An organizational perspective on implementing BIM for business value: a case study of a large public client

Abstract: Building Information Modelling (BIM) has been claimed to improve the construction industry’s productivity, lower the impact on the environment and support innovation. Most BIM research has focused on the technical aspects of BIM and on identifying the effects of using BIM, leaving the organizational perspective mostly neglected. In information systems (IS) research, the organizational perspective has received much attention and the IT business value model has been used to describe what organisational conditions are necessary for business value creation through IT. The IT business value model is applied as a framework when analysing a qualitative case study of a large Swedish public infrastructure clients’ implementation of BIM. The purpose is to explore what organisational challenges are related to implementing BIM for business value creation. The findings show there are both intra – and inter organisational challenges related to implementing BIM for business value, such as challenges in changing work processes, demanding BIM in procurement, providing incentives to BIM, providing new role descriptions and developing common industry-wide standards. The findings offer new insights into what organizational challenges there are related to implementing BIM for business value and develop the theories in construction management and BIM research on value creation through BIM.

Keywords: Building information modelling, business model, organizational change, construction management
Introduction

In the construction industry, which is characterized by high complexity, fragmentation and uncertainty (Dubois and Gadde 2002), low productivity and low innovation (Winch, 2010, Gann and Salter 2000), and slow uptake of IT (Teicholz et al. 2001), Building Information Modeling (BIM) has been positioned as a solution to the industry’s challenges (e.g. Azhar 2011, Succar 2009, Rezgui et al. 2009).

Building Information Modeling has been described as “a set of interacting policies, processes and technologies generating a methodology to manage the essential building design and project data in digital format throughout the buildings life cycle” (Succar 2009) and is often promoted as having the potential to positively support a buildings entire life-cycle (Eastman et al. 2011). BIM has also been promoted as a potential catalyst for overall change of the industry (Aranda-Mena et al. 2009, Eastman et al. 2011) and as a new paradigm towards the design, construction and maintenance of buildings (Succar 2009).

There has been great interest for BIM in research, especially from rational, process and technological perspectives. This bulk of research includes, for example, technical aspects of information handling, such as modelling, classification and standardisation (e.g. Hallberg and Tarandi, 2011, Grilo and Jardim-Goncalves, 2010) and optimizing planning and scheduling for more efficient processes (e.g. Khanzode et al. 2008, Kam et al. 2003). There has also been much research focused on identifying the effects of implementing and using BIM, such as lower costs, time savings, faster completion times, fewer change orders and fewer errors (e.g. Barlish and Sullivan 2012, Becerik-Gerber and Rice 2010, Bryde et al. 2013, McGraw-Hill 2010).
Benefits of BIM to information management, such as more accurate and on time exchange of information between projects and earlier creation of critical information, have also been presented (Demian and Walters 2014).

Despite the extensive research into BIM and the claims of BIM to contribute to the industry’s challenges, recent research shows that there are still large barriers persistent towards BIM adoption (e.g. Demian and Walters 2014, Hartmann et al. 2012, Zuppa et al. 2009, Fox and Hietanen 2007) and that there exists uncertainties as to whether the claimed benefits of BIM really have been fully achieved (e.g. Kang et al. 2013, Fox 2014, Fox and Hietanen 2007, Becerik Gerber Rice 2010). Fox (2014), for example, questioned the claims that BIM brings about increased productivity and highlights that, although it has been claimed for some years now that BIM will increase productivity, productivity has actually decreased while the claims for BIM have expanded. Thus, there is a possibility that the claims for BIM may be overly optimistic (Fox 2014). Kang et al. (2013) also questioned whether the claimed benefits of BIM have been fully achieved and concluded that the attempts in previous research to quantify the relationship between BIM and improved performance have been highly inconclusive and inconsistent. Becerik – Gerber and Rice (2010) argued that the proposed benefits of BIM in research in fact are quite difficult to evaluate because many of the claimed benefits are often intangible or semi-tangible and are almost never reported in any quantitative values. Furthermore, Davies and Harty (2013) showed that the expectations of the consequences of BIM use were related to expectations that BIM was compatible with existing ways of working. Also, the benefits of BIM presented in previous research have often been derived from singular project specific situations, making them difficult to translate.
and apply to other construction projects (Becerik-Gerber and Rice 2010, Kang et al. 2012). Even though the value of BIM is a topic currently intensively discussed in the industry, research shows that most construction organisations actually do not measure the effects of BIM and do not employ a formal methodology to evaluate possible benefits (Becerik-Gerber and Rice 2010, Sulankivi 2004). In fact, the construction industry has been described as a challenging context for ICT adoption (Davies and Harty 2013, Andresen et al. 2000) and the implementation of BIM to support construction management remains a challenging task with persisting barriers to adoption (Hartmann et al. 2012, Davies and Harty 2013).

One possible explanation to why there still are large barriers towards BIM adoption (e.g. Demian and Walters 2014, Hartmann et al. 2012, Zuppa et al. 2009, Fox and Hietanen 2007) and uncertainties as to whether the claimed benefits of BIM have been fully achieved (e.g. Kang et al. 2013, Fox 2014, Fox and Hietanen 2007, Becerik Gerber Rice 2010), could be because of a lack of research into the organisational perspectives of BIM. In fact, in recent years, there have been several calls for studies problematizing BIM in its organizational context. For example, Wikfors and Löfgren (2007) argued that research needs to broaden its perspective in regard to IT in construction and take on an organizational and management viewpoint. Karrbom Gustavsson et al. (2012) argued that there is limited research on construction IT tools in organizational contexts. Adriaanse and Voordijk (2005) and Fox and Hietanen (2007) called for more research on inter-organizational communication in construction IT. Fox (2009) and Fox (2014) discussed the hype concerning BIM and suggest that new approaches, such as critical realist descriptions of BIM, may provide improved understanding of why the implementation of BIM
has yet to meet the expectations of increased productivity.

