VISUALIZATIONS IN THE PLANNING PROCESS

A study of communication and understanding

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Abstract. Visualizations are playing an important role in the formulation and communication of design concepts. Various types of visualizations are being used in the planning process for the presentation of architectural design projects and planning scenarios. This study examines the process of working with visualizations in planning in Norway, and how it is being used as a means to communicate information. Two types of pilot studies were conducted. The first was a survey that sought to find out what visualization is being used by planners in Norway today. The second study was conducted in the Virtual Reality laboratory at the Norwegian University of Life Sciences and explored how different methods of visualization is being understood and experienced by lay people and professionals. Despite the fact that 2D visualizations (e.g. maps, floor plans, sections, elevations) and BIM visualizations can prove to be less engaging and understandable compared to 3D realistic model visualizations, the findings indicates that the use of mixed methods can provide a better overall understanding of a project.

Keywords. 2D; BIM; 3D; visualizations; planning.

1. Introduction

In design and planning in general there is in many cases a need for the ability to mix various types of visualizations methods to express a certain planning scenario. While planners and architects are trained to understand and follow project plans, lay people might have difficulty to read it or to imagine how the future physical elements, such as buildings, roads or trees will look like
and how they will integrate in the area. For ages planners used the ability to create beautiful perspective drawings and paintings where reality is mixed with planned objects. Considerable studies highlighted the importance of visualizations in planning in order to improve the understanding of projects for architectural design, urban and landscape planning (Daniel and Boster, 1976; Hanzl, 2007; Oh, 1994; Tress and Tress, 2003). Other studies found that 3D visualizations are able to convey experiential qualities more than 2D methods and to be especially beneficial for collaboration involving those untrained in spatial design disciplines (Lewis and Sheppard, 2006; Danahy, 2001; Bishop, 2005; Kwartler, 2005; Lindquist, 2010).

With the frequent introduction of new visualization technologies, there is a need to evaluate practices, traditions and types of visualizations in the planning process against the already known ones. It’s also important to check whether the design and planning community and the public has witnessed any new significant transformations. In this study we map what type of visualization methods that are used by Norwegian architectural design and planning companies. In addition, we explore what visualization methods that is most suitable in relation to the type of users (experts and lay people).

2. Method

The paper is based on two separate data collections. The first was a survey that sought to find out what visualization is being used by planners in Norway today. The second study was conducted in the Virtual Reality laboratory at the Norwegian University of Life Sciences and explored how different visualization methods is being understood and experienced by lay people and professionals. Below follows a description of each method.

2.1. PREPARING THE NATIONAL SURVEY

A questionnaire was built up containing four parts: In the first part we asked about number of employees and type of company (architecture, landscape architecture or other). In the second part respondents were asked to mark what type of visualizations their company used, such as hand drawings, digital 2D sketches, 3D models etc. The respondents were also asked to specify in what phase of the project they used the specific visualization (internal with colleagues or external with customers). In the third part we asked questions about the company’s communication with lay people and what experiences they had with lay peoples interpretation of different kinds of visualizations. Questions such as; "To what extent do you think/experience that people understand or can interpret 2D visualization such as maps and
plans”? And "to what extent do you think/experience that people understand or can interpret 3D images and perspective drawings”? In the last part of the survey we asked about use of visualizations at different phases in the process. An electronic questionnaire was sent out per email to 128 contact persons and members of the Norwegian landscape architect organization (NLA).

2.2. PREPARING THE VR-LABORATORY STUDY

In the second study we wanted to adopt an ongoing project. Emails were sent out to seven municipalities in near distance to the Virtual Reality laboratory in Ås. Among the responses we got back we chose to use the project "Campus Ås" sent in by Ås municipality. This project where in an early phase, it was well known by the researchers, it was located very near the Virtual Reality laboratory and people from the municipality were eager to contribute in the project. Three presentations of the same project were built up: 2D, BIM-model and 3D realistic model.

