LUND UNIVERSITY
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Challenges of Technological Implementation

An evaluative study of the BIM implementation process in a construction consultancy firm

by

Emma Josefine Schedvin

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Supervisor: Tomas Hellström
Examiner: Merle Jacob

Abstract

As a mean of tackling the harsher business environment of today has use of various enterprise resource planning systems (ERPS) increased. It, thus, felt self-evident to focus on what implementation of such new technology would mean and involve both for a whole organization as well as its employees. The construction industry has a long history of and is characterized with project-based work and yet has voices from the industry spoken about the difficulties implementing such a business-appropriate ERPS as BIM into organizations. The purpose of this research study was hence to gain further insights into why implementation of BIM technology was not as effectively diffused and successfully implemented as hoped, given the specific circumstances of prior project work experience in the construction industry of today. The research question was meant to identify the challenges of the BIM implementation process.

This research study was considered a case study in which an inductive, interpretative, qualitative research approach seemed most suitable. An internationally renowned construction consultancy company was approached and professionals of civil engineering background given the opportunity to participate in semi-structured phone interviews, which were recorded, transcribed and sorted according to relevant and recurring themes. A literature review of relevant theories connected to topics such as organizational development, change management, business process reengineering, and technological diffusion was conducted prior to this in order for theoretical framework to give possible explanations to the results of this study.

As a result of this study were the challenges identified as unfamiliarity with the technological system, partial or little user adoption amongst professionals of the organization for various reasons, difficulties with reengineering business processes and technological software-related issues. Possible reasons to this seemed to be inconsistencies in directions and support given by top management. With an encompassing corporate strategy of BIM implementation throughout the organization but with weak support for various departments, units and professional roles did the process subsequently comprise confusion and opposition resulting in a slow-paced implementation process. Possible corporate improvements suggested by the researcher were increased number of professionals training and development of a corporate-specific platform in which BIM- and corporate-related information would be shared organization-wide. Looking over corporate structure and addressing different managers to be in charge for the development of the implementation process was another improvement suggestion. It would lastly be of interest for future researchers to make comparative studies of technological implementation processes with multiple industries in order to learn more.

Keywords: Organizational change, Technological implementation, Enterprise resource planning system (ERPS), Building Information Modeling (BIM), Technological diffusion.

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1 Introduction

1.1 Background

The very ruthless global business environment of today requires that firms maintain and improve competitiveness in order to survive. In times of such a climate has a business strategy of aggressively using information technology become especially apparent according to Nah, Lau and Kuang (2001), as an attempt to improve firm performance and vital organizational components such as customer service, shorter lead times, and cost reductions (HassabElnaby, Hwang & Vonderembse, 2012; Suwardy, Ratnatunga & Sohal 2003).

Enterprise resource planning systems (ERPS) is one of these information systems that have become increasingly common in the progressively harsher business environment. It is a packaged software system with attributes that are meant to automate and integrate an organization's business processes, create data and information sharing across the entire firm, and enable access of information in a real-time environment (Nah et al, 2001; Shang & Seddon, 2002). By integrating departments and functions across a company into a single computer system, does the ERPS enable for improved business performance in meeting the changing business expectations (Chung, Ko, Cheung, Wong 2007; Trott & Hoecht, 2004, Wier, Hunton & HassabElnaby, 2007). As a result of raised information access, product variety, process improvement, and financial flexibility, do organizations further have the ability to make beneficial market response improvements (HassabElnaby et al, 2012, Peng, Schroeder & Shah, 2008).

ERPS implementation into an organization requires adaption, configuration, and integration of information flows and business processes and this has to be done on a regular basis as continuous changes in markets and of technology occurs (Teece, Pisano & Shuen, 1997; Hong, Dobrzykowski & Vonderembse, 2010). Difficulties and high failure rates to successfully implement ERPS into organizations have become apparent over time and efforts has been made to find critical success factors for the implementation of ERPS as it is a costly and time consuming organizational effort (Nah et al, 2001; HassabElnaby et al, 2012). A dozen of these critical success factors have been brought forth in literature by Davenport (1998) but research is according to Nah et al (2001) fragmented and so further investigation of possible successful implementation strategies is needed in order to understand and implement an ERPS successfully into organizations (Somers, Nelson & Ragowsky, 2000).

1.1.1 Problematics within the field of construction

Despite its long history of existence do professionals in the Architecture, Engineering and Construction (AEC) sector face numerous obstacles related to facility delivery processes of today (Haron, Marshall-Ponting & Auoad, 2009). The construction industry does not only suffer from low profitability rates, little research investment and development, non-existent training of newcomers replacing the aging workforce (Construction Task Force, 1998) but also practical issues in the project life-cycle such as improper planning, lack of control, and subcontractors delays (Hensey, 1993).

The most frequent excuse and source of malfunction to the industry is the fragmentation of the construction process (Construction Task Force, 1998; Bouchlaghem, Kimmance, & Anumba, 2004; Eastman, Teicholz, Sacks, & Liston, 2011). The interconnection between the basic supportive information technology, used by all employees during the work processes to alleviate information exchange, and the unique ways of carrying out tasks, depending on professional background, is fundamental. Since the facility delivery process involves many steps is collaboration in multi-disciplinary teams of outmost importance within the industry according to Bouchlaghem et al (2004). Eastman et al (2011, p. 14) further points at the specific problem and explains it as an "incompatibility between systems" that prevents project team members from sharing vital information rapidly and accurately, something that then causes frequent recurring problems throughout the construction process. Much of the informational and communicational fragmentation derives from errors within two-dimensional paper documents or electronic equivalents. Changes of the design do also continuously occur along the project life-cycle as a result of lacking information and preparation in beforehand and cause problems. This is closely connected to unanticipated site conditions, changes in material availabilities, design questions, new client requirements, and new technologies which consequently leads to raised field costs, delays and conflicts or may even cause lawsuits between different parties of the project team (Eastman et al, 2011).

As a response to break down the barriers of this multifaceted dilemma and improve conditions within the construction industry has an enterprise resource planning system (ERPS) called building information modeling (BIM) been developed. Azhar, Khalfan, & Maqsood (2012, p. 17) describes BIM as "a virtual process that encompasses all aspects, disciplines, and systems of a facility within a single, virtual model, allowing all team members (owners, architects, engineers, contractors, subcontractors and suppliers) to collaborate more accurately and efficiently than traditional processes." Typically characterized by an ERPS does BIM not only consist of the technological software that integrates and improves design and construction process but also a process-oriented approach which require changes in the organizational processes as well as workflows in order to reach optimal integration (Eastman et al, 2011). Benefits of a successful BIM implementation process are obviously vast and of major importance for alleviating work and information exchange within construction companies but despite all efforts and hard work does voices from the industry witness of the problematic implementation processes in which valuable success factors are difficult to grasp.

Despite the comprehensive existence of strategies on how to achieve organizational change effectively, successfully implement BIM or an ERPS into an organization (Nah, Zuckweiler, & Lau, 2003) has the diffusion of the new technology and implementation of BIM into

organizations not been as effective as many would have hoped for initially. In a conversation with Civil Engineer Pontus Bengtson (interview, September 29, 2014), presently occupied as an Operations Support Director within a larger globaly renowned construction consultancy firm, does he confirm the struggle of effectively diffusing the new BIM technology throughout the organization. Reflections on possible explanatory factors that influence the process that may have created a decrease in pace and success of implementation process has been suggested by Bengtson, such as the influence of end users for example. It becomes evident, with such a situation, that the general strategies suggested within the areas of organizational change, ERPS implementation and BIM have some shortcomings and that the influence of the employees on technological diffusion and successful implementation might be greater than formerly expected. It is therefore of major importance to further investigate and look into the experience, knowledge and reflections of end users in order to identify important explanatory factors to why the implementation process is not working as smoothly and effectively as possible as well as taking into consideration how this could be improved further in this change process.

1.2 Aim and Objectives

The intention of this thesis is to get a better understanding of how individuals experience and respond to such an organizational change as an implementation of new technology. This will be accomplished through the conduction of interviews with individuals of a well-established global consultancy firm operating within the construction industry and in which implementation of BIM technology is presently progressing. The reason for why BIM implementation into a construction consultancy firm has been chosen is because of the special circumstances surrounding the industry. The construction industry is, compared to other industries; project-based which mean that new team constellations form every time a new project begins. The construction process adds further complexity as it involves a series of distinctive phases in which hand-overs of relevant information related to the construction are frequently made, a process which has caused frequent information fragmentation between different groups of professionals involved. The ambition of BIM has been to bridge these gaps and create a well-functioning and smoothly running construction process amongst different stakeholders.

Indications of why the BIM implementation process is progressing slowly is what this study aims to look at. The hope of approaching the end users under circumstances of technological implementation is to gain further insights into the complexity of how individuals, units, divisions as well as the whole organization function during such a change process. Another objective is to find explanations on aspects that influence the effectiveness and success of a technological implementation which then, hopefully, could lead to the development of appropriate strategies on how to improve the adoption process further. Connecting the theoretical background of technological implementation, management and change strategies with reality in this study through these individuals, that are highly involved and connected to such an extensive change process, will hopefully give findings that could support, partly reject or maybe suggest alterations on former proposed strategies for successful technological

implementation. Not only may findings of such a study add value to prior academic theories but also make path for new aspects to consider and further look into.

1.3 Research Purpose

The purpose of this research study is to gain further insights into why implementation of BIM technology has not been as effectively diffused and successfully implemented as hoped, given the specific circumstances of the construction industry of today. This will be approached through the lens and hands-on experience from professionals presently occupied in a globally renowned consultancy firm of the construction industry in which BIM implementation is presently occurring. The hope with this research study is to identify aspects that are considered important for effective diffusion and successful implementation of new technology into an organization. By approaching individuals, presently occupied in the construction consultancy business that are directly influenced by the implementation of BIM technology, the hope is to get a better understanding of how such an organizational change functions in reality and how it may be improved. The following research question will thus make the foundation of and guide this study:

- What are the challenges encountered during a BIM implementation process?

The intention of this research is to move from a thorough literature-based approach to a more action- and reality-oriented approach in which further valuable insights could be made and improved strategies for implementations be found. It is often said that it is the smaller parts that makes up the bigger picture and so this is why this research study focuses on the individuals of the firm approached. By focusing on the details presented by the employees, practical knowledge and experience of these individuals could hopefully add another explanatory dimension to why the technological implementation process is not working as optimal as it possibly could. Hopefully, will the research findings also give way or highlight the most critical strategies on how to successfully implement new technology into an organization.

1.4 Research Limitations

Just like in any research study does also this one have its research limitations. The research participants are chosen from the early design and preconstruction phase as they are considered to be the most critical phases for sustainable decision-making within the construction process (Azhar, Brown, & Farooqui, 2009). This research study will also look into the experience of individuals presently operating within a construction consultancy firm and thus will neither contractors nor other stakeholders in the construction industry be accounted for.

1.5 Outline of the Thesis

The following chapter, chapter number two, is a literature review of relevant theoretical aspects that will be used in the analysis and discussion of the collected empirical material. The chapter is divided into two parts, organizational elements and change, and technological implementation, in which the first part encounters further consideration of change in organizations as well as communication. The second part of technological implementation encounters business process reengineering, technological diffusion as well as individual behaviors related to the implementation process. Chapter number three describes the methodological foundation for this study and touches upon relevant aspects such as research approach, research design, data collection method, as well as procedure of data analysis. Chapter number four comprises discussion and analysis of the empirical results whereas chapter number five concludes what has been found and suggests ideas on additional research related to the matter of this study.

2 Literature and Theoretical Review

This chapter is a review of relevant theoretical literature that will make up the foundation for further interpretations, discussion and analysis of the empirical results related to the case of BIM implementation. Relevant theories connected to organizational elements such as organizational culture, climate, leadership and communication will be presented. Following are theories and models related to technological implementation, furthermore being narrowed down to the subjects of business process reengineering, technological diffusion as well as individual behavioral responses to new technology. Presented at the end of this chapter is a concluding summary that builds up for the interpretation of the empirical results.

2.1 Organizational elements and change

Managing organizational change while operating in the field of construction is significantly different compared to other industries as the construction industry is characterized by project-based work and not standardized mass production. Entering a new project requires flexibility and good adaptation skills since the construction process involves rapidly changing working conditions, and for every new project team formations of partially known or completely new members of various backgrounds that together has to strive towards common goals, often under significant time pressure. Lewis (2011) implies that organizational change usually is needed when present activities and processes are not satisfactory; this view is commonly founded in the assumption that routines are standardized and neither in continuous movement nor in development. If one would base an organizational change on the presumption that there is no continuous movement or development involved in a construction process it would undoubtedly cause problems when implementing a new technology into such an organization as one operating within the field of construction. Like in any other industry do also the construction industry and the construction processes involve certain routines and standardized work performed on a regular basis but there is also a significant amount of alternating factors that needs to be accounted for both before, during and after the construction process. Factors that could result in drastic and rapid turns along the construction process if not being considered properly. It is realistic to acknowledge under such circumstances that much of the work being performed is not solely routine-based, especially not since the human factor is involved, and thus the reasoning behind why an organizational change like a technological implementation should occur looks somewhat different than compared to the assumption being made by Lewis (2011).