Only a few studies have regarded the implementation of BIM from an organizational standpoint. For example, Dossick and Neff (2009), argued that the organizational challenges have to be taken into account when implementing BIM. Hartmann et al. (2012) and Gu and London (2010) argued that the existing work processes need to be changed in order to adopt BIM. Taylor (2007) argued that the work processes, inter-organizational relationships and skills have to be changed in order to implement 3D CAD. Froese (2010) argued that changes in the organisations work practices and changes in the skills of the project participants are required in order for BIM to achieve its full potential. Fox and Hietanen (2007) discussed potential technological and organisational barriers to BIM use. Although these researchers have established that organizational changes are important when implementing BIM, there is a need for more construction management and BIM research that examines what organizational changes that are needed when implementing BIM for purposes of business value creation and that explores what organizational challenges that are related to implementing BIM for creating business value.

In Information Systems (IS) research, where the term business value has been studied, the business value of IT has been defined as both the economic impact of IT on organisational performance and the non-economic impact of IT on organisational performance (see for example in Schryen 2013, Kohli and Grover 2008, Cao 2010, Mooney et al. 1996). Early research on the business value of IT regarded mostly the economic effects of IT on organisational performance such as increased productivity, profitability, cost reduction and other measures of performance (e.g. Mukhopadhyay
et al. 1995, Barua et al. 1995, Melville et al. 2004). In more contemporary IS research, however, the business value of IT has increasingly been described as both the economic impacts of IT on organisational performance and the non-economic and intangible impacts of IT on organisational performance, including for example also organisational capabilities and strategic position, impacts on intermediate business process and on organisational capabilities (e.g. Schryen 2013, Kohli and Grover 2008, Cao 2010, Mooney et al. 1996). Mooney et al. (1996) regarded business value as both economic effects of IT and non-economic effects of IT. The economic effects of IT are reflected in what Mooney et al. (1996) referred to as automational effects, such as productivity improvements, labour savings and cost reductions. The non-economic effects of IT are reflected in what Mooney et al. (1996) referred to as informational effects, such as improved decision quality, employee empowerment, decreased use of resources, enhanced organizational effectiveness, and better quality, and in what Mooney et al. (1996) refer to as transformational effects, such as the facilitation and support of process innovation and transformation, improved responsiveness, downsizing, and service and product enhancement as a result of re-engineered processes and redesigned organizational structures.

Here, the definition of the term business value of BIM builds on the more holistic definitions of the business value of IT in IS research (as in for example Schryen 2013, Kohli and Grover 2008, Cao 2010, Mooney et al. 1996). The business value of BIM is defined as both the economic effects of BIM on organisational performance and the non-economic and intangible effects of BIM on organisational performance. The business value of BIM here thus refers to both measurable economic effects of BIM on organisational performance, such as productivity improvements, cost...
reductions, reduced errors and rework, time saving etc, and intangible and semi-
tangible non-economic effects of BIM, such as improved communication, better
decision making, improved coordination among different disciplines, and more
efficient management of information.

In line with research, by for example Davies and Harty (2013) and Jacobsson and
Linderoth (2012), the IS research field is drawn upon where the organisational
perspectives and the organizational challenges of IT business value creation have
received attention. In particular, the IT business value model by Melville et al.
(2004) examined what organisational challenges there are of using IT for business
value creation and elaborated on what types of organisational changes that are
required in order to implement IT for business value creation. The IT business value
model by Melville et al. (2004) is applied on a large Swedish public infrastructure
clients’ implementation of BIM with the purpose of exploring what organisational
challenges are related to implementing BIM for business value creation. By applying
the IT business value model to the clients’ implementation of BIM, the aim is to
respond to the previous calls in research for more studies problematizing BIM from
an organisational context perspective (e.g. Fox and Hietanen 2007, Fox 2009, Fox
2014, Wikfors and Löfgren 2007, Karrbom Gustavsson et al. 2012, Adriaanse and
Voordijk 2005). The aim of applying the IT business value model to the clients’
implementation of BIM is also to contribute with the much needed organisational
perspective to the current debate in construction management and BIM research on
the effects of using and implementing BIM, and in particular, to elaborate on the
organizational challenges of implementing BIM for business value. The overall
objective is to contribute with new perspectives and to develop the theories in construction management and BIM research on value creation through BIM.

**Literature review**

In the IS research field, the organizational perspective of using IT for generating business value have been studied for a long time. In particular, the role of organizational change for IT business value creation has received much attention and been studied in a variety of industries, ranging from manufacturing to banking (e.g. Barua et al. 1995, Hitt and Brynjolfsson 1996, Venkatraman 1994, Kohli and Devaraj 2004). Specifically, Melville et al. (2004) described how business value may be created through IT and under what organisational conditions. Melville et al. (2004) emphasized IT business value creation as an inter-organizational process and emphasized that, in order for IT to have a positive impact on organizational performance, organizational changes are required. IS research shows that business value creation through IT requires extensive and long-term investments in organisational change, an input that often is neglected in productivity estimations of the economic effects of IT (Hitt and Brynjolfsson 1996, Brynjolfsson and Saunders 2011, Venkatraman 1994, Melville et al. 2004). Wade and Hulland (2004) argued that deploying IT alone do not create IT business value, but must be a part of a business value creating process with the firms organizational factors. These organizational factors could include IT people and management, organisational routines and policies, organizational systems including employees and management, organisational business processes, knowledge assets, relationship assets and

Through various frameworks and models of IT business value creation, IS researchers have tried to explain what organisational changes that are required for IT business value creation. Examples of these frameworks include the IT business value model by Melville et al. (2004) that described how business value may be created through IT and under what organisational conditions. Melville et al. (2004) emphasized IT business value creation as an inter-organizational process and explained that, in order for IT to have a positive economic impact on organizational performance, organizational changes are required. Organisational changes includes, for example, changing organisational policies and rules, changing organizational structures, changing workplace practices and changing organisational culture (Melville et al. 2004), more innovative forms of sharing information, decentralizing the decision-making process, creating economic incentives to IT use and investing in IT training and education (Brynjolfsson and Saunders 2011). The IT business value model by Melville et al. (2004) explored what organisational changes that are necessary for and are a prerequisites for IT business value creation. The IT business value model (Figure 1) described the IT business value creation process as a multi-layered process contingent upon three primary impacts: the focal firm (firm-specific level), the competitive environment (industry-specific level) and the macro environment (macro level). Within each of these three levels, conditions for IT business value creation are described.
The macro environment

