The role of social networking in the AEC industry

-opportunities and challenges

Master thesis in building informatics
Author: Hilmar Th. Valsson
4. Semester 2011-2012
Faculty of Engineering and Science
Denmark

Aalborg University

Title:
The role of social networking in the AEC industry: opportunities and challenges

Project Type:
Master's Thesis from the department Engineering and Science in Building Informatics,

Aalborg University

Prepared by:
Hilmar Th. Valsson

Supervisor:
Shegaw Anagaw Mengiste

Project Period:
2011-2012

Page Number:
120 pages in the main report

Appendix:
Chapter 8
40 pages

Completed:
13 April 2012

Contact information:
Hilmar Th. Valsson
Tel: + 45 2664 1005
E-mail: hvalsson@mail.dk

Research scope:

The scope is social networking in the context of AEC industry.

Purpose:

The thesis purpose is to contribute to the understanding of the synthesis of social networking and AEC industry. Investigate the role of social networking in the context of the AEC industry: opportunities and challenges?

Findings:

Social networking is emerging into the AEC industry for internal communications, still limited to intra-organizational collaboration. This thesis reveals that the AEC actors believe on improved communications and development of ICT is related to BIM. The participants of this thesis though believe social networking can facilitate implementation of ICT solutions as BIM solutions.

Limitations:

This thesis is limited to period of time and not actually testing the usability in actual cases.

Implications:

Social networking in context of AEC industry provokes questions of the current communications pattern.

Value for practitioners:

The aim is to introduce social networking and introduce different meanings of the media to created context to think in. There are different opportunities as well challenges on the level of humans, technology and organizational interactions.

Keywords:

The AEC-industry, social media, social networking, integration, collaboration and communication.

Paper type:

Mixed-method study

Preface

This thesis is part of my own interests and a part of my education. My own private curiosity is to investigate social networking possibilities and challenges to improve the collaboration among the persons in the AEC industry. This interest was originally created from my earlier work as an architect assistant, where I was so brave to comment on potential changes that could happen during the construction of the project I had been working on for a long period. I got the response that there will be no changes. That meant that the process was supposed to be linear and non-iterative. Secondly the interest for integration was provoked when the windows specialist from another organization gave us some good comments that could be better projected. That was an example of integration and identity deviation.

The thesis actuality is related to my education in Master of Science and Technology (Civil Engineering with specialization in Building informatics). My education should be seen as building my competence skills, build upon my cross-sectional study as Bachelor's degree in Architectural Technology and Construction Management.

This thesis has been a challenge as English is my secondary language; the education has been Danish; while my mother tongue is Icelandic. There have been many new terms during the writing and valuable concepts.

Work is completed from August 2011 to April 2012 at Aalborg University in Denmark.

An acknowledgement shall be given to the persons that have participated in the thesis, that is; to the conversation; the survey; and those kind persons that shared their knowledge by interview.

My mentor Shegaw Anagaw Mengiste, has provided a great support and guidance, with friendliness and patience. For that I want to thank for. I also want to thank my wife and my friend Ron for their support.

Aalborg, January 2012

Hilmar Th. Valsson

> ***"In the long history of humankind (and animal kind, too) those who learned to collaborate and improvise most effectively have prevailed."***
> Charles Darwin

Table of Contents

1 INTRODUCTION 1

1.1 RESEARCH PROBLEM 7
1.2 THE THESIS OBJECTIVES 14
1.3 REPORT STRUCTURE 15

2 METHODOLOGY 17

2.1 KEY TERMINOLOGY 17
2.2 SOCIAL SCIENCE PARADIGMS 18
2.3 THE THREE HUMAN NATURE METHODOLOGIES APPROACHES 21
2.4 RESEARCH DESIGN 22
2.5 RESEARCH STRATEGY AND WRITING PROCESS 23
2.6 DATA COLLECTING METHODS 24
2.7 THE DEDUCTIVE PART / PRIOR-UNDERSTANDING 26
2.7.1 LINKEDIN DISCUSSION AND SURVEY 26
2.8 THE INDUCTIVE PART 27
2.8.1 INTERVIEWS WITH ACTOR IN THE AEC INDUSTRY 27
2.8.2 PARTICIPANT OBSERVATION 28
2.8.3 THE ANALYSIS AND DISCUSSION 29

3 RESEARCH CONTEXT AND LITERATURE REVIEW 31

3.1 RESEARCH CONTEXT: THE AEC INDUSTRY 31
3.1.1 GENERAL DESCRIPTION 32
3.1.2 PHILOSOPHICAL APPROACHES FROM OTHER INDUSTRIES 41
3.1.3 INTEGRATION AND COMMUNICATION 49
3.2 LITERATURE REVIEW 51
3.2.1 "WHAT DID YOU LEARN FROM PRACTICE TODAY?... 53
3.2.2 "UNDERSTANDING AND FACILITATING BIM ADOPTION IN THE AEC INDUSTRY" 54
3.2.3 "BOUNDARY MATTERS:... 54
3.3 SOCIAL MEDIA 56
3.3.1 DEFINITION 56
3.3.2 WEB 1.0 – WEB 2.0 56

3.3.3 USER-CREATED CONTENT (UCC)/ USER-GENERATED CONTENT (UGC) 57
3.3.4 SOCIAL NETWORKING 57

4 THEORETICAL FRAMEWORK 67

4.1 GIDDENS THEORY OF STRUCTURATION (ST) 68
4.2 ORLIKOWSKI'S STRUCTURATIONAL MODEL OF TECHNOLOGY (SMT) 69
4.3 BOUNDARY OBJECT 72

5 ANALYSIS AND DISCUSSION 75

5.1 TECHNOLOGY IS THE PRODUCT OF HUMAN ACTION (A) 76
5.2 TECHNOLOGY IS THE MEDIUM OF HUMAN ACTION (B), 88
5.3 INSTITUTIONAL CONDITIONS OF INTERACTION WITH TECHNOLOGY(C) 96
5.4 THE INSTITUTIONAL CONSEQUENCES OF INTERACTION WITH TECHNOLOGY (D) 102

6 CONCLUSION & FUTURE RESEARCH 105

7 REFERENCES 109

8 APPENDIX 1

8.1 INTERVIEW 1
8.1.1 FREE FLOW INTERVIEW TAKEN WITH BIM COORDINATOR AND DESIGNER ON-SITE. 1
8.1.2 AN INTERVIEW CONDUCTED WITH CHIEF CONSULTANT FOR ANALYSIS AND STRATEGY. 8
8.1.3 TELEPHONE INTERVIEW WITH FACEBOOK "USER" SITE DEVELOPER 6. JANUAR 12
8.2 DISCUSSION ON LINKEDIN 14
8.2.1 DISCUSSION 1 14
8.2.2 DISCUSSION 2 22
8.3 BOUNDARIES OBJECT LITERATURE COLLECTION. 24
8.4 SURVEY 25

Acronyms

AIA - The American Institute of Architects

AEC Industry - Architect, Engineering and Construction Industry

BIM - Building Information Modeling

B2B – Business to business

B2C – Business to costumer

CE - Concurrent Engineering

ERP - Enterprise Resource Planning

FtF – Face to Face

ICT - Information & Communication Technology

IFC - Industry Foundation Classes

IS – Information system

OECD - Organization for Economic Co-operation and Development

POP - Product, Organization and Process

SMT - Structurational Model of Technology

SNS – social network service

UCC – User-Created Content

UGC – User-Generated Content

VBM - Virtual Building Model

Web 2.0 – Social Media / social networking

List of figures

Figure 1: Shifting away from the goal (Kiviniemi, 2005). 3
Figure 2: The concept underlying BIM (Kalny 2007) 7
Figure 3: Construction industry productivity improvements compared to other industries. This has to do with a slow ICT uptake. The industry is proactive adopting e-business as a tool to increase competitiveness (Watch, 2005). 12
Figure 4: Productivity index for US construction industry and all non-farm industries from 1969-2003 12
Figure 5: Methodological process created by author. 25
Figure 6: Conceptual diagram representing an AEC project team and the typical organizational boundaries (CM Eastman et al., 2011). 34
Figure 7: High-Performance Building Attributes [13]. 35
Figure 8: Design-Bid-Build; the continuous line is contracts, the dashed line is contractual requirements [34]. 36
Figure 9: Design-build; the continuous line is contracts; the dashed line is contractual requirements. (CM Eastman et al., 2011) 37
Figure 10: Construction management at risk; the continuous line is contracts; the dashed thin line is contractual requirements, and the dark dashed line is the communication. (CM Eastman et al., 2011). 38
Figure 11: Traditional vs. BIM / Integrated workflow. By integrating assembled construction players in the early stages to improve information gathering in the early stages. It is expected that improved workflow [60]. 39
Figure 12: The difference between CE and traditional product development (G.Sohlenius, 2003) 44
Figure 13: Data integrity: The figure is showing the loss of value in information assets across phases and increased effort to produce project information. Compared is the traditional paper-based process vs. a collaborative BIM based delivery process [34]. 46
Figure 14: Johari Window [39] 50
Figure 15: The growth of Social Media (Henrikson, n.d.) 58
Figure 16: Companies that are utilizing social media and social networking. (Henrikson, 2011) 59

Figure 17: The functional building blocks of social media (Kietzmann, Hermkens, McCarthy, & Silvestre, 2011). 62
Figure 18: Your presence status on Skype 64
Figure 19: Three streams of technology research (Orlikowski, 1992) 70
Figure 20: Collection of Boundary Object literature 24

List of tabels

Table 1: Summary of construction changes (Hao & Shen, 2010). 4
Table 2: The thesis structure 15
Table 3: The objectivist-subjectivist disposition in Social Science [20]. 18
Table 4: Arbnor and Bjerke; six overlapping paradigms. The blue is the objective approach and the yellow is the subjective [20]. Combined table constructed by the author. 19
Table 5: Ontological considerations. Combined table adopted from summary tables of Kuada (2011) representations of human nature theory of Arbnor and Bjerke. 20
Table 6: Suggested difference between traditional project delivery and Integrated Project Delivery [61] [5] 40
Table 7: Structurational model of technology (SMT), (W J Orlikowski, 1992) 71
Table 8: Response to the question of social networking channels use in work related situation. 77
Table 9: The size of firms in the survey by numbers of employes. 81
Table 10: The survey participant's willingness to give inter-organizational support 88
Table 11: The survey questions of data collections methods of actors in the AEC industry. 89
Table 12: Indication of channels used for work-related purposes; result from survey (Appendix 8.4.) 91
Table 13: Participants current business process model (appendix 8.4) 97
Table 14: Respond from the survey, of what is predicted to be the best solution to improve the collaboration between the stakeholders in AEC construction process..... 98
Table 15: Respond to the question of the client's awareness/consciousness of BIM, in general cases, to be? 98

1 Introduction

This introduction will give concrete examples of the need for improvements and changes in the architecture, engineering and construction (AEC) industry, giving a fundament for further investigation of the domains of AEC industry and social networking. The AEC industry field is facing a plethora of challenges to meet the social, financial, and environmental goals of stakeholders and the need to make changes in the process that will affect the organization and improve the quality of the product. There are numerous elements that are not working correct for the industry and giving the AEC industry both external and internal incentives to introduce change in the way the different stakeholders communicate and share knowledge.

Constructions are part of our everyday life and play a significant role to support existence of the civilized life. Arranging new construction or maintaining existing ones is a complex task that involves both professionals and non-professionals. At the end of the construction period, we are all consumers of the product and have direct or indirect implications on all of us. As Orlikowski (2007), indicated:

> *" the social and the material are considered to be inextricably related — there is no social that is not also material, and no material that is not also social"* [1].

The size of the AEC industry and its implications is well shown in its impacts: great depletion of natural resources, consuming around 43% of the energy, 72% of the electricity, 17% of the water, and 32% of the materials and resources; in addition, it produces 40% of greenhouse emissions, 40% of solid wastes, soil loss, reduction on air quality, and has a high negative impact on bio diversity (Wallis, Bilan, Smith, & Kazi, 2010 p.65). This means that there is a need for improvements in constructing buildings and change. These environmental factors are increased with the regulations and political initiatives with ever changing regulations for improving the constructions.

Better buildings need more knowledge. This knowledge is not found within a single person; therefore, there is a need for collaboration as Aragon (2006) noted:

> "Design and engineering practices are collaborative by nature. AEC professionals have to collaborate, whether it is with internal project staff, clients, contractors, government regulators, concerned citizens, or others" [3].

This collaboration is throughout the project phases that are from the first idea to the end of the construction lifetime. This collaboration can't exist without communication that is a flow of information between various participants and technological artifacts.

This flow of information is being challenged by extreme fragmentation of the industry´s demand and supply chains. The construction work is being undertaken by variety of organizations, utilizing many different skill sets, processes, and technologies [4]. The traditional AEC construction process has been characterized as: linear, distinct, segregated; knowledge gathered "just-as-needed"; information hoarded; silos of knowledge and expertise [5].

Throughout the process there is an excessive route of information flowing between actors and machines with the objective to support the process from the initial client requirements, throughout the construction process and all the way to the end goal, valuable end product. An example of this route from the requirement to the end result is interpreted by Kiviniemi (2005) that states that there are initial requirements or initial goals that are not met in the end result, see figure 1, where it is graphically demonstrated how the process can be. That is, not meeting the initial requirements because of lack of communication. By improving this "quality bias" by Kiviniemis theory, there is need to update the initial requirements accordingly throughout the process. Finding updates and the evolution of the requirements is stated not to be a trivial task. Kiviniemi suggests to link the requirements to the building product model to be able to track this changes [6]. Kiviniemi (2005) states that the construction process is in its nature an iterative process that is the initial requirement usually changes during the construction process. This example is to provide the understanding and the need for the creators of the initial requirement to be part of the entire process and not ending up with result that come as a surprise. Summary of construction changes is shown in table 1,that indicates strongly that the nature of the construction process is an iterative process.

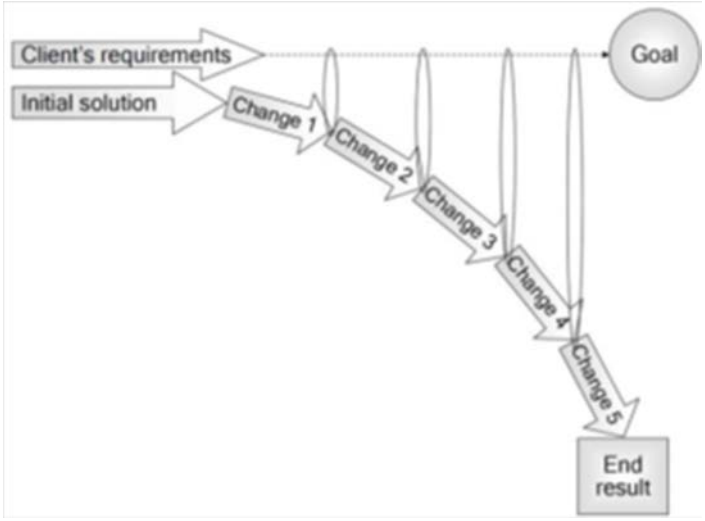


Figure 1: Shifting away from the goal (Kiviniemi, 2005).

Stage	Stakeholder	Types of changes	Impacts	Actions
Specification	Owner/Client/User or architect	Changes to requirements including specification, scope of projects, design brief, etc.	Changes in design and construction processes	Carefully provide detailed specification documents before bidding.
Design	Design/engineering Consultant	Incomplete/inconsistent drawings; design error/defect; design change; omissions of site conditions and build ability; changes in codes and regulations	Rework of design and drawing; rework in construction; change orders	Better control of design versions, drawings; site investigation; consider build ability in design
Construction	Contractor/sub-contractors	As-built not confirm with as-design; quality defect; unanticipated site conditions; value engineering; materials or equipment not available; inclement weather	Rework; change orders; changes in design	Quality control; site operational control; coordinated documents and drawings; daily logs

Table 1: Summary of construction changes (Hao & Shen, 2010).

The statement of the construction process as iterative, there is likeliness of changes during the construction process, in addition to proposed solutions. That is because evolution in the client requirements tents to happen quite often as Hao and Shen (2010) states it:

> *Changes in construction projects are very common and likely to occur from different sources, by various causes, at any stage of a project. Those changes may have considerable negative impacts on items such as costs and schedule delays. A critical change may cause consecutive delays in project schedule, re-estimation of work statement, and extra demands of equipment, materials, labor, and overtime. Changes, if not resolved through a formalized change management process, can become the major source of contract disputes, which is a severe risk contributing to project failure* [7].

The changes cause a considerable reworking, that is, re-doing a process or activity that was incorrectly implemented in the first place or wished to be changed by the buyer. This could indicate the process challenges after the requirements and there are various challenges that have to be solved during the construction process. If not properly handled, there will be quality defects, variance, negligence, and usually pure waste [7].

This is an example of the challenges that the AEC industry has to deal with, and the scale and the range of failures indicates the need for collaboration and communication, as it is not up to a single actor to solve those problems.

To prevent reworking, there is a need to integrate stakeholders into the multi-disciplinary teams. The term integration is seen by the author as involvement of individual, group or organizational actors into phases that they traditionally don't participate in, but can contribute with their knowledge by taking part in the collaboration process. Ideally, project teams should increase the integration and the communication to meet these challenges [8]. Aragon (2006) also noted that:

> *"…collaboration is intimately linked with communication—and to success. Great design ideas are realized through the hard work of many people. If design ideas cannot be effectively communicated, reviewed, and modified, then it is unlikely they will be realized in line with the designer's intent"* [3].

Integration is meant to improve the project delivery team performance and hence influences project performance [9].

For the integrated team to cooperate a communication system throughout the construction supply chain will ensure a good and reliable flow of information. In line with this, Ibrahim & Costello (2011) argued as follows:

> *"From the construction perspective, integration normally refers to be collaborative working practices, methods and behavior that promote an environment where information is freely exchanged between the construction parties. Integration also has been known as a means of improving the project delivery, team performance and hence influences project performance"* [9].

If there are changes there is a need to evaluate the consequences and propose for solutions that make sense to the rest of the team to approve suggested changes. The implement the change and then analyze the change that has been made this demands involvement of the multi-disciplinary construction team, that is this process is a flow of information among organizations and related actors. These actors are rarely positioned on the same geographical spot at the same time [7].

1.1 Research problem

The research problem is a short introduction to the challenges confronted by the AEC industry. One of the thesis aims is to explore recent technological concept in the AEC industry and its limitations. This should be seen as an introduction to the concept of social networking and how social networking could be beneficial to support the collective intelligence, increase the integration, and the knowledge sharing among participants in an AEC process, to support the adoption of new ICT solutions as BIM. Also as well as the process, organization that finally increase the quality of the final product.

The concept of the Building Information Modeling (BIM) in this section will be given more detailed description in chapter 3.

The AEC industry has been working on improvements on design integration or the "disaggregation of information" and BIM method for more than 50 years [2]. The BIM concept allows the information flow to be gathered in a 3D model as it is presented in figure 2 below.

