Bridging the gap: taking BIM to the construction site

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Abstract
Technology such as building information modeling (BIM) is changing the way the architecture, engineering and construction industry does business. Despite that BIM is quite widely used in the design phase it is significantly less used by site workers in the construction phase. In this paper, a real life case study from Statsbygg, The Norwegian Directorate of Public Construction and Property is studied. In this case, Statsbygg together with the general contractor Skanska have created so-called «BIM computer kiosks» to allow site workers access 3D models on-site. In this paper we investigate how these computer kiosks are used and examine the consequences of this use. The analysis shows that site workers find the visualization opportunities very useful and that BIM is appraised for efficiently handling complex elements as compared to paper drawings. Our findings also indicate that the data kiosks facilitate a greater level of face-to-face collaboration among site workers.

Keywords: BIM, collaboration, data kiosks, on-site, visualization

1 Introduction

In the last decades the AEC-industry (Architectural-Engineering-Construction) worldwide has faced major changes. The rapid development of information and communication technology (ICT) has provided some new promising digital tools for the industry. In recent years enabling technologies such as building information modeling (BIM) has appeared. Here, BIM is a term referring to three-dimensional computer-aided design technologies and processes in the AEC industry. With the use of BIM, a network of interdependent actors can collaborate to develop a model of the planned construction works (Taylor & Bernstein 2009). BIM can be seen as a collection of objects, properties and relations. One of the most striking arguments for using BIM in the in the design phase is that it has the potential to improve the collaboration among the actors involved which is expected to lead to increased efficiency, productivity and reduce costs. Despite that BIM is quite widely used in the design phase it is significantly less used by site workers in the construction phase which is still dominated by paper in the form of drawings. However, BIM represents a great potential in the construction phase. In a recent ITcon-article related to BIM on the construction site van Berlo & Natrop (2015) state the following:

> "At this moment drawings are created from a BIM model at a specific moment in the whole building process. The information on the drawings is the same as the information that was put on before BIM technology came around. It contains general information for lots of different workers and craftsmen. In a BIM data collection much more information is available, but this information stays hidden for construction workers on site. With a raising complexity and fragmentation of experts on a construction site, most drawings don't seem to provide enough information, and are not specific enough for specialized tasks".

This implies that the potentially benefits of using BIM to visualize and communicating 3D design so far have been limited in construction phase. Information to the workplace is largely dominated by paper drawings which naturally is limited to 2D representation. Nevertheless, there

are some exceptions. In this paper we are studying a case from the Norwegian construction industry. The case deals with an ongoing refurbishment project of a university building just outside Oslo. In this project Statsbygg, The Norwegian Directorate of Public Construction and Property, as the building commissioner and the general contractor Skanska have introduced so-called «BIM computer kiosks» to allow site workers access BIM and thereby up-to-date design information on-site. In other words it was the 3D model possibilities for visualization which was the primary issue for trying out BIM kiosks in this project. The aim of this paper is to take a closer look on this introduction and examine how these kiosks are used by the workers and craftsmen and analyze how this approach affects their work. Put differently, we want to find out more about how and for what purpose the BIM-kiosks are used by the site workers and which consequences this use have. The following two research questions will be examined: 1. how are the BIM computer kiosks utilized by the site workers? and 2. How does the use affect their work, including the collaboration with other workers and craftsmen?

This paper is structured as follows: First, existing research on the use of BIM on the construction site will be discussed, then aspects related to the research methods will be outlined. Next, the empirical material related to the introduction and use of the BIM kiosks will be accounted for. Finally follows a discussion and some concluding remarks.

2 Existing research on the use of BIM on the construction site

There are many possible opportunities for the use of BIM at the construction site. This use may, for instance involves visualization, planning, progress simulation and so on (Eastman et al. 2011). Despite this, today the construction phase is mainly executed by using traditional 2D drawings. Reasons of that could be due to the fact that until recently it has not existed appropriate solutions to make use of BIM in rough environments such as sites, as well as challenges associated with training of the workers and craftsmen. Nevertheless, there is still little research on how BIM has been used on site in real life projects (Davies and Harty 2013). In this section, some of this research will be discussed.