Country characteristics

The firms’ ability to generate business value is affected by the macro environment in which it operates, such as by governmental regulations of IT infrastructure, government promotions or country specific factors. Governmental regulations of IT infrastructure, technical developments, government promotions and country specific IT culture are examples of macro factors that could impact the firms business value creation process (Melville et al. 2004).
The competitive environment

Industry characteristics

The competitive environment is the environment in which the firm operates and it is comprised of the industry characteristics and the firms trading partners (Figure 1). Industry characteristics are the industry factors that impact the way IT is being used in the firm and includes regulations, competitiveness, technical changes, IT standards and other factors that positively or negatively impact the firms' ability to generate business value through IT.

Trading partners

The competitive environment also consists of the firms trading partners that impact the focal firms' ability to generate business value. IT enables organizational boundaries to expand and link together multiple firms and melding their business processes (Melville et al. 2004). A firm could perform several business processes on its own, but along with its trading partners it could also improve business process performance across organizational boundaries. With inter-organizational IT connecting the firm with its trading partners, joint business value creation can take place from sharing routines, synergies of dissonance, effective governance, joint problem solving and mutual exchange of information (Melville et al. 2004). The involved parties could then jointly benefit from reductions in market coordination costs, such as reduction in search costs, contracting costs, scheduling costs, budgeting costs, communication costs etc (Melville et al. 2004).
The focal firm

IT resources: technology and human

The focal firm can use two kinds of internal IT resources: technology IT resources and human IT resource. The technology IT resources are shared IT infrastructure of the firm and the specific business applications of the firm that use this IT infrastructure, such as purchasing systems, sales analysis tools etc. The human IT resources refer to the expertise and knowledge of IT within the firm such as the technical skills (e.g. programming, database development etc) and managerial IT skills (e.g. collaboration with business units and external organisations). Utilizing the technology IT resource, implies that the IT infrastructure is shared across the organization and utilized by the organizations members and units for different tasks, such as placing orders etc. Utilizing a human IT resource implies using the organizations members’ knowledge and expertise in both technical skills and managerial skills, such as integrating and maintaining multiple systems, programming or collaborating with different internal business units and external organizations through IT and motivating co-workers to complete projects through IT (Melville et al. 2004).

Organizational change

Organisational changes are prerequisites for IT business value creation (Figure 1). The technology IT resources and human IT resources alone seldom create IT business value, but need to be accompanied by organisational changes (referred to as complementary organisational resources). Organisational changes could include, for example, changing organisational policies and rules, changing organizational

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structures, changing workplace practices and changing organizational culture (Melville et al. 2004). Organizational changes are often neglected or unaccounted for in most productivity measures of IT (Melville et al. 2004, Hitt and Brynjolfsson 1996). Yet it is only through significant organizational changes that major improvements in business value can occur (Melville et al. 2004).

**Business processes and business process performance**

The business processes are those internal activities that underlie the value creating process. It is the activities that the firm performs to transform its inputs to outputs, such as order taking, manufacturing, customer service etc. The performance of these value creation activities are referred to as business process performance and can be expresses in a variety of measures, e.g. cycle times, on time shipping, customer satisfaction, turnover, information sharing.

**Organisational performance**

Melville et al. (2004) defined the business value creation of IT as “the organisational performance impacts of information technology at both the intermediate process level and the organisation-wide level, and comprising both efficiency impacts and competitive impacts” and includes for example productivity enhancement, profitability improvement, cost reduction and competitive advantage. In order for IT to have a positive economic impact on organizational performance, organizational changes are required on both an intra and inter-organisational level (Melville et al. 2004).
METHOD

When the subjective understanding of a phenomenon is of interest, inductive, explorative and interpretative procedures are suitable (Rudestam and Newton 2007, Bryman 2012). The case study of a large Swedish public infrastructure clients’ implementation of BIM consists of two subsets of data; a semi-structured open ended interview study parallel to two participant observation studies. The model of IT business value creation by Melville et al.(2004) is applied to explore what the organisational challenges are of using BIM for creating business value. During the interpretation of the empirical data, the framework components that make up the IT business value model (depicted in boxes in Figure 1) served as interpretative guidance in searching for patterns of organisational changes in the empirical data.

The case study: Sweden’s largest public infrastructure client

The public client in this study is the largest procurer of infrastructure in Sweden, procuring infrastructure projects for approximately 500 billion SEK per year. The public client’s task is to manage the existing infrastructure consisting of roads and railways, and to invest in new infrastructure. The public client has five departments: investments, major projects, maintenance, traffic management and planning. The implementation of BIM in the public client organisation was carried out through a BIM implementation project with its own project group including a total of 12 top and middle management representatives lead by an appointed project manager. The project had its own budget and time plan. The project started in early 2012 and was finished in early 2015. The BIM implementation project was initiated as a response to a Swedish government directive from 2012 (SOU 2012:39) and the overall long-
term objective of the BIM implementation project is to increase the public clients’ internal productivity by 2-3% yearly and drive industry development towards increased BIM use by demanding the use of BIM in procurements (Trafikanalys 2015, SOU 2012:39). A project outcome from the BIM implementation project was a BIM implementation project group and the implementation of 25 BIM pilot projects managed by appointed project managers with support from BIM coordinators. The role of the BIM coordinators was to support the BIM pilot project managers in their implementation of BIM by providing technical support.