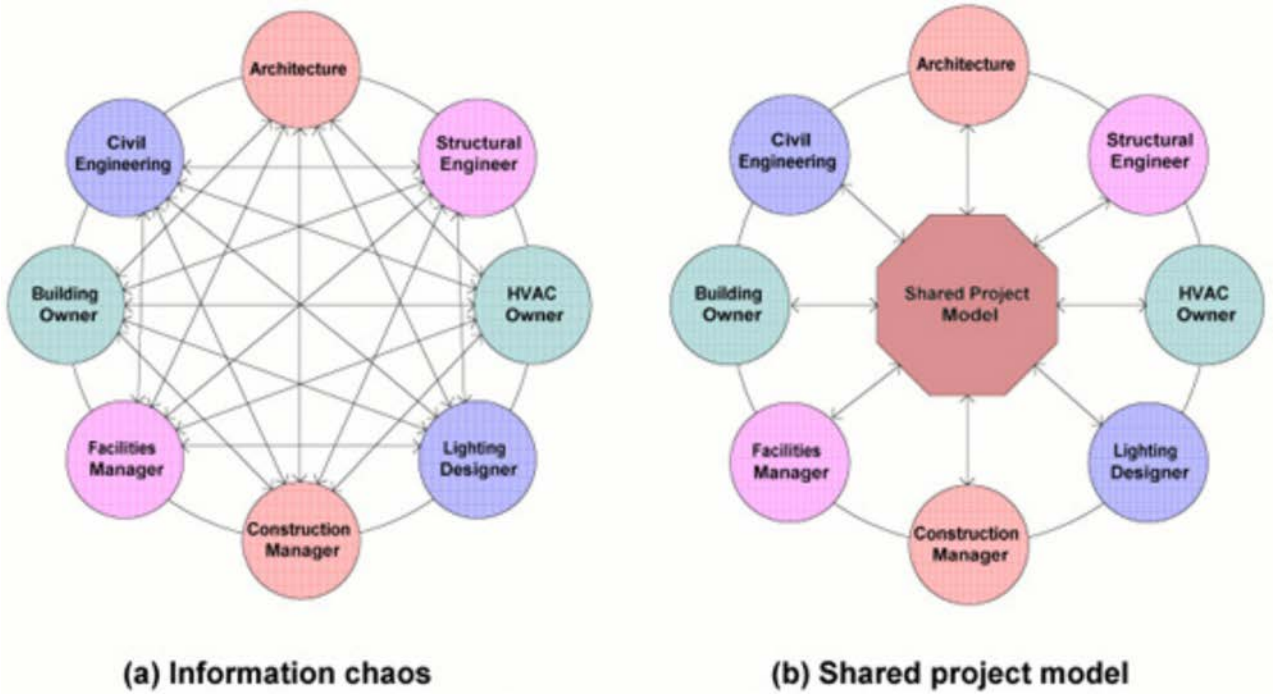


Figure 2: The concept underlying BIM (Kalny 2007)

The concept of BIM is to be a central point for improved integration among the shareholders ((AIA), 2010). BIM has been promoted as a model that enables the different stakeholders to collaborate, coordinate the different tasks into a single shared model. For example, Kalny (2007) noted the following about the potential of BIM in the AEC industry:

> *"Lately, Building Information Modeling (BIM) has been receiving a large amount of coverage in the AEC industry media. BIM enables architects, designers, contractors, and representatives of other concerned disciplines to work on a single shared model, therefore, enabling superior coordination of various design issues, which in turn leads to smoother project execution on the construction site. It compared to traditional inter disciplinary communication across multiple channels. The BIM approach highly improves efficiency for all the implicated disciplines. However, the building information model by itself cannot contain—and as a result cannot make more efficient—all the communication that takes place within and across design teams"* [10].

This interpretation of BIM indicates the need to look further to support communication and integration. This is supported by Ning Gu and Kerry London (2010). They admitted the potential and benefits of BIM, however at the same time also pointed out that it is not sufficient to support the integration of different project phases. The reason is that BIM is targeted to specific processes and aspects of the project. They thought of the ability of BIM as a technological approach support in collaboration and communication that is required, as quoted by Holzer (2007):

> *"There is no question about the usefulness of BIM in regard to data-interoperability issues, but rather about the nature of support it can/should offer in the various design stages. In how far is there a limit to what digital representations can do and where human interaction and communication together with new skill sets are required?"* [11]

How information gets into the BIM model and why, can be a process of negotiation among the stakeholders involved since the process is iterative as mentioned earlier in the paper.

> *Change orders are common to most projects, and very common with large projects. This type of change has to be negotiated case by case and requires a common (documented) agreement among all the parties involved* [7] .

The BIM is expected to be rolled out on all projects by 2016 [12]. This could be as true statement as any other, as there is very difficult to get information how the actual status is in the implementation of BIM and related standards. There is even difficult to define the concept of BIM. In the meantime, there is a distinct picture of the concept and nobody seems to agree on how to define the concept [11]. There have been efforts to give BIM and its implementations efforts meanings as there are scholars (such as Smith, 2011) that cited the problem of the BIM implementation as *"Not a technical problem – but cultural"* (Smith, 2011). Paul Morrell (2011) states that the main challenge of BIM is not the technology and Klaus-Dieter Thoben (1998) in his part argued that:

> *"… from an information technology point of view, only the appropriate availability of information is seen as crucial for product development in the Concurrent Enterprise. But making a decision in an efficient, effective and holistic way is not only about information technology, it's about people as well"* [14] .

When planning a BIM method implementation, there is a need for direct communication by the project team. These communications are between actors, which play a significant role in the project. For each project, there is a different team that must effectively design a tailored execution strategy for the objectives of the project and based on the capabilities of the team members [15]. Whatever the concept BIM stands for it is seen as an important factor to implement in the AEC industry. Whatever the problem is with the BIM it is stated as social factor that need to get focused on, not entirely in context of the BIM context but as by a holistic view of the AEC organizations.

The AEC organizations do consist of both professional and non-professional persons. It means that the organization does exist with people of different knowledge and skills, to interact with the model or those artifacts that are related to BIM. That is if we see the BIM model as central point in the integration, it is interpreted by the author that the information stored in e.g. the 3D model it can be difficult to access and to communicate through most common BIM artifacts. This can be obstacle that hinders integrated collaboration. At least until the BIM model and related technology will be that well developed that all the participants in the construction case can interact with the artifacts that are related to the BIM concept. There will be in the meantime a flow of information from different resources: E-mail, phone, face to face, etc.

This form for communication has caused several problems and dissatisfaction among the stakeholders [3]. This scattering of information during the construction phases, from the requirements work to the maintenance, Kiviniemi (2005) stated as problematic:

> *However, the requirements documentation is usually not updated accordingly. In the worst case the changes are recorded just in the memory of the participants, and in the best case in meeting or personal notes. Finding the latest updates and evolution of the requirements from the documentation is very difficult, if not impossible* [6].

There is need to encourage an integrated structure [12]. In the paper "*Integrated Project Delivery for Public and Private Owners, ©2010*" it is argued for "*Digitally based, virtual; Building Information Modeling (3, 4 and 5 dimensional)*". At the same time AIA arguments for other guidelines for integrated collaboration. One of these arguments is the co-location of the *team:*

> "When key project participants can be co-located, opportunities for collaboration and innovation increase. Project commitments are more likely to be met when one becomes closer to one's teammates"[5].

As the nature of AEC projects as an iterative, holistic construction process, these guidelines are difficult if the industry is working towards integration. Co-location of the

conversation and the negotiation mediated virtually is seen by the author as more realistic approach to gather and control the information flow.

With the rapid advancement of information and communication technologies (ICT), particularly Internet and Web-based technologies during the past 15 years, various systems integration and collaboration technologies have been developed and deployed to different application domains, including architecture, engineering, construction, and facilities management (AEC/FM). These technologies provide a consistent set of solutions to support the collaborative creation, management, dissemination, and use of information through the entire product and project lifecycle, and to further integrate people, processes, business systems, and information more effectively. For this process AIA (2010) has proposed open communication as highly desirable for integrated collaboration. Although much has been done and the industry is in constant positive development, there is still need for improvements: Jean-Noel Durvy Director, Innovation Policy Enterprise and Industry Directorate General European Commission states that an effective use of ICT by companies is a critical success factor for innovation, competitiveness and growth [16].

In general the construction industry is greatly lagging behind when it comes to adaptation of technology. This is because the AEC industry is reluctant to adopt new technology see figure 3. The industry struggles to leverage information technology to facilitate communication [8].

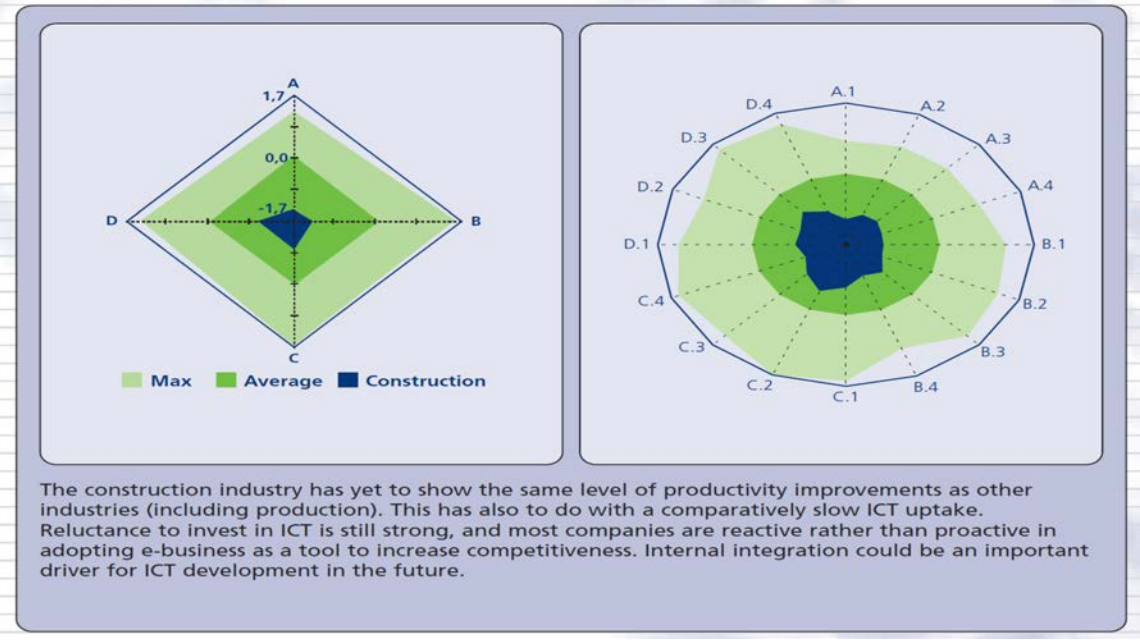


Figure 3: Construction industry productivity improvements compared to other industries. This has to do with a slow ICT uptake. The industry is proactive adopting e-business as a tool to increase competitiveness (Watch, 2005).

Another example of the inability of the AEC industry to be compared to the "other industries" in the term of productivity is represented by the figure 4.

As stated above, ICT is an important factor for innovation and increased revenues. It enables new services and new ways of working within the value networks. ICT improves the transparency of information flows and offers new forms for cooperation within networks [16]. Information and communication technology (ICT) is extended synonym for information technology (IT). By putting the C in-between the I and T there

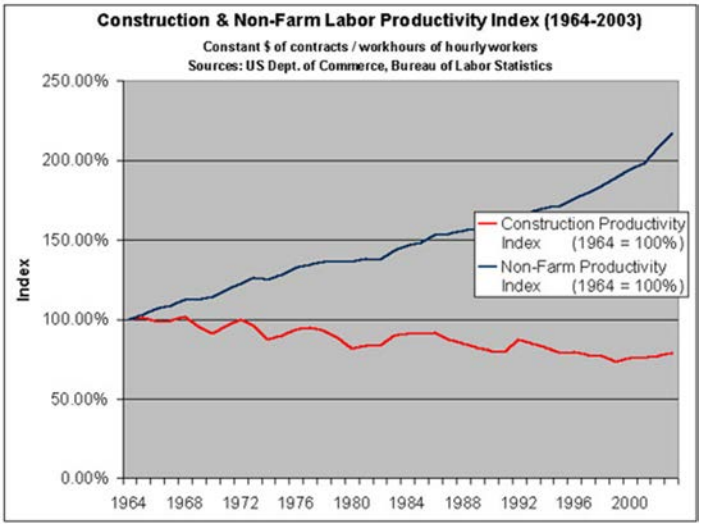


Figure 4: Productivity index for US construction industry and all non-farm industries from 1969-2003

is emphasis on the C as having the role of unified communication and the integration of telecommunications, computers, middleware as well as necessary software, storage- and audio-visual systems, which enable users to create access, store, transmit, and manipulate information. Unified communication is a term that is used for real-time communication as well as non-real-time communication. Real-time communication is e.g. chat, video conferencing, and telephony data sharing. Non-real-time communication is voicemail, e-mail, SMS and fax.

The latest social network services include many of these factors, which are those elements on one single platform. Recently, the rise of social media has seen tremendous growth, like Facebook that is expecting to go over one billion members on a world basis, this year.

Recent examples of the benefits of the usage of social networking are from the military usage of social media. Social Networking is the latest tool in communication for improved battlefield strategies and awareness for soldiers. The attempt is to speed up communication, spreading crucial information, speedy analysis, troubleshoot problems and improve strategic accuracy, broadening soldiers' bigger picture of the battlefield, and making possible access to information when you need it [17]. Using social networking in the military should indicate that there are security options available to protect the content.

Another example of the power of the social networking is the chaotic and emergent situation that occurred when the Costa Concordia cruise ship ran aground. Social networking sites like Facebook, Twitter and others delivered vital information among the rescue workers and families. This use of social networking in highly chaotic situations has also been evident in other disasters like the tsunami in Japan in 2011 [18]. In this later case e-mail isn't mentioned as a communication method in this particular situation. That indicates that people prefer the usage of social networking in dynamical situation.

1.2 The thesis objectives

The dynamic nature of social networking and the great usage and creative use of social media / social networking have inspired the author to investigate the possible benefits of social networking in the context of the AEC industry.

Research question is:

> *"What are the opportunities and challenges of social networking in the context of AEC industry?"*

1.3 Report structure

The following section will account for the structure of the project, presented in table 2.

The aim of table 2 is to provide an overview of the relation between each chapter and in the appearing order. This is then followed by a description of the individual parts of the project where each chapter of the project will be introduced, the objective of the chapters, and the sections will be described and the contents of each will be outlined.

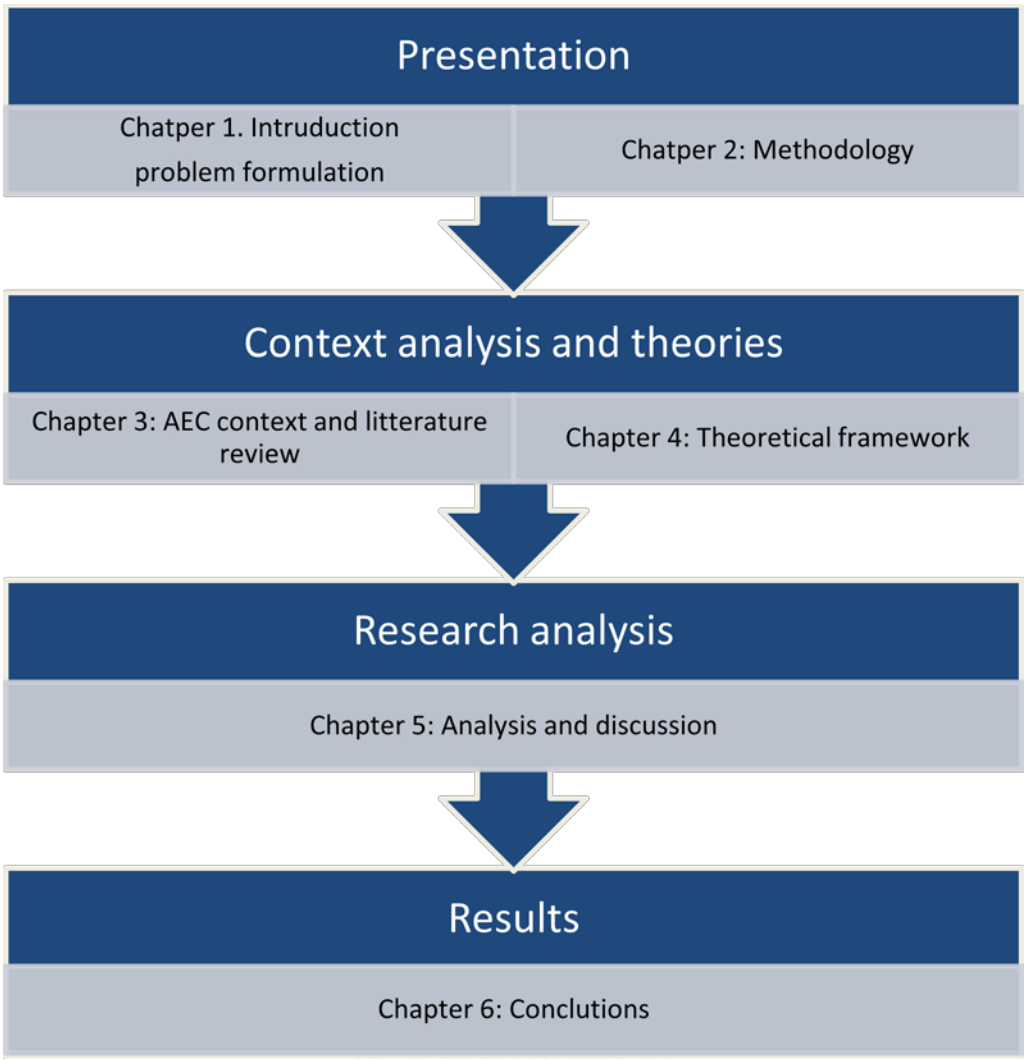


Table 2: The thesis structure

2 Methodology

This chapter's aim is to provide the reader the methodological choices that have been taken in the process of exploring the role of social networking in the context of the AEC industry.

As such it provides insight on the terminologies used, the approaches adopted, and the methods used to collect and analyze the data. The purpose is to guide the reader towards understanding the approach that has been used in this study based on the goals and aims to be achieved. The chapter there for is organized into the following sub-sections: section 2.1 provides background information on key concepts and terminologies from the general understanding of the Methodology and to the personal usage of distinctive methods.

2.1 Key terminology

To give the reader the best understanding of the author's position in this thesis and to make it as clear to understand as possible, there will be given a definition of some of the main terms to be used. These terms "methodology," "method" and "paradigm," are open to many interpretations. These later definitions are not meant to be the truth, but as definitions that will synchronize the understanding of the reader's and the author's understandings of those terms.

Methodology is what includes a study of a wide range of different methods and evaluations that suits the author to gain knowledge of the research domains. That is finding methods that will support the "creation of knowledge." The term has been defined as the study of the range of methods Mingers (2001) citing Checkland (1981). Every study has its own individual character, and is structured by methodology that works as guidelines.

Methods, is more prescriptive than methodology and is particular activity in conducting a survey, observation, interview or other methods of collecting data.

Paradigm is a set of philosophical assumptions e.g. conduction a social science research. These assumptions are defined from the view of ontology (what is assumed to exist), epistemology (the nature of valid knowledge) ethics or axiology (what is considered right) and finally methodology (as described above).

2.2 Social Science paradigms

To give the reader better understanding of the methods and approach that have been chosen to investigate social networking in the context of the AEC industry there will be given a further description of the term paradigms. This is to give the reader better overview of the research possibilities and the paradigms that have been chosen.

Under the term paradigms are two pillars; subjectivism and its antithesis positivism. These two pillars give two different perspectives. According to Burrell and Morgan (1979) who have given comparisons these two different sides of paradigm's dimensions, from the concepts of ontology, epistemology, human nature and methodology see table 3.

Dimensions	The Objectivist Approach	The Subjectivist Approach
Ontology	Realism	Nominalism
Epistemology	Positivism	Anti-positivism
Human Nature	Determinism	voluntarism
Methodology	Nomothetic	Idiographic

Table 3: The objectivist-subjectivist disposition in Social Science [20].

These concepts of Burrell and Morgan (1979) have been described by John Kuada in "A project guide for university students" that includes 4 dimensions:

- **Ontological** view is described as two different philosophical views of the researcher. The first is that reality is real and external to an individual, while the other is subjectively product of human cognition. The term ontology also relates to *human nature.* That is if the individual is outside of the social environment and others see it as co-determination.
- The **epistemology** term describes the view of "how we know what we know", or what is considered to be the truth. Is it through objective observation by

external observer or can the truth being subjective interpretation of the researcher?