All presentations were shown in the Virtual Reality laboratory at the campus. The component used for this study at the Virtual Reality laboratory consist of a visualization system of three Christie Digital Mirage S+2K front projectors with 1400x1050 native resolution and 3000 ANSI lumens brightness per projector. Warping and blending module for projection on cylindrical surface which is integrated inside each projector and is optimized for 3D projection. The projectors are projecting to a screen curving 160 degrees (7m width x 3m height) around an audience of maximum 24 people, see figure 1. The visualization systems is been powered by a workstation (Intel Xeon X5672 (24GB RAM) with Nvidia GeForce GTX 590 GPU with 4GB internal graphic memory). Because of its special set-up, the Virtual Reality laboratory facility provided the ideal place to conduct this experiment for groups.

The 2D presentation contained aerial photo, plans and elevation drawings. The BIM presentation was presented with Solibri Model Viewer. To show the complexity of the BIM model, the participants were both presented the model from above, navigating in a pre-fixed route above the project, and shown details from different elements in the project such as buildings, trees, and technical details such as pipes, doors etc. The 3D presentation was built up in different programs: Rhino, Sketchup and finally in Lumion3D. The 3D presentation shows a 3D model with high level of realism and was presented as a walk through the area, see figure 2.
All presentations were shown directly after each other where after a questionnaire was handed out. For each of the different models we asked if the presentation had given an increased understanding of: geographical location, location of the project buildings in relation to other buildings at campus, size of the project and use of vegetation.

We also asked about the experience of the presentation in relation to engagement and preciseness. Finally, we asked the respondents to rate the degree to which they thought that the presentation were suitable as presentation technique for professionals or lay people. After the questionnaire, we had a discussion about the experience of the visualization types. Experts, people from the municipality, the campus and Statsbygg (the owners/managers of the buildings), were invited to participate. In this study we wanted to explore group differences among lay people and experts hence we also invited "lay people" represented by students. Data collections were completed in April 2013. The same questions were asked to both experts and lay people.
Figure 2. Examples from of visualizations types used. From above down: 2D, 3D realistic model and BIM.
3. Results

3.1. Results from the National Survey

We had a response rate of 41% (N=53). Most respondent worked at small or large companies, see table 1.

<table>
<thead>
<tr>
<th>Category</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small companies, &lt; 11 employees</td>
<td>21</td>
</tr>
<tr>
<td>Medium sized companies, 11-20 employees</td>
<td>10</td>
</tr>
<tr>
<td>Large companies, &gt; 20</td>
<td>22</td>
</tr>
</tbody>
</table>

Results from the mapping of visualization methods showed that digital 2D maps and drawings was the most common method used in an early phase of the project. This was followed by hand drawings and 3D models see figure 3.

Figure 3. Analysis of visualizations types
When analysing differences between companies, we found that hand drawings as well as 3D models were less used by the smaller companies. However, due to the small sample size, no statistical t-tests were performed. According to our respondents, lay people were not so good at interpreting 2D maps and drawings. Most responses were on the lower half of the scale, i.e. low level of interpretation. However, lay peoples interpretation of 3D images were experienced as much better.

### 3.2. VIRTUAL REALITY LABORATORY EXPERIMENT

14 experts and 13 students participated in the Virtual Reality laboratory study. Due to small sample size, no statistical differences are calculated. However, differences among the two groups are briefly described. Assessing the experience of the different models, we found that 3D realistic model visualization were the most engaging one. No differences were found between engagement when comparing the 2D and the BIM visualizations. Analysing experiences of preciseness, the 2D visualization was experienced as the most precise one in both groups. The two groups experienced the models relatively equal. The only difference we found were the level of engagement for the BIM model visualisation. The professionals found the BIM presentation more engaging than the students did.

The different models were perceived as suitable for different aspects. The 2D visualization was the best one to present the geographical location. The 3D realistic model visualization was the most suitable for describing location of project building in relation to other buildings. It was also the best way of presenting the size and scale of the project and the use of vegetation. One of the students mentioned that the 3D realistic model brought a new understanding of the project. After the 3D realistic model presentation his understanding of the 2D presentation increased. However, many of the respondents mentioned that the 3D realistic model did not work on its own but was a good compliment to other visualization forms. Both students and experts thought that all three visualization types (2D, BIM, 3D) were suitable presentation forms if the audience were professionals. Both groups also agreed upon that 3D realistic model was more suitable when presenting projects to lay people.