The purpose of exploring what organisational challenges are related to implementing BIM for business value creation is examined through semi-structured open ended interviews with the BIM pilot project managers and through participant observation studies of the BIM implementation group. The participant observation studies with the BIM implementation group were conducted prior to the interviews with the BIM pilot project managers. The participant observation studies followed a two day conference of the BIM implementation project groups and consisted of discussions of what changes that were perceived as necessary by the BIM implementation project members when implementing BIM, and of discussions of how the BIM implementation project group, through a referral, could affect how the BIM pilot project were to conduct their BIM implementation. The referral that was being discussed considered what changes that the BIM implementation project could suggest to the steering documents of the public client (that govern and guide how the project managers are to conduct their projects), and thus affect how the BIM pilot project managers would conduct their implementation of BIM. The semi structured open ended interviews with the BIM pilot project managers were conducted after the
participant observation studies and were those that were being targeted in the referral by the BIM implementation project. At the time when the interviews took place, the referral (containing the proposed changes to the work processes and work practices of the BIM pilot projects by the BIM implementation project) had been sent out by the BIM implementation project to the BIM pilot project managers. In the interviews with the BIM pilot project managers, the BIM pilot project managers reflected upon the proposed changes by the BIM implementation project to the steering documents.

The participant observation studies

One of the authors attended a two-day BIM implementation meeting initiated by the project manager of the BIM implementation project group. The meeting took place at a conference centre and was planned, organised and managed by the project manager of the BIM implementation project group. All members of the BIM implementation project group were invited to attend the meeting. There were 12 members of the BIM implementation project group who participated including the project manager of the BIM implementation project group. All members of the BIM implementation project group had senior management positions in their respective departments. The members’ task was to ensure that BIM was being implemented in their respective departments (all departments except for the facilities management department were included in the BIM implementation project) and discuss what changes they could propose to the steering document in order to guide how the BIM pilot project managers were to implement BIM. The purpose of the meeting was to discuss the progress of the BIM pilot projects’ implementation of BIM and to discuss the progress of the referral that the BIM implementation project group was working on that would contain the suggested changes from the BIM implementation project.
group to the work practices and processes of the clients projects in order to guide how the BIM pilot project managers would implement BIM. Much of the discussions of the meeting concerned what type of changes that the BIM implementation project group members perceived as necessary to the work practices and work processes of the BIM pilot projects for implementing BIM. The BIM implementation project group member took turns to present the on-going change activities that were made in their respective departments where the BIM pilot projects were being conducted. The referral being discussed at the two day conference was to consist of proposed changes by the BIM implementation project group to the steering documents of the public client that describe and guide how the work in the projects is to be conducted. The participating author attended but did not take any active part in the discussion. The author took notes of what was being discussed and transcribed the notes directly afterwards.

One of the authors was also invited to listen to a three-hour telephone conference that the BIM coordinators of each of the 25 BIM pilot projects had set up. At the telephone conference, a total of eight BIM coordinators of the 25 BIM pilot projects attended and (a total of eight participants) discussed and shared their experiences of implementing and using BIM.

**The semi-structured open ended interview**

A literature review served as a basis for developing the semi-structured open-ended interview study (Kvale, 1996, Rudestam and Newton, 2007). The interview study applied an interview guide that contained a list of themes to steer the interview but it did also allow for flexibility (Bryman 2012, Rudestam and Newton, 2007). Purposive
sampling was the method used to identify the respondents (Bryman 2012). The selection criteria targeted the project managers from the 25 BIM pilot projects. As it turned out, some of the 25 BIM pilot projects were in fact managed by the same project manager. Hence there were a total of 18 pilot project managers. Out of the 18 contacted BIM pilot project managers, 10 responded and agreed on an interview (Table 1). The 8 BIM pilot project managers that declined said that they were in a too early project phase to be able to contribute to the interview, and in some cases, they said that they had not even started up their BIM pilot project yet.

<table>
<thead>
<tr>
<th>Respondent</th>
<th>Gender</th>
<th>BIM pilot project responsibilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Respondent A</td>
<td>Woman</td>
<td>1 road expansion</td>
</tr>
<tr>
<td>Respondent B</td>
<td>Man</td>
<td>1 road expansion/ pipeline work</td>
</tr>
<tr>
<td>Respondent C</td>
<td>Man</td>
<td>2 railway/yard extensions</td>
</tr>
<tr>
<td>Respondent D</td>
<td>Man</td>
<td>1 new high speed rail</td>
</tr>
<tr>
<td>Respondent E</td>
<td>Woman</td>
<td>1 traffic junction</td>
</tr>
<tr>
<td>Respondent F</td>
<td>Man</td>
<td>3 traffic junction/road expansions</td>
</tr>
<tr>
<td>Respondent G</td>
<td>Man</td>
<td>1 new road stretch</td>
</tr>
<tr>
<td>Respondent H</td>
<td>Man</td>
<td>2 railways</td>
</tr>
<tr>
<td>Respondent I</td>
<td>Woman</td>
<td>3 railway/yard extensions</td>
</tr>
<tr>
<td>Respondent J</td>
<td>Man</td>
<td>None (is a former pilot, no longer using BIM)</td>
</tr>
</tbody>
</table>

*Table 1. Respondent profile*
During the interviews, the respondents were asked to describe to what extent they used BIM in their BIM pilot project, what benefits they had perceived from working with NIM and by what means they had measured or perceived these benefits. The respondents were also asked to give an account of the challenges that they had encountered in their BIM pilot project(s) when implementing and using BIM and what their reactions and opinions were to the referral that the BIM implementation project group had shared with them. The respondents were also asked to describe what (if any) changes they had made to their work processes when starting to implement and use BIM.

The interviews lasted between one and a half to two hours each. The documentation consisted of hand written notes that were transcribed directly after each interview. From the interview study, representative extracts were selected to construct the narratives.