- The **human nature** is defined in two different approaches, determinism and voluntarism. The determinist approach would be selecting either subjective approaches or objective approaches. Humans that are subjective in nature and voluntarism can with free will select from both categories.
- Methodology includes nomothetic from the category of objectivism and idiographic from the subjective side. A brief description of nomothetic is the selection of systematic methods for example surveys, while the ideographic choose more anthropological approach, for example participant-observations, interview etc.

Burrell and Morgan have assumptions of two different paradigms, one that the researcher should follow choose either approach [19]. This reality view of choosing one perspective has been challenged by Arbnor and Bjerke by introducing complementary views by presenting six different overlapping paradigms, see table 4 and table 5

1	Reality as a concrete phenomenon that is conformable to law and independent of the observer
2	Reality as a concrete determining process
3	Reality as mutually dependent fields of information
4	Reality as a world of symbolic discourse
5	Reality as a social construction
6	Reality as a manifestation of human intentionality

Table 4: Arbnor and Bjerke; six overlapping paradigms. The blue is the objective approach and the yellow is the subjective [20]. Combined table constructed by the author.

Ontology	Objective			Subjective		
6 paradigms	1	2	3	4	5	6
Research approach Human nature methodology	The Analytical Approach					
		The System Approach				
				The Actors Approach		
	Explanatory Knowledge/ explanatics			Understanding Knowledge/ Hermeneutics		

Table 5: Ontological considerations. Combined table adopted from summary tables of Kuada (2011) representations of human nature theory of Arbnor and Bjerke.

The range is from one to six, from the extreme view of objectivist's research to the other extreme of subjectivism.

They argue for the three overlapping approaches seen in table 5 and in challenging the isolated view of Burrell and Morgan of choosing either the objective or subjective categories presented in table 3.

This clarification of research approaches for knowledge creation has then been divided to three main approaches: The first approach is the analytical approach. The second is the systems approach, and the third is the actors approach. In the view of Arbnor and Bjerke, it is the ultimate presumptions of the researcher to choose the most practical approach for the study, seen on the green felt (Research approach, human nature methodology) [20].

Explanatory knowledge versus understanding is two stands of creating knowledge. Arbnor and Bjerke argue there are these two standpoints that researcher may select for the study. Explanatory knowledge is a knowledge creation that is constructed in order to explain something that is invariable when analyzing and explaining the society in similar as .Understanding knowledge/ hermeneutics is a subjective approach that is on contrary to gain a "*deeper*" knowledge of the study area [21]. This thesis is to gain deeper understanding of social networking in the context of AEC industry, and its related opportunities and challenges.

2.3 The three human nature methodologies approaches

This part of the thesis is to give the reader increased understanding of the expansion of the Objectivist-subjectivist approach, as explained in Table 5:

- **The analytical approach**
  - This approach is characterized by the belief that the reality is objective and independent of the observer. The data collection starts with an initial hypothesis that controls the data collection. These collected data are not dependent on individual interpretation and presumed to be facts. The separate data can then be analyzed for increased understanding of the reality [20].
- **The system approach**
  - Group, organization or other social entities are defined as a system. Each system has different elements and can include a subsystem, and relations between those elements can vary. Change in one system can reflect change in another system. Researchers make objective analysis of changes in elements that they presume to be objectively accessible in their field of interest. Investigating is how one system can affect another system. That includes study of combination of the static and fixed structure and of the system and processes that can be regular or non-regular processes. The process acts on a system and produces changes. The regular is a dynamical processes but evolutionary. The non-regular processes refer to radical changes in the system and departure from the existing patterns. The difference between system approach and the former analytical approaches is the perception of predictability of the systems. The analytical approach predicts the environment to be stable while the latter draw attention to the possible unpredictability of the context of the system. Seen in Table 5, there are overlapping in the field of subjectivism. That is the information can be gathered by symbolic discourse [20].

- **The actors approach**
    - The actor's approach is very different from the above approaches. The reality is presumed from interaction between individual's experiences of the researcher and others over a period of time. The reality is created with negotiations, sharing of meanings and then constructed by interpretations of the actors. This interpretation is then the reality that individuals perceive the world from their own experience. Thoughts can be reformulated by the actor by comparing his thoughts with analysis. This approach adopts terms as subjectivity, individual, and interaction. It is understood by the act of the individual that has results and eventually the actor's reflection over their action's results. It is part of social development that the actor does act, counteract, reflect and think to influence an ongoing process. It creates "finite provinces of meaning" that is shared by a larger or smaller number of people. The research methods that adopt actors approach are similar to the subjective/ interpretative (hermeneutics) taxonomy of Burrell and Morgan. This research approach is characterized by the interplay of listening and talking, with equal terms. [20].

2.4 Research design

To give the reader short declarations how Arbnor and Bjerke influenced my research is briefly described by the three element presented in table 5. The analytical approach is seen in this thesis by the method of conducting a survey. The system approach is evident in the analysis, where different systems interactions are analyzed and discussed by theories of Orlikowski. The systems of organizations, humans and technology are investigated.

That is knowledge is dependent on systems, in that sense parts are understood by characteristics of the whole [21]. However in general the actors approach has been dominating. For example the evidences of hermeneutics in discussions conducted on LinkedIn, the interviews, and the authors own interpretations and egological character.

To explain my approach it will be related to Arbnor's and Bjerke's theory, presented above in table 4, where I selected elements from all of the 6 paradigms, shown in table 4. In my opinion methodology is something that is highly individual, on that I can agree to the theory of Arbnor and Bjerke with the concept of *"Human Nature*". I consider myself as an interpreter of the reality I want to study. It is grounded in my subjective believes that have been formed earlier and how I am interpreting the world. This should be understood as my egologcial sphere. This could be related to the actors view described by Arbnor and Bjerke (2009): *"… (Craft as creative activity and not as a repetition of routines).*

For valuating my own subjective interpretations the thesis has been written with the aim of grounding my own beliefs by primary and secondary data. The primary data collection was from discussions on LinkedIn, a survey launched on LinkedIn, and interview with two actors in the domain of AEC industry and communications advisements.

2.5 Research strategy and writing process

The research strategy was to gain extending knowledge of the two elements of social networking and the AEC industry. It is to gather knowledge of the two elements to investigate if Social network service (SNS) could give meaning in the context of AEC industry in form of opportunities as well its antithesis of challenges.

The strategy was not very formalized, the objectives of the research were to gain knowledge of the synthesis of those two elements and search for meanings. In other words my research actions were emergent during the process. I started with a discussion on LinkedIn that let me to survey, from there to interviews. The intervals between those above methods were covered with literature review and search for knowledge. This mixed methodical approach can be defined as pragmatism. That is in the sense of writing the thesis with open heart and mind and with the aim of not letting the rigor of preselected methods limit the research. The only way to conduct method like that is to be mentally equipped with lack of theoretical framework awareness, having methodologies curiosity as well with interest for the research scope of the AEC industry and social networking.

I do agree on the term of my hermeneutics positions as being subjective and interpreting the reality. That is the research is colored with my own experience of the world and as well the culture and the community of those two domains of social networking and AEC industry that is the thesis theme. The author's personal interpretation of reality is my thoughts are relative as others. The aim has created knowledge from different resources with the aim of holding the thesis and antithesis in balance. That is with the aim of getting broad and holistic perspectives of the AEC industry in which proposed social networking is entering in.

It is interpreted by the author by using mono methods that is a single research approach, would give a limited view of the these two considered complex instances. Therefore it was the aim to get broad a overview, with the aim of creating a clear picture to make more adequate explanations of the synthesis of AEC industry and social networking. It is interpreted by the author it would be too easy to accept or reject the idea to implement a social networking platform for cross organizational collaboration in the context of AEC industry.

This could be seen as the synthesis of two identities that are creating understanding of an artifact that is being used in personal and social life in the context of supporting collaboration on an interorganizational level.

2.6 Data collecting methods

This thesis as stated above should be seen as an iterative process: the discussion and the survey on LinkedIn and the discussion created questions, and new perspectives. The primary data collection was to investigate the synthesis of AEC industry and the social networking. To simplify for the reader, the aim of the thesis is those two fundamental questions;

"*What are the opportunities of implementing social networking in the context of AEC industry and what are the challenges?"*

To investigate this question and to investigate the level of implementation there were conducted multi methodical approaches.

The inductive part includes further research of the AEC context that both included interviews and literature review to create knowledge of the meaning of SNS in the context of AEC industry, the central question became: "*what are the opportunities and challenges of social networking in the context of AEC industry*"? The figure 5 is to provide the reader an overview of the research design and the methodological process.

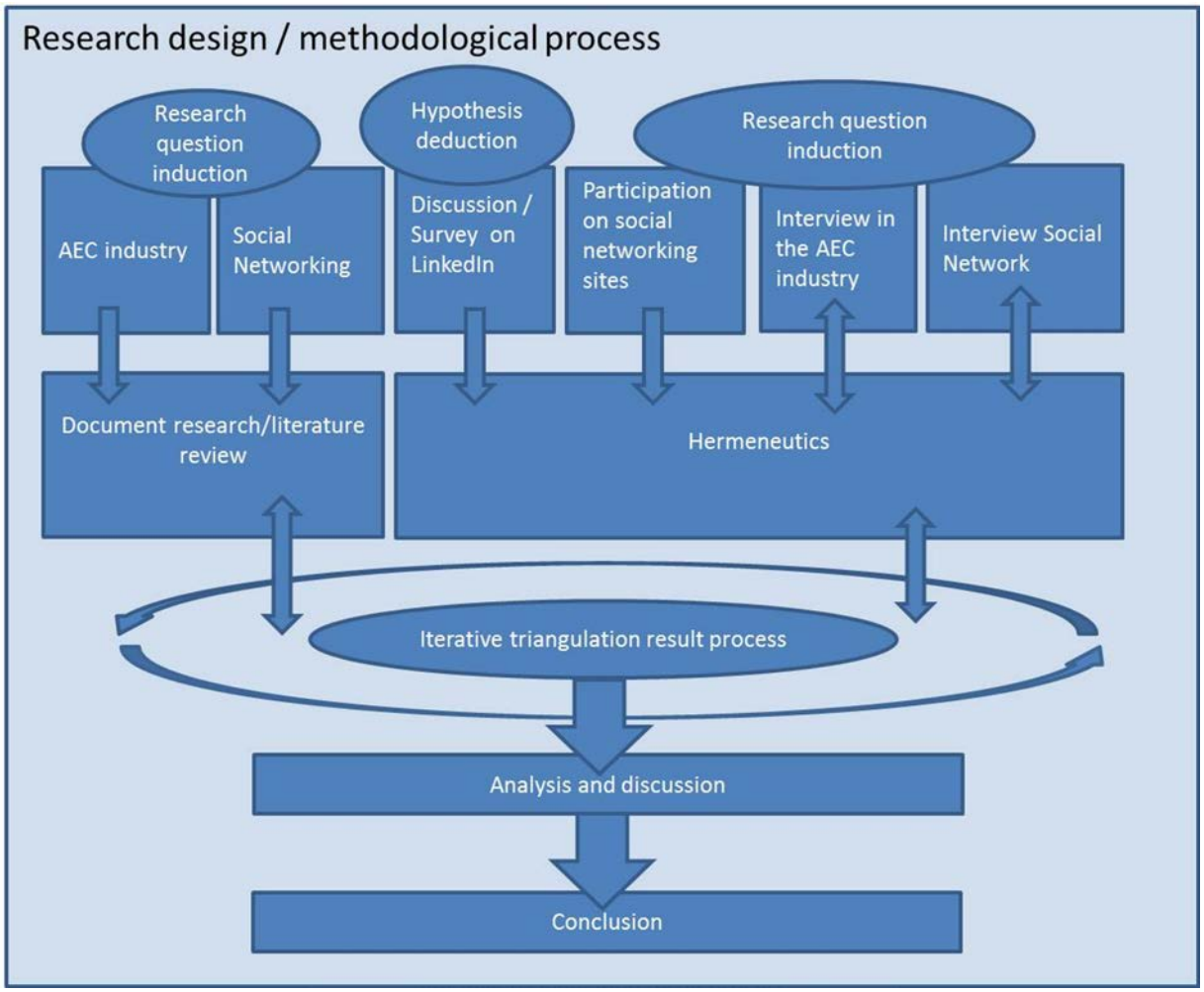


Figure 5: Methodological process created by author.

The data gathering process was approached both as deductive and inductive. The deductive part of the thesis is data gathering with a survey as well as a discussion on LinkedIn. The inductive part included various methods of the data collection such as participant observation and interviews. That is data from both secondary literature

and with the primary data collection of conducted interviews and participant observation.

2.7 The deductive part / prior-understanding

The deductive part was to gain prior-understanding and testing in AEC with a hypothetical approach. The aim was to get the overall notion of the AEC industry of utilizing social networking and to gain insight into how the AEC industry would respond to the idea of implementing social network in the AEC process.

The survey was divided into two parts. The first was to gain general context information, as to the role of the actor and the organizational information. The second part was to gain insight into the current ICT usage, communication and collaboration. That was with the initial idea of the AEC industry need to be supported

The initial idea was in its simplicity "*why don´t actors in the AEC industry use social media, like Facebook?* " That led to my hypothesis "*social media is relevant for the AEC industry.*" By testing that hypothesis, there was launched a discussion and a survey on LinkedIn.

2.7.1 LinkedIn discussion and survey

The discussion on LinkedIn was open for all members of the group. The discussion was conducted with the statement *"while I wait for the buildingSMART standards to be completed, I'm putting my focus on communications portals to facilitate a better building process?!"* with the open question if there was anyone who knew about reports written with the theme of communications portals to facilitate for improved construction process? This question created 12 comments, which includes nine answers from the other members of the community of BIM experts group on the LinkedIn site. The intention was to provoke a discussion to create knowledge and new input by presenting the idea of social networking in the AEC industry. That was the aim of further analyses of the reaction and notions of other group members for the idea and also in the hope of getting valuable data to increase my pre-understanding of the synthesis of social networking in the AEC industry.

The survey was a semi structured quantity of questions, with the possibilities for the participants to reflect on the answer in comment box after the initial question. Launching the survey on LinkedIn had several aims. The first was to reach out to actors with interest for BIM. By that interest they are interpreted by the author to also have interest for improvements to support integration and collaboration between of actors in the AEC industry, as well some experience participating in social networking. Secondly, the aim was to reach out to a big group of potential participants. The third reason was to get responses from broad range of professionals, since being a BIM interested is interpreted to be appealing for the whole construction organization.

This survey was conducted mainly with the aim to get the participants reactions to if it would be beneficial for the AEC construction process to implement social networking and to gain overview of how current communications are conducted. The LinkedIn groups in the survey were; “BIM architecture”, counting 1,281 member; “BIM experts”, counting 10,003. The number of members in those two groups is 11,284 people as of 14 December 2011. In addition the survey was launched on the forum of the WWW.BIMbyen.dk counting 3,619 on the 14 December 2011. I got 26 answers where, 16 finished the survey. The reason could be the number of questions and/ or the subject didn’t reach level of interest enough for members to participate.

The result from the survey and the discussion was interpreted to confirm these main factors: there are opportunities for social networking and there are implications that hinder the adoption of social networking site portals like Facebook. That led to further studies of literature and interviews. That was done to investigate the context of the industry and its objectives as well as deeper understanding of social networking.

2.8 The inductive part

2.8.1 Interviews with actor in the AEC industry

By conducting in-depth interviews there was an opportunity to conduct research questions, to investigate in more detail the view of the industry opportunities and challenges.

The interview part of the thesis was to gain deeper understanding of the result of the survey. The survey was not predicted to have given a sufficient amount of data, because of lack of participation. Therefore it was in my view not enough data to give insight into the combination of social networking and the AEC industry.

The aim was not to create the truth but to gain better understanding of the research scope.

The interview was conducted as a free flowing dialog. The interviewer's preparation before the interview was generated by viewing the survey's results and questions, and conduct in-depth interviews.

- The first interview conducted was taken in Aalborg the 17 of February 2012. The interviewee was a construction architect in an architecture office firm as a BIM coordinator and designer. The size of the firm is about 20 employees. The organizational structure was considered to be flat with consisting ease of internal communication among the actors.
- The second interview was with one of the "leading experts" in communication in Denmark, employed in a relatively big consulting firm: "one of Denmark's largest strategic design and "Communications Company's".
- The third interview was a person that develops Facebook sites for firms that want to expand their "one-way" html homepages to more interactive "two-way" channels. This interview was conducted by telephone.

The first two interviews were recorded, translated and transcribed. The third was noted down during the telephone interview.

2.8.2 Participant observation

The last research approach is participant observation, where the author has participated into two different communities of social networking. The participation gave the author the opportunity to observe the group members reactions in a conflict process as well as a development process. This has been chosen to demonstrate some of the characteristics of the human when interacting with a social networking site. The portal example is Facebook; the observation showed interesting results of conflict

solution communication. For example, is Facebook the right arena for solving conflicts? Is it better to solve the group issues FtF? How do people react to conflicts on these communications portals? This is by no mean, the aim to write deep theoretical analysis of this conflict analysis, just to demonstrate in a holistic view some elements in how the group utilizes this portal and their responses. This is brought to the thesis to view just one site of many of the interaction, collaboration and communication issues on theses portals. The result was not handled in the chapter five; the analysis and discussion. But it is interpreted by the author that people behave differently on same time of media.

2.8.3 The analysis and discussion

The analysis and discussion of the gathered knowledge is processed through the theoretical framework of Orlikowski's Structurational Model of Technology (SMT) with boundary object theories intersected into the text. The reason for following Orlikowski theoretical framework is the actuality of and recent tendencies of investigating the interaction between different systems. As in Orlikowski theory the interaction of humans, technology and organization is predicted to give valuable structure to analyzing the data. The data is then the information that has been gathered about the context of social networking in the AEC industry that includes dynamic interactions between the socio-technical parameters. The methodology adopted in this thesis and the less formal methods gives different views of the reality. The STM covers different aspects of humans in its interaction with the technology; it is predicted to give the broad framework to consume the gathered data as Orlikowski (1992) states Structuration theory; "*Structuration enables both sub and objectivism*". As stated previously the mode of the analysis and the discussion is hermeneutics, that is built on the human interpretations of the reality that is predicted by the author to be subjective, as well as the handling and combination of gathered data.

When using Orlikowski (1992) SMT it is both possible with a more objective methodology view as the subjective spectrum. Therefore this stage there should be needed to inform the reader one more time of the subjective nature of the thesis. That is the authors pragmatically approach that includes mixed methods and with strong

accent of the; "*actors approach,*". That is the author's subjective view, grounded with both primary and secondary data to increase the objectivity, of the current context and conditions of the AEC industry in which social networking is exposed to, guided with Orlikowski (1992) SMT.

That gives space for interpretation, and therefore, it is up to the reader to make his or her own interpretations of my writings, with the transparence of primary data in the appendix to review and make own conclusions, if wanted.

3 Research context and literature review

This part of the thesis serves as an introduction to some of the fundamental elements of social networking and the AEC industry. The industry has been adopting for a long period of time approaches that can improve the process, organizational collaboration and the product (POP). This section is to provide the reader some overview of the AEC industry; historical background; character; suggestions for improvements. It is to give the reader a better understanding of the potential role and meaning of social networking in this context, that will be handled in later chapters of analysis and discussion and finally in the conclusion chapter.

To do so I will be giving an overview of how the AEC industry operates based on existing literature and the authors own observations and interpretations of the industry. To provide the current status three papers will be reviewed that are predicted by the author to give an overview of the current status of the implementation of the latest approach of BIM and different knowledge levels of the industry actors to handle the technology. The last paper of boundary objects (explained in chapter four) gave the author the inspiration for writing this thesis in the terms of the possibilities of and the willingness of the industry actors to collaborate and facilitate with boundary object. In that paper it was the 3D model, in this thesis it is another potential boundary objects; social networking.

