

A PROPOSED BIM BUSINESS VALUE MODEL

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The business value of IT investments has long engaged researchers in fields of information systems (IS) and information technology (IT). Only in recent years has the business value of IT investments received attention in a construction industry context. Particularly, research on the business value of Building Information Modeling (BIM) has emerged in research during the last decade. However, much of the studies do not account for how organizational and business factors influence the value creation process. The research also tends to emphasize what the economic effects of BIM are rather than exploring how these values are created and under what organizational conditions. Hence, the aim is to explore how business value of BIM can be developed in an organizational and business process context. Building on models of IT business value creation from the IT/IS research field, together with findings from interviews on the perceived economic outcomes of BIM, a tentative BIM Business Value Model is proposed that accounts for organizational and business process factors. The model is then used to analyse and suggest what organizational and business related activities that need further attention from research in order to enable BIM business value creation. The findings indicate that among these activities are managing stakeholder requirements, incentives for BIM use, joint inter-organizational activities with partners and delivery of key information to operations and maintenance. A prerequisite for value creation with BIM is however to be able to manage organizational change if BIM is to have a potential impact on performance.

Keywords: business strategy, information technology, information systems, value management.

INTRODUCTION

Technological advancement enables refined solutions and new approaches towards more efficient ways of doing things. Building Information Modelling (BIM) is considered as more than just a technical tool (Eastman 2008). BIM also supports multi-disciplinary, collaborative and integrated approaches (Hartmann *et al.* 2012) and contributes to the development of business processes and work practices (Eastman 2008). The implementation of BIM in construction is however rather slow and the expected positive effects of BIM are not yet being met (Gustavsson *et al.* 2012).

Much of the research on BIM has been from rational, process and technological oriented perspectives, such as modelling, classification and standardisation (Grilo and Jardim-Goncalves 2010, Hallberg and Tarandi 2011), optimizing planning and scheduling for more efficient processes (Gilligan and Kunz 2007). There is less research from organizational and economical perspectives problematizing BIM in its organizational and business context (Adriaanse and Voordijk 2005, Gustavsson *et al.* 2012). Previous research indicates improved project performance by the use of BIM

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by making the building process more efficient, however does not provide a complete and comprehensive list of benefits and associated costs (Becerik-Gerber and Rice 2010).

The potential value of BIM has gained increasing interest in research (Barlisch and Sullivan 2012, Kam *et al.* 2013). However, most of the research has focused on identifying what the economic benefits are (Barlisch and Sullivan 2012, Gilligan and Kunz 2007, Kam *et al.* 2013), as opposed to how business value can be developed and under what organizational conditions. One example of current research that accounts for organizational prerequisites in value creation through BIM indicates that the economic effects of using BIM are perceived to be negative on short-term basis (i.e. additional costs) when there is insufficient emphasis on the organizational context in which value creation takes place (Vass and Gustavsson forthcoming).

In the area of information technologies (IT) and information systems (IS), IT business value has engaged research for a long time. IT business value has been studied in variety of industries (e.g. manufacturing, banking) and with various research approaches (Barua *et al.* 1995, Hitt and Brynjolfsson 1996, Keen 1981, Venkatraman 1994). Research on IT business value has focused on a more strategic perspective when evaluating the effects that IT has upon business processes in organizations and organisational performance (Davenport 2013, Grover and Kohli 2012, Kohli and Devaraj 2004, Melville *et al.* 2004). In the IT business value model, Melville *et al.* (2004) emphasizes that, in order for IT to have a positive impact on the business processes and organizational performance of a firm, organizational change has to occur on the operational level of the organisation alongside the implementation of IT. Until then, initiatives from industry level and macro level are not likely to have a positive effect on organizational performance (Melville *et al.* 2004, Winch 2010). Departing from the literature on IT/IS research, this paper will draw upon the conclusions from the IT business value model in Melville *et al.* 2004 and combine with the findings from an interview study of the perceived business value of BIM (Vass and Gustavsson forthcoming) in order to propose a tentative BIM business value model that includes organizational and business factors. The purpose is to increase the understanding of how BIM business value can be developed and thereby contribute to the much-needed discussion on BIM and the effects of using BIM within the organizational and business context. The rationale behind applying the IT business value model to the construction industry and BIM is because the IT business value models recognizes the need for organizational change alongside the introduction of IT and how organisational change induced by IT reforms the business processes of the organization, and hence, has a long-term effect on organizational performance.