The complexity of many stakeholders involved in the construction process raises the number of interests that the organization has to consider before undergoing such a change as implementing a new technology like BIM into the organization. Palmer, Akin and Dunford

(2008) mention the aspect concerning the organizational change work which involves the different stakeholders and their diverse views on the change process and how it preferably should be accomplished. The complexity lies in the fact that some might be of the opinion that the change should occur incrementally and others that the implementation of new technology should occur more rapidly. Eastman et al (2011) brings emphasis to the current problematics within the construction delivery process and discusses the frequently recurring problems and errors related to documentation and communication of changes in construction projects that consequently leads to raised costs, extended time spent in projects, decreased quality of end product, and poorer customer service amongst others. Taking such a huge step as implementing a new technology like BIM into such a complex situation as the construction process should reasonably have to take some time in order for the technological change to gain ground, be implemented and hopefully be used successfully throughout the organization. Deciding on whether to make an incremental or rapid change does, however, not affect how specific individuals within the organization will view the decision of going for an organizational change.

Individuals within the company might view the change process differently and have opinions related to other aspects of how the technological change strategically should be managed. Alvesson and Sveningsson (2007, p. 18) mentions the significant correlation between "personal interest, background, education, hierarchical position" and the specific stance taken by the individuals; relevant elements which vastly may influence how the employees thinks, perceives and acts during the change process. Finding appropriate strategies in order to meet and handle different individual preferences, behaviors and attitudes to achieve change might be quite difficult from an organizational point of view. Like Palmer et al (2008) suggests might some view the organization as machinery in which change should be strictly controlled by a certain number of people whereas others might be of the opinion that a more participative approach should be taken by the change initiators and that shaping of processes and individual actions is the most appropriate strategic way to go. It is likely that it depends on what the specific individual feels acquainted and comfortable with but these types of issues illustrates rather well the complexity of the human factors and their influence on desired change outcome and what the organizations has to deal with during organizational change.

Early identification of processes directly affected by the implementation process as well as creating commitment, involvement and some kind of shared perception amongst the employees are, according to Paton and McCalman (2008), important aspects in managing change. When it comes to the preparation of implementing a platform like BIM it seems preferable to deal with the soft parameters related to the employees first. Since the main idea behind BIM, as Azhar et al (2012) points out, is to create a shared information flow between all participants of a project it is of outmost importance that all employees really understand the significance of using the technology when implemented and that they directly puts it into practice. Obviously do consultants within a consultancy firm have various qualifications, related to educational backgrounds, working experiences and career goals, so initially should strategies not only touch upon the soft parameters of the human being but the company should also address different types of people across the entire organization from department down to every business unit and ultimately individual. Paton and McCalman (2008) suggest that strategies which evoke positive and optimistic feelings rather than intimidating ones should be emphasized during the change process. Perhaps could the enforcement in the sense of unity

and shared perception for members throughout the organization be achieved by setting new common goals and creating space in the working environment for mutual benefits for the employees in order to encourage use. If the employees engage in a productive way when faced with challenges or disruptions in their ordinary work due to the technological implementation might incentives like time off from work or small bonuses or other appropriate means create incentives and sense of mutual benefits from the employee's point of view. Masy, in Palmer et al (2008), adds further value to the discussion of careful preparation and emphasize the necessity of sufficient time spent on marketing the technological change and informing the employees beforehand about the possible impacts that the implementation might have in order to prepare for and possibly raise understanding and thus also consequently acceptance amongst employees.

Separating human factors from the organizational processes and structures while developing appropriate strategies before an implementation process actually begins is practically impossible. Leavitt (1965) illustrates this rather well in a model in which components of an organization and their interactions under pressure of change are demonstrated quite well. The model encounters the general organizational purpose, the employee competencies, the use of necessary technology in order for the organizational purpose to be accomplished as well as the structure (in terms of communication, power, and reporting system) - all important constituents of the organization that are considered to be interrelated and variously affected by the change process. Having an awareness and understanding that an event related to the organizational change might cause unexpected effects somewhere else in the organization because of the close interrelatedness of this network raises the probability for the company to flexibly adjust.

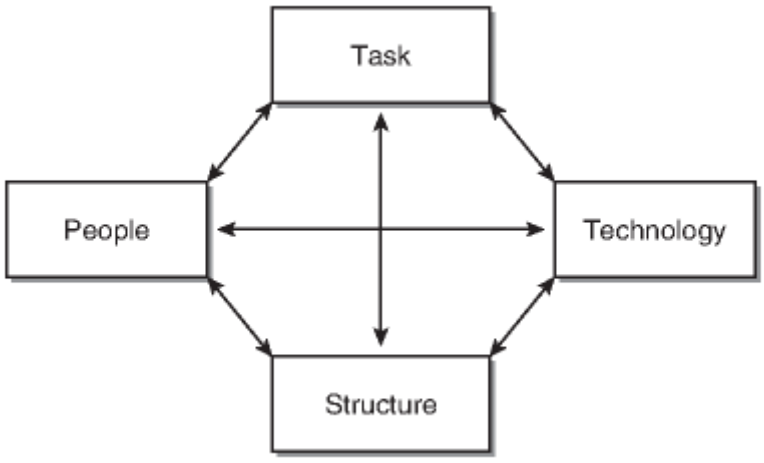

Figure 2.1.1 The Leavitt Model (1965)

Pettigrew, Woodman and Cameron (2001) recommends extra attentiveness paid to the pace and sequence of change during the implementation process. It could be that the implementation process reaches a certain stage in which one business unit needs more time to adapt than another of some reason and that continuous adjustments needs to be made depending on where in the organization and at what stage in the change process one are. It has also been found in longitudinal studies that a hasty radical change process may lead to

reduced successful enduring effects related to financial or social benefits created within the company (Amis, Slack, & Hinings, 2004). It is also of importance in the implementation process to find the appropriate purpose and place of the new technology within the organization (Feld & Stoddard, 2004), to identify critical voices amongst the employees and make them support the change (Huq, Huq, & Cutright, 2006), as well as have a functioning collaboration between the IT team and the rest of the corporate members. There is no doubt that the responsibility of managing a change process throughout an organization requires extensive planning, research and knowledge. Handling change does also demand skills to create trust and understanding while maintaining motivation amongst employees (Paton & McCalman, 2008). Consideration of additional organizational elements is further required in order to get a more comprehensive picture of what furthermore needs to be encountered in order to meet and effectively deal with challenges on the way to successful technological change.

2.1.1 Organizational development and change management

There are various explanatory approaches that touch upon the nature of organizational change and how to influence individual behaviors advantageously for the change outcome. The organizational development (OD) approach and the organizational change management (OCM) approach, amongst others, offers several theories of to how organizational change and technological implementation may be accomplished successfully. The OD approach is, according to Alvesson and Sveningsson (2007), one of the most prominent ones when it comes to planned change as its theories encompasses long-term organizational change throughout the entire company in which focus lies on means for changing attitudes and behaviors of individuals. Fuller, Griffin and Ludema (2000) further describes OD as focusing on problem-solving in which necessary steps of actions usually considers problem identification, analysis of causes and solutions, as well as development of action plan and implementation.

Not only does the OD approach provide general guidance for how to manage working processes within organizations but also specific actions to take when it comes to the human behavior. The theories behind Kurt Lewins three-step model has been very popular since it first was introduced in the field of OD as it describes the necessary steps to be taken in order to achieve successful change amongst individuals by altering behaviors (Alvesson & Sveningsson, 2007). The three stages are denoted unfreezing, change and refreezing in which the first preparatory stage is about challenging status quo and motivating the individual to alter behavior as this person supposedly comes to understand the necessity of the planned organizational change. The second step is about finding the new state of behavior in relation to the implemented change and the last step involves stabilizing the new state of behaviors in order to avoid falling back to previous ones. It is a rather illustrative model of how changing individual behaviors might occur but at the same time very simplistic in its description of the three steps. What would have been beneficial to this model is an explanation of what is being encountered in the human mind while these three steps actually do occur.

In that sense is the theory behind the change management model ADKAR more detailed and perhaps also more relevant to understanding what human efforts are needed in the actual

change process. According to Prosci (n.d.) may personal transition benefitting organizational change outcomes be accomplished when individuals have necessary awareness for the need of change, a desire to participate and support the change, knowledge on how to change, the ability to implement required skills and behaviors, and reinforcement to sustain the change. Having a theory which pinpoints these five issues makes it easier for managers to reflect upon current state of individuals and take necessary actions in order to influence the employees towards the preferable state of mind in which change evolve. It may however be the case that these five issues can vary greatly in time as it may be individually how much effort is needed according to the different circumstances of each individual. It may be that an individual has the necessary knowledge on how to change but objects to the need for it and thus need extensive persuasion from perhaps someone that is convincing and educated enough to argue against the negative attitudes that have been formed prior to the decision of accomplishing an organizational change. Persuading the individual on a personal plane might actually require quite extensive efforts from the manager and not be accomplished just by having educational courses and information meetings with larger groups of employees as companies tends to have as a given part of the change work within the organization. What becomes obvious with such an example is that change will demand more time than perhaps a smaller firm in which individual issues may be addressed but also resolved both easier and quicker. Taking a broader perspective and reflecting upon organizational culture and climate would thus be possible supplementary means to approach the matter of accomplishing change amongst individuals.

2.1.2 Organizational culture

The nature of organizational culture may explain why certain behaviors arise as a direct consequence of an organizational change and it may also offer explanations to why some behaviors occur to the extent they do within an organization. Organizational culture is according to the organizational development (OD) theory described and characterized as a state of mind for a group of individuals in which they share meanings, values, interpretations, and norms (HBHE, n.d.) and does according to Alvesson and Sveningsson (2007) guide behaviors when individuals are being exposed to change. This would imply that organizations should strive for a well-established unified cultural mindset within the organization so that it may develop appropriate strategies for the expected types of behavioral responses that will occur throughout the whole company when in the process of an organizational change. The features of a construction company speak against the achievement of a united organizational culture in which changes may be effectively imposed since it is characterized by project-based work. As Jansson and Ljung (2004) clarifies does a construction company usually have several construction projects running at the same time, which means that sub-cultures related to the different projects may form within the original organization instead. Often are shared meanings created by setting up common goals within organizations but with project-based work, in which new groups form every time a new project begins, it may be problematic to enforce. Having different phases in the construction process, which involves shifting team members at diverse points as well in the process, adds further complexity for top management on how to influence the organizational culture in any kind of direction.

The organizational culture is also described by Johnson (1992) in a model called the cultural web, in which seven elements are encountered as influencing factors of an organizational culture and thus also potential reasons to individual responses of organizational changes. It consists of the paradigm, which includes all the common assumptions made by the employees on basic business features. It also consists of rituals and routines, oral narratives, organizational symbols, control systems of measures and rewards, power structures, and organizational structure. Compared to the previous theory does this theory touch upon issues that are not only related to individuals and soft parameters but also the opposite by emphasizing control systems and organizational structures. Despite the advantage of looking to the broader perspective of culture-related aspects it is however questionable whether or not all seven elements have an equal part in why a specific culture does or does not respond as hoped to an organizational change. Organizational structure and power structures might be clear within the organization whereas retold stories or even small rumors that spread throughout the culture may influence and reinforce certain responses to change in one possible extreme direction or another.

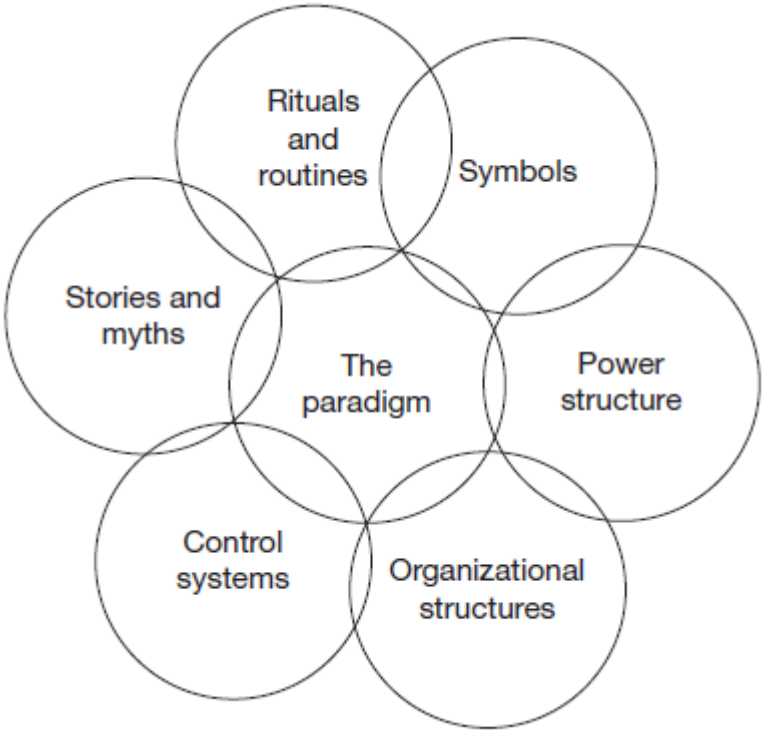

Figure 2.1.2 The Cultural Web (Johnson, 1992)

2.1.3 Organizational climate and leadership

Whereas culture develop over time and explains the foundation of an organization the climate is more seen as a contemporary element of the organization and part of the organizational development theory, in which it is described as the group atmosphere or mood of the

organization (HBHE, n.d.). Forehand and Glimer (1964) claims that organizational climate consists of three features; its variations amongst different organizations, its persistence, and the influence of climate on organizational members and their behaviors. Organizational climate is often associated with employee satisfaction, stress and successful implementations amongst others and is considered to be highly influenced by factors such as leadership, communication openness, role clarity, conflict resolutions, and leader support and control. For undergoing change it seems plausible that effective leadership within the organization plays a major part in the outcome of the change process as it may affect the organizational climate and consequently individual behaviors.