In their study, Davies & Harty (2013) are using the term "site BIM" and conduct an empirical case study of an implementation of BIM system which allows site workers using tablet computers to access design information as well as quality and progress information. They find that the "site BIM" "… was delivered through an exploratory and emergent development process of informal prototyping. Technical IT skills were adopted into the construction project through personal relationships and arrangements rather than formal processes". In a recent study, van Berlo & Natrop (2015) analyzes a concept which use BIM to generate drawings fit for a specific task or purpose for the site workers. The idea behind this concept "… is to provide site workers with all the information they need for the task, but nothing more". They find that this concept contributes to good communication between the site office manager and construction workers. Mäki & Kerosuo (2013) study site manager's use of BIM in two Finnish projects. They find that BIM models are utilized on site and the models advance the site management, but the authors also underlines that the use is challenged by factors such as insufficient and inaccurate information in the models. Moreover, they argue that: "Further research on BIM deployment, using BIM as a new tool and the changes in collaboration within the project partners is needed". As we can see based on this review, there is limited research on the usage of BIM on the construction phase, and certainly a need for more research on what the actual use of BIM implies for workers and craftsmen.

3 Methods

3.1 Case study

In this paper we are going to investigate the use of BIM by the site workers in the construction phase of a building project. This is done to gain knowledge about how BIM is used and what consequences this use may for the on-site workers. To shed light onto such a complex phenomenon, a case study seems like an appropriate strategy. Case studies allow researchers to retain holistic and meaningful characteristics of a real life event such as a building process. Case studies are also seen as appropriate to answer "how" and "why" questions and allows for the investigation of many variables consequently generating in-depth knowledge. According to Yin (2003, 2013), a case study consists of an in-depth inquiry into a specific and complex phenomenon, set within its real-world

context. This case study is based on qualitative data. The qualitative data consists of observational studies, different kind of interviews as well as document studies. In the following sections the different data sources applied will be discussed in detail.

3.2 Qualitative data

As a part of the data generation process we have done observational studies. Multiple times for several hours we walked near the different BIM kiosks to observe what was going on in front of and on these computers. Observational studies involve making field notes based on a detailed observation of behavior, talk, interaction, practices etc. In this study we chose a non-participant strategy. Such a strategy implies that we were not a part of the activity taking place, but simply a visible observer. One of the benefits with observational studies is that they provide us with directly access to social situations, without needing to go through the participants' interpretation as being the case with interviews. This means that we could see with our own eyes "what was going on" in front of the BIM-kiosks and in other places within the building.

The "standard model" of qualitative interviews within the social sciences is the so called semi-structured interviews. Semi-structured interviews involve using an interview guide that consists of some main themes and a list of questions that should be asked during the interviews. As part of the data collection we have done several semi-structured interviews with key actors in the project such as the project manager, site manager, BIM coordinator, different employees from Statsbygg and so on. The purpose of these interviews was two get the informants' own assessments of different sides of the project and in this case, issues concerning the BIM kiosks.

In addition, we have conducted lots of shorter interviews with workers and craftsmen at the construction site. These interviews were of a slightly different nature compared to that we referred to as semi-structured interviews. In the interviews with craftsmen and workers the purpose was to get more information about a specific issue, namely the BIM kiosks. This topic does not call for long-lasting and in-depth interviews and is uncontroversial. This opened up for conducting short interviews without extensive "warm up questions", which rather go straight to the point. Such interviews also help to prevent waste of the informant's time. Consequently, we chose to carry out so-called focused interviews (Merton & Kendall 1946). Such interviews made it possible to quickly go into the informant's experiences with the BIM kiosks and were done on the construction site. The interviews generally took place immediately after our informants had used the BIM kiosks. Sometimes we also encountered them more or less randomly on the site.

In addition, documents have been used as a supplement to the data generated through interviews and observation. Examples of documents used are: The Statsbygg BIM-manuals (different versions), meeting reports, contract documents and other written project-specific information.

3.3 A short note on the potential of generalization

How findings from qualitative case studies can be generalized and contribute to scientific and practical development is an everlasting topic within the social sciences as well as for research in the AEC-industry. Findings from qualitative case studies will not provide a basis for statistical generalization, as the numbers of cases studied are few. However, the use of case studies allows for other ways to accumulate knowledge. Yin (2003, 2013) has argued for the value of analytic or conceptual generalization (Tjora 2012). According to Yin (2013) this type of generalization implies "[…] the extraction of a more abstract level of ideas from a set of case study findings – ideas that nevertheless can pertain to newer situations other than the case(s) in the original case study". This will be discussed further towards the end of this paper.