3.1 Research context: The AEC Industry

This section aims to provide the reader a better understanding and overall description of the AEC industry and the context in which it operates. That is, to provide a general picture overview in which social networking is entering into. Besides, it provides background on challenges encountered by the industry in improving collaboration among stakeholders. The section will also introduce to the reader some of the opportunities and challenges that the AEC industry is confronted with. That is describing the industry, and the process of creating the product. Here the author presents his interpretation of the industry by selecting material that supports my

thoughts of the industry. This is to view the opportunities of the social-networking as well the challenges. The opportunities are to support the POP to improve the collaboration and the communication with modern communications artifacts and applications of social networking. The challenges are also included in the text as they will be given as part of the process description, the current and largely used deliverance process of Design Bid Build (DBB) that can heavily impact the communications pattern. Also it is to provide the reader the author's perception of the industries willingness to improve, as well as the need to improve. The objectives of this part are then to collect thesis that support the emergence of social networking as well the antithesis of the challenges that can hinder implementation. The thesis that supports the implementation of social networking are the philosophical approaches that support the need for improvements of the collaboration and the communication, while the more traditional approaches of DBB can in fact affect the willingness of new collaboration solutions to fragmentize the construction organization. However by introducing the secondary literature review of Uri Gal where he states that the boundary object can in fact break down walls of rigid traditions and identity practice to step out of the role and support other members behind the wall of non-communications. This should be understood by the fact DBB depends in lesser degree on inter-organizational collaboration than Integrated Product Deliverance (IPD). However, even though DBB is often chosen to be the process approach there is a small hope of inter-organizational collaboration by adopting an IT artifact; in this case social networking service site (SNS).

3.1.1 General description

As written in the introduction chapter, the global impact of the AEC industry is great as being one of the biggest industries worldwide. Its products involve most of the population in high degree. The AEC process includes organization and is to provide us houses, plays a significant role in our everyday life both for us individually and for housing communities, education, healthcare, culture, etc.

Organization

The AEC industry encompasses numerous professional organizations with the main undertaking in designing and engineering. These organizations perform various tasks involved in the building process to fulfill the project objectives of the deliverance of a product. In this thesis it is the whole process from ide to construction finish and related facilitates management. These different tasks that have to be accomplished can vary in size and nature, as e.g. quality controls, designing, juristically and economical, construction works as painting and plumbing, etc.

AEC organizations have been defined as a network organization. That consists of a "multi-industry" with a broad range of professional and commercial enterprises, varying in sizes and usually operating in "temporary" multi-organization. That is in inter-disciplinary entities that collaborate in short time processes. Those organizations are clusters of firms that are interconnected by contracts or by informal communications and exchange links. The service provided are in form of services or delivery of products within an explicitly defined scope, time-frame and budget, with the objective of the final products, "the buildings" [22].

Figure 6 demonstrate an example overview of different organizations and project teams.

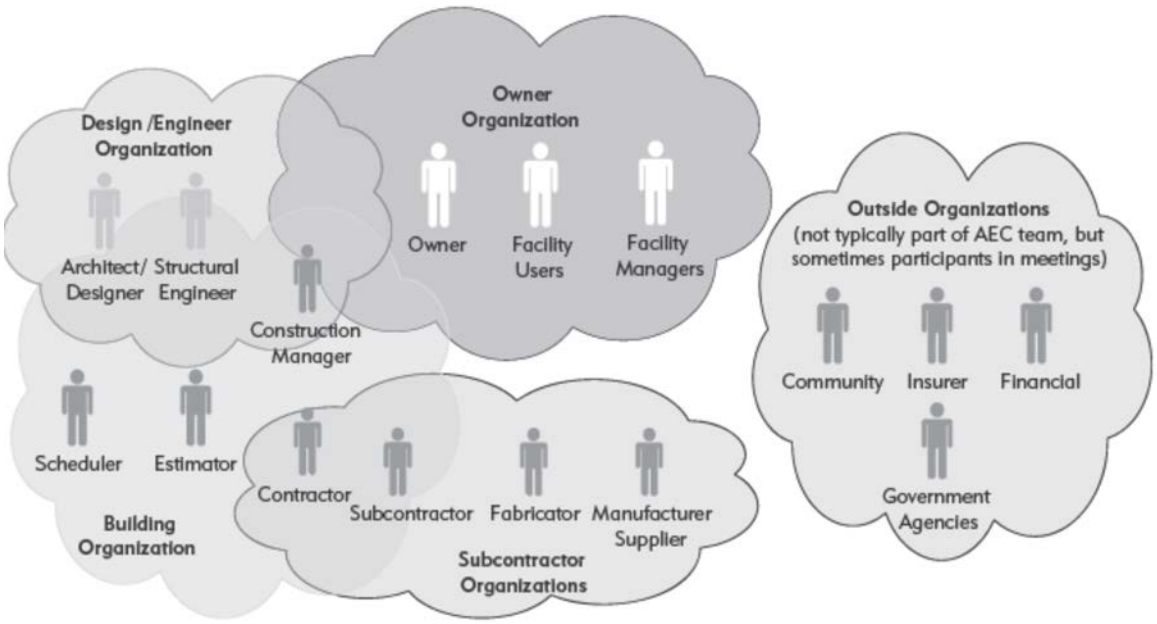


Figure 6: Conceptual diagram representing an AEC project team and the typical organizational boundaries (CM Eastman et al., 2011).

Product

The products can be highly individually customized, and they're constantly increased demands on better sustainability both in the private and in the public sector, in the form of economic, environmental and regulative decisions. That is the process of planning, designing, constructing, maintaining, and operating building projects, with the benefits to rethink design, construction and operation aspects of energy, water and resource use, indoor air quality, recycling programs, alternative transportation access, landscaping strategies, construction water management, construction site planning and management, wastewater management, and maintenance, etc.

The overall goal and challenge of the industry can be explained as to pull and pushing the right attributes demonstrated in example in figure 7. This is conducted by the effort of keeping the dynamic balance between cost, schedule and quality.

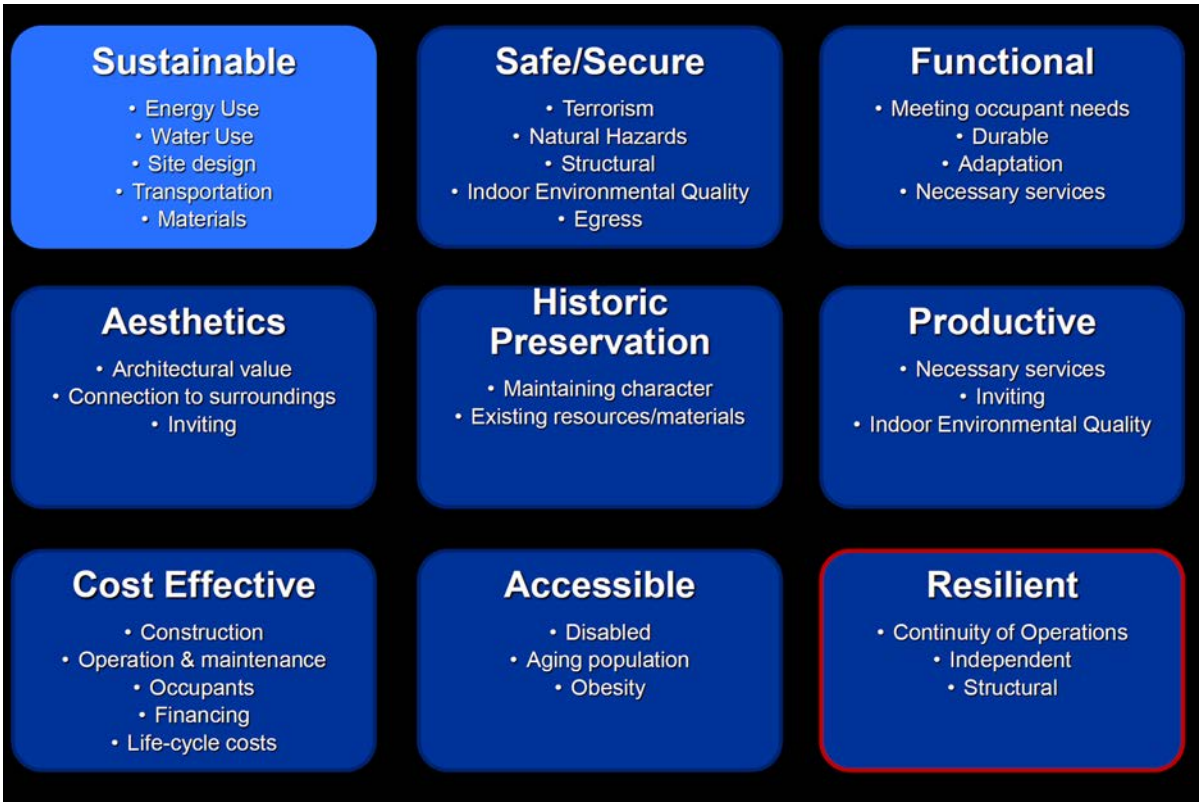


Figure 7: High-Performance Building Attributes [13].

Process

The author of the thesis adopts the idea of Weber (1947) that an AEC project is a complex process of information and communication exchange challenges between different stakeholders both within and outside the organization as a network of information exchanges.

For understanding the context of the AEC-industry, there is a lot to understand or take into account including the numerous ways to procure a project. That is the AEC organizations are network organizations that are dependent on communications, those communications are then pictured as a network of information exchanges. There are three main traditional approaches; design-bid-build (DBB), design-build (DB), and

collaborative methods that are dominating the collaboration and the communications pattern of the current operations in the AEC industry network.

Design-bid-build (DBB)

Traditional DBB is also known as Design-tender method; see figure 9. The main character of that delivery process is the owner or his agency that contracts with separate entities for each phase of the project. There are traditionally three main sequential phases: Design, Bidding and the Construction. The arguments for this method are e.g. the benefits of being well understood by the architect and the contractors, the control ability of the management and the lowest responsible bid provide the lowest-cost project. Typically this process defined as “over the wall” with little or no integration or collaboration between the participants in each phase [23]. This approach’s result generally is that the construction process is mostly separated from the preceding planning, design, and engineering processes.

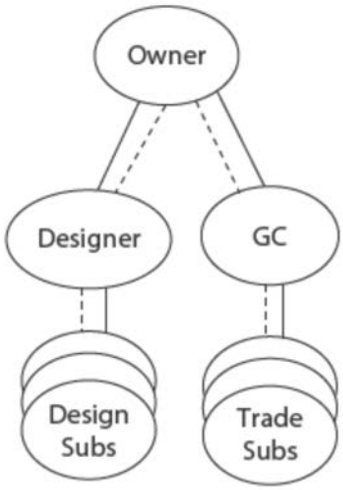


Figure 8: Design-Bid-Build; the continuous line is contracts, the dashed line is contractual requirements [34].

Design-build (DB)

The difference between the DBB and DB is the contractual relationship is established between the owner and a single organization. From the figure 9, is it shown where the Design Builder contracts with the owner and then to subcontractors. The owner defines preliminary, usually written descriptions for his requirements; it can though include form for drawings that indicate the owners' specifications. The benefit of this form for contracts is the possibilities to integrate the construction phase earlier in the design process, and improve the coordination between the builder and the designer. At the same time, reduce the contractual risks that are involved with the multiple contractual conditions of DBB, and the coordination of the subcontractors. That is the owner gives the responsibilities of the coordination work to the Design builder. Design builder then ensures; that all the work required is included; it provides a project schedule; the needed resources and budget control; effective internal and external communication; risk management; obtains necessary resources from external sources. [24]

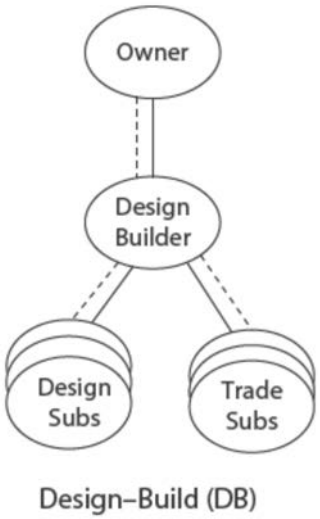


Figure 9: Design-build; the continuous line is contracts; the dashed line is contractual requirements. (CM Eastman et al., 2011)

Construction management at risk (CM@risk)

CM@risk projects delivery is a method in which an owner develops partnerships with the designer and construction manager demonstrated on figure 10. Partnership agreements between partners accepted in the beginning of the project that should hold throughout the construction project. The owner has the responsibility of the design before the cost can be set. The CM is usually a licensed general contractor and guarantees the cost of the project. The CM@risk differs from DBB, as the contractor is brought into the design process at the stage where they have significant input and reduce the cost overruns of the project [23].

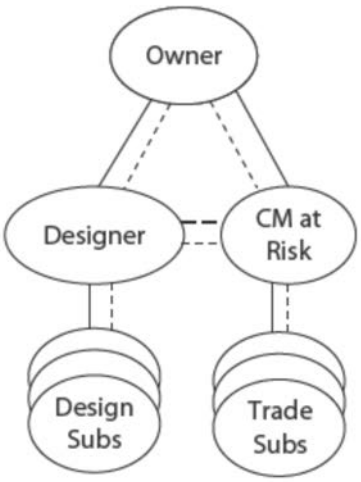


Figure 10: Construction management at risk; the continuous line is contracts; the dashed thin line is contractual requirements, and the dark dashed line is the communication. (CM Eastman et al., 2011).

A need to mix the best of both project delivery methods and provide greater owner interaction in the design and construction process lead to the development of the Construction Management at Risk (CM@risk) project delivery method [25] .

Integrated product delivery (IPD)

The integrated product delivery (IPD) is a recent approach to integrate teams in the procurement process, gaining popularity as the usage of new; tools; methodologies, e.g. the BIM method; and new roles are influencing and fundamental cultural and business shifts [5]. The American Institute of Architecture (AIA) has prepared a contract form to support this type of collaboration. The key concept is integration of the stakeholders in project teams, with the objectives of meeting the owners requirement's with the best collaborative tools, to reduce time and cost [23]. The difference between the traditional delivery methods and integrated delivery has been suggested by AIA in the table 6. The benefits of integrated design is presented in figure 11.

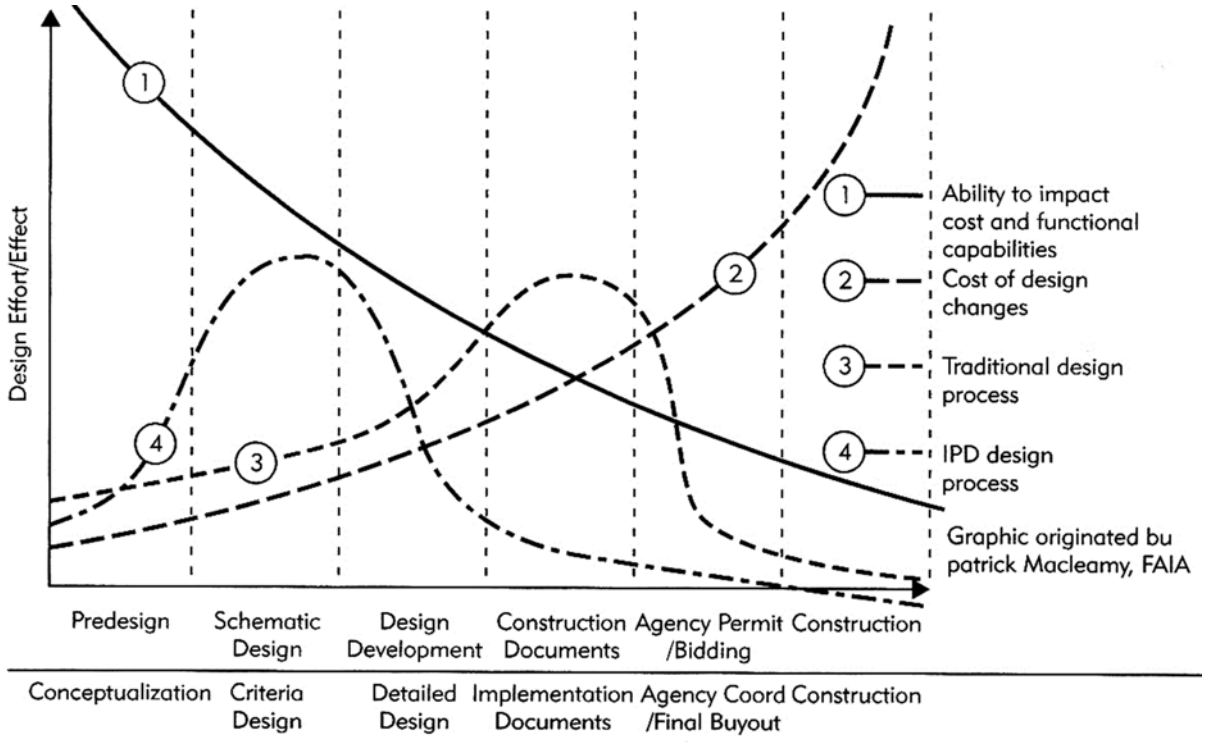


Figure 11: Traditional vs. BIM / Integrated workflow. By integrating assembled construction players in the early stages to improve information gathering in the early stages. It is expected that improved workflow [60].

Traditional Project Delivery		*Integrated Project Delivery*
An integrated team entity composed of key project stakeholders, assembled early in the process, open, collaborative	***Teams***	*An integrated team entity composed of key project stakeholders, assembled early in the process, open, collaborative*
Linear, distinct, segregated; knowledge gathered "just-as-needed;" information hoarded; silos of knowledge and expertise	***Process***	*Concurrent and multi-level; early contributions of knowledge and expertise; information openly shared; stakeholder trust and respect*
Individually managed, transferred to the greatest extent possible	***Risk***	*Collectively managed, appropriately shared*
Individually pursued; minimum effort for maximum return; (usually) first-cost based	***Compensation / Reward***	*Team success tied to project success; value-based*
Paper-based, 2 dimensional; analog	***Communications / Technology***	*Digitally based, virtual; Building Information Modeling (3, 4 and 5 dimensional)*
Encourage unilateral effort; allocate and transfer risk; no sharing *Encourage unilateral effort; allocate and transfer risk; no sharing*	***Agreements***	*Encourage, foster, promote and support multi-lateral open sharing and collaboration; risk sharing*

Table 6: Suggested difference between traditional project delivery and Integrated Project Delivery [61] [5].

As the thesis objective is to investigate the synthesis of networking and the AEC industry, there has only been short description of the project deliverables. It should to be seen as a big influence factor on the collaboration. A factor is predicted by the author to have influences on the implementations of ICT solutions that is seen as a foundation to enable for integrated collaboration as social networking services. The degree of inter-organizational collaboration should therefore be seen to be less with DBB and increased with DB and CM@risk, with the highest level of collaborations in IPD. IPD is the latest approach or evidence of the aims of the AEC industry to improve

the POP. This development has not been created in an AEC industries vacuum, but learning's and inspiration from the other industry.

3.1.2 Philosophical approaches from other industries

In this part of the thesis it will provide an overview on some of the AEC industry philosophical tools that are used to improve the production process. This is written with the aim to give the reader some of the aspects of what is predicted to be beneficial for the organization. This will give better understanding of the character and approaches that have been tested in the industry. That will also give some of the parameters to how to improve the collaboration, the integration and the communication among the shareholders, with new collaboration- and production methods.

These are solutions that have the characteristic of: decentralize organizations by networking; administrative process orientation; cross-organizational teamwork; "multi-skilled" and flexible employees; increased involvement and competency of all employees; focusing on core competencies. The result and conclusion of these philosophical methods is pointing in one direction: that is the customer and his needs. [26]

As a result of technological developments, it has been made possible for AEC actors to collaborate as a multidisciplinary team often geographically distributed. In managing and setting up strategies to manage the whole organization and the technology there have been efforts in learning from other industries. That industry has been more responsive to new philosophical approaches for getting improved and increased productivity.