There are several leadership theories which describes in what ways leaders may affect behaviors of individuals within an organization in order to reach common goals more effectively. The transactional leadership theory is based on the assumption that motivation amongst employees can be created in an environment in which punishments and rewards exist (Tyssen, Wald, & Spieth, 2014). Using these kinds of means to enforce specific behaviors through such incentives, the theory may be criticized as ignoring the circumstances related to the human being in the work processes and also be considered as highly undemocratic since employees would have to follow the leader blindly in order to not be punished. Another criticism against this way of leading an organization is the way in which the leader exclusively may take decisions without consulting anyone else. It is also questionable whether or not it will create long-term effectiveness since an environment in which the unceasing risk for being punished might lead to psychological health problems and an adverse working climate for the individuals. For a leader to even enforce such a leadership style the organization would have to have a clear hierarchical structure, which is not always the case in Swedish companies as they tend to be structured as flatter organizations (WorldBusinessCulture, n.d.).

The transformational leadership theory takes a slightly different and more participative approach against the interaction of leaders and the organizational members. It assumes that organizational integrity and work assignments will be motivating enough for the employees in order to raise effectiveness of a company (Leadership, n.d.). The tasks should preferably be challenging enough to inspire for collective collaborative work in which employees prioritize helping each other out to accomplish the task rather than fulfilling tasks that would boost their own egos. The integrity of the company plays an important part since it is viewed as something that comes before the individual motives of the employees and the tasks are usually performed as an attempt to achieve long-term goals. Whereas transactional leadership does not give any room to the individuals free choice without experiencing negative effects as in punishment this approach might actually give a bit too much of freedom to create the expected outcomes. There are usually individuals with higher ambitions and perhaps better knowledge and capacity to perform specific tasks, compared to other individuals of the same team, which consequently would get more in workload than compared to others. If this always would be the case when groups form around specific tasks to perform there is a chance that these individuals, that have the drive to make the collective group progress in work, would experience fatigue and a decrease in ambitions as a result of always engaging the group. It might be that no other individual would feel compelled to take the leading role of making the group move forward which may consequently result in general decreased effectivity within the organization. If incentives, like rewards and punishments, would be partially present it is

more likely that someone else would feel obliged to take over the role and then perhaps share the burden of driving the collective group work together with someone. In that sense might these two theories be better as complements to one another in the organizational setting rather than used separately.

It was found in a study conducted by Castro and Martins (2010) that there is a strong correlation between organizational climate and job satisfaction. This indicates that the perceptions of the employees on work environment does indeed influence their satisfaction and should thus be emphasized, perhaps through the means of how leadership is exerted, in order to create the optimal climate in which organizational efficiency may be raised. Fendt (2006) claims that there are four factors, important within the field of leadership that is related to success of a change process; the perceptions amongst employees of being credible, the perceptions of leaders making strategic and financially sound decisions, winning personnel trust, and persuasion of employees to believe in the change needed for the organization to improve. Not any of this would not be possible if it was not for effective communication.

2.1.4 Communication

Communication is undoubtedly an important medium for affecting the employee responses while undergoing an organizational change. According to Fendt (2006) should appropriate communication style and credibility be a fundamental part of leader communication in order for them to connect and imprint necessary information to remaining members of the organization. It is not surprising when Lewis (2000) states that issues related to poor communication have been rated as one of the most severe problems during implementation processes. Information may spread through different communication channels as well as in formal and informal ways and consequently influence the behaviors of employees throughout the organization (Lewis, 2011). There are some existing theories of today that offer explanations to how communicated information is being spread and incorporated by individuals before the actual individual responses occur.

The information dissemination theory is, according to Lewis (2011), based on the theory that lacking knowledge or confusion related to unambiguous information of the change shared within the organization may lead to uncertainty amongst employees. The theory entails three steps in order to resolve uncertainty; using appropriate means by which information of change may be effectively disseminated throughout the organization, detection of inaccurate interpretations or misunderstandings that has aroused since the initial information was spread, and lastly but not least should clarifications be made in order to clear out the misunderstandings that causes the uncertainty. This approach would consequently suggest that all behaviors related to organizational change has its ground in uncertainty and perhaps not so much in explicit knowledge and information possessed by the individual about what the organizational change involves and demands in reality. If the goal, according to the theory, is to extinguish feelings of uncertainty the question is where the line goes between sharing some information that might create confusion and uncertainty and sharing all information. It might be sensitive to share it all just to make things clear to organizational members as the information itself might cause other reactions amongst the employees than intended to. The strategy of finding misinterpretations and correcting these does also seem

inefficient and time consuming for an organization in which change itself should be the main focus of the organizational work. It may even be the case that a company would decide not to follow through with these strategic steps and ignore misinterpretations related to the organizational change, a necessary priority that in its turn possibly might lead to negative consequences since rumors for example tends to spread quite effectively.

Babrows (2001) theory of problematic integration (PI) offers a sense-making explanation to individual responses in which focus lies on how individuals perceive, evaluates and makes sense of the specific message and situation they are in. According to the theory does the sense-making world of the individual consist of a probabilistic and evaluative orientation, which means that the individuals evaluates the likelihood of whether or not what is being said is likely to happen and whether it will have negative or positive effects as an outcome for the individual. When these two stances go hand in hand the individual experiences harmony but when there is a disagreement or contradiction between the two of some kind the problematic integration may lead to discomfort or even internal conflicts for individuals. Insufficient information due to communicational efforts, from top management of the company, in relation to these two considerations may very well result in feelings of uncertainty for the individual.

The theory behind soliciting input is to partly empower and engage employees by giving them a participative role to play while communicating circumstances related to the change process (Lewis, 2011). This means that the opportunity given for the employees to provide input, feedback and express their opinions could add further value to their feelings of satisfaction and control in the situation of change and consequently result in raised acceptance of the changing circumstances that occurs in their work environment (Bordia, Hunt, Paulsen, Tourish, & DiFonso, 2004; Sagie, Elizur, & Koslowsky, 2001). This may be one way of creating opportunities in which change initiators could reach out to employees at lower levels of the company and address the different misinterpretations and issues that needs to be resolved in relation to implementing an organizational change. It may, however, be difficult to apply since employees of a construction consultancy firm may be allocated to different teams depending on what projects they are in. Kuhn and Deets (2008) brings further complexity to this method when suggesting that the ideal speech situation between change initiators and employees might be difficult to get. There may actually be a stronger tendency for the leaders to focus on raising loyalty and commitment amongst the personnel in a conversation rather than genuinely listening to the input and respond to possible criticism that has arose amongst the organizational members.

2.2 Technological implementation

When assigning a project group, consisting of individuals with various disciplinary backgrounds, to prepare for and implement a technology like BIM into an organization; both technical, structural and human aspects needs to be considered in order for the software to be situated in the correct place of the organization to fulfill its intended purpose. Despite the technology being “a total, integrated solution to companies’ information-processing needs”

(Markus & Tanis, 2000, p. 173) in which information flows are enhanced, individuals of the organization may decide to partially adopt it or not even at all depending on the circumstances. The Process Theory of Enterprise System Success (see Appendix A) emphasize and describes the phases a technological implementation process consists of and also addresses what typical organizational activities that occur, possible problems that might arise and which individuals who are closely connected to the different events of the change process. The Enterprise System Experience Cycle is a precursor of the theory and may be viewed in figure 2.2.1 in which the general steps of the process are being illustrated. Nah et al. (2001) found in their study that eleven critical success factors could be drawn from the different phases of the model and explain why technological implementation did not reach the success organizations hoped for. These factors were team composition of implementation group, top management support, clarity in business plan and vision, effective communication, project management of the implementation, project champion, appropriate business and legacy systems, change management program and culture, business process reengineering, software development, testing and troubleshooting, and monitoring and evaluation of performance.

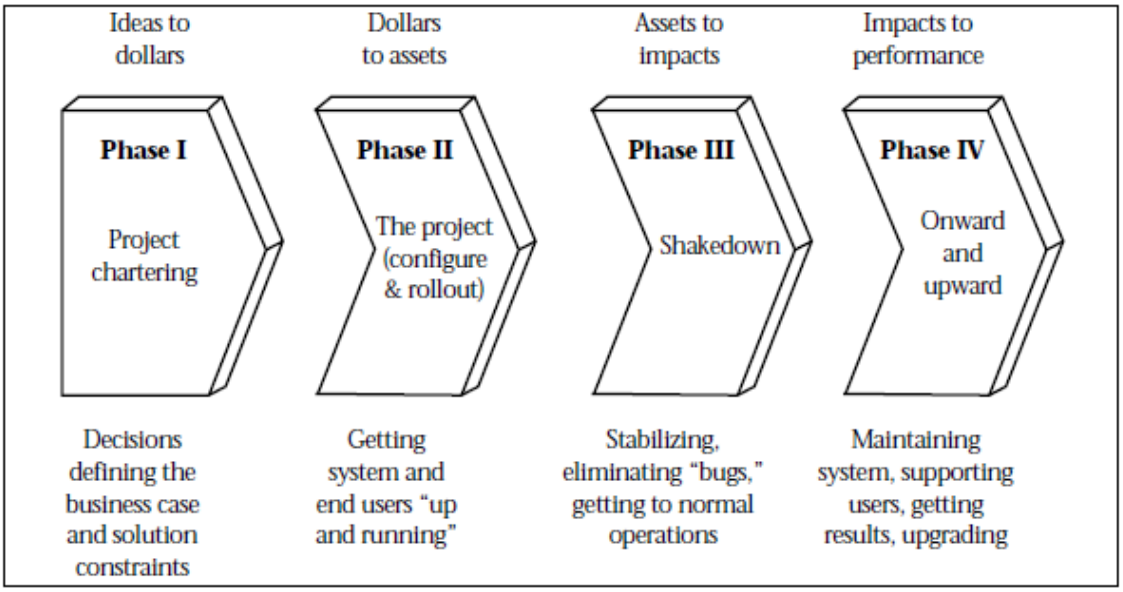

Figure 2.2.1 The Enterprise System Experience Cycle (Markus & Tanis, 2000)

2.2.1 Business process reengineering and technological diffusion

Since a part of the main purpose, when it comes to technological implementation, is to improve overall business performance of an organization it is surprisingly not also required of the company to adjust working processes in order for the change to effectively occur throughout the company. The theory of business process reengineering entails evaluation and development of all organizational processes down to the smallest working activity in order for the new technological system and organizational structure to fit one another successfully (Holland, Light, & Gibson, 1999). Buckhout, Frey and Nemec (1999) states that a clear business plan and vision may be critical for business process reengineering to occur during

technological implementation as it directs and specifies for the employees in what ways their business processes should be evaluated and possibly altered in order for the company to increase efficiency. Examples of practically altering business processes through reengineering would perhaps involve modifying steps for the construction consultant on how to share project information with its client; in what order to inform, how and when it comes to possible changes related to the construction process. By mapping up the sequence of events that are related to such a procedure with the client it is possible to reduce the numbers of unnecessary steps and consequently raise effectivity for the employee. Having access to important data and information gathered in a BIM-platform will, according to Brockman and Morgan (2002), reduce variability both in time and quality for the employee while performing tasks and thus make work more reliable, which consequently may reduce some of stress the employee feels when put under pressure before an upcoming deadline of some sort.

According to Choi (2009) does the theory concerning diffusion of technology give possible explanations on how information related to the technological innovation is communicated and spreads throughout social systems of the organization. Diffusion of (preferably positive) information through the social systems may not only enhance user adoption amongst employees but also raise understanding of the implemented technology itself in the same time and create positive effects on business process reengineering as well. Diffusion of technology is considered to be consisting of four elements that explain the rates of user adoption; type of innovation, communication channels used, time, and the social systems of the organization (Mahajan & Peterson, 1985; Rogers, 2003). It is not strange that users evaluates the advantages of the technological innovation, its compatibility with existing work procedures, complexity of the technological system, extent to which it may be trialable and observable. Communication and communication channels may be seen as important means for information spread to occur but what may influence the pace of informal information sharing related to the technological innovation even more within the organization is the social structures of the company. Depending on the information that is spread individuals will make judgements and decide whether or not to communicate the information further or not. The information communicated about the technological innovation may further affect the individual in its response to the technological system.

2.2.2 Individual behavioral responses

When employees have their first experiences with the newly implemented technology the individual behavioral responses may differ. There are several theories that touch upon the concerns of what is being encountered in the human mind, which then determines the individual response to the technology. The theory behind the technology acceptance model (TAM) explains how users of a new technological system decides to adopt and use it by suggesting that two types of beliefs, perceived usefulness and perceived ease of use of the technology, determines attitudes and thus individual behaviors to whether or not the intentions to use the new technology for the individual exists or not. Taylor and Todd (1995, p. 148) sums it up nicely by stating that “the easier a technology is to use and the more useful it is perceived to be, the more positive are people’s attitudes and intentions toward using the technology”.