### 4. Discussion

As presented in the paper, it is obvious that traditional hand drawings and 2D plans are still in use in an early phase of the project. It is mainly used as a communication tool between colleagues but also in relation to customers.
During the last years new techniques such as Tablet computers that substitute traditional pen and paper have made this way of communication even easier. One would expect that traditional methods such as hand drawings would be the most common presentation and communication technique in smaller companies due to lack of competence in digital presentation techniques. However, as it seems in our results, there are no big differences between small and large companies, in fact it seems as if larger companies use hand drawings more actively in an early phase of the project specifically in communication with colleagues. When it comes to use of 3D visualizations there is however a difference between small and large companies. Large companies are more frequent users of 3D visualizations. This can most likely explain why less man made models are used compared to other visualization techniques. Less frequent use of 3D visualizations among small companies can be explained by lack of competence and running fee, many program licenses are relatively expensive. The number of companies using 3D printers was very low. However, the use of this technique is expected to increase in the near future (Teknologirådet, 2012).

The companies in our study thought that lay people were not so good at interpreting 2D maps and drawings. This is interesting since this technique is found to be the most used method among the companies in our study. However, lay peoples interpretation of 3D images were experienced as much better. According to Sheppard (1989) 3D visualizations are perceived as more realistic compared to analogue visualization types. Use of visualizations is not only about presenting the project and its details it is very much about presenting a feeling. That’s probably why we very often see people in the images. Smiling people indicate a place in which it is nice to be.

In the Virtual Reality laboratory study we found that the level of engagement differed between the presentation forms. The 3D realistic model visualization was the most engaging one while the 2D and BIM visualizations was perceived as exact. The 3D realistic model was the best way of presenting the project in many ways, however when it came to geographical location the 2D visualization type was the best. This indicates that even if 3D realistic model visualizations have a number of benefits, there is still a need for more traditional methods as a compliment. It seems as if 3D realistic model visualizations can give a general overview and understanding of the project, it can also illustrate a sense of place, but for presentation of details 2D and BIM visualizations are more suitable. While the level of realism was much higher for the 3D model, the level of preciseness was higher for the 2D and BIM. There seems to be something about reliability when it comes to the 3D mod-
el visualizations. Maybe people are not trained enough in seeing 3D models. Maybe they associate the 3D models visualizations with computer games. According to MacDonald (2012) there exists skepticism towards visualizations. However, as found in this study this skepticism is rather person dependent than expert dependent.

In the questionnaire survey we found that 3D visualizations are mainly used towards the end of the projects. Because it is obviously a more engaging presentation form and it increases the level of understanding of the project in many ways. We would suggest that this type of presentation technique be used earlier in the project. We think that being able to interact with the model, such as looking at it from different angles, moving around in it or being able to move objects in the model is something that we will see more of in the future. It is also something that will increase the level of participation among lay people. Increasing the use of 3D visualizations in an early phase will also help lay people understand and follow the project and be more active in the planning process, which is in accordance with the Norwegian planning and building act.

There are a number of methodological limitations in this study, such as the low number of participants and the procedure in the Virtual Reality laboratory, having all respondents rating all the visualizations. However, this study is based on a master thesis and is meant as a pilot study rather than anything else. The two studies presented in this paper are not meant to be compared but rather a complement each other. They explore different perspectives and can in combination give a better view of the use and understanding of visualization techniques. The students participating in the Virtual Reality laboratory study represented lay people. Students at the campus are most likely familiar with the project, and students are a very specific group of people, however, none of them were directly involved in the project. Gathering citizens from Ås would have been more appropriate but also more time consuming. Despite all limitations mentioned we would like to end this paper with highlighting the importance of use of different presentation techniques not least 3D visualizations. 3D visualizations seem to cover many of the important aspects that have to do with understanding of a project and it is not least an engaging presentation form very suitable for lay people. However, the geographical orientation and experience of preciseness is higher for 2D presentations such as maps and drawings.
References