That is in the manner of getting the advance of new production's philosophies. That is e.g. how to integrate the communication between actors and stakeholders in information sharing collaboration.

To mention some of the actual approaches there will be given a summary of some of the methods that can be seen as an overview and part of this thesis to the

investigation of Social Media in the AEC construction industry, to compare these philosophical approaches to the “new form of communication in the AEC industry."

Lean construction

There have been written excessive papers of Lean and Lean construction philosophical approaches. It is not in the purpose of this or in the time limits to write in depth on the elements and purposes of this approaches. But it should be thought as elements that have been pulled into the AEC industry for improvements for the POP. These elements are like the bottom up and top down concepts that emphasize the need of involvement and communication among the shareholders, no matter the level or divisions of the organization. The elements from Lean construction that are relevant to this thesis are the view of the owner and involvement of all actors during the production to communicate. In this sense it is interpreted by the author that social networking is a lean medium for communication and knowledge sharing.

There have been adopted methods from Lean manufacturing in streamlining the process to increase the value of the owner. Improving the process performance is done by e.g. optimizing through increased collaboration, systematic learning of failure, supporting positive iteration, reduces the negative iteration. That is repeating a process, usually by the aim of approaching a desired goal, target or the result. Each repetition is called an “iteration” and is then a starting point for the next iteration (“Iteration - Free Merriam-Webster Dictionary,” n d). The objectives of the Lean Construction philosophy are to maximize value and minimize waste for the benefits of the owner. The facility and its delivery process are for supporting customer purposes by positive iteration within the process. [28]

Supply-chain management

Supply-chain management, is also another perspective in managing the complexity for better end product and values for the stakeholders by integrating teamwork in both cross-functional and cross-firm teams to collaborate, with an interface to the customer [29]. Supply-chain management is an approach in the AEC-industry as a part of the collaboration among various stakeholders, which is sharing information across companies. The difference between supply-chain management in business to business (B2B) and business to customer (B2C), was often the case in the AEC-industry, is that the AEC-industry includes lay people and eventually one-time buyer. That raises the question of social networking as a convenient tool to integrate the stakeholders instead of more complicate systems that are implemented in B2B.

Concurrent Engineering (CE)

There are many names of (CE) e.g. Design for Manufacture (DFM), Simultaneous Engineering (SE) and Integrated Product Development. The objective of CE is to integrate the product development to the marked and the production [26]. The term is relatively new; used for the first time in the US in 1989 [30]. The concept embraces also Just in Time (JIT) [30]. That could be seen as cost reducing by reducing the in-process inventory.

Concurrent engineering is the simultaneous and integrated engineering of all design, manufacturing, and operational aspects of a project from the conceptual formulation of the project through project completion.

> *It is a team-engineering process in which all the specialists who normally get involved in a project combine into a multi-disciplinary task force to carry out a project. They work together, trading ideas, and ensuring what they do early in the project (like major design decisions or changes) will not adversely affect what they do later (like "manufacturing in" quality or supporting flight operations). All disciplines are addressed simultaneously* [31] .

The difference of the traditional process and the CE can be explained by the figure 12; where the traditional process is currently defined as “Waterfall” and the latter as an “Iterative process."

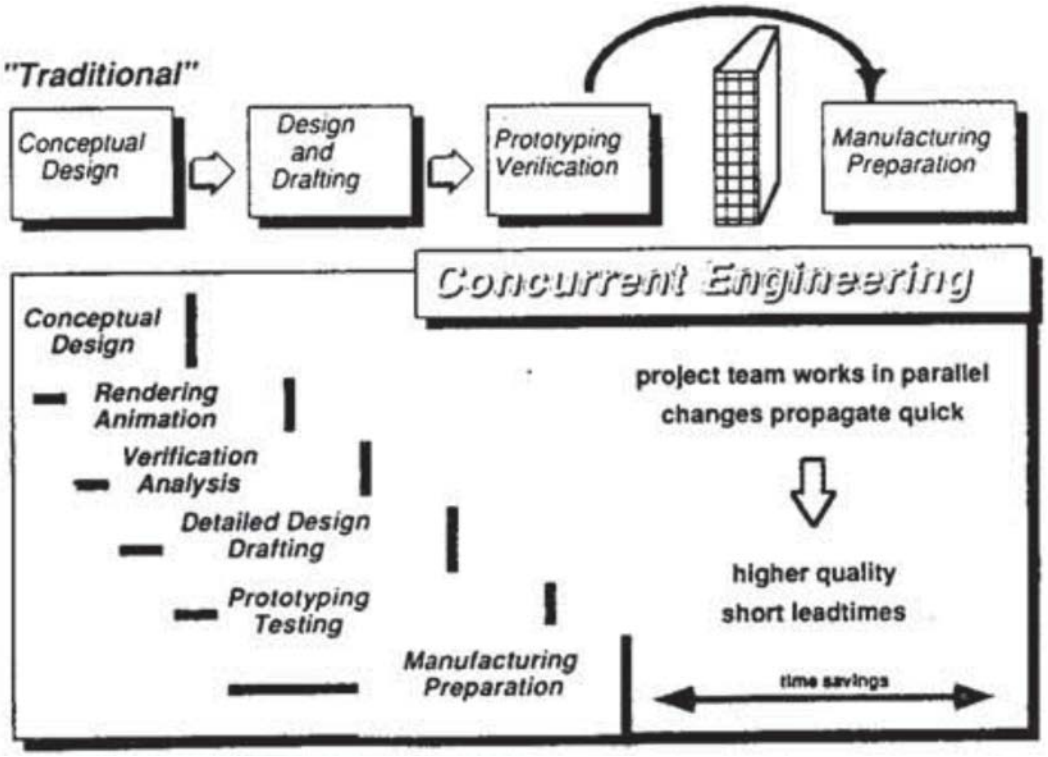


Figure 12: The difference between CE and traditional product development (G.Sohlenius, 2003).

CE concept indeed changes the view of product development due to the increasing complexity of engineering products and intense competition on a global basis. The traditional product development practice has changed from being centralized knowledge and easily led by a few individuals to being distributed. This distributed iterative process deals with complexities by dispensing product development functions to a team of engineers, where everyone contributes his special expertise to the product specifications. This method allows complex products to be developed but is difficult to manage. [30]

In figure 11 can CE has been thought to integrate actors to make careful consideration in the early design phases. That is the product’s life-cycle, functionality, production aibility, assembly, testability, maintenance issues, environmental impact and finally disposal, and recycling should be considered by the various stockholders. Another approach to the concept of CE is that product development should all be occurring at the same time, or concurrently. That is with the objective of an increase in product

quality [32]. This philosophycal approach enables the stakeholders to discover errors and related re-design earlier in the design process, when the project is still in a more abstract and possibly digital realm [33].

> *"The fully integrated design is then subjected to process engineering and production functions to provide operational hardware and software. Concurrent engineering teams must be encouraged to develop a free flow of ideas between team members. The object of the team approach is to provide an environment in which potential problems can be easily and quickly exposed to creative and synergistic problem solving by the innovative engineering and design processes of the team itself. To do this, the hardware and software configurations under consideration must be communicated to all team members with equal rapidity and understanding"*[31].

Building Information Modeling (BIM)

New ICT technological solutions as e.g. the concepts of BIM methods and related international standards efforts, pretended to support the process buildingSMART.

Recent approaches are getting familiar to the actors in the industry as increasing use of Web-based project management for hosting collaborative 3D models and e-procurement. This emergence of new high-tech solutions and currently surrounding the AEC-industry is getting integrated into the work processes and demonstrating stimulation for innovation for the benefits of the process, the product and the organization [34]. There is not known to the actor any standardized definition of the concept of BIM; therefore there will be presented some of the ideas that have been created of the "buzzword" BIM. Eastman and Kiviniemi do agree it is not a thing or software; it is described more related to the human or sociological activities and issues?!

> *"…BIM is not a thing or a type of software but a human activity that ultimately involves broad process changes in construction" (Eastman et al., 2008).*

> *"20% technological and 80% human issues"* [6].

The concept of BIM is interpreted by the author to be used as a concept of all technological improvements in the AEC construction industry: one of the latest efforts of the construction industry to improve the agility in the AEC process to accomplish "integration" will be found in Building Information Modeling (BIM)… [2]. The aim of BIM is presented graphically at figure 11 and figure 13 and the importance of the BIM and integration, expected to improve by BIM to the workflow.

BIM is proclaimed to become the future construction process of the Architect,

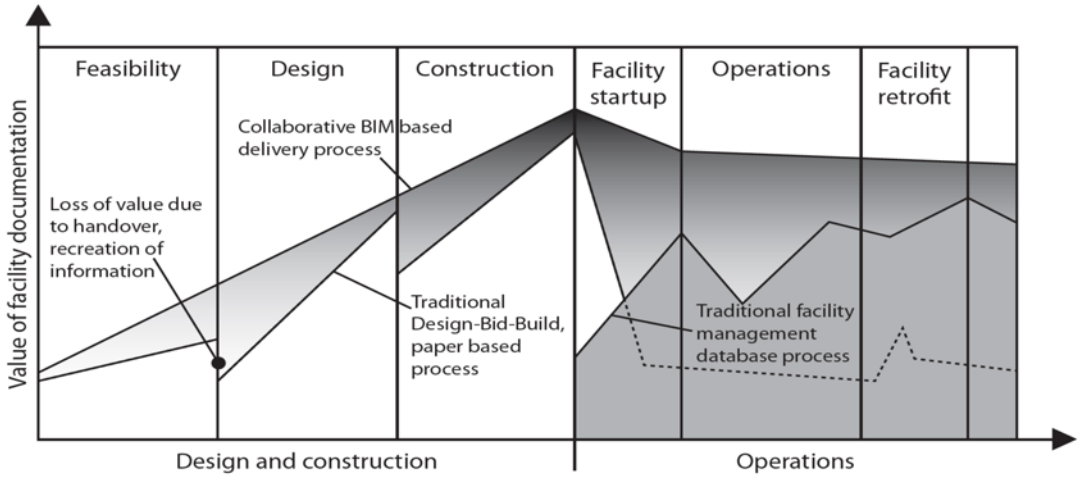


Figure 3 - Data integrity (Eastman et al., 2008): *Graphic presentation of the data losses during the lifetime of a building. Compared is the traditional paper-based process vs. a collaborative BIM based delivery process.*

Figure 13: Data integrity: The figure is showing the loss of value in information assets across phases and increased effort to produce project information. Compared is the traditional paper-based process vs. a collaborative BIM based delivery process [34].

Engineering & Construction (AEC) industry, involving all parts in new ways according to the project evolution (Eastman et. al., 2008).

> *"Building Information Modelling (BIM) is an IT enabled approach that involves applying and maintaining an integral digital representation of all building information for different phases of the project lifecycle in the form of a data repository. The building information involved in the BIM approach can include both geometric data as well as non-geometric data. BIM is one of the important areas in current Virtual Reality (VR) research and is*

> *expected to envision efficient collaboration, improved data integrity [12], intelligent documentation [38], distributed access and retrieval of building data [23] and high quality project outcome through enhanced performance analysis, as well as multidisciplinary planning and coordination [14,19,20]*"[35].

> *Among the main impacts are the increasing value of information throughout the lifecycle of the buildings, more efficient use of simulation and analysis tools in the early phases of design, improved and semi-automated design coordination, and more accurate and efficient investment and lifecycle cost management*" [36].

"BIM, BAM, BOOM! Strategy" is a phrase that has been used when referring to potential benefits of the BIM method. That is the comparison of expenses of design, assembly and the final operation of the building. The industry is waiting for the bomb to blast after years of promising potential benefits of the BIM method. The reason for this slow adoption is stated by many as a social issue, rather than technological disabilities, that could be stated as a gap between the technological possibilities of latest technology and the skills of the users. Below are some of the possible reasons and symptoms of the implementation issues.

- Despite the still increasing entity of digital devices and the current need for BIM, the ideology of BIM has for more than 20 years struggled to become the preferred process of the industry (Eastman et al., 2008).
- Even though getting increased awareness of the benefits of BIM method and increased implementations of supporting artifacts for the BIM method, there are numerous challenges for the industry to keep up with the technology and the implementations of these new technologies for improved collaboration is potentially beneficial, but slow [35].
- When it comes to the BIM method, people do have different understandings of the concept [35].

- When it comes to e.g. to the contractor there has not been the same willingness to use the 3D model, and fill it with informational data for reaching the as build level for the facilitates-management [37].
- The collaboration is still based on exchange of 2D drawings, despite most of the disciplines are currently working in 3D environment [35].

Implementation of BIM methods is demanding, because of the complexity and the enormous technological and institutional transformations and their implications to the AEC industry. The AEC industry's stakeholders and software developers are constantly working on improvement on the field of technological innovation, strategies and improvements of processes and products. Nevertheless the stage of the development has not reached the level of the problem-free building process, and the construction industry is lagging behind in the terms of productivity [34].

With regard to information sharing between the actors; it has its limitations of being rigid, static and limits the dynamic agilities of effective holistic workflow. The rigid structure companies are forced to organize themselves according to predefined structures instead of their needs and practice [38].

There have been developed distributed and heterogeneous systems for the data management by various technological solutions for wide range of specialist in the AEC industry. There is constantly being worked on standards to improve the interoperability of these systems, e.g. the IFC standard that improves the acceptance of the data model to be shared and recognized of the receiving application. It improves the agility and the flexibility to facilitate an immediately sharing data for the benefits of the product. That in a short term will lower the production cost, shorter production time and improves the quality [32].

> *"Yet, even with the increased availability and pervasiveness of Information Technology (IT), project teams still struggle to communicate"* [8].

International Standardization

For supporting “envisioned” BIM process there has been international collaboration by various international organizations to gather their efforts around the concept of buildingSMART. The concept is to provide standardized infrastructure for the AEC industry to improve the information flow between artifacts and humans. The organization has been developing framework tools to jointly link processes by exchanging information together and make the interaction between platforms more intelligent. These tools are described as a trio consisting of open formats of: Data model that is intended to describe building and construction industry data, Industry Foundation Class (IFC); management tool, Information Delivery Manual (IDM); translation tool, International framework for dictionary (IFD). An information flow is considered to be standardized and thought to be as illuminated in the manner: who should do what, how, in what order, when in the process and why? The process is therefore controlled via IDM (Information Delivery Manual). The flow of information gathered from practitioners in IFC format and shared among the actors, are expected to be managed with IDM technical descriptions and rules. The technical part takes care of the Model View Definition (MVD), which is a subdivision of IDM, which specifically handles the technical aspects of this management tool. To combine this triangle of tools IFD must be mentioned. This tool seeks to translate the supported information exchange and help to the goal of a greater standardization and globalization.

3.1.3 Integration and communication

The construction process is more or less information sharing of the organization, with different artifacts and methods. There is not a single person or application that can solve complexity of a building construction process. What is the best solution for the process can be difficult to define, therefore there is predicted need for interactions between shareholders and open up the discussion of choosing the right methods or tools. This is predicted to be valuable for the POP.

The term integration is one widely used in the AEC industry in its effort to improve the collaborations among the AEC industry stakeholders. The benefits of integration can be explained by Johari Window see figure 14. The figure represents the Area as the

existing knowledge to be continuously expanded. This expansion reduces the knowledge conflicts and creates shared understanding. This should be done as early in the phases as possible [26], In that sense it is relevant to refer to Figure 12.

The key element with Johari Window has been stated that groups should develop the open Arena for every person. That is concluded to enhance individual and the team effectiveness and productivity. In the Arena there is the space where the good communication and cooperation occur, free from confusion, conflict and misunderstanding.

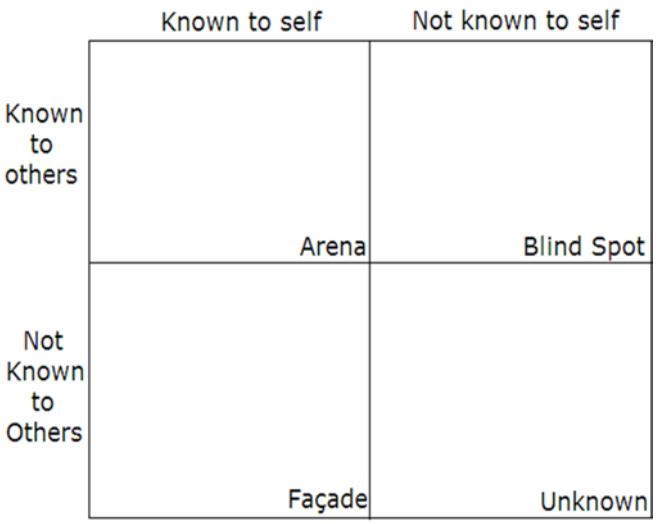


Figure 14: Johari Window [39]

This is done by opening up your known façade for the others as well to gather information from the other, by sensitive feedback with the aim of creating stronger and more effective teams [39]

> "Experts in the building industry around the world have worked diligently for more than 50 years to put the concept of "design integration" into practice… *The AEC industry has been criticized for about 70 decades for its poor performance in its operation and providing value to the customer as a cause of the fragmentation nature of the collaboration among AEC project stakeholders…"* [2].

The actuality of Johari for this thesis is the view of self-closure and openness. This could be connected to social networking, where people blog and share their thoughts and communicating. This is eventually not the case with the construction industry, that have been termed as having stove-piped designers in fragmented industry, practicing rigid communication, living in silos, throwing over the wall the data to actors been described as poker players and dealers, actors reading only one chapter of the book,

saving their own skin, producing failures etc. while the customer doesn't get what he wants. The positive view is how ineffective the industry is if this is the case.

The involvement and collaboration of the numbers of the heterogeneous group of actors is a challenging task, e.g. because the organization involves a broad spectrum of lay people, practitioners and stakeholders [2].

One of the premises for integration as the designers have emphasized to be literally understood "co-located", it was difficult to find a definition of who are supposed to be integrated. Kiviniemi (2005) state the need for the updates of the owner or his consultant to be integrated into the process, otherwise the end result will not match the initial requirements. Lean and CE state the importance of integrated collaboration and view of the quality of the product that is in response of the collaboration of the entire supply chain. Recently, we have seen new approaches of what is termed as contextual design, a R&D approach for ICT that emphasizes the importance of the users and its context is highlighted. This view of the user is gaining more importance, and the concept of contextual design and concepts like the scrum method have been paving its way into the product development as it does in software-development emphasize the integration of the shareholders, agility and integration.

An example of high degree customer involvement is the collaboration with a person who literally wanted to be directly involved with the design in time and space. It currently influences the integration determined by the delivery business contracts such as DBB that can greatly influence the integration and the collaboration. If integration is the way forward for the AEC industry, as indicated with philosophical approaches from other industries, reviewed in 3.1.2 it raises the question if 3D BIM can support holistic collaboration process alone? Also should new approaches be reviewed such as social networking to support the integration?

3.2 Literature review

The purpose of the literature review is to provide the reader some of the implications that the AEC industry is dealing with in its effort of improving the collaboration among the shareholders. This is shown by introducing the methodological approaches that in

more or less degree have been implemented. That is philosophical approaches like Lean Construction, Concurrent Engineering should be thought as borrowing methods from other industries.

In the literature review there will be presented research that point out current challenges in the AEC industry.

This is seen as illuminating to the reader some fundamental knowledge of previous efforts of improving the collaboration and additional challenges. In that sense providing the reader some of the aspects of the industry needs for improving the collaborative methods.