4 The case: BIM-kiosks on the construction site

First in this section, Statsbygg's role in the Norwegian construction industry will be discussed. Then, the empirical material related to the BIM-kiosks process will be presented.

4.1 The case project and the SamBIM research project

Statsbygg and Skanska is both part of an ongoing Norwegian research project called SamBIM (Collaboration with BIM as a catalyst) financed by the Norwegian research council. This research project is based on a joint effort of Norwegian industry and research partners. In this project several actors from the construction industry wants to try out new forms of organization and technologies

such as building information models. The aim of the project is to increase value creation and innovation in the society, the AEC-industry and the companies involved by developing and improving BIM-supported processes and collaboration in real-life projects.

In the following sections we will take a closer look at the construction phase of an ongoing project where the SamBIM-partners Statsbygg acted as the building commissioner and Skanska as the general contractor. The case deals with the refurbishment of a university building named Urbygningen at the Norwegian University of Life Sciences located outside Oslo. This facility was opened in the in 1901 and has three floors as well as an attic and a basement. The project aims to retain the buildings cultural heritage while the rehabilitation intends to give a modern, flexible and functional educational building. The preliminary design was completed in 2009, and in 2013 Statsbygg started up with the detailed design phase. The construction phase started in august 2014. Because of the connection to SamBIM, the project's BIM ambitions were raised compared to a more "normal Statsbygg project". As a result of the elevated ambitions, Statsbygg wanted to test out BIM for site workers in the construction phase. This will be described in the following sections.

4.2 BIM-kiosks

According to one of our informants from Statsbygg, on-site workers often experience that drawings do not give enough and sufficient detailed information. In order to remedy such problems, Statsbygg wanted to try out technology that allows site workers and craftsmen to access the BIM model at the construction site. Statsbygg's objective was to find out more on how this would affect the work situation as well as lead to a good understanding of the projected material. I an interview one Statsbygg employee told us about how the idea about using BIM kiosks had come up:

> "In recent years 'everyone' have started to design in 3D with fancy programs and all that. A paradox occurs when we the construction phase starts and we are going to build stuff. In this phase it usually like this: the carpenter receives a 2D drawing from the architect, the plumber gets a drawing from the HVAC engineer, and the electrician gets a drawing from electrical engineer and so on. In my opinion this kind of practice continues the old 'silo mindset' which we have been really concerned about avoiding in the design phase in the last years. I think one of the most important things is how we communicate the totality to those doing the actual construction work. In order to improve this communication we have to get BIM into the construction site".

Furthermore the same informant told how the idea had materialized and had become a part of this specific project:

> "In everyday life, we have e-mail on our smartphones, and most people have computers at home. We're available all the time and we are used to the fact that communication is pretty easy. If things are difficult, we are not so interested. Consequently, we have to follow the same 'logic' on the construction site. This means that we need to make it easy to use BIM on construction site. It was related to this the idea with BIM kiosks came up. We did not know much about BIM kiosks, we had heard a bit here and there, searched the internet etc. What triggered me was the easy accessibility; to get the model out to those who actually do the work, namely the craftsmen. In this project we had an opportunity to try out BIM kiosks because of our connection to the SamBIM research project".

Consequently, it was decided that Statsbygg would require the use of BIM kiosks in the construction phase. In Statsbygg's contract documents the following can be read about what is expected from the contractor related to BIM kiosks:

> «[The general contractor should] establish and operate 5 stationary BIM stations with 50" monitors connected to a PC with Solibri Viewer (free version) software and a wired network access. The equipment should be encapsulated so that the screen and PC can operate in a dusty and rough environment» (Statsbygg 2014).

As we can see, the decision about using BIM kiosks in the construction phase was made by Statsbygg. Despite this, the contracts had fairly vague specifications of how the kiosks should look like and actually be used. Consequently, it became mostly the general contractor Skanska's responsibility to determine the details. On the basis Statsbygg's requirements Skanska produced five identical BIM kiosks. As we can see from the photo below (figure 1) each BIM kiosk was established with a 50 inch LCD screen, a Windows-based PC inside the wood cabinet, as well as a keyboard and a mouse. The computers also had wired broadband Internet access. When the construction phase started the kiosks was placed in each floor of the building.