METHOD

The research approach is exploratory and qualitative. The basis is literature reviews (within IT/IS and Construction management) combined with a recent interview study based on nine in-depth semi-structured interviews. The literature reviews were done based on IT business value development in industry in general and in construction in particular. The respondents were selected by purposive sampling and they represent client/owner, contractor and consultant. The respondents were selected on the basis of long engagement in the Swedish construction BIM-community (for example BIM Alliance Sweden), their experience of working with BIM and their current position. The rationale behind purposive sampling is that the research aim of discovering the consequences of using BIM for doing business remains unclear and ambiguous, which

makes early BIM-adopters and experienced BIM users of more interest to the survey (Bryman 2012). All interviews lasted 1,5 hours and were documented and analysed. The analysis was based on interpretation until a meaningful and sense-making pattern was found. Representative extracts were selected to construct the narratives. The analysis continued with a comparison with the IT business model.

RESEARCH ON BUSINESS VALUE IN IT/IS

Research on IT business value originates from computer and information systems research in the early 1990s (Bakos and Kemerer 1992, Barua *et al.* 1995). IT business value can be defined as “*the organizational performance impacts of IT, including productivity enhancement, profitability improvement, cost reduction, competitive advantage, inventory reduction, and other measures of performance*” (Melville *et al.* 2004). Much research point to positive outcomes from IT on organizational performance (albeit there are also research concluding the opposite) (Venkatraman 1994). The bulk of research on IT business value in the IS/IT field includes inter-organizational and business processes as key enablers of value creation. There are systematic attempts to leverage IT, both on technical levels and on business process levels, e.g. organizational change (Venkatraman 1994). Research shows that value creation through IT requires extensive and long-term investments organisational change, an input that often is neglected in productivity estimations (Brynjolfsson 2011).

A MODEL OF IT BUSINESS VALUE

The “*IT Business Value Model*” (Figure 1) by Melville *et al.* (2004) is based on the resource-based view of the firm (that aligns the rationale of economics with management research) and integrates the research on IT and organizational performance into a single framework. In the model, it is assumed that IT impacts organizational performance via microeconomics, industrial organizational theory and via socio-political perspective. The IT value creating process is multi-layered process contingent upon three primary impacts: the focal firm, the competitive environment and the macro environment.

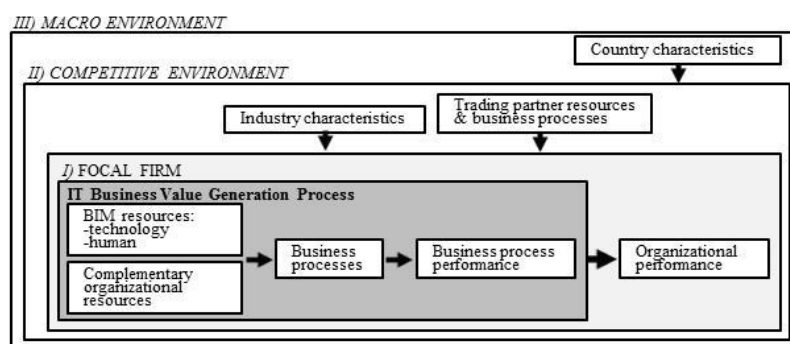


Figure 1. *IT Business Value Model* (Melville *et al.* 2004)

The focal firm represents the organizations’ IT resources and complementary organizational resources (organizational change). These generate value when deployed in the organizations’ business processes. IT resources alone seldom create IT business value, but need to be accompanied by organisational change, i.e. complementary organizational resources, such as changes in organizational structures, culture and work place practices. The complementary resources are often neglected or unaccounted for in most productivity measures. Business processes are those activities that the organization performs to transform its resources into outputs, e.g. customer service and sales. The competitive environment is the environment in which the focal

firm operates. The competitive environment is comprised of the industry characteristics, for example regulations, competitiveness and trading partners. Finally, the focal firms' ability to generate business value is affected by the macro environment in which it operates, such as governmental regulations of IT infrastructure, government promotions or country specific factors (Melville *et al.* 2004).