1. The first literature case is to demonstrate some of the challenges that the AEC industry is dealing with. That is to provide an example of the issues in the implementation of BIM. Even though the construction case has been presented as a BIM project, it was not a problem free process. That is there was only part of the total construction organization that could utilize part of the BIM potential, while other shareholders completely practiced 2D methods. This should give indications that there are different levels of BIM abilities for individual organizations. This is supported by the second example below.
2. The second example is for providing the reader the fundamental knowledge of the different level of awareness knowledge, and skills, among the stakeholders. It indicates that the knowledge can be dammed or piled up within organizations or clustered in individuals, waiting to flow out to the rest of the organization. Improved and increased communications can break down barriers that hinder an effective flow of information among the stakeholders that are working toward collective objectives and aims, for the benefit of the product, process and for the construction organization, including the owner. This case gave the author the idea that increased communication could in fact synchronize and support monolithic understanding of the organization, what it means to adopt BIM methods and create discussion and negotiations to get to agreement on innovative possibilities.

3. The third paper gave the author the hope that by using boundary objects, in the case of 3D models it could get the actors to step out of their role and give support to other members in the inter-organizational network. The inter-organizational network should be understood as a social structure that connects a collective: group, community, agency, organization, etc. This is interpreted by the author as an opportunity for the cases mentioned above for improvements. That is by equipping the inter-organization with a social-networking tool could increase the collaboration and the information flow by opening up communications channels that would support knowledge sharing. This social-networking was also interpreted by the author to be a more effective communications media to integrate shareholders for information sharing than 3D model.

3.2.1 "What did you learn from practice today?...

…Exploring experiences from a Danish R&D effort in digital construction [37]"

The paper reports on the lessons learned from developing strategies, demands and guidelines in the "Digital Construction" program and from adapting one of its "digital foundations," the "3D Working Method," to the design process of the large-scale building project "The Icelandic National Concert and Conference Centre." The explorations were based on a process evaluation of the R&D program and a qualitative case study of a building project. The report points out several implications of the BIM methodological utilization. To mention some of these issues; *"…the architects did not commit themselves to deliver a 3D object model, neither to the engineer nor to the contractor,...*" The 3D model wasn't used until the end of the design proposal phase. All the information that is "I" in the BIM method were exchanged at meetings, via e-mail and though hand-sketches. On the building site, itself the traditional 2D drawings had the main role. The report pointed out some main barriers on different levels, which prohibited the 3D object models, that is*:* no client demands, no issue in the contract, different organizational traditions, no extra time and money: high risk, 2D delivery to contractor, contractor and client not using 3d models, different ambitions and aims, different working cultures, different cultures due to who shall have CAD

skills, different starting point modeling, lack of skills and experience, individual attitudes, shortcomings in software, not user-friendly interfaces easier and faster to use known techniques under time pressure, user discipline [37].

3.2.2 "Understanding and facilitating BIM adoption in the AEC industry"

[35].

This paper analyzes the current state of BIM adoption by the practices in the AEC-industry. The paper states the importance of the adoption by the practices as both technical and non-technical issues that should be considered. The paper states that there are varying levels of adoption and expectations across disciplines. Therefore, they state that there is a need for specific tools to facilitate the BIM adoption. The papers conclusions are that there are numerous factors affecting BIM adoptions that are grouped into two mains areas: the technological tool functional requirements and needs, and non-technical strategic issues. "There are varying levels of adoption and understanding within countries – from discipline to discipline and client to client [35].

3.2.3 "Boundary matters:…

…the dynamics of boundary objects, information infrastructures, and organizational identities." [40]

This dissertation examines the organizational implications of the introduction of a new information system that is designed for the sharing of information and collaboration across organizational boundaries. He defines 3D modeling tools as boundary objects that can change the identity of an organization. Some of his finding are that there are some AEC construction cases that are too complex to be solved with 2D technology, and the report states that using 3D technology not only facilitates cross-organizational communication and collaboration, but also is a resource to form organizational identities. Uri Gal defines organizational identities as an:

> *"…ongoing enactment that unfolds as organizations interact with each other. This interaction is dynamically constituted by the engagement of organizations in mutual practices. Therefore, the articulation of*

> *organizational identities takes place in the interfaces between organisations, a region where multiple information infrastructures overlap and that is populated by boundary objects"*[40].

These three cases have inspired the author of this thesis to investigate new collaboration approaches for supporting the AEC construction industry. That is with the aim of getting better understanding of the social-networking in the context of AEC industry.

3.3 Social Media

3.3.1 Definition

This part of the thesis will demonstrate for the reader the term social networking, as a type of distribution platform that should be seen as a sub element of the domain of social media. There are many different terms for social media and there seems to be confusion of what is included in the term [41]. This part is not going to dive in too deep into that discussion, although it is written with the aim to give the reader some understanding where the term social networking derives from. An additional aim is to describe the elementary terminology by tracking elements from different sources. That is to give an overview picture of the phenomenon; social networking. The other elements of social media, such as blogs, virtual worlds and wikis will not be handled in this thesis.

3.3.2 Web 1.0 – Web 2.0

Social networking is a part of the Internet that is a global system of connected computers around the world using TCP/IP standard that is known as the Internet Protocol. The content is interconnected web pages that together create the World Wide Web (WWW), W3 or the Web. The Web term Web 1.0 is to describe the part of the internet that is; static; HTML page; one-way; and non-interactive for the user. That means that the user can access those pages, get information, however the user cannot make changes on the visited page [42]. The Internet has been developed further to what we might call "*the next step*" of what has been termed as Web 2.0. It is seen as the platform for the evolution of Social Media. Social Media has been seen as a group of Internet-based applications that builds on the ideological and technological foundations of Web 2.0, and that allow the creation and exchange of user-generated content [41].

3.3.3 User-Created Content (UCC)/ User-Generated Content (UGC)

OECD terms social media as “participative web." It describes a new way of utilizing the WWW as a platform where users participate and collaboratively create content with the functionality of Adobe Flash and Really Simple Syndication (RSS). That is to frequently update content to the site with e.g. blog, headlines with the characteristic of “two-way” communication. UCC is people’s activity in creating content and expressing themselves. (French: “contenu auto-créé”) That is “rise of the amateur creators." This pro-active, collaborative role in the creation of content on the Internet is seen to have increasing economic impacts and social importance related to this user-centered innovation [43].

UCC is commonly expressed as user-generated content (UGC) although UCC might have been the original term, there is also referred to consumer generated media (CGM). This should be seen as the opposite of content generated by the administrator of the site.

The content can differ in formats; text, fiction and poetry; photos and images; music and film; citizen Journalism, as blogs; photos; educational content, as content created in schools, universities; mobile content, e.g. text messaging, photos and videos, e-mail; virtual contents, as content created within the context of an online virtual environment. The platforms can be; blogs; wikis; sites that allow feedback on written works; group-based aggregation; Podcasting; Social network sites; Virtual worlds; content of file sharing sites This is based on web services and new internet-based software applications. Those “tools” enable users to collaborate and contribute to develop, extending, rating, commenting on and distributing digital content and developing and customizing Internet applications and harnessing the “collective intelligence” (OECD, 2007).

3.3.4 Social networking

The recent rise of social- media/ networking has been rapid see figure 15. People of all ages are creating their own profiles, sharing their personal life, joining groups, blogging their ideas, communicating on sites as e.g. Facebook, Twitter and LinkedIn [44].

For professional organizations and firms there is increased interest for using Social Media/ Enterprise 2.0. as Enterprise resource planning (ERP) that should be seen as using Web 2.0 technologies within an organizations technologies for ERP business processes today with success as Sony [45].

Figure 16 indicates a rapid adoption of social media in the profitable context. In general, firms are increasingly adopting social media and finding values in this new way of networking. Numbers of companies have embraced social networks, by setting up Facebook and LinkedIn pages that don't differ much from their websites. It is done for marketing, as providing a channel for new customers, for giving product information and getting into relationships with the customer. This type of media is used for discussions, comments, and complaints by the customer and their employees toward their company, products and services. The aim is to engage the communities in collaboration and innovative ideas [46].

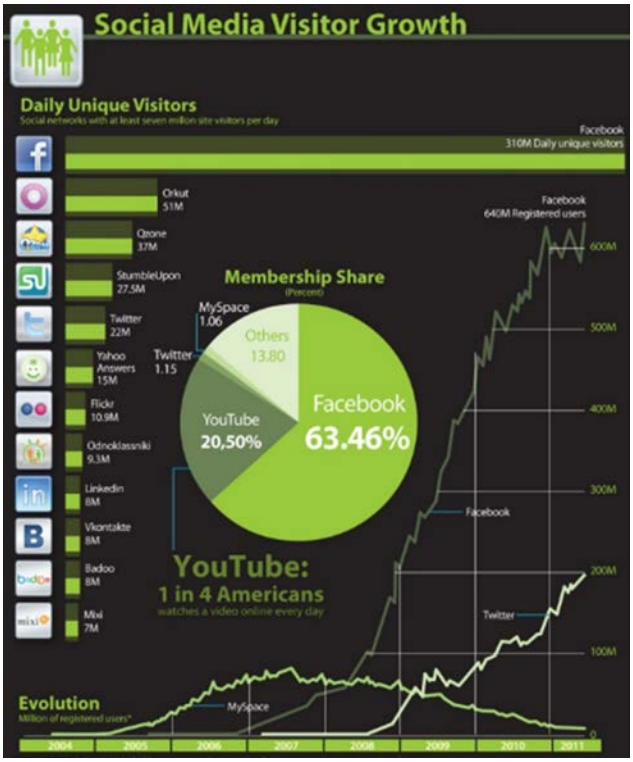


Figure 15: The growth of Social Media (Henrikson, n.d.)

For marketing purpose, there are some that are convinced of the benefits of the media as Stelzner (2010) quote:

"Social media is hot. And for businesses, it represents a marketing opportunity that transcends the traditional middleman and connects companies directly with customers. This is why nearly every business on the planet—from giants like Starbucks and IBM to the local ice cream shop—are exploring social media marketing initiatives. A year ago, businesses were uncertain about social media. Now it's here to stay, and companies are rapidly adopting social media marketing. Much like email and websites first empowered businesses, social media is the next marketing wave" (Stelzner, 2010).

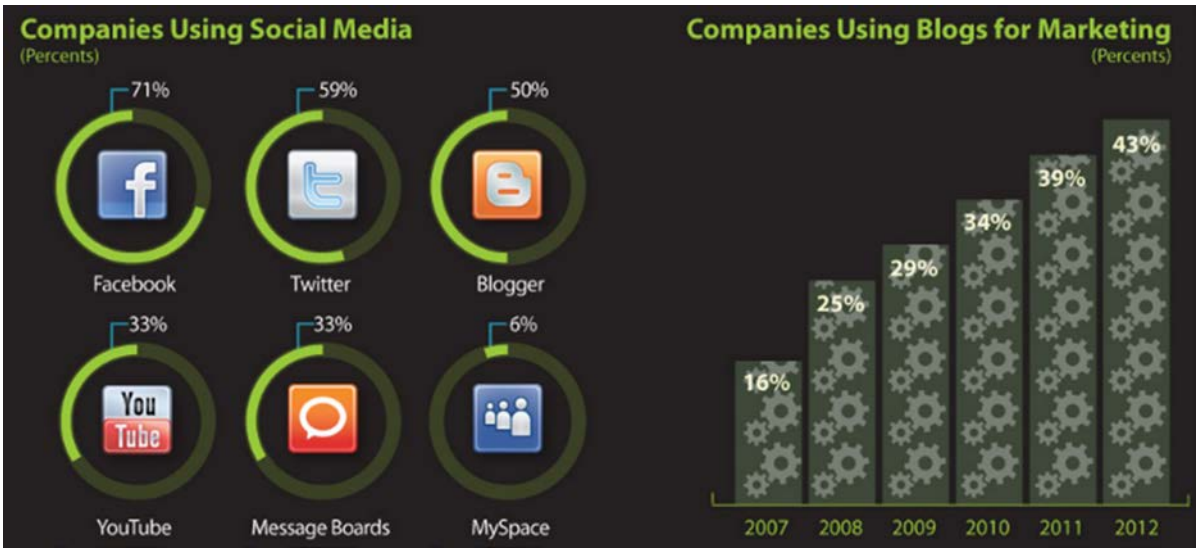


Figure 16: Companies that are utilizing social media and social networking. (Henrikson, 2011)

A Survey made by McKinsey & Company in February 2009, executed around the world, across a range of industries and functional areas, states the benefits of the Web 2.0 technology. Of nearly 1,700 companies, 69% claimed to have gained measurable business benefits; including more innovative products and services; more effective marketing; better access to knowledge; lower cost of doing business; and higher revenues [47].

"Companies that made greater use of the technologies, the results show, report even greater benefits (J. Bughin, M. Chui, 2009)."[47]*".*

There are new tendencies of using social media like Facebook to gather user-generated content (UGC) in Denmark where an architectural firm has launched a Facebook site

that presents their work and other information that gives their community (in date 12 Dec. count 14.883 persons joined the network) possibilities both to respond and write on their wall. Another example is a new university construction case here in Denmark where there has been launched a Facebook profile to inform and receive data from the students, that could benefit the construction. Moore (2011) summarizes the process as following statement indicates:

> *"But the biggest value that social networks offer goes beyond being marketing channels to push communication to prospects and customers. They are morphing into new channels for collaboration and innovation. Social networks are becoming unique touch points to engage communities, start conversations, recruit skillful employees, and develop new innovative ideas. Firms that successfully leverage social networks are doing so to engage their communities in conversation explicitly to tap into their brainpower and energy. They ask customers and followers to participate in brainstorming with them so they can learn how to be a better company, offer better products and services, or support the values and issues of the community"* [46].

This should be promising for the AEC industry as expressed by Moore (2011). Stated in the introduction of the thesis and in the literature review, there are numerous potentials for improvements, as there has been slow adoption of new technological approaches. Compared to the thoughts of Moore (2011), social networking should be actual tool to support the POP by integration and conversations.

One of these "distribution portals" is Facebook that has turned into a big business. To date the Facebook site is one of the leading and fastest growing brands in the world. At the age of seven and not being launched to the stock market it is currently 35th in real value of the world's firms, with growth of 246%. To date there are 710 million users on global basis, almost 200 million users in last year, and expected to become one billion in 2012. That means about one-seventh of the habitant of the earth are using this application [48].

LinkedIn is also paving its way as a professional networking site, with professional and interest related groups. It is seen "as more professional" than Facebook, and is utilized for example by its users to expand their network for the professional career. Headhunters also access this portal to find potential candidates for job hiring, and for professionals discussing issues related to their industry [49].

As there are tendencies of openness and transparency; people want and are getting used to access to data anytime, in easy-to-view with the modern technology [48], it should be beneficial for the AEC industry. However there are several issues stated in the implementations in the literature. It is argued that the AEC industry is two years behind others in implementing social media; as Carney (2010) interpretation of the current situation and stating:

> *"AEC industry is 2-3 years behind other fields in the use of #socialmedia. Referenced from statement made at last SMPS National Conference. I don't understand why the AEC industry is behind others in adopting social media tools. Some of the smartest folks I know work in this industry. The very people who could grasp the game-changing power of social media platforms are choosing to ignore them or dismissing them as a fad."*[50]

There have been listed some of the benefits and tendencies of the adoption of social networking in both as a marketing and as a collaboration platform. As following it should thereafter to be actual to view some of the functions and properties provided by those social networking platforms for its users.

Functional element's example from Facebook

To give an example of social-networking platform functions, it is been selected the most used portal to date and a portal that is understood to be rich in communications channels possibilities, that is Facebook. It will be referred to the function of other similar portals. This part is not expected to give an overall description of communications portals, but to give general description of the most common features and functions. It's difficult to define social networking. There isn't a global standardized definition, the main functions of Facebook will referred to as the seven functional blocks of social media from the paper: "*Social media? Get serious! Understanding the functional building blocks of social media"* [51].

The elements of these building blocks are: Identity, Conversations, Sharing, Presence, Relationships and Reputation Groups as shown in figure 17

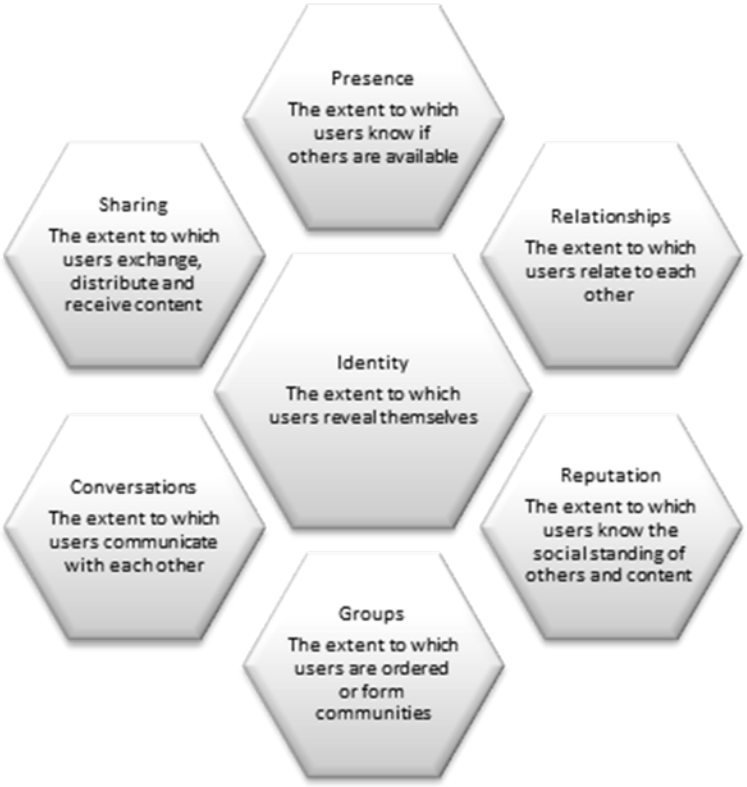


Figure 17: The functional building blocks of social media (Kietzmann, Hermkens, McCarthy, & Silvestre, 2011).

The Identity term is to explain how the user presents oneself as a profile. The identity on Facebook is where people can add their basic information like name, birth, gender. Many add their professional or educational information, marital status, religious and political view. Contact information like address location, e-mail, telephone numbers or personal websites are often found. Additionally, people can add their philosophical, personal comments and/ or other favorite quotations written by others. People can upload pictures and documents for one self to access or for other friends to view. People can add their pictures and other related material on your timeline. Status update is also to present the identity of the site profile.

This information is considered to be self-promotion while others like LinkedIn are more self-branding (Kietzmann et al., 2011). Reviewing the identity can be useful for the management when selecting actors for collaboration team or for viewing the actor's skills.

Conversations is the term that is used for describing how people communicate with each other in the settings of social networking. There are numerous ways to communicate on Facebook. Some of the most utilized communications channels are:

- Comment on other's people status, by writing text or push the like button on the site interface.
- Chat function where people can chat with a friend with instant messaging text, or through the groups feature on to many, which open up for many to many conversation. This is interoperable with numerous other applications, as Skype, Yahoo!Messenger as well as Windows Live Messenger.
- With plugin it is possible to add video telephony to Facebook that opens up channels for live FtF conversation, with audio-video signals. This function is only available for one to one conversation, while Skype offers up to ten profiles to participate at once.
- The news feed feature is when one of your friends or group members post on their status it will be brought out to you. You can then respond to the feed by "like," add a comment or simply ignore the update.

This means that it is possible to communicate one to one, one to many and many to many.

Sharing represents the ability of the site to serve the users need to exchange, distribute and receive content. Sharing is a connection between people, friends and groups that are gathered around an interest that they have in common. This could be like e.g. shared group interest and give this reinforcement for interaction or for the friendship between the users. On Facebook's site, there is possible to share objects like, links, photos and videos as well as your knowledge. People can also share media-related material that has been "liked" or copied and pasted link, for example, articles, pictures or other media related content.

