

Using BIM technology in the construction process. Experiences from Deichmanske hovedbibliotek (Oslo main library)

Summary of

Gjennomføringsmodell med BIM for detaljprosjektering. Erfaringer fra Deichmanske hovedbibliotek Fafø-rapport 2016:26

This report presents one of several reports from an innovation project titled SamBIM, which is partially funded by the Norwegian Research Council program "User-driven Research based Innovation (BIA)." SamBIM aims to develop and establish processes and collaborative models supported by BIM technology to increase value creation in construction projects, the construction industry and within individual enterprises.

BIM in the construction process has, up until recently, revolved around implementing BIM as a tool, and to a lesser extent focused on the interaction between those who operate these tools. The point of departure for the SamBIM project was that it was now time to apply BIM tools to establish new or modified work processes for improved coordination and collaboration.

SamBIM thus addresses industry challenges by enabling participants, through innovative initiatives and with the help of BIM tools, to plan, design, and produce buildings more efficiently, without errors and on time. The motive for SamBIM has been to identify knowledge, test methods, and gain experience through interaction and integrated processes, by a constant focus on a lean construction process.

Thus, SamBIM addresses challenges related to the triangular relationship between *process, individuals and technology*. SamBIM focuses on the value chain that embraces the relationship between participants in the client and design processes, and later in the production process.

This report is based on findings from a case study project in SamBIM. Multiconsult is the case owner, and the particular construction project is a new Main Library in Oslo, Deichmanske hovedbibliotek. The client is the City of Oslo, by Kulturbyggene i Bjørvika (KIB).

This report describes and discusses findings from an experiment with coordinating measures in the detailed design phase of a construction project. In this construction project a lean approach in itself was not a stated ambition. The objective of the case study was to gain experiences with 1) how a model for coordination, progression management and quality control (The Multiconsult execution model) in a limited phase of the design process can affect the way participants collaborate, and 2) how collaboration inflicts upon quality of delivery performance from the design phase.

Issues raised were:

1. How can Multiconsult's execution model contribute to improve interdisciplinary collaboration in the detailed design phase?

2. How can Multiconsult's execution model contribute to put pressure on decision-making in the interdisciplinary interaction in the detailed design phase?

The framework for the project

The case study construction project (Deichman) is a design-bid-build contract managed by ÅF Advansia, i.e. they have the overall project management responsibility. The architect is Lund Hagem Architects AS and Atelier Oslo AS. A joint venture consisting of Multiconsult ASA, Hjellnes Consult AS and Brekke Strand, has constituted the consulting engineering group, with COWI AS, Rambøll AS and Asplan Viak AS and KanEnergi AS as side advisors contracted directly by the client.

Although ÅF Advansia had the overall responsibility for the planning and construction of the Deichman library, Multiconsult was given responsibility for the consulting engineering disciplines' design process. Multiconsult and ÅF Advansia established a consensus on using the Multiconsult execution model for the detailed design phase. Multiconsult was thus a chief adviser, and it was therefore natural for the case study to revolve around Multiconsult's role and tasks in the detailed design phase. Although Multiconsult in reality took on the responsibility to establish an engineering plan and to coordinate all technical disciplines, they did not possess a formal role and was not in a position to make demands towards the other disciplines.

Testing of coordination with milestones and colour codes

Multiconsult wanted to use the Deichman project to gain experience with its execution model. Data is collected within in a limited time period (2013) in the detailed design phase. Use of Multiconsult's execution model in this project has largely revolved around experimenting with a system using quality milestones in the progression planning process and assign objects in the BIM model with coloured statuses towards milestones. A milestone is a checkpoint on the time axis where one measures a delivery or a partial delivery against a pre-defined content.

The intention of the use of milestones, or "freeze dates", was on the one hand to achieve a concerted and coordinated engineering progress, and on the other hand to establish quality levels as a common basis for detailing out the design further.

The experiment with the milestone plan was described by interviewees as a good initiative. They argued that without such a milestone plan, the decision making process would have been more vague and thus created a larger degree of chaos and rework. All parties expressed consent that the milestone approach pushes progress.

As an extension of the initiative with the use of progression milestones another measure was implemented. This was an attempt to use color coding to indicate the level of maturity an object in a 2D-drawing or a BIM model has. Objects in the BIM model was given a color (red, yellow and green) based on the quality status (S1, S2 etc.) reached. It could also be a combination of different colored statuses on all objects in the model. The purpose of the color codes to establish a maturity status was to communicate the status of objects more visibly in the BIM model.

