TRENDS AND PRACTICES USING 3D VISUALIZATIONS FOR LARGE-SCALE LANDSCAPE PROJECTS IN NORWAY

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Abstract. New advances in 3D modelling and visualization tools for large-scale landscape and construction projects have been achieved recently. The introduction of the new 3D digital modelling and visualization tools, e.g. CAD, VR, GIS and BIM initiated a huge shift in the way planners and designers develop, communicate and present project scenarios. This paper outlines the challenges, new trends and workflows connected to the use of new tools and how it's been practiced and experienced by professionals and stakeholders as observed in Norway. The observation shows that the latest developments are providing new potentials for performing better communication and collaboration. Planners could now demonstrate many aspects of a project which exceed the usual minimum requirements. An important functionality is the capability to work with huge amount of data-sets for large-scale projects which were previously almost impossible to work with.

1. Introduction

The practice of planning and design in Norway is witnessing new transformations and challenges when dealing with planning for large-scale projects. There is an increased demand for planning tools that allow projects to be more sustainably and economically constructed. There are pressures to develop planning proposals that more accurately connect to their

geographical context. Projects including multiple disciplines make it difficult to visualize project goals in ways that are comprehensible to all stakeholders. In the context of increasingly strong competition to secure a project, clarity of communication is key in making sure a proposal is selected over many. Furthermore, there is a struggle to engage community groups effectively into the planning process.

Advancements in the field of 3D modelling and visualization make it possible to present alternative planning and design scenarios with a high degree of realism and interactivity. Using these tools, it is now possible to explore many aspects of a design in real time. These new approaches can be helpful in streamlining workflows, fostering greater efficiency and incorporating feedback in the concept evaluation and approval phases. This in return can greatly enhance collaboration and communication in the design and planning process.

Considerable studies highlighted the importance of visualizations in planning, architecture, urban and landscape planning (Hanzl, 2007; Oh, 1994; Tress & Tress, 2003). Other studies found that 3D visualizations tools are able to convey experiential qualities better than traditional 2D representations and are especially beneficial for collaborations involving audiences with no training in spatial design disciplines (Lewis and Sheppard, 2006; Kwartler, 2005; Lindquist, 2010).

This paper explores an approach to implementing 3D modelling and visualizations tools starting from the conceptual stage of planning process for large-scale landscape and constructions projects. It focuses on the E-16 highway project in Norway by the planning and design firm COWI. The project was supported by researchers at the Virtual Reality Laboratory (VR-Lab) of the Norwegian University of Life Sciences (NMBU) in Aas. The study is part of a project aimed at strengthening research on digital applications in landscape architecture and planning. It aims to explore the potentials and complications associated with 3D digital tools and visualizations when applied to landscape, urban systems, architecture and construction projects.

2. Method

This study followed a two-track methodological approach. The focus for the first track is on studying and learning the technical capabilities and limitations of the latest commercially-available 3D digital applications. This involved work by planning students and professionals with intermediate digital modelling skills enrolled in courses offered at NMBU in 2013 and 2014. Through the courses, case studies were used to uncover the challenges working with large-scale projects. The courses made use of two recently

launched software products: Infraworks from Autodesk and Lumion3D from ACT3D B.V. Autodesk Infraworks provided the possibility to collect various types of datasets in a 3D environment. The software supported a BIM approach for creating data-rich 3D models. In addition, the software was able to create various types of planning scenarios in a 3D environment and communicate them through the net using a special viewer. Lumion3D provided the functionality to produce real-time, realistic 3D visualizations compatible with the models produced by Autodesk InfraWorks. Participants to the courses were exposed to a learning methodology that forced them to use large data-sets which included GIS layers of roads, building layouts, water features, landscape contour lines, vegetation and aerial photography. The focus of the second track was to monitor and observe how planning and design professionals used these technologies in real projects, like the large-scale road construction E16 led by the planning and construction firm COWI.

2.1. E-16 HIGHWAY PROJECT BY COWI

The new E16 is a 4 lane, 32 km long highway planned in the eastern part of Norway, stretching from Nybakk in the south to Slomarka in the north. At the time of the announcement (2012) it was the single largest contract for a road project ever announced by the Norwegian Public Roads Administration. The project required three major deliverables: an area plan, technical plans and a BIM model. The E16-project was the first infrastructural project for which COWI used Autodesk InfraWorks. During the initial piloting of the software, COWI was especially impressed by the software`s ability to handle large datasets and by the intuitiveness and user-friendliness of the software when sketching conceptual designs. After deciding to utilize the software in the E16-project, the digital modeling efforts were divided into three parts: a model of the existing conditions, a conceptual design model and a detailed design model. The three stages of the model came to be the basis for the subsequent zoning plan and the project budgets.