**Results**

The IT business value model by Melville et al. (2004) was applied as framework when interpreting the data from the case study on the Swedish public infrastructure clients’ implementation of BIM. The data was analysed in line with the IT business value models’ three levels: the focal firm, the competitive environment and the macro environment. Here follows the findings, first on a general level based on the three levels, then followed by a section interpreting the organisational challenges of implementing BIM specifically.
The macro environment

Country characteristics

The macro environment consists of government regulations that decide what the public client is to achieve during a specific year and directly influences and governs the public client's operations. The government is also ushering the public client to set an example and drive the implementation of BIM in Sweden forward.

The competitive environment

Industry characteristics

The competitive environment consists of the construction industry. In the case of the public infrastructure client, it can be argued that its competitive environment also consists of other state institutions that compete for government funds.

Trading partners

The public client procures services and goods from, for example, planners, consultants, contractors, builders, logistics, municipalities etc operating in the construction industry.

The focal firm

IT resources: technology and human

The public client utilizes a number of internal technology IT resources including for example BIM, financial reporting systems, traffic management systems, billing
Business processes

The main business process of the client is to purchase and procure operations, maintenance and investments of the national infrastructure. As a government agency, the client is governed and regulated in its public procurement.

Organizational performance

The client has a mission from the government to to promote increased productivity in the construction industry (Trafikanalys 2015, SOU 2012:39). According to the project manager of the BIM implementation group, the ultimate goal of the client’s BIM implementation is to achieve a yearly increase in productivity of 2-3 %. However, in many of the interviews with the BIM pilot project managers, the benefits of implementing and using BIM were not perceived in terms of productivity but were perceived as semi-tangible and intangible effects, often evolved around improving project management, for example improved coordination and communication, improved decision making, improved information management and reduced handling of drawings, increased innovation and new ideas, more engaged staff, improved accounting, control and monitoring of project goals, less errors and rework, fewer changes and change orders, better information management and information sharing between the different actors and phases and fewer appeals were benefits perceived by the project managers. Many of the BIM pilot project managers spoke of BIM in terms of extra costs. Many of the respondents did not perceive measurable benefits from implementing BIM. The vast majority of the BIM pilot
project managers associated BIM with costs, such as a costly software tool in need of frequent updates and additional education. Some BIM pilot project managers did however perceive some positive effects from implementing BIM, such as fewer drawings, clash detections, fewer errors, but had not actually measured these effects of BIM.

Also, most of the BIM pilot project managers said that the perceived benefits of BIM were largely experience-based and were not directly expressed in documents, spreadsheets, databases, etc. Many of the interviewed also believed that the perceived benefits of BIM were linked to specific projects and dependent upon the work of certain BIM enthusiastic project managers. One of the BIM pilot project managers (respondent G) perceived cost savings from implementing BIM. The savings from reduced handling of drawings were estimated to approximately 65 million SEK and savings from fewer errors in design and planning to approximately 500 million SEK. Other perceived cost savings from BIM by respondent G were improved cost estimations and cheaper bids from contractors. The cost savings by Respondent G had however not been measured, they were only perceived by Respondent G.

**Organizational change**

When applying the IT business value model by Melville et al. (2004) as framework when analysing the implementation of BIM at the public firm, it became apparent that organisational change (both intra-organisational and inter-organisational change) is needed in order to create any business value from implementing BIM. According
to the IT business value model by Melville et al. (2004), organizational changes on both an intra and inter-organizational level (together with industry partners) is a prerequisite for creating business value. Organizational changes could include, for example, being able to manage and change its policies and rules, organizational structures, roles and responsibilities, workplace practices and routines, work processes and its culture (Melville et al. 2004). Based on the interviews and participant observation studies, creating organisational change (and subsequently business value) turned out to be a challenge when the client attempted to implement BIM. In the following section, empirical examples and representative extracts on the challenges of implementing BIM for business value creation are presented. There were both intra- and inter-organisational challenges that the client faced when attempting to create organisational change as a result from implementing BIM. Both the intra-organisational and the inter-organisational challenges in the client attempt to create creating organisational change (and subsequently business value) are presented.

Challenges of managing intra-and inter organisational change

Challenges in changing work processes and work routines

In the participant observation study, the BIM implementation project group were discussing a the contents of a referral in which they proposed changes to be made to the steering documents (the documents that stipulate the work processes of the public
The contents of the referral include proposed changes to the descriptions and guidelines of the client work practices and processes to, as a result of the BIM implementation, also including descriptions and guidelines of how to work with BIM early in the process of the clients projects. For example, the BIM implementation project group suggests that new working templates needs to be created, changes also need to be made to the project specifications, staffing documents, documents of responsibilities, agendas and to other internal governing documents. During the time of the interviews, the referral containing the proposed changes to the work practices and work processes to regard BIM in the early stages of the clients projects, had been completed by the BIM implementation group and been sent out to the BIM pilot project managers for feedback and comments. The changes to the work practices and work processes that the BIM implementation project group proposed in the referral were perceived differently by the BIM pilot project managers than by the BIM implementation project group who had constructed the referral. The BIM pilot project managers perceived the proposed changes to the steering documents as rather complex, fuzzy and incomplete. The BIM pilot project managers also perceived that the public client is not certain on how the work practices and processes will actually change as a result of the BIM implementation. The BIM implementation project group and the BIM pilot project managers had opposite views of what changes that were important, and the BIM pilot project managers were also of the view that the referral was difficult to read and contained too many suggested changes.

“The referral was quite heavy and difficult to read and at times very fuzzy and even contradictory, which I think that made other project managers also put it aside and not read it” (Respondent I)
During the interviews, some of the BIM pilot project managers also said that they believed the complexity in the BIM pilot project would increase since the changes that were being proposed to the steering documents also would have an effects upon the way in which the public client does business with other actors in the industry. The proposed changes to the steering documents were perceived by some of the BIM pilot project managers as likely to affect the whole industry’s work processes and work routines, and that they, therefore, should have been more clear and precise.