Presence is the concept that is used to present if the users that you have to communicate with are present or not. On Facebook, you can easily see if people are online by a green dot symbol, then you have possibilities to communicate to the person in real time, or send him a message if he is off line. This presence can also be noticed with other tools like Skype, as those two platforms are interoperable in the term of status. If you are online on Skype, it is possible to reach to you from Facebook and vice versa. On Facebook, you are not able to give as detailed statuses as seen on Skype see figure 18, but it is possible to limit your presence to selected friends or not at all to the other members.

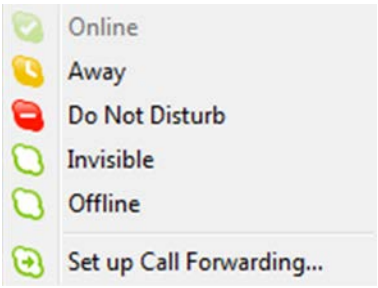


Figure 18: Your presence status on Skype

The concept of presence can be brought into deeper definitions, and seen by the author to give some fundamental issues about how people communicate via mediated tools like Facebook versus FtF.

Social presence theory, [41] (attributed to Short, Williams, & Christie, (1976), states that media differ in the degree of ‘‘social presence’’. That is the level of awareness or degree of the other people in form of acoustic, visual, and physical communication contacts. This theory has influences that affect the communication, like intimacy and immediacy. Interpersonal contact like FtF is predicted to have more intimacy than

mediated. [41] Another theory that is related to presence is closely related to the idea of social presence in the concept of media richness. Media richness theory (Daft & Lengel, 1986), emphasizing the goal of communication is to reduce ambiguity and uncertainty. It states the importance of richness of the media to bring a rich amount of information in a given time interval as media can differ in the degree of richness. The presence concept could also be useful to view the persons that are present in the network, as e.g. on Facebook there is often information about the personal life of the individual. On LinkedIn, it can be useful to review the skills of potential team member, and how he presents his character on his LinkedIn "CV.". In addition, this presence could be useful for the management, if people post their activity and current status of the work. Working methods like the Scrum method where one of the procedures is meetings, where people update each other by FtF meetings. This meeting can concern their work for coordination and to synchronize the working process. As it isn't always possible for the team member to be co-located at the same time, this could be a useful feature in managing the process.

Relationships represent the extent to which users can be related to other users. On Facebook you can view your friend's friends. That is how many and the name of the person. From there it is possible to view the friend, friends, etc. there is also potential to see how many friends people have in common. Relationship on Facebook can be suggested by others, to add a new friend that the person thinks should be part of the individual's friendship circle. Adding a new friend is done by sending request to be accepted, rejected or ignore.

This can also determine the what-and-how of information exchanges between users, on Facebook; there are possibilities to filter information dependent on relationship. For example, when people update their status, it is sent out to the person's friend as a Newsfeed. This can be disturbing; therefore, it can be relevant to put up a filter to limit the amount of information received, and if wanted limit the status update's news feed to certain friends whom you want to follow.

Reputation is the term for the extent of how people can identify the standing of others. This reputation is how people communicate, and their history on a social-

networking site. It can be difficult to determinate the conversation, therefore, the reputation is built on ethics and trust. The reputation can be affected by others by “likes” or by comments. On LinkedIn, the reputation can be supported by practical endorsement from other actors. For firms that want to be noticed it can be beneficial to have many followers. Facebook has a filtering function on considered bad reputation interaction, like limiting information sending to a person that has been added to restricted list, or even remove a person from your friendship list.

4 Theoretical framework

This section will give the reader a background on the theoretical framework that has been adopted in guiding the data collection and analysis of the findings.

This part of this thesis will be largely built upon Orlikowski's Structurational model of technology (SMT) and boundary object theory originated from Star and Griesemer (1989). Orlikowski's SMT draws concepts from the work of Anthony Giddens (1984) structuration theory and aimed to expand the view of the determinists as she considered the either view to be incomplete in technological research. The determinists focused upon either the objective approach of technology research or as the social view on the subjective view of the human factors affecting the technology. By that understanding her new model was intended to give insight into the limits and opportunities of human choice, technological development and utilizing, and organizational design. As stated in the introduction there is both the subjective view of the BIM technology. The reason for selecting Orlikowski SMT model and boundary object theories is the fact that the technology has created gab, as is stated that the humans do not follow or adopt the technological possibilities as the technological solutions is predicted to solve. As BIM is stated by Smith (2011): *"Not a technical problem – cultural"* [13] as another definition of BIM define: *"BIM is not a thing or a type of software but a human activity that ultimately involves broad process changes in construction"*[34], in addition the interaction between human and technology in R&D have been evolving in Information system research from the positivist approach to the subjective interpretivism [19]. This human factor interacting with technology is interpreted by the author to be well defined by Orlikowski (1992) and giving broad framework that is very adoptable for this human nature research approach, that cover elements of organization, technology and the human factor from various angles.

4.1 Giddens Theory of structuration (ST)

To digest the SMT theory it is necessary to introduce some of Anthony Gidden's historical statements and concepts that constitute the ST, on which Orlikowski (1992) builds her theory.

His theory was in few words challenges the philosophical determinists of the objectivist and the subjective approaches of understanding the reality. Giddens proposed an alternative meta-theory that incorporates both dimensions. Neither can exist without retrospective influences, but as interaction between those two elements. His approach is briefly described as human (often stated as human agency with capacity properties) built structures and structures affect the human behavior, in an ongoing process. A structure is part of the social system, which deals with the structural properties. Structural properties are then rules and resources that agents utilize in their interaction. These rules are shaped by human actions and at the same time shape the human action, in that sense the separation of those two elements cannot exist presented by the view of determinists. Therefore it was needed for the new dual view of the interaction between the view of the subjectivist and the objectivist.

This structuration's process is described by the concept of: knowledge and reflexivity. That is the human stops and reflects on an example of the situation or its action and has the opportunity to change the pattern by meaningful communication. Double hermeneutics is a valuable concept that describes two way communication [52]. Those changes become established as standardized practices in organizations, that is then in an ongoing process of transformation that challenges the structure by structuration. This is a short presentation of what is defined as the new paradigm of researching the interaction between humans and its products and emphasize the importance of adopting research paradigms of both categories of subjectivists and objectivists [53].

> *Instead, the social and the material are considered to be inextricably related — there is no social that is not also material, and no material that is not also social* [1].

4.2 Orlikowski's Structurational model of technology (SMT)

Orlikowski (1992) presented SMT to re-conceptualize the notion of technology and to reformulate the relationship between technology and organizations. This new framework was constructed to support her study of information technology and organizations. The research was conducted with focus on the development, usage and implementation of the information technology in organizations. Earlier research scopes have either "black boxed" the technology or the social factor, that is ignored the retrospective context and interaction of those two elements (Orlikowski, 1992).

That view of the historical role of technological research has Orlikowski (1991) stated the research and development to be threefold:

1. "The technological Imperative model", where the technology was in focus and organization and the social "black boxed'" as there was not predicted that the technology would affect the organizational properties and its structure, see Figure 19 A.
2. Is the human aspect of interpretations and interventions? See Figure 19 B
3. The "Soft" version, where technology affects the organization but is moderated by humans and the context of the organization figure 19 C.

Those three research categories states Orlikowski as “false dichotomy” of either subjective or the objective view of the technology.

> *That is, technology is physically constructed by actors working in a given social context, and technology are socially constructed by actors through the different meanings, they attach to it and the various features they emphasize and use* [53].

The elements of SMT (Orlikowski, 1992) comprise the following components:

- Human agents-technology designers, users, and decision-makers;
- Technology-material artifacts mediating task execution in the workplace;
- Institutional properties of organizations.

Those elements are shown in figure 19 and further utilized in next chapter of analysis and discussion.

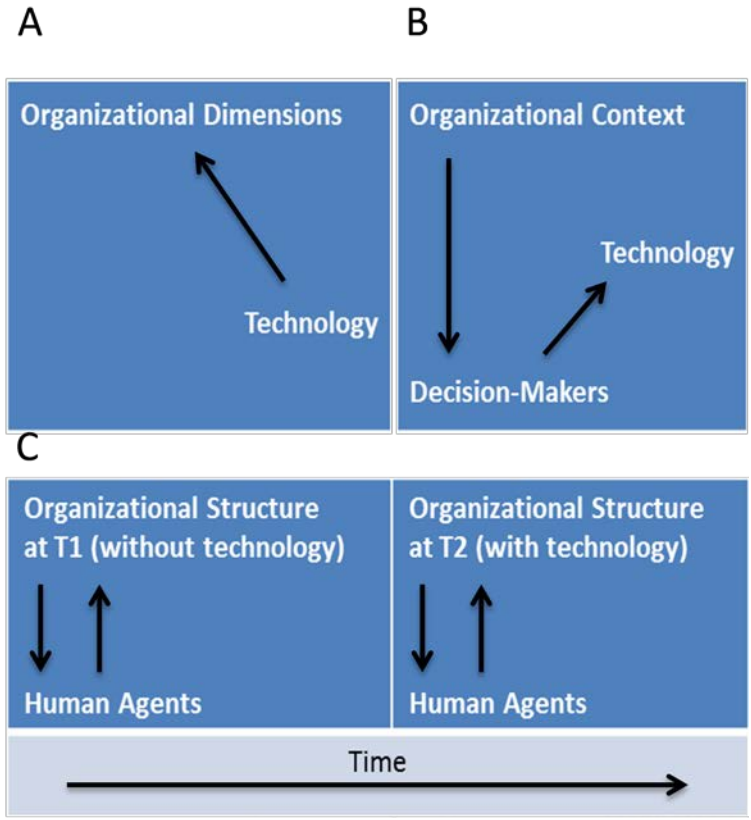
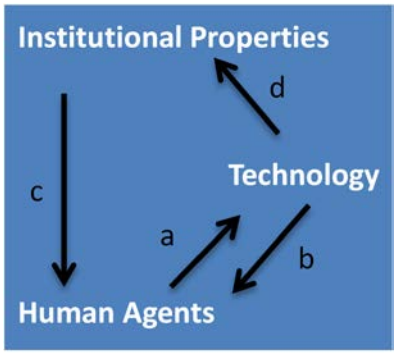


Figure 19: Three streams of technology research (Orlikowski, 1992)

A. **Technological imperative model**
B. **Structurational model of technology**
C. **Model of Technology-triggered Structural Change, Orlikowski (1992) citing Barley (1986)**



ARROW	TYPE OF INFLUENCE	NATURE OF INFLUENCE
a	Technology as a Product of Human Action	Technology is an outcome of such human action as design, development, appropriation, and modification
b	Technology as a Medium of Human Action	Technology facilitates and constrains human action through the provision of interpretive schemes, facilities, and norms
c	Institutional Conditions of Interaction with Technology	Institutional Properties influence humans in their interaction with technology, for example, intentions, professional norms, state of the art in materials and knowledge, design standards, and available resources (time, money, skills)
d	Institutional Consequences of Interaction with Technology	Interaction with technology influences the institutional properties of an organization, through reinforcing or transforming structures of signification, domination, and legitimation

Table 7: Structurational model of technology (SMT), (W J Orlikowski, 1992)

4.3 Boundary object

Star and Griesemer (1989) originally introduced the concept of boundary object and stated that creation and management of boundary objects are a key process in developing and maintaining coherence across intersecting social worlds. They defined boundary object as concepts or artifacts that reside in the interface between organizations when groups from different worlds work together. Boundary object has been defined as flexible, robust and adaptable enough to serve as a common reference point for organizational members with mutual objectives and aims, when engaged in collaboration and communication. These objects have different meaning in different communities of practice. The structure is common enough to more than one community, and acts as an anchor or bridge [54]. Star and Griesemer (1989) have listed four types of boundary objects:

1. ***Repositories*** *which are piles of objects that are indexed in a standardized fashion such as a library or museum.*
2. ***Ideal Type*** *which does not accurately describe the details of any one locality or thing but is abstract and vague and therefore, adaptable, such as a diagram or atlas.*
3. ***Coincident Boundaries*** *which are common objects, which have the same boundaries but different internal contents, such as the political boundary of the state of California.*
4. ***Standardized*** *Forms which are standardized indices that serve as methods of common communication, such as forms.*

Boundary objects are part of the information infrastructure to satisfy the informational requirements between several communities of practice as a classification [55]. This is quite difficult to define the term, as boundary objects have different meanings, purpose and for different people as terrain on which conflicts and collaboration occur [56]. Since they presented the concept of the boundary object it has been used in the different collaborative IS research and Information science. The concept of boundary objects has been related to different context as to design teams, new-product

development, knowledge brokering activities, production and manufacturing systems, implementation of information systems, boundary spanning activities and IS developmental projects (Gal, 2008; Lee, 2007).

Boundary object can be contracts to regulate the roles, allocate responsibilities and to lay activity plans, and act as a "social lubricant" that enables fragmented or disjointed parties to work together. Boundary object creates space where organizations can develop reciprocal social practices. Reciprocity implies that organizations are able to cooperate without sharing the same meanings to their work, actions, and communications or to the artifact, they share [40].

The necessity for classification has been challenged and is predicted to be limited and, in summary, boundary negotiating artifacts embrace chaos. These are elements listed by Lee (2007):

- *Are surrounded by sets of practices that may or may not be agreed upon by participants;*
- *Facilitate the crossing of boundaries (transmitting information);*
- *Facilitate the pushing and establishing of boundaries (dividing labor);*
- *May seem ''effortful'' in use as opposed to effortless;*
- *Are fluid: (1) a boundary negotiating artifact can change from one type to another when the context of use changes; and (2) a boundary negotiating artifact can sometimes also simultaneously be physically incorporated or transformed into another artifact;*
- *Can be largely sufficient for collaboration;*
- *Are possible predecessors of boundary objects* [57].

This is by no means the complete overview of the elements of what is being attributed to boundary object. It should be seen by the author that there is a different view on the concept "boundary object." These examples and more are listed in appendix that is

working sheet to gather literature regarded to the concept of the boundary objects. It is by no means possible to review the complete literature and relate it to this thesis in detail; therefore examples were selected from a list of some of the elements and attributions of the boundary objects from the theories.

5 Analysis and discussion

This chapter presents the result of this thesis, i.e. empirical evidence and results from the empirical research, was analyzed and discussed. That is the primary, and the secondary data collected through a survey and interview will be structured into the theoretical framework of Orlikowski's (1992) SMT, and notion of boundary objects.

This analysis and discussion aims to investigate the possibilities and the challenges that social networking have in the context of AEC industry. Orlikowski (1992), states that the technology is "*inanimate if not given meaning*" for the organization. Similarly, in this chapter, I focus on analyzing the meaning of social networking in the AEC industry. If it doesn't have any meaning it will not come into existence, that is it will not be utilized by the actors of the AEC industry. Meaning is subjective and related to human factors, as stated in the methodology chapter two, therefore, the aim of giving examples of the challenges as well. The analysis and the discussion chapter should therefore have been seen as from the actor view as Arbnor & Bjerke (2009) describes the process as *construction of data*, that is *impregnate* with theory of Orlikowski and boundary objects. This should be understood as the subjective view of the authors aims to gather the collected data and put it into the framework of Orlikowski (1992) SMT and boundary objects.

Orlikowski's (1992) SMT is thought simply as a guideline and inspiration, it is by no mean the aim to reflect on her model; it is only utilized as a framework/paradigm to guide the writing for increased understanding of the synthesis of those two phenomenons of social networking and AEC industry.

The aim of this thesis analysis could be to support this view of discussions member:

> *"By arriving at a structure for communication early in the project based upon well-defined project outcomes, a team can spend less time on trying to communicate and more time communicating" (Person 5, Appendix 8.2.1).*

5.1 Technology is the product of human action (a)

The hammers do not reproduce automatically…

The first element of STM states that the technology only comes into existence through;

- Creative human action;
- Sustained by ongoing maintenance;
- Adoption and usage by human agents.

The interaction and influence of the humans with the technology is twofold, design mode and use mode. The previous concept is aimed at the process of designing the technology. Secondly, it is the humans' interaction with the technology [53]. The thesis aim is not to design a new social-networking site, but to investigate the challenges and opportunities that existing social networking have for the AEC organizations.

In general, the existence and construction of social networking as its name indicates is a social as well as a technical phenomenon. Social is the population of humans that is connected to a network that connects and transforms information with a technical artifact between the users who compose the element of social networking. This transformation is a flow of information that is termed as User-Generated Content (UGC). Without the UGC there wouldn't be a need for the technological structure. Social networking wouldn't be much without its users, in that sense; social networking exists only with human interaction and sustained as such by adoption and usage by human agents, as Orlikowski (1992) states it:

> *"Technology is deployed in organizations but remains inanimate and hence ineffectual unless it is given meaning and is manipulated-directly or indirectly-by humans. On its own, technology is of no import; it plays no meaningful role in human affairs. It is only through the appropriation of technology by humans (whether for productive or symbolic ends), that it plays a significant role and hence exerts influence. It is only through human action that technology* qua *technology can be understood"* [53].

It has been stated earlier in the thesis that social networking is utilized in great scale on a worldwide basis both in the terms of degree of usage and also the number of human profiles. Even though the adoption is still limited in the AEC industry, and the initial design of social networking were in many cases not aimed to the industry, there are clear indications that social networking is emerging in the context of AEC industry. For example, an answer from my interviewee gave indications of adoption of social networking in the AEC industry:

> *"We do communicate both internal and external FtF, but also we use Skype. I use Skype, e.g. I collaborate with actor in Copenhagen, and we have collaboration's partners in Norway with the same artifact. It works quite well, to say… …Yes, it is remarkable how easy it is to get in contact to persons, and it saves a lot of time.*
>
> *It is rather clear that there are many opportunities associated with this new media, and we are already using those media in some degree. We have a homepage to broadcast fresh news related to the firm. We use also LinkedIn and Twitter to give status update and relate to articles of the firm. We are going to have been meeting to discuss the possibilities of using the homepage as a central point for the information flow, were we can gather those media into one place. From there is should be possible to share information to Twitter and LinkedIn." (Appendix: 8.1.1)*

This emergence of social networking is also evident in the survey result see Table 8.

This usage of social networking is limited to intra-organizational communication and not at the stage of being bounded the inter-organizational communications. Alternatively, what might be defined as boundary object among communities of practice, as defined by Star and Griesemer (1989)?

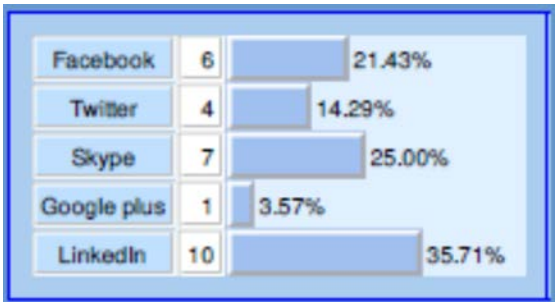


Table 8: Response to the question of social networking channels use in work related situation (Appendix 8.4.).

However, there is this indication of social-networking being utilized in the AEC construction process, this could also indicate the bottom-up implementation that supports the view of Orlikowski (1992) and how human action can support the implementation and adoption of social media:

> *"Through the regular action of knowledgeable and reflexive actors, patterns of interactions become established as standardized practices in organizations, e.g., ways of manufacturing a product, coordinating a meeting, or evaluating an employee. Over time, habitual use of such practices eventually becomes institutionalized, forming the structural properties of organizations"* [53]

This could indicate the initial stage of the social-networking adoption that could be later given increased meaning as boundary object. That is an artifact that can bind inter-organizational communities together. To do so Orlikowski (1992) states the need for shared meaning of the technology (social networking). If the above example of social networking is generalized to be not adopted properly in the AEC industry, could the reason be the lack of shared meanings of the possibilities of the technology, lack of norms or simply it the technology itself is not beneficial for the human agents? Therefore there is a need to view the opportunities and the challenges.