Figure 1 BIM kiosk located at the construction site

4.3 Training at the construction site

Virtually none of the site workers had any experience with BIM from other projects. Therefore it was set up a short training program that would give the workers a sufficient basis to use the model in their daily work. This training program was developed by Skanska's BIM coordinator in the project together with a Statsbygg employee with a similar role. These two individuals have extensive knowledge and interest in BIM, and can thus be characterized as experts and enthusiasts in their respective companies.

4.3.1 Training sessions

The training was planned to take place at the construction site using the actual BIM kiosks. Each training session was scheduled to last about one hour and took place in groups where approximately five workers were gathered, as well as an instructor. The first part of the training sessions was carried out as a demonstration of the model by the instructor. In this demonstration the workers was shown how they could navigate in the model and how to obtain various design information. The purpose of the training was to give the workers and craftsmen an introduction so they were a bit familiar with the possibilities of the BIM kiosks. It was planned that these sessions would take place several times so that everyone on the site should get the opportunity to participate. Below we have inserted a photo (figure 2) from one of the training sessions. The instructor is the person with the blue helmet, while four carpenters with white helmets are standing

around.

Figure 2 BIM training at the construction site

In other words, one of the main goals with training sessions was to give a brief introduction to how the craftsmen themselves could use the BIM and how this could be useful in their daily work. In addition, it was emphasized by the instructors that everyone should get to try the BIM kiosk within a safe setting during the session; "[e]veryone should have tried spinning around in the model during the sessions to see how this could be done", as one of the instructors told us in an interview. Because of this consideration it was essential that the group only consisted of approximately five persons, so everyone got opportunity to ask questions and try to navigate in the model. In our interviews it appeared that it was more or less unproblematic to get workers and craftsmen to show up for training sessions – most of them perceived the BIM kiosk as an interesting and exciting innovation. In some of the sessions it was also tempted with coffee and buns, which probably not made it less attractive to participate.

In the training sessions we noticed that site workers were interested and had a positive attitude towards the use of BIM. The following quotations are taken from some of our interviews with workers and craftsmen and illustrate some of what was being said about the training sessions:

> "I think that course was pretty good, we got to know a lot. Moreover I'll learn more when I begin to use it and by looking at others".

> "... it was a good introduction to what it might be used for and how we can do it" .

Albeit, a few workers stated that they think the use of BIM seemed complicated and that they probably would not use the BIM kiosks to any great extent. It should nevertheless be underlined that this was a minority of the responses we observed.

5 Discussion

In the next sections we will discuss the influence of BIM kiosks at the construction site. More specifically, we will discuss how the kiosks are used by the site workers and how this use affects their work, including collaboration with other workers and craftsmen.

5.1 The training sessions had an important participative purpose

As previously described, the training sessions could be characterized as a type of practical on-the-job training. The sessions were clearly necessary because none of the workers were familiar with the use of BIM or BIM kiosks from previous projects. To some extent these sessions also served as an arena where the workers to a certain degree had an opportunity to influence and give feedback on how the functionality of the kiosks might be improved. For example, some of the workers requested a simpler layout to find relevant information for their own discipline, i.e. a clear division between viewings for the carpenter, bricklayer, plumber etc.

Additionally, our data suggests that the training sessions also had another important but more unintended function. This function is coupled to the actual implementation of BIM at the construction site. This is partly about communicating to all actors involved why and for what they should use the BIM kiosks, i.e. the methods purpose. Innovations and developments such as BIM kiosks that are perceived as important and necessary by managers and enthusiasts are not always viewed in the same way by the troops on the ground. Although the main purpose may be clear, it is also important that those who are involved and affected by the change have a meaningful understanding of the goals for the initiative. It is also crucial to involve the craftsmen affected and listen to their opinions and allow them to have an impact on the process. This is particularly important when it comes to the use of BIM in project organizations due to actors across organizational boundaries that are set to work together towards common goals. Consequently, it was important to communicate to the workers that BIM kiosks were not particularly difficult to operate, and that it would probably be helpful rather than a hassle and annoyance in their daily work. For some people, especially those without computer experience, the sessions were essential to demystify the purpose of using computers in construction work. In one of the interviews an informant told us about a senior worker with limited computer experience who was thrilled when

he discovered the opportunities with BIM in of the training sessions. In the next sections we will take a closer look at the experiences site workers have with the actual use of BIM.