**Challenges in providing learning and feedback**

Another challenge brought up by the BIM implementation project group as well as the BIM pilot project managers, was the learning curve associated with BIM. A BIM critical project manager (respondent J) said that there was not enough time to begin engaging in BIM, and that they could not afford BIM with their tight project budgets. The participant observation study showed that the BIM implementation project group was planning to do coordinated efforts for sharing experiences and feedback of using BIM. However, as of today, there are no structured and systematic approaches towards sharing experiences among BIM pilot project managers. The BIM implementation project group has also proposed that experience feedback reports are to be created in order to share the experiences of implementing and using BIM among the BIM pilot project managers. These initiatives were on an initial level and the creation of feedback experience reports was at the time of the interviews being tested by the BIM pilot project managers. The BIM pilot project managers had varying experiences of establishing experience feedback reports, from incomplete
experience feedback reports to ones that were very detailed and described the experiences of BIM thoroughly. Also, several of the respondent’s expressed that the implementation and use of BIM often seems to be dependent more upon BIM-enthusiastic individuals than on the efforts pursued of the BIM implementation project.

“*We have not received any pressure from upper management on using BIM. Rather, our regions success of working with BIM has been dependent upon our own initiatives and that we have had a very strong BIM enthusiastic person taking the leading role*” (Respondent C)

Many of the interviewed BIM pilot project managers also feel that there is a need for the public client to develop their own BIM expertise instead of hiring external BIM consultants. The outsourcing of BIM expertise was perceived to be a problem as it inhibits the public client to develop its own internal long-term BIM skills.

**Challenges in sharing a common and mutual understanding and definition of BIM**

Based on the findings from the interview study and participant observation studies, the public client’s daily work depends to a large extent on close collaboration with its construction industry partners. The interviews indicated that there is a perception among BIM pilot project managers that it is important that all the parties involved in the project share a mutual understanding of BIM and share a common industry-wide adopted definition of BIM. This was, however, according to many of the BIM pilot
project managers not the case. There was perceived to be a lack of a mutual and common understanding and definition of BIM. The BIM pilot project managers pointed out that there is a need for a common definition of what a BIM project is and what a BIM projects includes (and not), both internally and externally towards project partners.

“What is needed, yet is missing today, is a common and mutual understanding of what we are to use BIM for and how we define a “BIM project”” (Respondent B)

“At the client, and among the consultants and entrepreneurs as well, people seem to be using BIM for all different causes. We have to be able to agree on what it is that we want to use BIM for” (Respondent C)

**Challenges in sharing mutual work processes with industry partners**

Many BIM pilot project managers indicate that inter-organizational aspects, such as sharing working methods and collaborating across organizational boundaries, are important if their BIM implementation is to create any value. There was also a perception among a few of the BIM pilot project managers that is the industry actors that are educating the BIM pilot projects on how to use BIM rather than the BIM implementation project group. As Respondent I said:

“Today, our industry partners are educating us on BIM” (Respondent I)
Another respondent (Respondent A) explained that their BIM project had been able to reach a continuous acceptance among the project members as they had been allowed by the contractor to be involved in the contractors’ creation of the BIM model. Many respondents also argued that BIM seemed to enable better coordination and collaboration as BIM united all the involved partners and stakeholders to come together around a single model to share knowledge and experiences.

**Challenges in demanding BIM in procurement**

The BIM implementation project group had also suggested changes to be made to the contracts and contract templates in the referral. For example, that the contract templates were to be changed so that they demanded digital models and object oriented processes instead of 2D drawing and drawings oriented processes. Among the changes suggested to be made to the contract templates, the BIM implementation project group also suggested that a new role – a BIM manager – is required in all new contracts. There should be BIM managers present, both from the public client and from its business partners. There was an activity taking place as a result of the BIM implementation project which involved educating the BIM pilot project managers on how to formulate contracts that demand BIM and how to procure models instead of drawings. The respondents also emphasized that the public clients must demand BIM from its partners. For example,

“One must early on make demands in procurement that the partners must use BIM in order to realize benefits such as better coordination, clash detections and better
However, making changes to the contracts and contract templates seemed to be a tedious task consuming a lot of time. There seemed to be a clash between what the BIM pilot project wanted to be demanded in the new contract templates and between how the procurement organisation wanted the contract templates to be formulated to include BIM. At the time of the interviews, the proposed changes to the contract templates to demand BIM in procurement were yet to be finalized, yet at the same time more and more projects at the public client were using BIM and were formulating and making their own demands for BIM in their respective contracts and specifications when procuring.

**Challenges in providing incentives tied to BIM**

A few BIM pilot project also mentioned how creating incentives for using BIM could force its industry partners to use BIM in a manner which was demanded by the client. Making changes to the contract templates to require industry partners to use BIM not only involved making contractually binding requirements in the procurement to use BIM, but also included incentives related to BIM. For example, one respondents explained that:

“What makes this BIM pilot special is that in addition to the BIM requirements demanded in the procurement, we also have a list of BIM related activities that we consider as value creating activities that the entrepreneur can chose to perform and get a bonus” (Respondent E)
However, there were no structured and systematic approaches at the public client in how to provide incentives for project partners to use BIM. The incentives in the contracts and in the project specifications were often created in isolated projects by the initiative from a BIM enthusiastic project manager, and were not something that all BIM pilot project managers were creating. In the interview study, only a fraction of the BIM pilot project managers took own initiatives to create incentives for BIM use in their contracts and project specification templates.