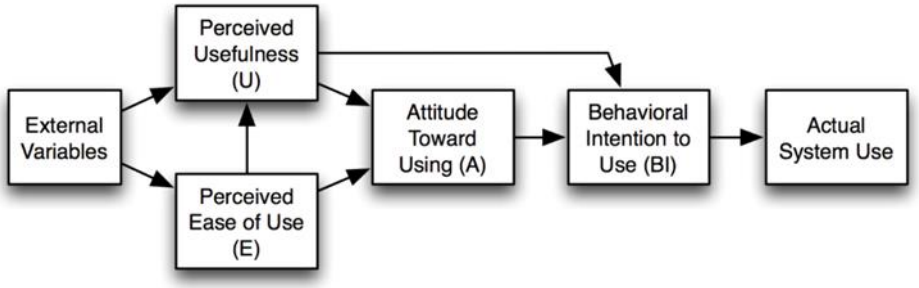

Figure 2.2.2 The Technology Acceptance Model (Taylor & Todd, 1995).

2.3 Chapter Summary

This chapter encounters numerous possible explanatory theories that exist within the fields of organizational development, change management, business process reengineering, and technological diffusion. This theoretical framework is meant to serve as a foundation for interpreting the empirical findings as well as elaborating on appropriate aspects and strategies to consider under such circumstances as a technological implementation into an organization involves.

3 Methodology

This chapter encounters relevant aspects connected to the conduction and gathering of empirical data for this research study. It consists of relevant information related to the research approach, the research design, followed by data collection method, data analysis and subsequently a conclusion at the end of this chapter.

3.1 Research Approach

The aim of this research study was to identify challenges encountered during a BIM implementation process and means by which effective diffusion and successful implementation of new technology into an organization may take place. While conducting research within the field of social sciences it is of importance to state approach taken during the study as it explains how knowledge has been sought and used to gain new and valuable insights into a new area or existing dilemma (Thomas, 2013).

Since the ambition of this research study was to increase understanding of such an organizational change as a technological implementation through the eyes and valuable observations of the individuals working at the company, it felt natural to adopt an interpretative and qualitative research approach. By taking an interpretative stance, knowledge and results is being accepted as relevant although it has a basis in the construct of the human mind. What further speaks for a qualitative approach is that research based on human experience usually examines the meanings behind for example words, images and/or thoughts of research individuals rather than numerical data produced from a quantitative point of view (Coolican, 2006; Thomas, 2013).

Because this study aims to evaluate the consequences and effects perceived by the professionals working at the company in which a technological implementation process occurs, a qualitative approach seems preferable as it raises the probability of getting a more holistic view on this matter than quantitative strategies would do. Overall is this research study based on the inductive reasoning that “many observations gathered from experience” (Thomas, 2013, p. 122) may result in a general principle, or perhaps even several principles. Elements of deductive reasoning might, however, occur during the research process, as some conclusions may be based on premises made by the researcher, but overall will induction permeate the research process.

3.2 Research Design

The aim of this research was to find possible explanations to why the diffusion and implementation of new technology into an organization was not working as effectively and fast as it possibly could, given the circumstances of the construction industry at present state. The goal of the research question set up in the beginning was to identify challenges encountered during the process of implementing BIM into a construction company.

There is an extensive amount of research and literature on how to successfully implement and manage organizational change but there are, of some reasons, still complications and shortcomings in reality to how it best and most effectively could be conducted. The purpose of approaching the constituents of an organization, the employees, was to find alternative explanations and insights of why this was the case and maybe how this could be improved. Given the circumstances of the research dilemma approached and the inductive qualitative stance taken, it seemed appropriate to conduct a case study in which this phenomenon could be studied further in depth. Described by Thomas (2013) and typically characterized by a case study was the use of subject, in this case the employees, through which the object, effectiveness of diffusion and implementation of new technology, was being examined.

Since the participants had to be involved in such special circumstances, as a setting in which BIM technology was being implemented, a purposive sampling of participants was used in this case study. Since the implementation and use of such a technology as BIM makes the greatest difference in the initial phases of the construction process it was also of interest to address participants involved in the early stages of the construction process in this matter. This resulted in approaching participants working within a globally renowned construction consultancy company in which the Swedish offices consists of approximately 3000 professionals. The participants had an academic background in Civil Engineering and were to a large extent involved in work related to project management, often involved in the early design and preconstruction phase, with some few exceptions where they were present all the way out into the production phase of the project. The participants were also of both genders and various ages.

The data collection method chosen was telephone interviews since preferable, ordinary one-to-one interviews, were not possible due to geographic circumstances amongst others. Conducting research in which interviews are being used is often preferable under circumstances like these since the researcher is given the ability to observe and take notes on details in body language as well as facial and vocal reactions to questions. This was, however, not possible so semi-structured interviews were thus conducted by phone instead. Having semi-structured interviews allowed both for preparation of possibly relevant questions in advance but also for the interviewee to speak freely under the conversation of what felt relevant to the topic or question asked.

3.3 Data Collection Method

The procedure of data collection set off in the selection of appropriate research participants. The participants were expected to have a background in the construction business, some kind of relationship to the process of BIM-technology implementation and a connection to the early design and preconstruction phase. These fundamental elements of this study lead to the approach of seven professionals active within a larger construction consultancy firm. All research participants involved had an educational background within Civil Engineering and were occupied with work related to project management in construction projects. Other necessary requirements were that the participants would have some prior experience of or contact with BIM in order to participate.

Initial contacts occurred via e-mail and then agreements on phone interviews were made with the participants involved. Seven participants of various ages, and career lengths were altogether being interviewed for this study. Initial information was given about the assurance of the participant's anonymity, probable length of interview, and consent to having the interview recorded as well. The conversations during the phone interviews were semi-structured, in which a set of pre-determined questions and some additional questions for possible further evaluation of the case existed, see Interview guide in Appendix B. This was meant to open up for freely spoken conversations in which further information and insights of the implementation process would be given.

The interviews were between 15-45 minutes long and were after the recordings transcribed for further data analysis. After that did the researcher read through the material several times, pick out relevant reflections and put them underneath different recurring themes and categories that seemed relevant to the given research questions. Respondents were denoted as "Rx" or "RPDx" while looking through their responses in the material where x where a number which each individual participant was given at the beginning of the procedure. Thereafter was an analysis of the empirical findings and its relevance to the theoretical framework made, building up for a discussion of the subject and some conclusions based on the material brought forth by this study.

3.4 Data Analysis

Succeeding the semi-structured interviews being held was a comprehensive data analysis of their content. The data analysis involved identifying recurring themes related to the subject being examined, in this case BIM implementation process effects. This meant that transcriptions of the recorded interview material initially were produced in order to ease the identification process and enhance correctness to the results of this study. Then a systematic way of working through the different texts began, reading through the material repeatedly in which related subjects was identified and put into groups underneath larger headings according to their relevance of the specific headline subject. When relevant material could not be placed underneath an existing headline another appropriate one was made. This process

resulted in eight different categories in which sub-categories also occurred, see illustration in Appendix C.

Themes having its basis in the three areas of organizational, technological and individual matters that was further developed into overall headlines were perceptions of BIM, routines around it, pros and cons of it, organizational issues related to the implementation, opinions about BIM affecting it, technical issues as well as communication and user behavior. Further categorization of the data collected can be found in Appendix D as well as Appendix E.

3.5 Chapter Summary

It was decided to take on an inductive, interpretative, qualitative research approach in which the focus of this case study was to identify the challenges that individuals had encountered during an implementation process of new technology into a construction consultancy company. Semi-structured interviews were conducted, recorded, and transcribed for analysis related to the theoretical framework.

4 Analysis and Discussion

4.1 Initial contacts with and experiences of BIM

The results of this study have indeed illustrated the complexity regarding the implementation process of BIM technology into a construction company. It became obvious early on that the respondents had a pretty unified view when speaking broadly, in general terms, about the complexity surrounding BIM and its implementation process compared to the individual definitions and comments being made during the conversations. Reflections being made related to the subject during the interviews suggests that the variation of personal definitions were due to individual circumstances closely connected to prior occupational role, prior technological experience, career lengths, and kind of involvement at present state with the BIM process. These circumstances illustrate and support the correlations in the theories stated by Palmer et al (2008) - that professionals' backgrounds do count when it comes to different views and extent of support for such an implementation process, such as BIM, amongst the personnel.

Not only was individual differences related to backgrounds a feature identified as important and related to the success of the BIM implementation process but also the point at which the technology and process was being introduced. Whereas some respondents were just previously introduced to BIM (both as a tool and a process), others had specialist experience due to prior and present work within the field, creating a very diverse and complex image of how to address the professionals of the company as a whole. It is understandable in such a working climate that not only pace or sequence of the change process, as Pettigrew et al (2001) points out, is important but that the company has to look further into what possibly could be done on a deeper organizational level in order to address the complexity of the change challenge and make way for a more efficient technological diffusion to occur within the company. Some of the professionals did also identify and report of a correlation between individual responses and "the gains the individuals see with it" (R4). These types of comments are in line with what the change management approach and, more specifically, the adkar model (n.d.) suggests when it comes to positive individual awareness and its direct relation to the understanding of the necessity of change within an organization.

However, some recurring statements related to BIM and what it involves was made amongst the participants such as BIM being a digital tool used for information management. That BIM encompasses a 3D model with a great deal of information related to the construction project and the importance of emphasizing the processes related to the model and not just the software itself while working with it. Perceptions of BIM seems strongly connected to how and when initial contacts with BIM was made, since one of the newcomers clarifies that it "is there to simplify the work that one is already doing" (R3), indicating that despite this

professionals relatively short employment history within the company does this person have a clear and simple view of BIM, most likely as a result of an introduction in which it has been clear-cut, comprehensive and easy to understand BIM. A contrast in comparison to some of the comments made from professionals with more experience of the construction business in which confusion still prevails around the system.

There is diversity in the experiences of working with BIM; for some, being just recently introduced to the concept and technique, this means undergoing training on how to first and foremost work in projects, how to set reasonable standards or levels of to what extent BIM should be involved in the process in order to fit the needs of the client for example. While for others BIM has meant continuous daily use in which respondents almost always, at least for start-ups of projects, emphasize the importance of clarity and simplicity that the three dimensional models bring about for the professional team working together during a construction process. The BIM tool has become inevitably important as suitable workarounds constantly needs to be found along the construction process in order for the company to deal with construction errors in progressive and efficient ways.

The impression might be that the implementation process and technological diffusion of BIM throughout the company has come a long way but there are circumstances that create drawbacks. Several respondents speaks about newcomers from universities as well as leading senior project managers working in BIM projects that has the slightest clue of what it actually is and involves and so there is still progress to be made within the company as a whole.

One of the corporate means for enhancing the diffusion of BIM being mentioned is that of developing general knowledge into expert skills within the subject amongst colleagues in order to deal with the issues of the slow-paced implementation process. Professionals' working directly with BIM-related issues expresses the appreciation of getting more BIM enthusiasts to their team in order to gain new ground in the field but also alleviating the diffusion process throughout the organization. Several respondents also mentions reactions of initial skepticism amongst their fellow colleagues before real-life experiences of BIM replaces skepticism with optimism due to the benefits seen with the use of it. This supports Lewis' (2011) information dissemination theory about initial unambiguous information sharing as well as the theory of technology acceptance presented by Taylor & Todd in 1995. Further notice is that "the picture of BIM has become more comprehensive … because there are more platforms today in which one can discuss" (R7). Indicating that Choi's (2009) theory of communication and information spread throughout social systems are of importance for enhancing user adoption within a firm. So working experience as well as social interactions, i.e. in different digital platforms built up by various companies of the construction industry (as one of the respondents points out) in which people share their experiences, might actually raise the knowledge and use of BIM further.

4.2 Routines in relation to BIM

The extent to or level of contact with BIM looks quite different depending on what kind of position the professional has got. Even though BIM might be used in early preconstruction phase it does not necessarily mean that everybody involved in that phase have to work actively in or with BIM during the project. Some has experienced that the "team that handles project management does not use BIM" (R1) whereas others states that the level of BIM in a present project is pretty low due to circumstances related to client demands instead. It is simply not up to the company to say to what extent BIM should be used in the project but rather up to the client in the end to decide. If the client's knowledge, of what BIM may encounter in a project, is limited then the level of using it in the construction process decreases. Another concern related to the client is that it might ask for BIM but not really know what to demand for when it comes down to deciding on what details or information should be put into the model, something which is usually explained by a lack of knowledge concerning what BIM is and may involve.

For a consultancy firm in which the goal is to use BIM as much as possible in the assigned projects the issue of demands from clients might be a bit problematic. Not only will it affect the degree to which BIM is being used in the project but it will also affect what specific parameters to put into the model in order to collect the information needed throughout the construction process. With occasionally very little or no chance to use the software and working method in projects it becomes difficult to improve both procedures and individual's knowledge connected to BIM. Since projects usually spans over extensive periods of time, sometimes around a year or more, it would of course affect and extend the process of not getting the necessary experience and practical training of BIM in real-life projects even more. Another aspect related to organizational issues is that different departments within the company works more or less with BIM compared to other departments, shifting the balance of use as well as experience of professionals within the company quite a bit.

The development of BIM in the company and industry in general has meant that it has become "a more digitized project world" (R2) in which both model, data and text format is connected to projects. This new technical environment has also enabled for legal documents, such as contracts, to be coordinated and shared with team members in working teams in order to ease the construction process. Cross-collaborations between different companies in the construction industry exist in common attempts to develop BIM further which also has resulted in "groupings that follows different gurus within the industry" (R7). These industry-common development groups that have been established does, amongst other things, examine newly entered technologies related to BIM in order to have some kind of overview and grip of what is going on in relation to BIM in the whole industry when it comes to development.