RESEARCH ON THE BUSINESS VALUE OF BIM

BIM offers an effective IT-tool for information storage and transfer (Becerik-Gerber and Rice 2010) but there is still a lack of knowledge of the economic effects and outcomes of BIM. BIM is thought to represent all the information needed for the building life cycle (Eastman 2008) with the following benefits reported in research: improved business performance, lower costs, increased profitability and increased safety (Barlish and Sullivan 2012, Gilligan and Kunz 2007). According to Kam *et al.* (2013), applying BIM in business also has positive effects on collaboration, coordination of multiple disciplines, sustainable design as well as competency and reputation. Kam *et al.* (2013) has formulated the VDC Scorecard in an attempt to evaluate the maturity of BIM in practice. According to Kam *et al.* (2013), the findings indicate that the BIM performance depends on early stakeholder involvement and the use of quantifiable objectives, among other things. However, there is research that accounts for negative perceptions of the business value of BIM as well and highlights the difficulties in quantifying these (Vass and Gustavsson forthcoming).

TOWARDS A MODEL OF BIM BUSINESS VALUE

In this section, findings from the interviews that contribute to the developing of a corresponding BIM business value model are presented. The results from the interviews are presented on three levels: the focal firm, the competitive environment and the macro environment (in accordance with the IT business value model).

The focal firm

The interviews indicate that the use of BIM currently seems to be dependent upon BIM-enthusiastic individuals rather than coordinated and collaborative efforts of the organization. However, some of the respondents did expect that the construction project managers' role would extend to also become information managers, or coordinator of building information models, whereas others expected BIM to become the responsibility of another individual, such as a third party consultant. Most respondents did agree on that more collaboration among the project participants is needed in order to change the organizational structures, routines and attitudes relating to BIM. For example, one respondent stated that:

“Technical innovations come and go, but the work processes basically stay the same and those are the ones that need to change” (Respondent H).

Yet, one of the biggest challenges has been to successfully implement change and the respondents' efforts have had varying results. For example, some of the respondents explained that they currently could not tell whether the effects of BIM stem from merely using the model, or if they are a result of BIM forcing them to change their work processes. Most respondents also emphasized how BIM projects that typically depend on having a BIM enthusiastic project manager on-board hinder organizational change as the vital knowledge and routines of the project become too much tied to certain individuals and too much experience based. As one respondent explained:

"Most of the BIM use is taking place in the project where a BIM driven project manager sees to that BIM is being used, but in the rest of the organization we do not have any established routines or guidelines for how to implement BIM" (Respondent G)

Another respondent experienced that what is needed for changing the organizational routines and processes alongside using BIM in the organization is a business case for BIM. Other respondents, however, were of the view that organizational change with BIM is merely a talk in the industry and not so much work in progress as it ought to be. One respondent expressed how the construction industry is actually not far behind other industries when it comes to the general use of IT, but that the industry has troubles managing paradigm shifts from new technologies and from changes because it is so fragmented. The respondents also argue that there are not enough incentives today to actually use BIM and to change the existing work processes. And there are no clear incentives for project managers, who are responsible for project time, cost and quality (i.e. project goal), to work with BIM and add risk and thereby jeopardize the project fulfilment:

"It is a challenge to convince project managers to use BIM when the traditional work ways are sufficient and when they already make money" (Respondent E)

One respondent expressed the view that merely introducing incentives is not enough - all the project partners must synchronize their efforts to change their business models and business processes accordingly to the incentives. Another respondent explained that altering and crafting your organizations work processes to meet the demands and needs of the clients enables organizations to make more money, and consequently further drive the use of BIM forward. However, most respondents did share the understanding of the construction industry procurement process as driven by price pressure and a lowest bid mentality, thus impairing the use of BIM. A few respondents also discuss how it is currently a problem that BIM is not yet fully a legal document and does not yet have full legal status that stretches above the status of, for example, paper drawings.

The respondents currently did not see any direct positive economic benefits from BIM, and the vast majority of the respondents associated BIM with costs, such as a costly software tool in need of frequent updates and additional education. However, the respondents did speak of BIM in terms of desired future positive economic benefits, such as more efficient and optimized processes, internal benchmarking, fewer errors and reworks and improved project performance. Project performance was often emphasized in terms of satisfied clients and satisfied end-users, but the most prominent desired effects of BIM on organizational performance was that of an improved flow of information to the operations and maintenance phase for the entire life cycle.

In conclusion, BIM resources and complementary resources (organizational change) are merely a means to an end, and are insufficient for business value creation unless they are applied in some value creating activities. As one respondent explained: *"The business effects of BIM do not originate from the model itself, but from the business processes built around the model"* (Respondent E).

The competitive environment

There respondents provided examples of factors that are unique to the construction industry and that can have a positive or negative impact on their ability to create BIM

business value. The strongly project-based environment with temporary relationships among a multitude of stakeholders, matched together by a lowest-bid procurement process, is considered an industry specific factor that has impact on the focal firm. For example:

"The fragmented construction process leads to loss of information between each project phase and overhead costs for each project actor" (Respondent H).