Challenges in getting different departments to start working together

The majority of the BIM pilot project managers highlighted the need for engaging the end users in BIM. In the case of the public client, the end users were their facility managers. Many respondents argued that the public client should have engaged the BIM implementation at the facilities management department first, and that in fact, not having facilities management interested in BIM might overturn the entire BIM implementation process. Many respondents expressed their concern for the lack of engagement in BIM from the facilities management department. Many respondents argue that the various departments of the public client must begin working together. Many respondents regard it as a problem that the BIM implementation project group were demanding BIM in some departments, but not in others. They argued that it is at the facilities management department where the long term value is generated, but here the BIM implementation project was not demanding BIM.
“Today BIM offers no value as we do not have the facilities management with us on BIM” (Respondent J)

“As of today, the facilities management is not part of the BIM implementation. This is a major problem as they able to make demands early on in the process”
(Respondent I)

Challenges in changing roles and providing new role descriptions

The findings from the participant observation studies also showed that the BIM implementation project group had suggested that new role descriptions were to be made. They suggested that a new role was to be created – the BIM coordinator. It was also suggested that the project managers role should expand into becoming responsible for the implementation of BIM. In the referral, one of the suggestions included the new role descriptions for the BIM coordinator. However, according to the interviews with the BIM pilot project managers, there were no clear description of the BIM coordinators role and much of the responsibility of implementing BIM had been passed down to the project managers of the BIM pilot projects.

Challenges in developing common industry-wide standards

In the case of the public clients implementation of BIM, there has been a large focus on the technical aspects of BIM. Many BIM pilot project managers also highlighted that the lack of interoperability is a problem faced by both the client and its industry partners. They also said that it is a challenge that the client needs to resolve together with its partners. For example,
“A problem is that we are required to have multiple licenses and updates from several software suppliers in order to work with BIM and it is costly” (Respondent H)

The participant observation studies and several BIM pilot project managers indicated the need for mutual and shared industry-wide efforts in developing standards for BIM in the infrastructure industry and the need for mutually adopting these industry standards.

“A hinder towards BIM implementation are all the technical issues related to BIM. It’s important that we manage to create a common language that enables the different technical units to talk to each other, and thus enables different project phases to start communicating more” (Respondent H)

“The work of driving and developing open and neutral industry wide formats and standards have to come from a large public client who has the power to significantly affect the rest of the industry” (Respondent D)

**Challenges of managing the lack of interoperability together with the industry**

Another technical aspect of BIM that has received much attention from the public client in their implementation of BIM is the lack of interoperability. The lack of interoperability was identified as a major challenge towards the public clients
implementation of BIM. Many project managers claimed that it would have been much easier to implement BIM should the software and hardware had been able to efficiently communicate and exchange information. Many BIM pilot project managers said that the lack of interoperability is a barrier when arguing for why one should use BIM. The lack of interoperability is seen by the opponents of BIM as an argument for why BIM should not be used.

“It would have been easier to argue for our BIM implementation if the software and hardware would have been able to communicate without any frictions and problems” (Respondent D)

“We did not force our entrepreneur to use BIM, partly because we did not have any software or hardware that could read the models in question” (Respondent J)

**Challenges in demanding BIM standards and formats in procurement**

Again, based on the interviews and participant observation studies, a large focus from the client regarded the technicalities of BIM. The public client had tried to tackle some of the problems of the lack of interoperability by demanding certain standards and formats to be used by its partners in the procurement. With regard to the technicalities of BIM, changes have been made to the steering documents and procurement templates of the public client to specifically demand from its partners what type of software to use, what type of exchange formats and standards to use and which versions of software to use. By demanding this from its partners, the public
client had an opportunity to guide the industry in its work with developing industry-wide BIM standards and formats. For example, one respondent explains that:

“Much of the work for developing open and neutral formats must be powered on and come from a big client with power to influence on the rest of the construction industry, just like the public client” (Respondent D)

Discussion

The purpose of exploring what organisational challenges there are related to implementing BIM for business value creation was explored by applying the IT business value model (by Melville et al. 2004) as a framework for analysing the clients’ implementation of BIM. The aim was to address the organizational perspective of implementing BIM for business value creation, and in particular the organizational challenges related to the implementation of BIM for business value creation.

When applying the IT business value model (Melville et al. 2004) to the case study, it became apparent that the client was facing challenges with respect to creating and managing organisational changes for business value creation through BIM. Melville et al. (2004) argued for the need of creating and managing organisational change, not in isolation, but in close synergy with industry partners in order to be able to create IT business value. In this respect, there were both intra- and inter-organisational challenges that the client faced when attempting to create organisational change. These intra- and inter-organizational challenges were challenges in changing work
processes and work routines, providing learning and feedback, sharing a common
and mutual understanding and definition of BIM, sharing mutual work processes
with industry partners, demanding BIM in procurement, providing incentives tied to
BIM, getting different departments to start working together, changing roles and
providing new role descriptions, developing common industry-wide standards,
managing the lack of interoperability together with the industry and in demanding
BIM standards and formats in procurement. Some of these challenges were related to
both the client and its partners, such as the challenges of developing common
industry-wide standards, managing the lack of interoperability together with the
industry and in demanding BIM standards and formats in procurement. The client
attempted to deal with these challenges by, for example, making clear demands for
BIM in procurement, making changes to internal governing documents, creating new
role descriptions, engaging the end users and providing experience feedback.

In the outset, it was argued that previous BIM research had focused too much on the
technical aspects of BIM implementation (e.g. Hallberg and Tarandi, 2011, Grilo and
Jardim-Goncalves, 2010, Khanzode et al. 2008, Kam et al. 2003) and identifying the
effects of implementing BIM (e.g. Barlish and Sullivan 2012, Becerik-Gerber and
Rice 2010, McGraw-Hill 2010), and less on the organisational perspective of BIM
implementation. It was proposed that this lack of research could be the reason for
why there are still barriers towards BIM adoption (e.g. Demian and Walters 2014,
Hartmann et al. 2012, Zuppa et al. 2009, Fox and Hietanen 2007) and there still
exists uncertainties as to whether the claimed benefits of BIM in previous research
have been fully achieved (e.g. Kang et al. 2013, Fox 2014, Fox and Hietanen 2007,
Becerik Gerber Rice 2010). It was also brought to attention that there had been some
research into the organisational aspects of BIM implementation (e.g. Dossick and Neff 2009, Taylor 2007, Gu and London 2010, Froese 2010, Hartmann et al. 2012), but that more research from an organisational perspective is needed if BIM is to support construction management (e.g. Hartmann et al. 2010, Wikfors and Löfgren 2007, Karrbom Gustavsson et al. 2012, Adriaanse and Voordijk 2005, Fox and Hietanen 2007, Fox 2009, Fox 2014).