BIM usage within the company seems fragmented since claims like "it is being used in most projects today" (R2) come up during the conversations whereas others states that "it could be used to a much larger extent than it is used today" (R1). Possible reasons to these contradicting statements might be the subjective perceptions on BIM usage but also due to the possibility that general usage of BIM has increased in construction projects whereas

individual usage still varies greatly depending on factors such as occupation and role in the construction process. One person exemplifies this by speaking of a situation in which a professional, with expert skills in BIM, sits next to another professional responsible for project costs, and helps to collect raw data concerning amount of construction materials from the BIM model to spreadsheets. This will of course increase understanding and learning of the person who sits next to the one who explains and demonstrates what is being done in the model but speaking against this kind of routines is the fact that resources, as in one extra employee, is being used when it could have been put elsewhere in the construction process. The time spent could have been used to holding a course for several individuals instead of just one in order to raise the efficiency of teaching out the new technical procedures in BIM amongst fellow colleagues with lacking knowledge and experience.

4.3 Individual insights and work effects

Several individuals speaks of the benefits when it comes to using BIM in working processes and mentions advantages like detections of collisions between different structural elements as well as installations and the easiness of viewing these complex matters in the 3D model while talking through coordination of procedures during inter-disciplinary meetings. Highlighting important and critical steps of the construction process is one effective way of reducing errors that could lead both to execution problems but also financial deficits. Another point mentioned related to BIM usage is the urge to make clients want to use BIM models more, partly because of the need to raise clients' knowledge of what BIM is and how procedures related to the technology works but also because it would help them understand what information and parameters to demand of the consultants and why.

Since BIM implementation first was initiated it has affected job descriptions in various ways. It was expressed during the interviews that "the role for coordinating BIM within projects is getting bigger than the role of the project manager" and that "it has become something completely different compared to 3-4 years ago" (R2). It is evident that new roles directly connected with both the implementation process of BIM as well as the settings of the technical environment have involved change and new work assignments.

Since the idea behind BIM also has been to optimize processes, more comments about further change to regular work assignments of existing roles within the company were expected to be expressed during the interviews, but was to most extent non-existent. Some were too new for the industry to know what the change of this BIM introduction would have involved whereas other experienced employees had been given the offer to take some introductory courses but not yet felt that they had seen the full potentials of change related to their daily work.

4.4 Challenges with the technology

What was, however, being expressed as necessary actions to consider in relation to BIM implementation was the process of revising formats of all legal documents. A measure in order to increase transparency of who would be responsible for what if errors related to the information in the model would create problems during the construction process and consequently create disputes between the stakeholders.

When new roles, related to the implementation process, are being created it is also of importance to look over the responsibilities of individuals in project teams so that it does not become unclear and create misunderstandings related to the information put and used in the model of who is responsible for what. What effects BIM has had on the experience of job assignments also depends on prior experience of digital tools in general, since "some are enthusiastic and knows the tools well" (R1) and thus uses it more frequently in construction management assignments than others who do not experience the same eagerness.

There were some typical errors encountered by the employees in the interaction between human and BIM technology. According to some were the potential scenario of misinformation-spread one of the most "scariest parts" (R4) with the introduction of technology. This was due to the fact that one inaccurate information source in the model possibly could lead to and create a snowball effect in which the faulty information would have detrimental consequences for the project itself. It was expressed that that is the reason to why it is so important to decide "on a general information level" (R7) which clarifies and determines what level the information in the model should have and also which parameters that should be used. Whether it is connected to timetables, structural components or economy linked to the specific construction project.

The role of the client is important as this is the one in charge of which parameters to be used in the project so it is of high relevance to thoroughly discuss both what the client considers BIM to be, what specifications are considered important and what information the client wants the model to comprise at the end of the process. It is also important that a common level or standard is set amongst colleagues so that errors related to such small and presumably given things as for example units in the model is not different and creates inaccuracies throughout the project. Another example related to setting common standards in the beginning is the naming of "different construction parts" (R4). These suggestions would not only lower the frequency rates of mistakes connected to the human factors but it would also ease the working processes when people for some reason are being replaced.

It was also expressed and wished for during the conversations that the role for keeping all information and data correct in the BIM model should have a pre-determined consecutive order of who should be in charge if this person for some reason would be absent. That there should be back-up personnel taking this responsibility just for the sake of it since "everybody might do whatever they feel like" (R6) when the one in charge is missing and it consequently could become quite chaotic, both in the project as well as information-wise in the model.

No matter the level of usage degree in a project it should also be clear to all employees what BIM actually is and involves for the project itself since it has happened "that those who do not understand what it is believes that they get the advantages of BIM by using a certain software when this is really not the case" (R7). So initial consensus on the BIM concept is almost a must before the project is being initiated.

4.5 Individual gains

There was one comment made that very well illustrates the particular insights and benefits of use that the individuals might have come to gain in the implementation process of BIM – that "it ensures content in product development and contributes to higher quality in end product" (R1). All of the respondents could confirm that they saw benefits of using BIM in various ways. There would be system warnings alerting risks for construction element collisions under the process of installment. There would be more detailed and specified illustrations concerning how and what the construction is going to be like in order for the "human being [to] have a chance to execute it in a good way" (R5), and also an increased ease in devolution when and/or if people would be absent.

There were also reflections made about collecting "amount of raw material directly in the model instead of getting drawings from the model and then let one employee, a resource, sit with it and get the amount needed from the drawings instead" (R7). This is an illustrative example of how the concept of BIM may alternate the working routine in ways that effectively would decrease the number of steps and consequently save money for the organization.

The number of issues BIM has raised within the organization was quite a few. There was one individual who said that having good knowledge of BIM would actually require specialist skills within the subject just like any other professional role within the company demands today. With this meaning that asking all employees to acquire the relevant knowledge of BIM would be like asking employees to get specialized twice, this was expressed to be considered quite demanding according to some. It was further stated that since BIM is such a complex and great area to work with that "several people... [would have to be]… actively involved in BIM as it becomes too heavy for one person" (R2) to be in charge of within a project.

Continuously improving processes surrounding the work of implementing BIM throughout the organization was also something that was brought up and expressed to be of interest within the company. However, reflections were made on the difficulty to do just that in relation to the fact that it, in the construction industry, involves people that works project-based and thus are more of the spirit to "look and move forward [rather] than maybe look[ing] back so much" (R2). Knowledge transfer concerning new insights gained during the work and process of continuously improving the implementation of BIM does under such circumstances suffer a loss. Lack of or poor knowledge transfer as typically occurring in project-based work overall as well as a typical feature of the construction industry itself, as it tends to be poor or even precluded, increases the tendency of ignoring knowledge transfer when it comes to the

BIM implementation process. This does consequently lead to a prolonged and ineffective technological diffusion that thus needs to be addressed better.

On the one hand did one of the individuals mention the importance of genuine interest in the field of BIM in order to reach successful system adoption amongst the employees rather than forcing it upon people. But it was on the other hand stated clearly, several times, that "the construction business [is] very conservative" (R4), apparently in particular against new ideas, so the question is what appropriate strategies there are to be used if BIM is not supposed to be forced upon people but the incentives or interest for the individuals themselves to start use it does not exist. Not only does prejudices about the system itself exist but also prejudices amongst and between employees and colleagues on how surrounding people responds to BIM and the change in work itself. Having prejudices that gives room to theorizing that other people would react negatively to change might actually influence and de-motivate the individual response to change as well, despite the own initial attitudes towards a new system.

4.6 Organizational issues related to BIM

Since the initial introduction of the BIM system was made it has, at least to some extent, "changed working processes" (R2). There has been trainings held within the company but this is, according to some of the professionals, evidently not enough within the organization. "To get BIM into the whole process it is important to work with it continuously" (R4) so that employees that do have the necessary knowledge actually are located in different projects, enabling for knowledge diffusion and thus also knowledge increase of the system, that subsequently can result in adoption and daily use of the system. One strategy of increasing knowledge connected to the system that has been progressively used as a common strategy has been the making to match junior competencies (those understanding the applications of the technological environment) with the senior competencies (those understanding the process and product demands) in order to bridge the different knowledge gaps that currently exists.

Employee's experience that demands today look somewhat different to the organization compared to before as a consequence of the BIM implementation process. One of the professionals states that BIM has meant that it "requires another approach and more prior knowledge" (R2) and consequently believes that the role of being a BIM coordinator will not end up as a part of the project management role like the company initially envisioned when the change process once started off. It is further clarified that "this role already requires special competences so it is most likely that the BIM coordinator will remain for the future as well" (R2), which is explained by the complexity that it means "to collect the amount of data and get the application of the BIM software to function properly" (R2).

It is especially interesting how two of the individuals approach the same kind of problem, but from two diverse angles, when it comes to the present state of the BIM implementation process within the company. One of them saying that "education is good but the company needs to clarify more that BIM should be used and in what ways we should work with it. As long as the company does not do that the use of BIM will be individually" (R1). Many

different aspects related to change can be drawn from this comment; it illustrates uncertainty of what is expected of the employee when it comes to work performance, pointing at ineffective processes when it comes to information dissemination within the organization. It is also a sign for ambiguity when it comes to the exerted leadership within the organization. It could further be the case that this comment is made from the subjective view that leadership should be more transactional than transformational in the organizational context of today. This individual clearly understands and appreciates the purpose of BIM but show that there is more knowledge needed in order to understand the process of business process reengineering. It illustrates the need for evaluation of working procedures in order for the company to identify and acknowledge where unnecessary actions occur so that work processes can become more efficient.

Whereas one individual focuses on what needs to be done in the BIM process at the moment from the perspective of a regular employee, there is another comment made from one of those with valuable insights from the opposite position of the table, a person involved in the development process of BIM within the company. This individual describes the current position by saying that "the company's and my biggest challenge right now is to get a grip of where we are now and where we are heading, how far we have to go or what we need to do to support people because we want to raise the level generally" (R7). Having insights of Markus' and Tanis' (2000) Enterprise System Experience Cycle (see Appendix A) would involve identification of the current phase and what appropriate strategies to consider, in this case it would become obvious that the company is in the shakeout phase. This due to the fact that there is still a lot of work to do before the company have reached the stage of having normal operations in which BIM is relatively integrated to the organizational structure and work procedures. Further enhancements needs to be done when it comes to effective communication, time consuming as it might seem. Following the soliciting input theory would most likely give top management as well as BIM implementers and developers a lot to do, both when it comes to creating opportunities for the employees to gain further experience and knowledge within the subject but also when it comes to uniting the image of what the concept of BIM really means in order to progress effectively with the implementation process.

4.7 Attitudes

When it comes to circulating opinions about BIM it seems that comments are influenced by personal prejudices as well as real-life experiences. Lacking knowledge amongst some individuals tend to raise reluctance to the technology at first, and some do believe that younger generations are much more positive towards technological implementation in general because of past experience within the technological field. However, there are no clear-cut answers to which camp individuals tend to drop to; seniors might never have the chance to become technological experts (perhaps not even beginners) but they do understand and appreciate the benefits that come with this new technology and they are not late to confirm this. It should however be stated clearly that this concerns seniors within the construction consultancy world, comments made about seniors within the field of production tends to fall into the negative category in which resistance to change most often is mentioned during the

conversations. Possible theories of why some are more positive to BIM than others were explained with theories that it depends on the individual and its openness and susceptibility to changes and development in general terms rather than being age-related or connected to individual backgrounds. The plan and vision of BIM usage and knowledge seems to be on unit level, perhaps sometimes even department level, but there are no indications of a united strategy concerning BIM and the whole organization and that all employees should try to adopt the technology and idea behind the whole concept as such.

When adoption has occurred there are some technical and organizational issues related to BIM that needs to be resolved in order for it to function effectively in work processes. One of the "biggest problem[s] [is] related to the functions between different software's and the collection of information from different sources" (R2). There is at present state no standard BIM-software stated within the industry but it has rather evolved into the selection of specific neutral software because of its popularity amongst the majority of construction companies. There is neither European nor Swedish guidelines or regulations on this which would have been appreciated by the professionals in order to relieve the headache of bringing together information from different kind of software's which are, for the better or worse, variously compatible with one another. Further development on updates to all employees, concerning changes in the information linked to the model, is also relevant as some incidents of individuals changing in the 3D model, for some reason, without anyone else noticing it remarkably has occurred. There is also a need for common structures in order to ease the information processes which relates to using the same terms and vocabulary "so that people understands that they speak about the same thing" (R7).

What is of significance to the company in times like these is that most of their employees eventually tend to see the benefits and value of BIM, despite perhaps lack of experience in use of technology or initial prejudices or fear. BIM is being considered as *the* innovation that gives hope of a needed change that hopefully will enable for effective knowledge transfer throughout the entire organization as well as improved business processes. It is being expressed that there is hope that construction and IT, at some point, will be able to conjoin and create a singular track in which effective progress will be possible. It is obvious that there are gains with the concept and system of BIM and employees hope that senior together with junior competencies will be passed on in the long run so that operational knowledge and experiences becomes more integrated with the technological aspects of BIM in the construction processes as well.

4.8 Chapter Summary

This chapter includes the professionals' insights of the BIM implementation process that has taken place within their company as well as a discussion-related dialogue in which some conclusions may be drawn from the theoretical framework brought forth in chapter 2. Professionals has brought forth opinions about the complexity regarding the initial contact and experience of the system, routines around it, individually experienced insights and work

effects, challenges with the technology itself, individual gains with it as well as organizational-related issues and attitudes around BIM.