Experiences with milestones and freeze dates

Informants expressed that the use of milestones in theory is a reasonable and sensible concept. However, they point to several issues that in practice have caused only partial success with the initiative. Barriers were revealed that prevented a full effect:

- Late clarifications and amendments from the client, users and side advisors
- Lack of respect for freeze dates
- Practice of "partial freeze"
- Sequential planning issues in the detailed design
- Unrealistic expectations of freeze dates (milestones)
- Lack of a definition of status

Experiences with colour codes to set quality status

According to informants colour codes on objects contributed to an effective interdisciplinary work practice which assured necessary discipline feedback. A discipline's colour of an object informs other disciplines which quality status an object has; whether the object is still being developed, if it is decided upon, or frozen. It also helps assure discipline alignment.

Still, informants point a number of barriers:

- Difficult to achieve good systematics
- The process of status setting started late into the design process
- Not all disciplines applied the system
- Changes within in the project design team and their priorities
- Parallel and iterative / nonlinear processes
- Changes throughout

Startup and legitimization processes

In the detailed design phase a kick-off with ÅF Advansia was arranged. Multiconsult's execution model was launched for the design team, and initiatives with milestones and status setting were introduced. The design team engaged in an interdisciplinary planning of the detailed design. ÅF Advansia, the architect together with an internal group of technical consultants attended the kick-off.

Despite the emphasis that Multiconsult put on establishing the execution model as a basis for collaborative work, others expressed that they would have preferred a more thorough introduction to the content of the model followed by a discussion about what it would entail for the participants in the design team to collaborate according to it. In addition, a clarification of discipline expectations was prompted. Multiconsult's strategy was to focus on guiding the group in the right direction in terms of the use of the execution model. Here we detected a mismatch between Multiconsult's intention to keep information simple and focused, and the partners' expressed need for a more thorough introduction.

Some terms and conditions challenged the interdisciplinary collaboration, such as

- Continuity in staffing in the design team

- Co-location of the designers
- Different emphasis on the use of BIM tools

There were a number of changes to the design team among most of the disciplines which made it difficult to fully understand the reasoning behind previous decisions. The technical disciplines were co-located two days per week in Multiconsult's offices. Informants highlighted the positive effects of the proximity to other disciplines, protection from other tasks at their respective headquarters, and the possibility to focus solely on one project at a time. However, some informants pointed out a lack of coordination by Multiconsult. Co-location is thus not in itself a guarantee for better interdisciplinary coordination and communication, but still, co-location enables it. The design team worked traditionally in this project, in terms of their use of BIM technology. That is, no new models for collaboration based on BIM technology were introduced. Informants, to varying degrees, also had experience with the use of and emphasis on BIM-modeling from past projects.

Findings in a business development perspective

In terms of a process analysis, we can point to several obstacles for full effect to take place in this case. The data indicate a somewhat weak legitimizing of the concepts. The expectations of how the discipline representatives should relate to each other and the entire process were somewhat unclear.

Participants, although they expressed a positive attitude towards collaboration in line with the execution model, took limited ownership of the change process. Besides, the project management created challenges to Multiconsult by giving them the responsibility to coordinate the efforts of the design team, while at the same time not being given any authority to influence on other disciplines' performance. Multiconsult was not in a position to demand anything from the team members. Multiconsult could only give recommendations and advice.

The collaboration was affected by several of the initiatives starting late into the design process, such as the colour coding of objects to communicate quality levels in the model. Moreover, a practice evolved where participants ignored decisions concerning freeze dates and milestones, or they operated with "half frozen" solutions. Participants as a result lost confidence in the basis for decisions made at earlier stages of the design process. This unfortunate practice may have been caused by many factors, such as discontinuity in the design team, a weak legitimacy process of the execution model, and that Multiconsult had the coordinating role without authority to exert pressure on the disciplines to deliver according to milestones.

Participants in the design team were positive to the initiatives for a milestone plan and the visual colour coding of objects. The concepts made sense to them and they expressed a wish that Multiconsult would develop them further in future projects. Nobody found the idea to be a bad idea. However, the potential for the execution model is larger than the lessons learned from this case study suggests. We have pointed to a number of improvement features for future design teams to achieve greater impact with these measures. One key feature is to deal with the change process more than refining the

actual content of the measures. A major concern is to establish good roles and responsibilities from the outset.

Although the experiences described were not totally successful, the Multiconsult, in a business performance perspective, was successful in implementing all deliveries to their customer.