5.2 BIM helps to ensure quicker and more holistic understanding of the facility

By introducing the BIM kiosks, Statsbygg and Skanska sought to gain experience with how the use of this kind of computers influenced the work at the construction site. Our data indicates that the workers who use the kiosks experienced great advantages compared to a situation where only drawings were used. Almost all workers interviewed emphasized the model's ability to visualize complex situations and display the totality of the building as particularly helpful. Further it was pointed out by many workers that it was much easier and quicker to "get the overall picture" and that the model brings out a greater detail compared to drawings. Below are a few quotes that illustrate some of the advantages we were told about in the interviews:

> "It is much easier to look up details in the model compared to drawings. The drawings can sometimes be almost impossible to interpret".

> "I can see by the drawing that there should be some pipes here. This is what I'm working on right now. But by this drawing I cannot see if the pipes should lie under the floor or over the ceiling. By using the model I can see immediate that the pipes must be over the ceiling".

> "I have never used it [BIM] before, but think it's awesome! I can check things out more accurately than with drawings. Often we have so many drawings. Look at this big stack, it's almost impossible to find the right one".

> "I am an electrician; look at these complicated drawings we use. It I much easier to look at the model on the screen".

> "I am working on ventilation and our drawings are often intricate with lots of details. There are other disciplines we must deal with as well. The model illustrations things much clearer and I can see how this will look when everything is completed".

One of the informants was an apprentice and hence new to the trade. This person highlighted the model as easier to understand compared with drawings for a novice like himself:

> "For me as an apprentice this [the model] is much easier, we have not learned so much about drawings at the trade school. I find it much easier to understand the 3D model".

Several workers explained that they often approached the BIM kiosks to look into some specific details or problems. This could e.g. be details that were difficult to identify or details that were completely missing on the drawings. The informants expressed in other words that the paper drawings does not provide enough information and are not sufficient specific. The 3D models richness of the details was by many highlighted as one of its major advantages.

5.3 BIM-kiosks as meeting places

Already in the very beginning of our data collection and throughout the observation of the first training sessions, we observed some particularly interesting situations. These situations happened when the workers themselves should try the model; to navigate and "spin around" for the first time. While this was going on we observed that the workers who were gathered in front of the BIM kiosks started a dialogue about the details displayed on screen. Comments such as "look over here" and "what have the architects and engineers planned here?" reflected that the model opened for a professionally discussion among some of the people standing in front the screen. This was of course not the case all the time, nor in all the training sessions observed.

During observations of the actual use we encountered similar situations and got the impression that the kiosks by itself clearly had an interesting feature. Occasionally we observed that people gathered around the kiosks and discussed issues displayed on the screen. Such "meetings" was sometimes planned, i.e. two or more workers went together to the BIM kiosks, or had a more

spontaneously character. Such spontaneous meetings occurred when one or several workers stood by the BIM kiosk and additional persons came along and participated in the discussion. When these situations occurred we used the opportunity to ask why it was so. Below are a few quotes that illustrate some of the answers we got to these questions:

> "Again and again it has been useful standing in front of the computer together so that we can discuss what we see. Sometime we discuss what to do in a specific part of the building, other times it is more about making planes or clarify what we are going to throughout the day".

> "If I see another person standing at the BIM kiosk when I pass along, sometimes I join in for a short talk about what he is doing, or potentially difficulties etc. It's space for more than just one in front of the computer. I think this is a good thing".

> "We did not discuss anything special. I have used the model more than him; I'm pretty good at this. He was with me so I can show and teach him about how to use it [the BIM kiosk]. This is the future, right?".

5.4 How are the BIM kiosks used? Three ideal-typical situations

Based on our data, we can identify some ideal-typical situations for how the BIM kiosks are used and thus how it affects the work at the construction site. In her reflection on the possibilities of analytical generalization in qualitative research Halkier (2011) mentions one of the founding fathers of sociology, Max Weber, and his term "ideal types". Halkier (2011) refers to Weber's definition of an ideal type as "[…] a one-sidedly focused synthesis of diffuse and discrete empirical phenomena into a unified abstract analytical construct which will never be discovered in this specific form". Ideal types can thus be seen as a kind of generalization that attempts to enable a more general perspective on specific patterns. The following three ideal situations could be identified in our empirical material:

1. **Individual use**. This first ideal type involves a situation where a single worker uses the BIM kiosk alone. The person may of course perform various tasks, but the bottom line is that in this ideal situation there is a single person who uses the kiosks on their own.