5 Conclusion

5.1 Research Aims and Objectives

The intention of this research was to get a better understanding of how individuals experience and respond to an organizational change as an implementation of new technology. It was found that individuals generally could recount for the common idea behind the concept of BIM; that it was a technology for improving information flow as well as a measure to raise organizational efficiency through business process reengineering. There were however a discrepancy between the understanding of the concept and the practical experiences and knowledge of how to actually be a part of the implementation process. Several challenges and explanatory circumstances were found to why the implementation process has not gained a more steady ground within the company. The challenges that were encountered in this study were unfamiliarity with the BIM system, partial system adoption amongst employees, difficulties reengineering business processes as well as technological-related issues to the software's used.

5.2 Practical Implications

The findings of this research study show that the challenges that may be encountered by an organization while implementing a technology are vast and complex. The challenges that have been encountered have mainly been related to BIM being unfamiliar and/or not fully adopted by individuals of the company due to various reasons. Top level management has, according to the participants of this study, not demanded mandatory acquaintance with the system throughout the organization and it has been difficult for the company to influence other stakeholder, such as the clients, to raise awareness of its use in projects and subsequently amongst individuals of the company.

There is still fragmentation in the views and perceptions related to BIM and its intended purpose and poor reliance on the technology at initial stages of introduction amongst the members of the organization that has resulted in skepticism, uncertainty and ignorant behaviors amongst others. When BIM first was implemented did many co-workers misunderstand the concept behind BIM and focus on the technology rather than technology and process reengineering. This is still an issue of today but perhaps not to the same extent as before since there is an increasingly number of BIM-skilled employees being frequently hired and/or trained in order to emphasize development and enhance the technological diffusion throughout the organization further.

Other explanatory reasons to why the system has not been as effectively implemented as hoped nor used by the employees are due to poor training and/or prior experience of the technology in combination with the nonexistent interest from some clients to use BIM in construction projects. It has also been expressed that some specialized roles within the company does, more or less, not have a need for any of the existing applications in their work, demonstrating that further software development is needed in order for the system to fully serve its purpose within the organization. It has additionally been difficult for employees to effectively participate in the implementation process as business process reengineering requires both knowledge as well as the authority to change aspects related to work procedures which has not been quite that easy.

Drawing conclusions, from the findings of this research, involves acknowledging the complexity of organizations under technological change. What has been observed in this research study is the importance of focusing on the individuals of the company, continuously communicating information, giving training and approaching negative attitudes and behaviors directly in order to overcome the basic barriers that a technological implementation such as BIM involves. Possible ways to overcome the challenges would be to construct more training courses that could be held within the company. Developing an additional corporate IT platform that the entire organization can access, in which relevant information sharing and updates around BIM continuously is spread as well as a place for the employees to speak about their personal reflections, thoughts and feedback is of relevant matter. There are industry-common IT platforms in which discussions occur but this could possibly be developed further in order for the process to gain ground within the specific company and then be developed further. It is of importance to work with BIM development at all levels and across all units to gain progress in process, despite structure and/or purpose of different departments. So clearer structures when it comes to BIM-responsible managers is very much needed so that there always is a clarity of whom to turn to as well as someone creating spirit and influencing for progress and system adoption to occur.

Last but by no means the least should more focus be put on industry-common development groups in which common work will see to the fact that further knowledge in the area of BIM is being spread in the construction industry. Engaging universities in the matter of subject as well as government and parliament is most probably some of the answers to the bigger picture and spread of BIM that needs to be dealt with in the future as well.

5.3 Future Research

What would be further interesting when it comes to future research related to implementation of new technology is perhaps a comparative study of the implementation process made within a different industry than the construction industry. Comparing any two would hopefully give new insights to how other industries has approached the concept of an enterprise resource planning system and what strategies has been used in order to successfully reach out to the employees and raise system adoption amongst the employees.

5.4 Chapter Summary

This chapter accounts for answers, practical implications as well as possible solutions to the research question of possible challenges that may be encountered during a BIM implementation process in a larger construction firm. The encountered challenges were identified as unfamiliarity with the technological system, partial or little user adoption amongst professionals of the organization for various reasons, difficulties with reengineering business processes and technological software-related issues. Many of the practical implications are related to inconsistencies in the top management directions that have made things unclear at individual levels. Some of the potential solutions to the problems are increased information sharing of BIM through more training within the company, a corporate-specific IT platform in which continuous information about BIM and the process as well as discussions between staff may take place to ease the diffusion and acceptance further in the organization. It could be of relevance for future research to make a comparative analysis of a technological implementation process in another industry and compare it to that of the construction industry in order to learn more about the positive and negative aspects that influences the process.

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Appendix A

A Process Theory of Enterprise System Success

Phase	Successful Outcome	Necessary Conditions	Probabilistic Processes	Recipe for Success
Chartering ("ideas to dollars")	Decision to proceed with enterprise systems in a properly chartered project with a sound business case	• Executive participation • Sound assessment of business conditions and needs • Good understanding of enterprise systems' capabilities and limitations • Carefully constructed business case well communicated to relevant parties	• Managerial decision making ("garbage can" dynamics and politics) • Distribution of good information about environment and technology • Availability of people willing and able to challenge untested assumptions • Human communication gaps and acceptance of need to change • Volatility of business conditions	Success occurs when executives make sound decisions about investing in enterprise systems and bring the organization into alignment with these decisions
Project ("dollars to assets")	Rollout, within reasonable cost and schedule, of enterprise systems functionality that is operational and sufficient to address business needs to an organization prepared to accept it	• Expenditures • Participation by various organizational groups • Technical resources, methodologies, and expertise • Project, vendor, and stakeholder management • Organizational change management expertise • Knowledgeable and skilled IT specialists and project participants	• Quality of business plan resulting from earlier phase • Volatility of business conditions • Availability and quality of technical resources, methodologies, expertise • Execution of project plan • Stakeholder politics • Resolution of problems arising during project phase	Success occurs when 1. The project team faithfully executes a sound project plan and appropriately responds to technical and human challenges that arise during the project OR 2. The project team appropriately modifies the project plan to match changing business and organizational conditions
Shakeout ("assets to impacts")	Normal operations achieved within reasonable time frame and expense with impacts that are sufficient to meet business needs	• Trained users • Well-configured and integrated enterprise system • Redesigned business processes • Additional human, financial, and technical resources to cope with problems arising during shakeout	• Quality of assets resulting from earlier phases • Volatility of business conditions • Stakeholder politics • Execution of shakedown phase problem resolution activities	Success occurs when 1. The organization is well prepared to accept and use a system and related infrastructure of sufficient quality to meet business needs OR 2. Appropriate measures are taken to fix technical and organizational problems arising during shakedown quickly and effectively

(continued on the next page)

Phase	Successful Outcome	Necessary Conditions	Probabilistic Processes	Recipe for Success
Onward and upward ("impacts to outcomes")	Organization improves its competitive position as a result of enterprise system project and maintains its technological and business flexibility for future developments	• Managers committed to achieving business results (e.g., to use system-generated information to improve organizational performance) • Impacts attributable to use of high-quality enterprise system and infrastructure • System, technical infrastructure, business processes, and human resources sufficiently flexible to adapt to changing business conditions • Adequate resources devoted to maintaining and renewing system, technical infrastructure, and human competence	• Quality of assets resulting from earlier phases • Volatility of business conditions • Stakeholder politics • Execution of results management and maintenance/enhancement activities • Survival of software vendor	Success occurs when 1. Benefits from use of the system combine with favorable competitive conditions AND 2. The future evolution of the enterprise system and related infrastructure is well managed

Source: Markus and Tanis (2000)

Appendix B

Interview guide:

1. What do you consider BIM to be?

2. What has BIM meant in your work?

3. What has BIM meant for the work performed by your colleagues?

4. Is there anything particular that one should consider in relation to BIM?

5. Is there anything particular that could be done differently regarding introduction of BIM?

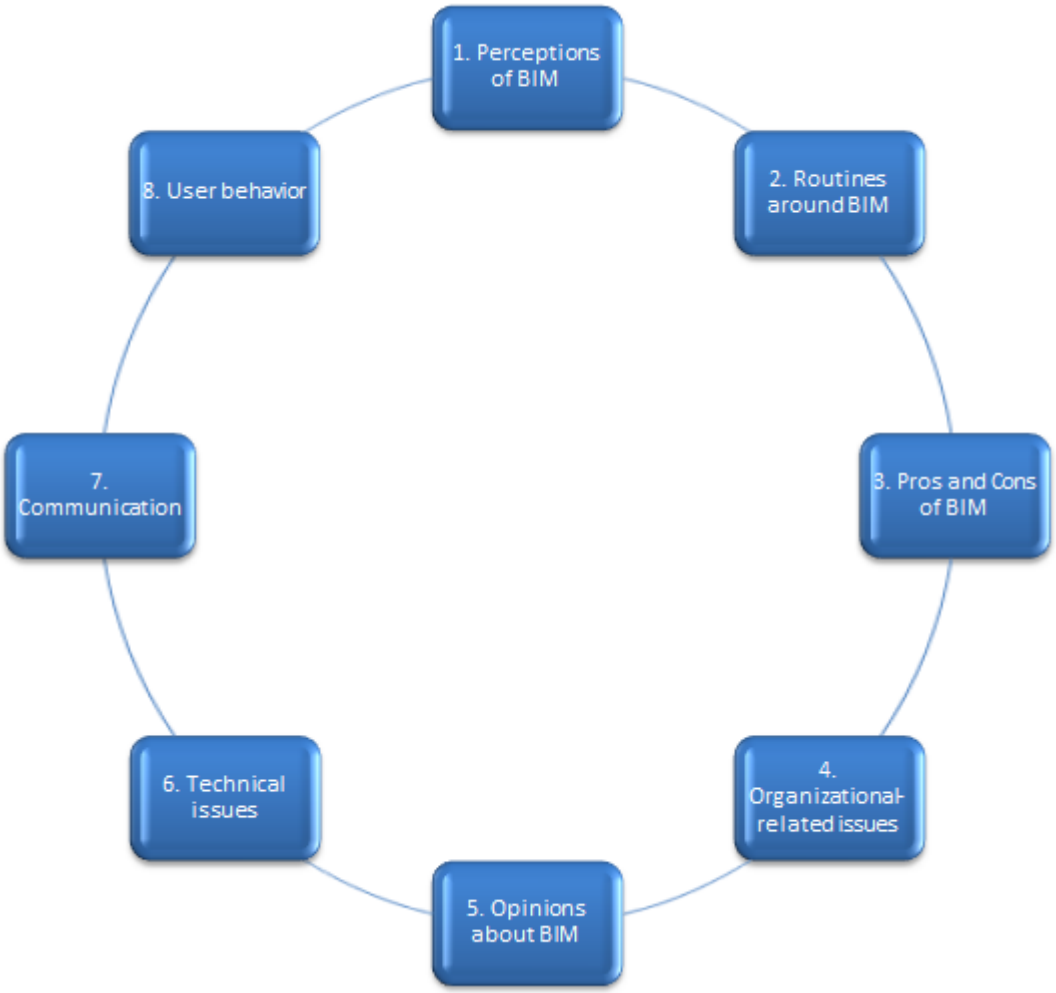
6. Have you encountered any particular opinions about BIM?

Potential follow-up questions if not mentioned before in the interview:

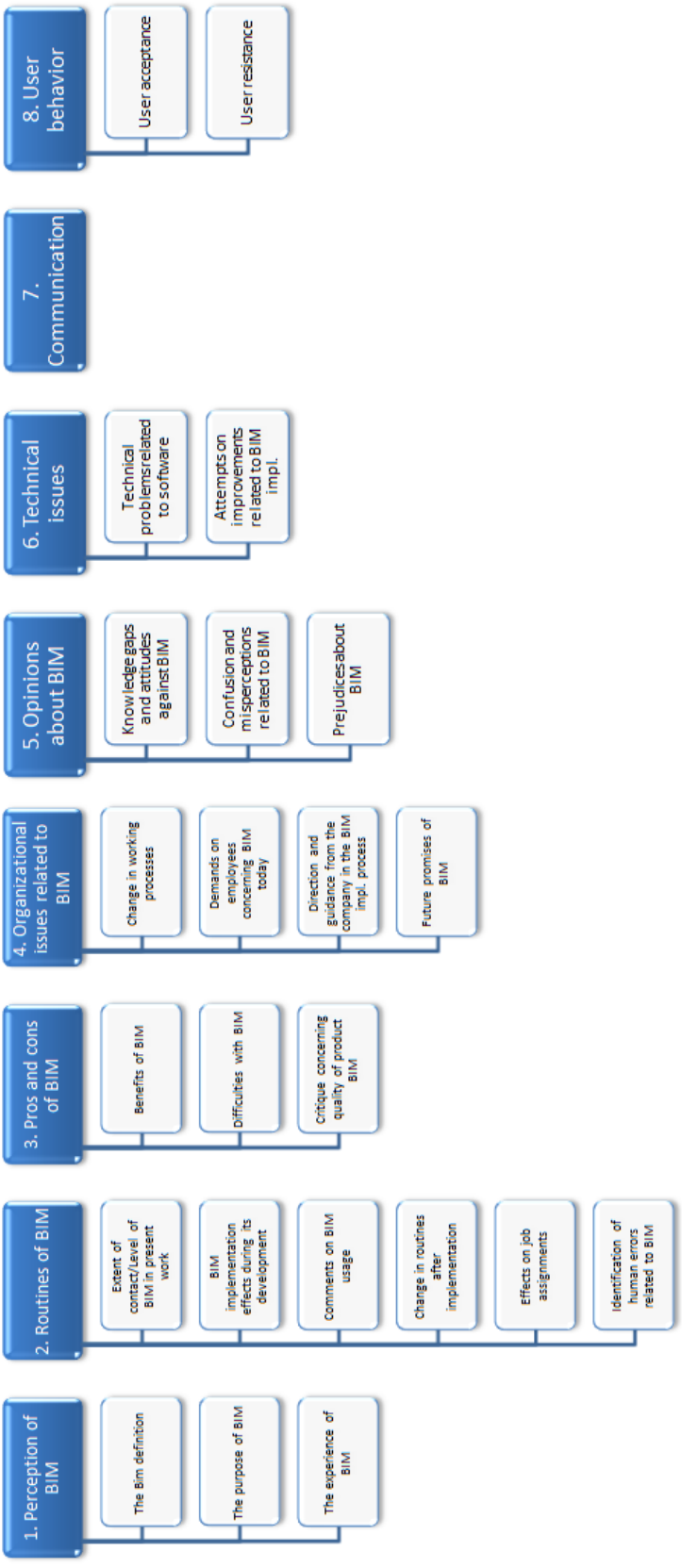
7. Has BIM involved or resulted in any specific changes within the organization?