"The project-based industry and fragmentation may sometimes result in errors, rework, duplication of data, and having to reconstruct the model" (Respondent C)

Another example is the persistent and strongly rooted traditional approaches. To actually use BIM, there has to be clear and reliable arguments for the positive benefits. Otherwise there is no reason for changing something that already works 'good enough'. Moreover, industry associations, e.g. BIM Alliance Sweden, are considered as an example of a positive factor for value creation through BIM. The respondent also brought up the need for more a simple and comprehensible framework for BIM. Some respondents put emphasis on the role of software suppliers and stated that BIM is considered an extra cost due to costly software updates that they can't fully make use of.

Most respondents indicated that they perceived value creation with BIM to be dependent on inter-organizational collaboration and sharing of knowledge and routines. It was explained that project actors are now forced to work together with BIM and start communicating with each other:

"It is a two-way street. You need to understand not only your own firm's business processes, but also the clients" (Respondent D).

The macro environment

The macro environment is also influencing the BIM business value generation process, such as government regulations, industry standards, software developments, national building codes, government subsidies, public procurement forms, funds allocated to education and research, laws and regulations and culture. A few respondents especially emphasized the difficulties of BIM not having legal status:

"There have only been modest efforts towards giving the building information model legal status" (Respondent A)

Different country specific characteristics also steer the direction of BIM. For example, based on the respondents understanding of Sweden's developments in IT, the respondents explain that Sweden has had a good IT maturity and strong engineering and telecom industry and good IT infrastructure. A few respondents also explain how they perceive that the entrepreneurs in Sweden have been at the forefront of BIM implementation.

The BIM Business Value Model

To conclude the interview findings, the construction industry is not yet fully making use of BIM on the three levels of the IT business value model (see Figure 1). Based on the interviews, the components that make up the IT business value model, e.g. organizational change, seem to be lacking or be insufficient in the construction industry. The respondents do show insights and an awareness into what organizational conditions are needed for value creation through BIM, but these are expressed as expectations and beliefs of the future and not as efforts carried out today. What this

means for the proposed BIM business value model (see Figure 2), is that the model is built upon these deficiencies (as identified in the interviews) and on what is currently lacking in the industry's ways of working with BIM, rather than on positive examples from the industry. Thus, the BIM business value model can serve as a map and guidance for what organizational conditions that are missing and need to exist for business value creation.

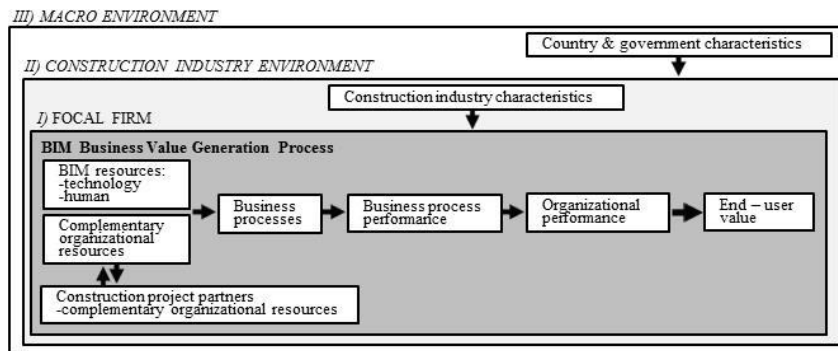


Figure 2. A proposed tentative BIM Business Value Model

For example, on the operational level (focal firm), successful BIM use seems to be dependent on certain key individuals according to the interviews. Organisational change is thus tied to a few BIM knowledgeable individuals rather than the organization as a whole. What this means for the BIM business value model, is that the project participants outside of the organization, e.g. suppliers and consultants, contribute with BIM knowledge that is fully understood and made use of perhaps only by the certain BIM knowledgeable key individuals in the organization, and that the knowledge exchange between the organization and its partners is tied rather loosely to the organization as a whole. In the BIM business value model therefore the role of the construction project partners is more emphasized than in the IT business value model. What can be understood from the interviews is then that the daily work practices, routines, culture etc on the operational level is the level from where organizational change needs to originate from, and then work its way up the organization. BIM initiatives from the construction industry environment (e.g. different BIM associations) and from the macro environment (e.g. government BIM imposes), are then more likely to have an effect on the operational level.