The findings show that the areas in previous BIM research that have received most attention, i.e. the technical aspects of BIM implementation and the identification of the effects of BIM, were also those areas that have received much attention in the clients implementation of BIM as well. For example, the technical aspects of BIM implementation posed challenges for the public client in terms of developing common industry-wide standards, managing the lack of interoperability together with the industry and in demanding BIM standards and formats in procurement). Also the identification of the effects of BIM had also received much attention at the client. The findings showed that the effects of BIM often evolved around improving the project management practices and often were intangible or semi-tangible, such as improved coordination and communication, improved decision making, improved information management and reduced handling of drawings, increased innovation and new ideas, more engaged staff, improved accounting, control and monitoring of project goals, less errors and rework, fewer changes and change orders, better information management and information sharing between the different actors and phases and fewer appeals were benefits perceived by the project managers. There effects of implementing BIM were difficult to detect at the client, partly due to that the client had failed to produce any clear and common definition of BIM and partly
because there had not been any structured and systematic attempts to evaluate and measure the effects of BIM. The desired effect of using BIM was proposed by the BIM implementation project group to be a yearly increase in productivity of 2-3%. However, this differed largely from effects of BIM that the BIM pilot project managers had perceived.

It was also proposed in the outset that the organizational aspects of BIM implementation have received too little attention in previous construction management and BIM research. In the case of the public client, the organizational aspects of their BIM implementation posed a major challenge. The client had challenges in making changes to its organization as a result of BIM. For example, the referral by the BIM implementation project group that contained the proposed changes to the organization’s work practices and work processes did not receive the desired response from the BIM pilot project managers when it was shared with them. The suggested changes to the steering documents by the BIM implementation project group were perceived as fuzzy, ambiguous and difficult to understand by the BIM pilot project managers. The clients attempt to regard an organizational perspectives of implementing BIM, in the form of the proposed changes to the steering documents in the referral, did not have the intended effect upon the BIM pilot project managers, and the proposed changes to the work practices and routines to regard BIM earlier in the projects, were difficult to communicate to the BIM pilot project managers. Rather, the clients attempt to consider the organizational aspect of their BIM implementation turned out to pose a challenge. The results from the BIM implementation of the public client in this research thus confirms what was being proposed in the outset; that there is a too large focus on the technical aspects of BIM.
implementation and that the organisational aspects of BIM implementation tend to be neglected, overlooked or perceived as a hindrance. Thus, the results confirm that there is a need for more research into the organisational aspects of BIM implementation (as proposed by e.g. Wikfors and Löfgren 2007, Karrbom Gustavsson et al. 2012, Adriaanse and Voordijk 2005, Fox and Hietanen 2007, Fox 2009 and Fox 2014). By applying the IT business value model to the client implementation of BIM, it was shown that there were both inter – and intra-organizational challenges related to implementing BIM for business value.

Finally, what the results also showed was that BIM implementation cannot be studied in isolation but that BIM implementation also has to be studied and evaluated from an organisational perspective. The findings contribute to construction management and BIM research by highlighting the organizational challenges of implementing and using BIM for purposes of business value creation; a subject that has not received much attention in previous research but that has both theoretical and practical relevance. Thus the findings contribute with the much-needed organisational perspective to the current debates in construction management and BIM research on the effects of implementing BIM. By drawing on theories of value creation through IT from the IS field, the theories in construction management and BIM research on value creation through IT have aimed to be developed, and new insight into what organizational changes that are important yet currently pose challenges towards implementing BIM for business value, have been gained.
Conclusions

In order to better understand how business value can be created through BIM, the perspectives from other research fields can offer construction management and BIM research new insights into how to consider and problematize BIM in an organizational context. By applying the IT business value model from the IS field to a large public infrastructure clients implementation of BIM, the current paper highlights that organizational change is an important condition for business value creation through BIM. But it also sheds light on how organizational change in can pose an organizational challenge rather than a facilitator for BIM business value creation. There are currently many intra- and inter-organizational challenges with respect to creating organizational change (and subsequently business value). The findings show that, despite the extensive previous research efforts into the technical aspects of BIM implementation and into identifying the effects of BIM, it is the same issues, i.e. the technical aspects and the identification of the effects of BIM, that currently received the attention of the client in their implementation of BIM. Less effort by the client was put into discussing and elaborating on the intra- and inter-organisational challenges that they suffered from in their attempt to implement BIM for business value. These organisational challenges have been the main focus here. The findings show that more research is needed on into the intra – and inter-organisational challenges of implementing BIM if the implementation of BIM is to enable any business value creation.

The importance and relevance of the findings lie in that they contribute with the organisational perspective to the ongoing debate in construction management and BIM research on the effects of implementing and using BIM. In particular, the
findings emphasize the organizational challenges related to implementing BIM for business value. By drawing on the IT business value model as a framework for analysing the case study, new insights into what organizational changes that are important when implementing BIM for purposes of business value creation, yet currently remain a challenge for BIM business value creation were highlighted. The findings emphasize the importance of more studies on business value creation through BIM from an organizational perspective.

There are also limitations to the chosen method. The respondents in the interviews were only 10 and chosen on a quite narrow selection criteria; they had to be BIM pilot project managers. BIM was being implemented in other projects as well other than the designated BIM pilot projects, but were not included in the research. But as Patton (1990) puts it, “the validity, meaningfulness, and insights generated from qualitative inquiry have more to do with the information-richness of the cases selected and the observational/analytical capabilities of the researcher than with sample size”. Also, the operations of the public client are politically driven which implies that the overall decisions and guidelines are made by the responsible politicians. Suggestions for future research include more studies into how organisational change could be managed in order to create BIM business value. There is also a future need for developing new frameworks and new business models for business value creation through BIM.
References


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