2. **One-way communication**. In this ideal type, the situation is somewhat similar to the first one. The difference is that in this second type, it is more than just one person standing in front of the BIM kiosk. However, it is mainly one worker who is in command, i.e. who is actively using the computer. The other workers are not involved in any kind of professional discussion or dialog with the person in command, but they pay attention to and benefits from what is happening on the screen. These kinds of situations are pretty similar to the first ideal type. Nevertheless it distinguish itself from pure individual use as it also partly can be looked upon as a form of "instruction or teaching coworkers BIM" as a couple of informants named it. These situations are in other words characterized by individual use as well as one-way communication or instruction from the person in command to colleagues nearby.

3. **Two-way communication**. The third ideal type differs significant from the two others. In this type, discussions and exchanges of views and ideas among two or more people in front of BIM kiosks are taking place. The kiosks can be said to act as a meeting place for professional discussions. The kiosks possibility to show the model on a big screen where everyone nearby can see challenges, problems, errors, ambiguities etc. is the basis for the discussion; the kiosks facilitate face-to-face collaboration between site workers.

The reality will obviously be a lot more complex than illustrated by the different ideal types in this paper. Still, it is essential to one-sidedly underline particular characteristics to show some key points in our empirical data. The three types will be useful as they specify some complex and yet rather unexplored situations and thus make them more tangible. The ideal types illustrate in a clear manner some of the potential opportunities for the use of BIM kiosks and such on the construction site. Despite the fact that all of the three types represent interesting situations, it is mainly in the third ideal type (two-way communication) the kiosks yields something fundamentally new. In these kinds of situations the BIM kiosks leads to a new form of collaboration among site workers in addition to communicate the design information by an innovative approach.

6 Concluding remarks

In the construction project studied in this paper the commissioner Statsbygg specified only a few requirements in the contract related to BIM kiosks. The requirements were related to some technical specifications and number of kiosks that the contractor should create. As this case study shows, the training session played an important role for introducing the workers to some basic functions in addition to inform about the purpose of the BIM kiosk, as well as listen to the workers needs and feedback. Construction has some particular characteristics, which makes it different from other areas of industry. Specialists from different firms and trades work together in a project, and the workers often attend only for a rather short moment of time doing a highly specialized task. Consequently, the implementation of innovations such as BIM kiosks should be seen as an ongoing effort due the special characteristics of the construction industry. Based on this, we can also derive a more practically oriented implication form our case study. The "BIM kiosk project" described in this paper has largely been governed by two enthusiasts from Statsbygg and Skanska respectively. In upcoming projects with BIM kiosks and similar technology it should be a greater emphasis on strategic planning among leaders in the project and involved firms. This thinking could for instance be linked to a clear goal for the number of workers who is expected to use the BIM kiosks. Such a goal would most likely place the needed focus on the importance of the implementation and training process, and thus increase the possibility to succeed.

This case study demonstrates that it exists some obvious advantages for adopting BIM and similar technology at the construction site. This relates among others to the fact that the workers obtain a more holistic understanding of the planned building through the excellent possibilities for visualization. The workers get the ability to investigate particularly complex issues, as well as access to details that hardly can be seen on a regular drawing. In addition, our findings indicate that in certain cases the data kiosks facilitate a greater level of face-to-face collaboration between site workers. This occurs because workers meet, both planned and randomly, to discuss in front of the computer kiosk while using the model for visualizing complex problems. This means that the data kiosk paves the way for new collaboration forms on-site. These kinds of situations would most likely not have happened if the site workers used individual computers such as tablets. Still, too little is known about how BIM kiosks affect collaboration across organizational boundaries and disciplines on site. This is an unexplored area where additional testing and research is needed in order to draw firm conclusions.

Future research should also take a closer look on this topic from several starting points in addition to BIM kiosks. One possibility is to study the potential of using tools such as computer tablets and smartphones on site. An obvious advantage is that kind of tools are mobile devices and thus allow workers to bring the 3D model to the specific working situation. It would also be worthwhile to study projects where several tools, e.g. BIM kiosks and mobile devices, were used in combination. This combination might open up for new interesting ways of working for site workers and craftsmen. The possibilities are many; exciting times are ahead at construction sites throughout the world.

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