The current procurement forms with price pressure and the incentives forms within the construction industry environment seem to hamper organizational change rather than enable it. This has implications for the BIM business value model as not only the organization and its immediate project partners are important for co-creating business value, but also actors in the competitive - and macro environment, such as the legal and juridical environment surrounding the construction industry. Organizational change in the BIM business value model is thus suggested to expand over organizational boundaries and mutual and synchronized efforts are needed in order to change the organizational structures, routines and attitudes.

In terms of organizational performance, the interviews interestingly indicated that the respondents currently do not see any direct positive economic benefits from BIM, and the vast majority of the respondents associated BIM with costs. However, the respondents did speak in terms of desired benefits of BIM in the future, such as end-user value and improved facilities management. Consequently, in the BIM business

value model, the business value for the end-user is an integral part of what is considered organizational performance.

To summarize the BIM business value model, the model requires careful consideration and attention to the construction industry environment. What is proposed in the BIM business value model is what organizational prerequisites are important, yet missing in the construction industry. For example, close attention has to be paid to transforming the BIM knowledgeable individuals' tacit knowledge into knowledge for the entire organization. The BIM business value model suggests mainly two important proposals on what organizational prerequisites are necessary for value creation with BIM. Firstly, organizational change has to occur within the operational level (focal firm), meaning that the BIM knowledge that is currently tied to individuals rather than to the organizations has to become internalized into the knowledge base of the organizations as a whole. Secondly organizational change has to occur on operational level in the focal firm before organizational change can have an effect on the industry environment and on the macro environment. These conditions are currently lacking in the Swedish context and are the organizational prerequisites for BIM business value creation that are highlighted the BIM business value model.

CONCLUSIONS AND DISCUSSION

The proposed BIM business value model can be viewed as a snapshot of how far the Swedish construction industry currently has come in its use of BIM for value creation. Much of what was discussed in the interviews suggests that the use of BIM in the industry is currently not mature enough today to be analysed in a business value context. There seem to be too many technical and implementation issues persistent in the industry that requires immediate attention from the respondents. However, applying a BIM business value model to the construction industry is still valuable as it enables a deeper exploration of where in the organization that the conditions for business value creation are good and where they are weak. It is therefore considered important to propose a tentative model that can form the basis for the industry's continued development. The rationale behind the proposed BIM business value model is to highlight what is currently lacking in the industries ways of working with BIM and what needs more attention in research.

The purpose of developing a tentative BIM business value model based on the IT and IS fields, was to explore what organizational factors and business factors that seem to be prerequisites for BIM business value creation. The organizational and business enabling factors turned out to be a complex and problematic issue for the respondents. The respondents' organizations simply don't speak of BIM in terms of business value. However, much of what was discussed as problem areas in the interviews relate to the problems in IT/IS research that later laid the foundation for the development of the IT business value model. By applying the IT business value model to the BIM context, the problem areas for value creation with BIM can be understood in the light of a model that has been developed in IT/IS research over three decades and that has been thoroughly built upon in several years of research within a variety of research fields and through a variety of research approaches.

The quest for developing a tentative BIM business value model has shed light on the special circumstances of the construction industry that creates difficulties for business value. The question is whether the construction industry should take on influences from other industries, as it is so different and unique, or if doing so enables BIM

business value creation to move forward. By applying the BIM business value model as a lens for observing value creation in the construction industry, it could be argued that much of the organisational and business factors necessary for BIM value creation can be unravelled. By illustrating what organisational and business process prerequisites that are lacking, an awareness and insight on what might be the missing link in BIM value creation can start to form. The tentative BIM business value model thus serves a guide for future research on BIM business value creation by pointing out areas of research that need more exploration. Suggestions for future research include more empirical research and support on how the BIM business value model can be expanded.

Limitations of the study relate to the qualitative material that the proposed model is based upon. The sample contains only nine respondents, who are also part of the same BIM community, which raises the question of whether the results can be generalized to the industry as a whole. Yet, each of the respondents represent BIM experts within their respective fields, and as they represent several actors and thus enable triangulation (Denzin 2006). The original model from the IT/IS field that was used to modify and suggest a tentative BIM business value model, also raises limits the study. The theoretical pillars used to construct the IT business value model (e.g. the resource-based view of the firm) suffers from limitations, and these put limits to both the IT business value model as well as the proposed BIM business value model. Despite these limitations, the findings give a current view on the industries progress in using BIM for value creation.

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