8. How does the work of following up effects of BIM look like?

Appendix C


1. Perceptions of BIM
2. Routines around BIM
3. Pros and Cons of BIM
4. Organizational-related issues
5. Opinions about BIM
6. Technical issues
7. Communication
8. User behavior

Appendix D


1. Perception of BIM
The Bim definition
The purpose of BIM
The experience of BIM
2. Routines of BIM
Extent of contact/Level of BIM in present work
BIM implementation effects during its development
Comments on BIM usage
Change in routines after implementation
Effects on job assignments
Identification of human errors related to BIM
3. Pros and cons of BIM
Benefits of BIM
Difficulties with BIM
Critique concerning quality of product BIM
4. Organizational issues related to BIM
Change in working processes
Demands on employees concerning BIM today
Direction and guidance from the company in the BIM impl. process
Future promises of BIM
5. Opinions about BIM
Knowledge gaps and attitudes against BIM
Confusion and misperceptions related to BIM
Prejudices about BIM
6. Technical issues
Technical problems related to software
Attempts on improvements related to BIM impl.
7. Communication
8. User behavior
User acceptance
User resistance

Appendix E

Collected and thematically divided material from interviews held 5th -18th of May, 2015.

1. Perceptions of BIM

1.1 BIM definition

"BIM feels like a tool used to simplify what one is already doing. It is not a completely new thing but is there to simplify the work that one is already doing." (RPD3)

"There are many definitions about what BIM is depending on the gains the individuals see with it. For me is BIM information management in which you think a lot about where the information comes from, that it is the correct information from the start and that the same information given in the early phases of the construction process is also used out in production of the construction. It does not only involve looking into 3D models but also about how you work, what kind of information you get and that it is correct." (RPD 4)

"BIM is more or less a digitalized information management. It includes all information that we have in our construction projects, which is a bit too much in my opinion. It is about attempting to use all the digital tools that exist and take advantage of them by actually dealing with information and keeping it editable above all, which is what I consider important to focus on when you speak about BIM." (RPD 7)

"I use to say that "BIM is not a tool it is a process"". (RPD4)

"I was at course in which the course director asked its audience about the definition of BIM and that varied. I am of the opinion that one should think about the methodology and not just the tool itself, because it is just a tool in which you perform your work and that's not how you work with BIM." (RPD4)

"BIM is a kind of work procedure that follows from early stage of the project and all the way to management of the completed construction." (RPD6)

".. it is an information carrier.." (RPD7)

1.2 The purpose of BIM

"BIM gathers information about the building, what parts should be in the construction and what it will look like. It simply becomes a 3D model with a lot of information concerning the building components." (RPD1)

"For me is it when you gather all information in one place, that you collect all necessary information and puts it in a model. Like in some projects there is just a model which I don't fully consider BIM because when it's BIM you also put in a lot of information and data into the model". (RPD6)

1.3 Experience of BIM

“Has meant a lot of introduction, a lot of training. First and foremost has it been about how to work in projects, how to put it at a good level so that it fits the client. Thereafter it has been about the softwares.” (RPD3)

“Have had an initial work meeting with the model coordinator and it worked very well, everything was much clearer and it was easy to follow and discuss with other disciplines when the product/model was used to illustrate what we were talking about. It simplified most of it.” (RPD3)

“BIM is not that familiar yet, it is still a revolution in the industry. There are very few who recognizes BIM and there are maybe those that have heard about BIM but they still don’t know what it involves. Being new in the industry visiting working places you could tell that there are some project managers who does not recognize BIM and even though they are into a project and know that it is a BIM project, they still don’t know what that entails.” (RPD4)

“The newly employed that we’ve got, when one has spoken with them you realize that they have very little knowledge about BIM so then we try to inform as much as possible and if we see an extra interest we would appreciate to get that one to our team if you may put it like that”. (RPD4)

“On the other hand do I meet people in different projects and clients that maybe hasn’t as much experience, that has not had the same insights as I have gained but I would say that as soon as someone sees the benefits of what it actually can deliver, the benefits of working with BIM then people are quite quickly to get along on the train so to speak.” (RPD7)

“People are skeptical until they have seen the benefits themselves” (RPD7)

“It relates a lot to how you are as an individual when it comes to changes. Are you open to changes and susceptible to development then you usually tend to be more open to this that it won’t feel uncomfortable to work with these kind of tools but I would definitely not say that it is related to age or what kind of background you’ve got but more how you are as an individual” (RPD7)

“But it is also like that when one works in projects as you do all the time in the construction industry that it depends a lot on what kind of project you get because you might be interested yourself but maybe there’s not space for development depending on the project that you’re in” (RPD7)

“The picture of BIM has become more comprehensive and it is probably because there are more platforms today in which one can discuss” (RPD7)

2. Routines of BIM

2.1 Extent of contact with BIM/Level of BIM in present work

“I do not have much contact with BIM. I don’t work actively in BIM myself, has been used in early preconstruction phase in the latest two projects.” (RPD1)

“Team that handles project management does not use BIM.” (RPD 1)

“It is on a very low level I this project when it comes to BIM since the client has taken quite a huge step to just work at this level compared to before. There is a model coordinator from XXX; then will architects, constructs, specialists on ventilation/sanitation and electricity make models.” (RPD3)

“Some colleagues has worked with BIM before. In this particular project is it this specific individual that will learn the different programmes related to BIM. There are other departments that work a lot more with BIM, this is just applied to the Management department at this office.” (RPD3)

“In collaboration with others we usually have a little presentation where I explain the definition of BIM, how one works, not only what you should think about (that it is a tool) but that it also is a working process so that people see the whole picture. I usually explain the gains of it, what it involves to work with BIM, so that people do not just look at it like a 3D model.” (RPD4)

“.. work with internal development related to BIM so I work pretty extensively with it..” (RPD7)

2.2 What BIM implementation has involved during its development

“It has become a more digitized project world in which all information related to project, contracts, planning and program before that, is digitized and coordinated in different ways. It comes both in model, data and text format and then is that information used for different applications.” (RPD2)

“Since there is a lot of development going on in the industry, there exists different groupings that follows different gurus within the industry” (RPD7)

“Because there has been spent a lot of time and work on creating industry-common development groups where one looks at, because it is needed, new things when they enter the industry” (RPD7)

2.3 BIM usage

“It could be used to a much larger extent than it is used today; it is today used in the early preconstruction and design phase. I believe that it could be used much more in bigger projects out on the field in production when that phase has started.” (RPD1)

“Can use it to detect and solve problems; for example collisions out in production. It is easier to arrange and coordinate meetings related to problems that arise and then use the 3D model to demonstrate and find different solutions. This way of working is much faster than compared to before.” (RPD1)

“It has been used in coordinating design phase, 3D model, installations and in collision controls in simpler types of coordination functions.” (RPD2)

“It has developed over time. It is being used in most projects today.” (RPD2)

“Applications of information are rather guided by what the contractor needs and what they considers important.” (RPD2)

“It happens more and more often that junior competency, that understands applications of BIM and the technical environment, and senior competences, that understand the process and product demands, are paired together. It happens more and more often.” (RPD2)

“Working right now in a project with someone who is calculating on the project costs who is not use to work in BIM or CAD programs or to get amounts of materials from the models and then it helps that I sit next to him and get that information for him from the 3D models, that I help him to get in the correct amount into the spreadsheet.” (RPD4)

“In collaboration with others we usually have a little presentation where I explain the definition of BIM, how one works, not only what you should think about (that it is a tool) but that it also is a working process so that people see the whole picture.” (RPD4)

“I describe it shortly to increase understanding for what I am doing and how I work when it sit together with colleagues and we collaborate” (RPD4).

“Then there are those that doesn’t need BIM in their work and those that do.” (RPD4)

“Should get clients to use the model more. It is those who decides to what extent BIM will be used in a project. For those that do not want BIM we just make a 3D model without any information. But for those who wants BIM we put in those parameters that they want to have in their object”. (RPD6)

“The level is extremely varied. Both when it comes to knowledge and experiences but also when it comes to what BIM is considered to be” (RPD7)

2.4 Change in routines (implementation)

“The role for coordinating BIM within projects is getting bigger than the role of the project manager. It has become something completely different compared to 3-4 years ago.” (RPD2)

“Difficult to tell the difference before/after of BIM implementation since the participant has only been involved for a couple of weeks.” (RPD3)

“It is also important to look over the legal parts when it comes to contracts and so on because contracts are binding and often when it works smoothly then you’re grateful about it and may put in a little extra for the sake of it but then when it comes down to the bottom line and something is incorrect or there’s a dispute you always go back and look at the contracts” (RPD7)

“So you need to look over contracts/agreements and then also if there are any extra roles/positions added to the organization, you need to look over what kind of responsibility they should have and so on” (RPD7)

“There is a lot of different things that you need to look over and it is an advantage if you actually does it together within the industry so that you may form some kind of unified standard that you could relate to” (RPD7)

2.5 Effects on job assignments

“It is individually how BIM has affected job assignments, some are enthusiastic and knows the tools well and these individuals use it more in assignments related to construction management.” (RPD1)

2.6 Human errors related to BIM

“Differences may appear, concerning for example square meters, but those types of errors are usually related to the individuals own definition put into the system rather than the BIM model itself.” (RPD1)

“And double-checked so that everything was correct since the scariest part when it comes to BIM is misinformation. That when there is misinformation, that is when it goes completely wrong and that requires check-ups and getting to know how to handle the tools better.” (RPD4)

“What we focus on very much and what you should consider when it comes to BIM … is that you at an early stage … demands certain standards to be set up. And by demand I mean that you for example demand and decide for how you should name different construction parts.. “ (RPD4)
“If we get involved at an early stage in the process then it facilitates a lot” (RPD4).

“in every project one decides on a general information level, this is clarified and determined in the beginning that this is the level we should have and these are the relevant parameters to put into the model. Then you stick to that, especially when you have someone that is responsible for every model. But then again you also need someone who is responsible for it, which is also something you need to consider. Otherwise it might be a little so and so with that. It is

“If you switch people and don’t have anyone specifically responsible, everybody might do whatever they feel like and it can become pretty messy.” (RPD6)

“Since the term is pretty new and entails a lot BIM might be considered as one thing for you and then a completely different thing for me that does not match with what you had in mind” (RPD7)*contacts with clients

“And there is always a risk when we say that we want to work with BIM that those who do not understand what it is believes that they get the advantages of BIM by using a certain software when this is really not the case” (RPD7)

3. Pros and cons of BIM

3.1 Benefits with BIM

“It ensures content in product development and contributes to higher quality in end product.” (RPD1)

“It ensures and eases the process so that no installations collide. If detected the system will warn. It may sometimes indicate collisions that are not that difficult to adjust.” (RPD1)

“Many thinks that BIM is really good, it makes things easier to understand, is much clearer what kind of product it is that you get.” (RPD1)

“One could use different methods within BIM. It could be used to make collision controls in different models and that could be discovered at an early stage where one could save a lot of money.” (RPD4)

“It facilitates the devolution, when people are going on holidays and you have to hand over the project to someone” (RPD5)

“It is easy to get an overview by looking at the model. Clearer.” (RPD5).

“When I have worked with complex renovations on hospitals while in use where operations has occurred in the room next door where you’ve been renovating … If one would have used BIM and models and one is doing some restructuring because the business has to keep on running then it would probably be much easier to revise and re-do documents in that way, there is great potential.” (RPD5)

“.. all involved disciplines can pretty easily see in the models where there are risks at stake and where to avoid strange variations related to the construction so that the human being have a chance to execute it in a good way” (RPD5).

