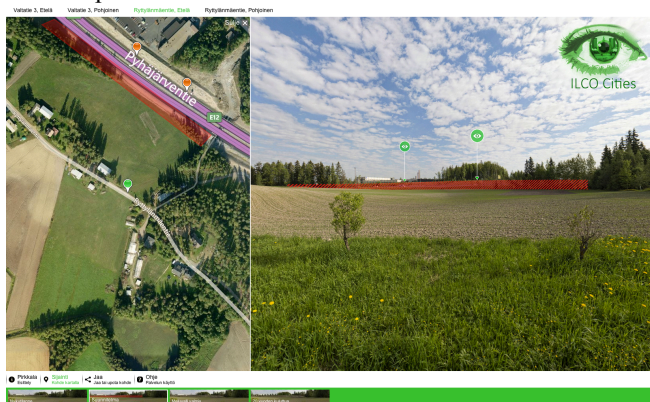


Figure 6. ILCO Cities noise barrier plans illustration

Questionnaires, a map and extra information on the noise barrier can be seen on the left side of the user interface. The user can also see the viewpoints and noise barrier drawings on the map.

VII. CITIZENS' FEEDBACK ON PARTICIPATORY URBAN PLANNING DEMO

In all 25 respondents (12 males, 13 females) completed the questionnaire. Most of them belonged to the age group from 35 to 44 year olds. Their attitudes towards environment-related development activities were mainly very positive.

Respondents were mainly interested in the projects that are linked to their neighbourhood area, somehow reflect their everyday lives or projects that are supposed to have large, revolutionary influences not only geographical but also at the societal level. At present the information of ongoing projects is sought mainly from municipal's websites (76%) and from the local newspaper (80%), which both are listed as municipal official communication channels. Only three out of 25 have visited an official bureau or participated in an event organised by municipal to inform citizens about new projects.

The results of the survey were very much in line with the issues discussed with decision makers. In open-ended questions urban planning information was complained of as being difficult to find, and the participation process is perceived as being too complex. Opportunities to interact and be heard were claimed to be very challenging. It was even said that citizens are given an opportunity to give their feedback, but that feedback is rarely really taken into consideration. Respondents demanded involvement at an earlier phase of the planning process, more alternative solutions to be compared, clear timetables and information on how the process is progressing.

General attitude toward presented demonstration was very positive. The service was found to be interesting, useful, easy to use, and it was thought to bring something new into

urban planning and citizen participation. Despite of positive attitude, a common concern related to new participatory methods used in urban planning was, how the results will be used and will there be a real impact.

Participants were asked how the visualisation service succeeded in visualising the example case. Figure 7 indicates respondents' feedback related to how well future visualization and participation tools are applicable for different municipalities' environmental development domains.

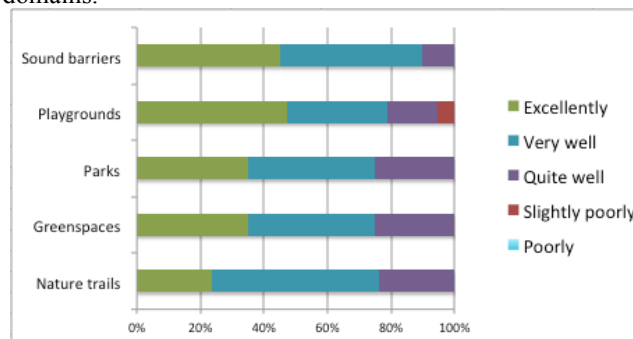


Figure 7. How well does the service suit different environment and sustainability projects?

People are willing to search information and explore the material at home or other private premises. Public spaces such as shopping mall or railway station were seen the most unlikely contexts to take part in urban planning. Lack of privacy and office hours were mentioned as major barriers. Figure 8 shows more detailed, how users would like to have access to participatory urban planning service. They preferred mobile devices as a convenient way of using the services in local environments. However, users reflected that they would be quite unlikely to use it from a municipal service point and also municipal public events and notices in public transport were quite uncertain or unlikely places to access and use these services. In open-ended questions, users reflected that it would be problematic to give their opinions in such public places, if they wanted to maintain their privacy.