In the first meeting with the client, three weeks after the contract was won, COWI showed a model with the basic existing conditions of the project area and a road that was planned in an earlier stage of the project. From the onset, the planning of the new road took place in a 3D environment, and different road concepts where discussed and modified during the meetings. After gathering and visualizing even data on existing conditions, the model evolved to become a conceptual design model. At meetings with the client, different proposals and concepts were presented, discussed and altered. New proposals and concept were also created at these meetings. This was possible because of InfraWorks`s ability to rapidly create new road concepts, by simply pointing and clicking on a computer. After the meetings the different

proposals where communicated back to the rest of the design team through the cloud and refined before the client meetings that followed. After deciding which concept to evolve further, each discipline made their model in their preferred software, and then imported this into InfraWorks. The purpose of this was to make a model that would show the detailed design.

Interaction with the client and the public improved considerably. Proposals that in previous projects had been shown in 2D now were shown in a 3D environment. The 3D model COWI showed had never been at such a high level of detail at such an early stage in the planning process in former projects. This made the decision-making more precise and made both the client and the project team more confident that the right proposals were forwarded to the more detailed face. The high quality of the 3D visual information gave the stakeholders accessible and readable information at an early stage of planning, but also made it important for COWI and the client to emphasize towards the stakeholders that further changes in the design could apply later on in the planning process.

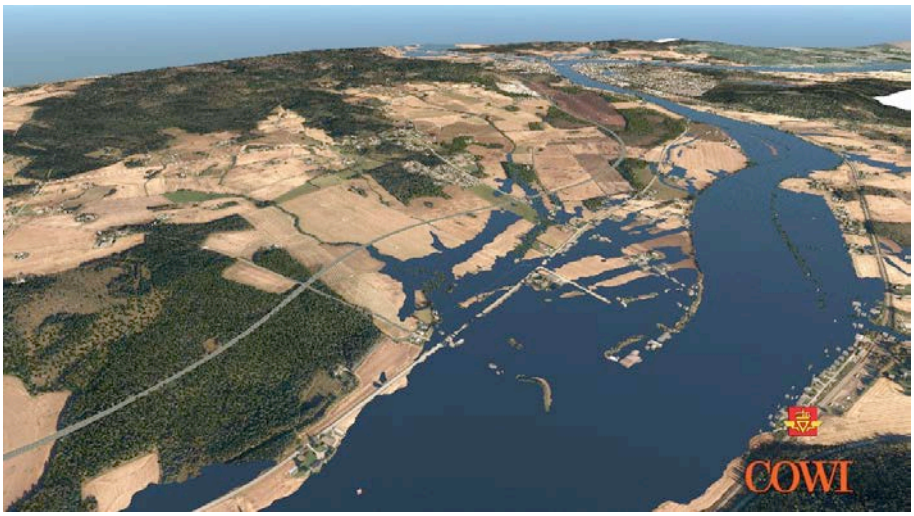

Figure 1. E-16 highway project. Analyzing flood situations (Source: COWI).

Figure 2. E-16 highway project. Detailed road design model (Source: COWI).

3. Reflections and Discussion

The use of 3D digital tools for large construction and landscape engineering projects has always been challenging because planners, architects, engineers, landscape architects and governmental institutions operate at different scales, using different data sources and working with digital tools that are not designed to work in sync. Our experimentation with 3D digital tools for developing planning scenarios in the context of NMBU courses shows that the learning process was relatively short and straightforward and also that planners and designers were able to visualize in 3D simply and in real time any changes and adaptations of every design concept. At a very early stage of the planning process, alternative proposals were visualized quickly, in greater detail and accuracy, and could thus be evaluated more accurately than 2D maps and illustrations.

Working with 3D visualizations increased the efficiency of the planning process, especially in the concept phase. The ability to create and edit proposals made it possible to visualize and examine different design proposals at a speed that the design team had never experienced before, often during live interaction with the client. In addition, the ability to share the different proposals through the cloud, made communication within the design team and towards the client more efficient than before.

Projects of the scale and complexity of our E16 case study involve many participants who often do not have either the motivation nor the time necessary to understand a project in sufficient depth. Engineers, project leaders, project owners and end users are mostly dependent on a complete

3D understanding of the project. This will enable them to do correct planning, to make well-informed decisions, or to give adequate and accurate feedback. The experience from E-16 highway project show that clients, community groups and experts felt engaged by the 3D visualizations used in project meetings and public presentations, greatly improving collaboration and communication at various levels in the planning process.

The technical capabilities of readily available commercial 3D digital applications could be utilized to establish a common 3D collaborative planning platform. It provides possibilities to create functional design models with enough details to better inform preliminary reviews of large-scale projects fully within a 3D environment. During interactive feedback sessions, professionals could evaluate and consider making *on the fly* adjustments to the models in response to other stakeholders' concerns. The case study also illustrates new capabilities for planners to work at different scales using a wide variety of datasets. An important functionality is the ability to work simultaneously and with greater than usual accuracy with large datasets, which was almost impossible prior to the recent advances in 3D visualization software and hardware.

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