“.. there are advantages of working with BIM, you could for example collect amount of raw material directly in the model instead of getting drawings from the model and then let one employee, a resource, sit with it and get the amount needed from the drawings instead” “Then you get more steps in one procedure which is an advantage when one gets information directly from the model” (RPD7)

3.2 Difficulties with BIM

“Roles become more and more specialized and then having several specializations, such as BIM and something else, will make the role very demanding. So demanding that several people is required for BIM as it becomes too heavy for one person.” (RPD2)

“Most people would possibly want to improve BIM-related issues but since these are “project people” they would much rather look and move forward than maybe look back so much.” (RPD2)

“There should be an interest; you can never force someone to use BIM. It is almost like saying that someone in a phone store should sell an iPhone to a pensioner that has a difficulty with touch screens, it is not as easy for someone on their 50s to work with softwares so one can’t force people to that type of work” (RPD4)

“Generally speaking is the construction business very conservative when it comes to new ideas.. “ (RPD4)

“Just because we work in projects we do not have the big advantages of using digital media as other industries has had. Just because we all these projects, it’s so many people involved, there are so many soft parameters involved that affects and so on.” (RPD7)

“There is a discrepancy between what software developers wants to deliver and what it actually serves as a purpose in the industry” (RPD7)

“There is also a lot of information that maybe is not gathered in the same model but it is rather the possibility to share this information that is needed within the industry” (RPD7)

3.3 Critique concerning quality of product – BIM

“It is supposed to be some kind of revision concerning newly gained knowledge in projects and all ISO certifications demands it and is a part of the project plan but when it really comes down to it that half-day meeting is never held. And even if it is held the knowledge is not documented in a good way and spread systematically amongst others. The work to spread such information throughout a large organization is pretty difficult.” (RPD2)

4. Organizational issues related to BIM

4.1 Change – working processes

“It happens more and more often that junior competency, that understands applications of BIM and the technical environment, and senior competences, that understands the process and product demands, are paired together. It happens more and more often.” (RPD2)

“It has changed working processes.” (RPD2)

“In collaboration with others we usually have a little presentation where I explain the definition of BIM, how one works, not only what you should think about (that it is a tool) but that it also is a working process so that people see the whole picture.” (RPD4)

“Generally speaking it is not enough with just holding a few courses. To get BIM into the whole process it is important to work with it continuously, to be part of projects in which you work with it.” (RPD4).

“.. that you in an early stage of the process and by that I mean when you’ve just started, when the architect have started sketching, that you sets certain standards.” (RPD4).

“If one mixes those with a lot of experience and those that are great at BIM it should give really good results”(RPD5)

4.2 Demands on employees concerning BIM today

“It requires another approach and more prior knowledge. It demands that you can combine those that know the tools with those who have the knowledge and experiences about processes.” (RPD2)

“The company said 3-4 years ago that the specialist role as BIM coordinator will end up as a part of the project management role. This role does already require special competences so it is most likely that the BIM coordinator will remain for the future as well. It is so complex to collect the amount of data and get the application of the BIM software to function properly.” (RPD2)

“There should be an interest; you can never force someone to use BIM.” (RPD4)

“I have had much focus on demands, that is what kind of structures/settings you should have in these models, how to structure the information that is saved in the models because it is extremely important that different programmes can interpret the same information in a correct way” (RPD7)

4.3 Direction/guidance from the company in the BIM implementation process

“Education is good but the company needs to clarify more that BIM should be used and in what ways we should work with it. As long as the company does not do that the use of BIM will be individually. It may be better implemented by the use of a project group in which you use BIM. If it is done the traditional way the working processes would be more time consuming.” (RPD1)

“What is the company’s and mine biggest challenge right now is to get a grip of where we are now and where we are heading, how far we have to go or what we need to do to support people because we want to raise the level generally.” (RPD7)

“The level is extremely varied. Both when it comes to knowledge and experiences but also when it comes to what BIM is considered to be” (RPD7)

4.4 Future promises of BIM

“BIM is the great future for construction industry, the great innovation that will happen the coming 5-10 years. I believe that construction and IT will be more coherent, that it will not go in parallel tracks beside each other but instead be tied together and used in one common track.” (RPD1)

“I consider myself totally ignorant when it comes to IT but I see the benefits in an adapted and easy tool that could help from a production point of view.” (RPD1)

“There is much to gain by using a 3D model, instead of paper drawings, in which you may twist and turn and see all the details. Everything goes much faster.” (RPD1)

“That competence hopefully, in the long run, is passed on to juniors from seniors.” (RPD2)

“But otherwise I think the it is pretty good with BIM and the model and that it’s good with the combination of younger people who has the skills to perform these models and those that

have a work experience of several years, which has been involved in building and knows the difficulties related to certain performances/procedures, knows about personal safety, performance and work environment." (RPD5)

"If one mixes those with a lot of experience and those that are great at BIM it should give really good results"(RPD5)

"It feels like the company is pretty interested in BIM and that they pushes this forward" (RPD6)

"That is probably the biggest challenge ahead now when we've realized that too much focus has been on the technical matters when we need to speak more about working method and processes and so on and that it actually makes a difference" (RPD7)

5. Opinions about BIM

5.1 Knowledge gaps and attitudes against BIM

"Everybody is not acquainted with what BIM is and what it might involve work wise, because of that there is a certain reluctance to it." (RPD1)

"Younger generations that more easily can adopt technology are much more positive. Older generations avoids all technology (at least in the production phase where a change is needed the most)." (RPD1)

"There are different attitudes towards BIM. Those that do not know about the technology do however understand that it is useful to use, even though they don't know how to use it themselves. There are of course some exceptions. This concerns the seniors or people in the ages of 60+. They understand that it can raise efficiency, that it makes work go faster and that it improves quality but they don't know how to use it themselves." (RPD2)

"Senior project managers might not know the software and exact application procedures but they understand the needs and use of it." (RPD2)

"There are some BIM courses held at schools and universities I've been told but I believe that those that are newly graduated, even if they tell you that they have had a course in BIM, they have actually worked in a general CAD software and not gained that much understanding for how it actually works" (RPD4)

"I've got the feeling that when you have explained and showed some, people tend to be more positive." (RPD4)

"We have a group here in which we focus on development and BIM… Generally speaking I don't think that the entire company focus on and has it as a goal that everybody should start working with BIM, it is more about spreading out more and more information about it in order to get most people to understand before they draw a conclusion on what it really is" (RPD4).

“There are very different opinions about BIM, whether one has tried it or not, but the construction industry is a bit conservative and I guess there are those like me [age-related] who continues doing the old things” (RPD5)

“It relates a lot to how you are as an individual when it comes to changes. Are you open to changes and susceptible to development then you usually tend to be more open to this that it won’t feel uncomfortable to work with these kind of tools but I would definitely not say that it is related to age or what kind of background you’ve got but more how you are as an individual” (RPD7)

“If you like development and you try to find new ways of raising efficiency in your work then you tend to see the benefits of BIM pretty fast” (RPD7)

5.2 Confusion/Misperceptions related to BIM

“There are many who mixes up the BIM software with other kinds of softwares, so many believe that they are working in and according to the philosophy of BIM when they are actually active in other kinds of softwares and vice versa. This is the largest misconception.” (RPD2)

“When it comes to the opinions about BIM amongst colleagues it is usually met, in the beginning, with confusion about what it actually is. It varies what one is aiming on, there is confusion if one just uses the concept so one would have to go more into detail when speaking about it.” (RPD3)

I am of the opinion that one should think about the methodology and not just the tool itself, because it is just a tool in which you perform your work and that’s not how you work with BIM.” (RPD4)

“And double-checked so that everything was correct since the scariest part when it comes to BIM is misinformation. That when there is misinformation, that is when it goes completely wrong and that requires check-ups and getting to know how to handle the tools better.” (RPD4)

“My opinion is that it has been too much focus on the software and the reason to that I believe is that much talk related to BIM is thanks to the two major software developers in the business has talked about it. They have actually developed this term very much when they have been trying to sell in their products, their softwares.” (RPD7).

“I would rather say that that you should more on the fact that BIM is an information carrier and not so much the programme itself.” (RPD7)

5.3 Prejudices about BIM

“That it is considered to be much more difficult than it actually is before being introduced to the concept and system. Before the introduction I studied a theoretical course related to BIM, so I have prior basic knowledge about it but then when you meet the experts it does not exactly feel like rocket science but it is rather much at once since there are so many concepts

and there is so many different concepts just for one and same thing. That kind of confuses you in the start. But then when one has gotten into it a bit more it does not feel like it is that extraordinary, it is just overwhelming in the beginning when one has to learn new names, abbreviations and similar. When one finally understands what is meant then it is not as difficult as everybody else believes." (RPD3)

6. Technical issues

6.1 Technical problems related to the software

"Biggest problem related to the functions between different softwares and the collection of information from different sources." (RPD2)

"There is no neutral BIM software/platform within the construction industry; instead different parties in the project have different softwares that works better or worse together depending on the compatibility between them." (RPD2)

"The software that is the most well-known within the industry has become the neutral format in which everybody exports their files/information to. There are no European directives on how to work with these types of issues so that a decision on neutral common platform could be made." (RPD2)

".. we have put in the construction into BIM and coordinated information in the model and then all of a sudden the constructor changes his/her mind and starts to re-dimension construction parts so that it becomes more difficult to execute. And this is discovered in at a very late stage which it should not but rather early instead." (RPD5)
"In this case did the constructor withhold information which should not be the case with BIM but rather transparent and reviewed during this long process that it was" (RPD5)

6.2 Attempts on improvements related to BIM implementation

"Follow-up on BIM implementation is as horrible as other types of project-based work/procedures. There is always a lack in feedback, debriefing, transfer of gained knowledge, and learnt lessons from previous mistakes. Nothing unique for neither BIM nor construction industry. It is the format of project based work that does not allow for it to happen; it is not built into the process and results in going to the next project. Does not depend on the content of the project but rather is the nature of project members to move on to the next project." (RPD2)

"We have, amongst others, trainings as one of our goals, to have a few courses where we relate different working areas to BIM like courses names BIM for project leaders, for project managers and for those that estimates project costs." (RPD4)

"Vico Office, one of those programmes that XX is focusing on, have had some courses for those that are interested and will be part of projects in which this programme is going to be used." (RPD4)

“We have a group here in which we focus on development and BIM… Generally speaking I don’t think that the entire company focus on and has it as a goal that everybody should start working with BIM, it is more about spreading out more and more information about it in order to get most people to understand before they draw a conclusion on what it really is” (RPD4).

“If one mixes those with a lot of experience and those that are great at BIM it should give really good results”(RPD5)

“One needs common structures. By that I mean that you need to use same terms, vocabulary, so that people understands that they speak about the same thing” (RPD7)

“You need to have, since it is about information and storage, it is also important that you know if you have a specific type of information where you actually should put it and how to classify it” (RPD7)

“It is also important to look over the legal parts when it comes to contracts and so on because contracts are binding and often when it works smoothly then you’re grateful about it and may put in a little extra for the sake of it but then when it comes down to the bottom line and something is incorrect or there’s a dispute you always go back and look at the contracts” (RPD7)

7. Communication

“It has facilitated how the communication works between contractor and client. It is easy to mark and pass it forward” (RPD1)

“I describe it shortly to increase understanding for what I am doing and how I work when it sit together with colleagues and we collaborate” (RPD4).

“When it comes to the clients they demands more and more but it is still very unspecific. It is often decided on a level that you should demand for BIM in projects but then again they don’t really know what they should demand more specifically so then they just say that they want BIM and then you don’t really know what they’re ordering” (RPD7) *clients and BIM

“And then on the other side you have those that should deliver BIM but who doesn’t really know exactly what they should deliver. I believe that you would get pretty far by actually sitting down with the client and question them and not just accept that they order BIM without getting more specific guidelines, what they mean about BIM and what BIM is to them and so on.” (RPD7)

8. User behavior

8.1 User acceptance

“I describe it shortly to increase understanding for what I am doing and how I work when it sit together with colleagues and we collaborate” (RPD4).

“If you like development and you try to find new ways of raising efficiency in your work then you tend to see the benefits of BIM pretty fast” (RPD7)

8.2 User resistance

“Resistant industry right now that demands driving individuals that wants a change.” (RPD1)

“For those with no prior experience in BIM , it is a bit terrifying to get started since they have had the same kind of working routines for the last 10-20 years or so. It is a bit difficult for these individuals to learn something new since they don’t really know if it is good enough or not”. (RPD4) *suspicion

“It takes some time, when you work with it and they see that the results are good enough and they acknowledge the profits with BIM, then they feel they can trust it.” (RPD4)

“It has been a bit tough with resistance now in the beginning”. (RPD4)

“It is the same with most things, that everything that is new is frightening until you understand and get a grip of it” (RPD7)

“There is much in the digital world that becomes frightening to many since they’re not use to sitting by the computer by themselves” (RPD7)

“The construction industry is quite behind in development compared to many other industries. That makes this step quite huge for many but in the same time people are quite quick to realize that this might relieve my daily work. That this is something they want to absorb” (RPD7)

“Even though you feel ‘wow, this seems good’ people are quite skeptical against it, if you really should trust it or not.” (RPD7)

“The first threshold involves understanding what I might gain out of it and the second threshold is whether or not I can trust you, that I will be able to do these things with it. Those are the two problems I am use to meet” (RPD7)

“It is a lot about understanding the reason to why a person is negative. It may often be the case that you have some kind of experience of working with BIM in a project in which demands on settings has not been clear but instead people have just told you to work with without knowing in what ways and then it’s been left like that opening up for insecurity, that you have come in contact with it and then not known how to deal with it” (RPD7)

“So there is still a lot of people being negative about it but I still believe, I think you could notice in the industry that it is not the way it was with the attitudes like ‘no that doesn’t suit me, its way to new school’, that those kind of attitudes are slowly fading away” (RPD7).