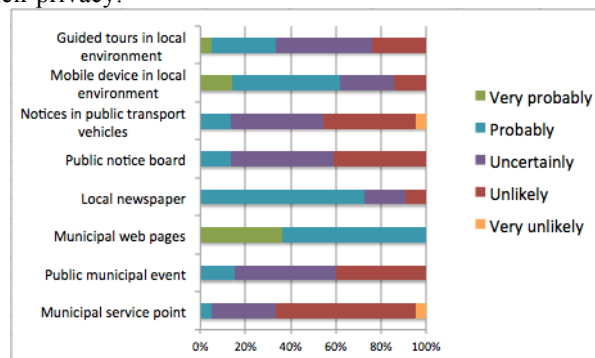


Figure 8. Where would users like to have an access to participatory urban planning service?

VIII. CONCLUSIONS AND FUTURE WORK

In this paper, we have discussed how new visual web-based service concepts using mixed reality technologies can be used for participatory urban planning and co-creation of future living environments with different stakeholders. The new tools were expected to bring certainty and eliminate uncertainty in the decision-making processes. The interviewed decision-makers reflected that they often receive urban plans that are too prepared just to accept or reject. They wanted real team play instead and more open discussions with different stakeholders. Illustrating and visualizing urban plans was thought to enhance the quality of the decision-making materials. The new web-based visualization services were seen as furthering the perception of entireties, complex dimensions, measures and impacts, which were seen as difficult to figure out at present. The new tools were expected to make it possible to illustrate and compare different options and their direct and indirect impacts on the environment. In addition, they would offer users the option to give feedback and share their ideas at any time of the day they wanted. This would be useful, especially in trying to target younger age groups that rarely participate in workshops organized by communities.

A good option to demonstrate future urban plans to different stakeholders is lightweight mobile solutions, which can be taken to different places and situations at any time and used to illustrate alternatives. More demanding approaches, such as interactive design tables could also be useful, especially for large urban planning projects. They were seen as suitable co-creation tools for decision-makers and active citizens. The public display boards were seen as effective marketing methods for new urban plans. However, as long as the system is located in a public place and close to people flows, it will have an effect on participation by shy or privacy-oriented people. The actual participation, e.g., responding to surveys, sharing ideas and feedback, would happen most conveniently with a personal mobile or other personal device. Citizens in general are interested in commenting on and participating in urban planning projects, which are related to their everyday lives and their own neighbourhood. New participatory design tools for urban planning should also be efficient at collecting and processing user feedback and other data. Currently, data processing and analysis of surveys take a large amount of resources. Afterwards, citizens should be informed, for instance, that answering the survey was useful and that their feedback has been taken into consideration in the urban planning. There are currently no proper tools for this.

However, there are many open questions regarding the development of visual, web-based participatory design tools. What kind of things do citizens want to comment on and influence in their living environments? What kind of public projects arouse interest? Are citizens interested in commenting on renewable energy solutions such as the placement of solar panels on public buildings? How can these new tools be used for sustainable urban planning? Should comments and feedback be collected from all

possible user segments or mainly or only from the users who are involved in the project in their everyday lives?

In the near future, the ILCO Cities demonstrators will be piloted and used to involve citizens in large-scale urban planning projects. We will proceed to end-user trials in real use situations and compare the way citizens and other stakeholders perceive the demonstration system. The piloting phase will also provide an opportunity to analyse differences between on-site and off-site utilization approaches. Technically, the system could be developed to be more location- and augmented-reality-oriented, which means that the architectural 3D models could be automatically adapted to the real-time camera views. The objects on the screen could also be interactive, and users could add comments or fill out questionnaires by selecting preferred design solutions in the view. Moreover, land use planning projects are often so complex and extensive that using new participatory tools would probably not always impact on their length but on the quality of planning. Digitizing information and increasing on-line channels are the most powerful way to facilitate access to information and make the recent closed urban planning processes more open and participative.

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