Therefore, could social networking give meaning and opportunities as boundary object if it could support?:

- Improved interaction between AEC industry inter-organizational collaboration
- Knowledge sharing
- Implementation of BIM
- Integration

Improved interaction between AEC industry inter-organizational collaboration is considered by the author to be a central aim to give meaning to social networking. What are the potential benefits of social networking to facilitate the communication? A response from the survey gave this additional comment:

> *"I think the creation of project groups within a social media site could be a fast and efficient method of communicating common information to all*

> *team members instantly. It could be a better method than routing emails to various team members."(Appendix: 8.3)*

As described there is a forum that is available for all the members to view and comment on. This can create dynamic conversation unrelated to time or space. That is the conversation can occur without being physically co-located, as well you have time to reflect to a different view in a more spontaneous manner than routing e-mails. E-mail can of course have the ability to be sent with group mail, but the overview is more trivial as the conversation is shattered into multiple data files. The conversation is a forum that makes it easy to follow the conversation and comment. As I commented in the discussion of social networking on LinkedIn:

> *"Discussion can be through social media: Social communications are often better than email, because they discourage attachments and informal decisions" (Appendix: 8.2.1)*

This could be understood or interpreted by the routing of information that are attached to e-mail message can result in duplication of data files as the original message is not automatically deleted. Reworking or duplication of files can cause considerable waste. Even though it is common to store data files in databases, there can be misunderstanding, or lack of an overview that can be solved by articulation of conversation. That is asking, or telling the team about related document production. The informal decisions could be understood as taking decision on their own, that have consequences for the whole team. As a construction case is a combination of teams producing a project, there are often intersections or Booleans of elements that are in the process. Changing one element affects the others actors work. In this discussion, it can be relevant to bring in the ability of social networking as boundary object to connect different organizations or as Lee (2005) claims a boundary negotiating artifact. It has been used as pre boundary object to negotiate for project solutions as different communications platform, databases, for example, communication platform, construction elements, time schedules, etc. This could increase the meaning of social networking, for example, adopting Facebook as an initial platform, then to find another even more suitable platform after negations of the participants. That is human

action that influences technical adoption or implementations of ICT as well as **BIM solutions** with related standards and other technical solutions, that is needed for the AEC process. In that sense negotiate what tool to use, and **share knowledge** for utilizing those elements that could be and have been defined as boundary objects for inter-organizational collaboration.

The survey indicates the willingness to share their knowledge in a form of providing support between social worlds. This knowledge sharing is dependent on the openness and the willingness to share the knowledge. The survey (see appendix 8.4) indicates that the respondents are ready and predict themselves to be allowed to share knowledge and support inter-organizational by the employer. In addition their prediction of the current communication is characterized with openness. The survey also indicates their willingness to step out of their identity even though it is not in the contract for inter-organizational support; people are willing to give help for providing ICT support. This could indicate that there are fundamental conditions for utilizing social networking at the same time the prediction of the best tool by the survey result to improve the collaboration is by using 3D/BIM model. One comment from the survey indicates the view of change of the current situation:

> *"A new way of doing "Projekt web" based on open standards and social media (web 2.0). I would love if one day we could have a free alternative to byggeweb supported by the government"*

This indicates there is some willingness of the humans to affect the existing technology, by viewing new alternatives.

Integration as mentioned in research context and literature review is noted as recent approaches for harnessing the social intelligence of the AEC industry actors. Therefore it is the question, if social networking could support this aim? The response from the communication expert that was interviewed states the possibilities of using web application for the dialog between the stakeholders. Mentioned LinkedIn and developed in-house solutions, for brainstorming or knowledge sharing, as well the need to make business and marketing consideration before selecting tools to use 8.1.2. This is interpreted by the author to negotiate the portal to use for the communication.

To do so there is the suggestion to use Facebook, as it is the most common portal, thereafter the team could negotiate to the portal to use. In house-solution would probably cause great filtering of those not familiar to the system. The survey indicates that the industry is composed of many small firms see table 9. In addition of training issues of those portals the dynamic networking nature of the AEC industry causes new connections as a new task is created. Those factors are predicted by the author to greatly diminish the adoption of in-house solutions the portal.

Table 9: The participant's firms size in the survey by numbers of employees (Appendix 8.4.).

In general, the idea of shared meaning can be difficult, as Orlikowski (1992) states "the appropriate technology by assigning shared meanings to it." This notion is greatly challenged with collected data from the discussion on LinkedIn:

- "Public social networks are for sharing pictures of your cats (or handbags), chatting about last night's soap opera or generic business discussions like this one" (Appendix 8.2.1)
- *"The Facebook image is more based on sharing amusing experiences among friends and the family, etc. by posting videos, pictures, and comments"* (Appendix 8.1.2)
- *"I DON'T FEEL FACEBOOK IS THE PROPER CHANNEL FOR THIS PROCESS. TO FACE BOOK IS MORE PERSONAL I THINK LINKEDIN AND TWITTER IS A BETTER CHANNEL" (Appendix: 8.3)*
- *"One should be social and the other professional" (Appendix: 8.3)*
- *"In Finland generally, Facebook and Twitter are considered mainly as private media, not work related. However, there are other tools that have more work-related status. Furthermore, in some software's these are combined, for example. Start page is extranet*

page for users, etc. That's of course where narrow scope, but as an idea seems to work" (Appendix: 8.3)

- *"Worthless" (Appendix: 8.3)*
- *"It is superfluous. currently E-mail works as this communication tool" (Appendix: 8.3)*
- *"Yes, it is true, as this site is used for leisure and amusements. I can easily understand that people get annoyed if there are too many announcements on the portal, as this is more for leisure. Maybe this is just how you conceive this" (Appendix: 8.1.1).*

Appropriation of the technology is then challenged as there are distinctive meanings; as well, there are different meanings about various portals. It is the author's interpretation of that different view of idea supporting comments as the rejecting one that there are both opportunities as well as challenges. This could also reveal the view of mixing business with pleasure. That is you are introducing your individual private data and behavior into the context of your work. In that sense, you are dragging your personal habits of utilizing as e.g. Facebook into the work site, as well as inviting your work into your living room. This is an exciting dilemma of the blurring of the private and professional life in increasingly transparent exposure by the social networking. It is evident, as the artifacts are becoming to an increased degree interoperable and the access to data is not dependent of place or time. For example, you can easily access your working data from your personal home computer, laptop or smartphone. The need for humans to control the content and as e.g. interruptions it is therefore predicted to be the bearing structure, and demonstrated by Orlikowski with the "a" arrow, introduced on her SMT. The survey gave clear indication of the notion of the participants of the privacy issue, as the majority had concerned about the blurring of the social and the working life.

The human aspect is also evident in the design mode that is the possibilities of the users to create additional applications to the media. Facebook gives e.g. opportunities for giving the technology even more sense by altered to individual use that can give

meaning to others by accessing the developer's area. This is although interpreted by the author to be a little progressive. The user has also the opportunity to alter the media, with security and privacy settings, that are predicted not to be as advanced as creating new application or programming with PHP scripting language. This could be related to the boundary object that states the flexibility importance:

> *„It is not wise to make Facebook's site yet as Facebook of thing; as it has is not approved by the Facebook Inc., and they could close the profile. Then it would be possible to make fan site, but it has security limitations as either being completely open to everyone or the management of members is controlled by all members. It is also possible to control the members by geological placement. Groups have the limitations of data sharing, and it is impossible to add group into the group, which means issues of management of the conversation. It is also possible to overcome some of these stated issues by skilled programming Google+ would better shout to solve these problems"(Appendix 8.1.3).*

As mentioned above, the technology of social-networking is emerging into the context of AEC industry with mixed emotions and different meanings as well as technological disability can hinder the adoption of social-networking.

This could then answer if Facebook is the right tool, as there is soon predicted to be 1 billion users on a worldwide basis. At the same time, the focus is upon BIM, where the structure is rather abstract. In contrast, if the users are not willing to use the portal, it will not come into existence. This dilemma of a boundary object is then as stated by Larson (2003):

> *There is quite difficult to define the term, as boundary objects have different meanings, purpose and for different people as terrain on which conflicts and collaboration occur (Larsson, 2003).*

This is true in the context of the survey, there were different meanings, do people then don't have to agree to use e.g. Facebook?

When asking the question on the survey (appendix 8.4) what could possibly be challenged for the adoption of social networking, the response indicates several different factors. The tradition plays an important role. This tradition could be related to the POP that is processed, product and the organization. The process can be briefly described as the survey response to the current business model indicates seen on results of my survey where the DBB is in 40% of the cases (appendix 8.4). The DBB has been used as an indicator for the fragmentation of the organizations that have resulted from the disability of the AEC industry to follow other industries in efficiency and effectivity that have caused the bad quality results.

The response to the question if there is **lack of knowledge of utilizing social media,** there was not as strong indication as the tradition to implement the social media. It although indicates some element of concern. This is interpreted by the author as a surprising result; however, it should be seen as interpretation of the LinkedIn participants that are already on a social-networking site. And therefore it should be interpreted as their view of the "others" in the industry. This can be influenced by the factor of their egological position, with the interest in the BIM methodology or technic, as described earlier can cause frustration and shape their view that exposed boundary objects to be considered a complex task to implement (as stated earlier expected ready in 2016). According to the survey, there was a surprising comment of not using LinkedIn where the survey was launched on, another vice; there was a clear sign of considerable usage of Facebook and LinkedIn, while Google+ and Twitter indicated lesser usage.

Concern for **overload of information** is also a factor that could hinder the acceptance of social networking. This is predicted by the author that there is a need for indexing the information into categories. That could be done by grouping the actors, the phases or the data into appropriate themes.

The **disturbing factor** of social networking is predicted to be neutral, that is there are both concerns and the view of not having an impact. My interviewee worked at an architecture office responded to this element as follows:

> *"No, but we have made some considerations in resent meetings. We want to communicate as smart as possible. E.g. it could be vice to control the e-mails in certain time of the day. That is to save time due to the interruption of workflow and working rhythm. Checking e-mail could then be in the afternoon, and the morning time could be more concentrated to the actual work. However, in general, there is better to contact a co-worker to gain needed information instead of using time consuming methods of finding the information by on your own. This is up to you". (Appendix 8.1.1)*

The survey participants responded to the question statement; **if social media would not change the process?** The results indicate very different meanings. This could, in fact, symbolize the challenge of the implementation process that is the challenge to convince the actors of the benefits and the opportunities of usage.

They responded to the question, if **social media could support the collaboration of the team to find solutions,** and there were clear indications of improved possibilities for the team. This could indicate that respondent's see the opportunities of social networking to improve the process.

The difficulties of the team to come to conclusions are neutral. It is easy to make the conclusion of the difficulties of increased democracy in the AEC process. However, the author's opinion is that every democracy has its leaders. That could be expressed with my view of the project manager that should make the decisions, or the owner and the buyer, depending on the process chosen. This in turn gives the decision makers unique opportunities to follow the discussion on the portal, publishing his opinions as well as the challenge for the manager to deal with the democracy that in turn could have an opposite meaning.

The **difficulties of choosing the right media** question states the concern of possible disagreement of which portal to choose. This is in the author's opinion, and has been reviewed earlier as the initial chose of the team to select the most common media to negotiate for the appropriate portal for the task.

As mentioned above the **willingness of knowledge sharing** is positive by the actors who answered the question if they were willing to share knowledge. On the other hand, their opinion of the others to share knowledge is more blended, although having slightly higher on the positive side than on the negative unwillingness side.

The **notion of the possibilities of social media to improve the communication among stakeholders,** there was in general the view that the new approach wouldn't improve communication. This indicates either the technology does not belong to the AEC industry; existing technology is capable of serve the need, or lack of knowledge of the possibilities of social networking.

During the usage of the social networking, **the aim of keeping the stakeholders active** on the portal was predicted to be challenge. This states the importance of choosing the right media. As predicted by the author, if choosing the media that is not in the custom of the actor will greatly diminish the usage. Selecting a portal that is known to the actor, as well as amusing, and practical, is predicted by the author to support or increase the usage of the actor of the social-networking site.

The view of **no communication rules** issues; there were clear indications of the participant's opinions of the need to keep it structured. This can mean there is a need for evident rules for guiding the conversation on the social-networking site. This is interpreted by the author to diminish the dynamics, the creative flow and the interaction on the portal, and the AEC construction industry is stiff enough. On the other hand, it is the author's opinion that some form for ethical guidance is needed if the organization is not self-regulating.

Discussing the **integration** and the meaning of social networking is dependent on the willingness and the need for the integration itself. That is what the scale of integration is, and who are supposed to be part of the construction process. In the traditional DBB; there are sequences of collaboration patterns. This could diminish the meaning of social networking, as the process is sequential with distinct collaboration team's dominations dependent on different phases. These phases are defined as traditional could affect the view of possibilities of social networking to be an open collaboration platform that could give all the actors access to the information flow. As one of my

interviewees responded to the idea of giving the owner access to the process from the beginning of the process to the end:

> *It is a very different degree of how the owner wants to be involved with the construction case (Appendix 8.1.1)*

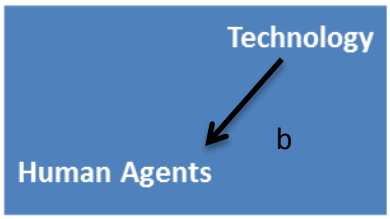
This analysis indicates that there are very different meanings of social networking in the AEC industry, the possible explanation is limited adoption and use of social networking in the AEC industry. That could limit the knowledge of the opportunities of social networking. It is the opinion of the author that the ideal situation of shared meaning of social networking is an illusion and futile effort as the AEC industry is composed of broad range of heterogeneous actors ranging from non-professionals to highly skilled professionals. Therefore the view of Lee (2007) of a boundary object could be appropriate when implementing social networking for inter-organizational collaboration:

> *"Are surrounded by sets of practices that may or may not be agreed upon by participants"* [57]

This can be seen as challenging the view of Orlikowski (1992) of the shared meaning of the technology, as it is interpreted by the author to be almost impossible to have the same meaning of the communication portal to use.

5.2 Technology is the medium of human action (b),

When technology is used it mediates their activity. Having a hammer in the hand will mediate and facilitate the performance of certain type of work, like nailing. However, the hammer cannot determine you to use it [53].



The interpretation of Orlikowski's (1992) statement of the *"technology cannot determine social practice"* is the philosophical view of the bottom-up process. It is people's free will to utilize the technology as "chosen." On the other hand, the technology as stated by Orlikowski (1992) does create certain conditions. As this thesis' aim is to investigate the opportunities and the challenges of social networking, the focus will therefore be on the analysis of possible condition changes that social networking can have on the human agents.

What are the current conditions and what kind of condition can social-networking cause in form of opportunities and challenges?

Uri Gal has pointed out in his thesis "*Boundary matters: the dynamics in boundary objects,*" the willingness of humans to step out of their elements or changing the identity to support other team members conditioned by the 3D model.

In this thesis, the theme is social networking in the context of AEC industry; can social networking creates similar conditions as stated by Uri Gal, that implementing boundary objects like social networking to facilitate conditions for improved collaboration? This thesis has investigated the willingness of the participants of the survey, to support other actors in an inter-organizational process. The result, revealed in previous section, indicates the willingness of participants to share their knowledge and support see table 10. The previous section also indicated there are different meanings of social networking as well as different meanings of different

Yes	17	89.47%
No	2	10.53%

Table 10: The survey participant's willingness to give inter-organizational support (Appendix 8.4.).

sites or portals. This section will pull this analysis forward by setting the focus on the technology and it potential conditions to facilitate the social practices as well as challenges.

From the broad perspective; the development of a medium to facilitate the communication is constantly evolving. There is hardly anyone that still transmits Morse code; the telefax is almost extinct; using e-mail for personal message is also a way out. A portal like MySpace is changing dramatically in character from presentation of personal profiles to more focusing on the entertainment industry; MSN that once was "hot" is barely used today, eventually partially hibernating for later entrance to the market. There are new entrants like Google+ has made an effort to gain users; more professional site tailored to the specifics purposes has been developed, like Projectplace. There are constantly being launched new portals and technological solution for humans to communicate. The aim with this perspective is to provide the dynamic changes that are constantly occurring, both in adoption and development of technological tools. Presenting this view of the author of that innovation and development of the technology is a process, and the implemented technology is not a static event but an ongoing process. Therefore, it could give meaning to view the opportunities of social networking to support the implementation of ICT solutions, discussed below.

Current communications channels used for professional interaction for gathering project data in the AEC industry were indicated in the table 12. This indicates that traditional forms for meetings, telephone and routing e-mails are currently mostly utilized for communication.

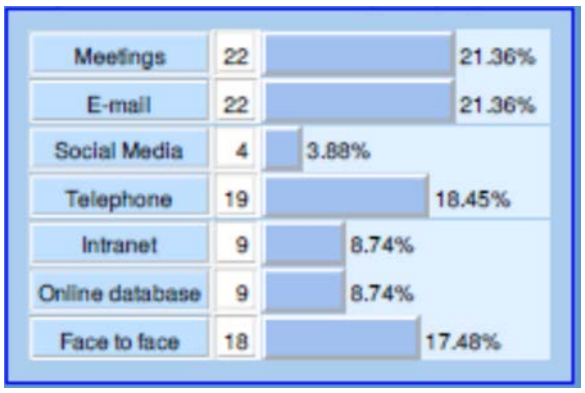


Table 11: The survey questions of data collections methods of actors in the AEC industry (Appendix 8.4.).

To mention a negative factor, it is the former statement of scattered data by Kiviniemi (2005). Although his statement is from 2005, it is interpreted by the author as the

current situation in the AEC industry and argued earlier in this thesis as well suggested by the interviewee:

> *"There is a whole lot of communication that is not to be found that could maybe be gathered in a better way" (Appendix 8.1.2.)*

This indicates the general suggestion for improvements. It has been further stated the conditions are not optimal; even though the technology could be defined as robust and well developed, it does not mean that it is or will be used;

> *"People do not seem to use it, cause of frightens of legal issues and shyness of people utilizing the possibilities of the portal forum"* (citation from informal discussion with a database vendor).

This greatly reduces the benefits of the technology as it reduces the usage of the portal, if the technology forces the social practices into trajectories of bureaucracy. This is supported with the following statement of need for understanding the role of the media, as well as potential paradigm shifts with the younger generation that is "*native*" to social networking usage:

> *"Yes, I think is because of pre understood role of the media, and what you can allow yourself to use the media. As with "Byggeweb," there are many concerns of the actors what they communicate on the portal. The actors strive to keep all the material well documented and verified, to prevent later issues that could make them responsible for failure. However, I think this will be different as the younger generation is used to work with distinct kinds of media at school, and it will be gradually adopted in firms"* (Appendix 8.1.1.).

It is obvious, if humans are e.g. frightened to use the portal, as because of making mistakes, it is considered by the author to reduce the usage, and related possibilities to harness the social intelligence.

These examples give opportunities to investigate the social networking as a boundary object to support the collaboration and give improved conditions. For that discussion

there will be reviewed social-networking alternatives. What can be done to reduce the negative sites as well as to view the positive site?

To reduce the negative factor of rejection of the technology, it is considered by the author to be wise to select the portal that has the greatest usage or the portal that people are at ease with, to get the broadest integration. That can be done as stated by my interviewee:

> *Before implementing SM for the AEC construction firms, there is a need to make business- and marketing considerations. That that concern what to tool to choose, Facebook, LinkedIn, Twitter or own systems. There is a need to take a look of the current business process and consider the firms communications strategies, target groups and how you want to catch them. That is giving the social media opportunities to be the collaboration framework to support business, development, brainstorming and knowledge sharing.* (Appendix 8.1.2)

Then it is the question, what portal to use? The survey indicates the usage of LinkedIn is the most common platform, followed by Skype and Facebook see table 12. However, when the participants were asked about what technology, they would prefer to use when supporting other's actors the social-networking score was low, while other possibilities of BIM and TeamViewer could be more appropriated for the support.

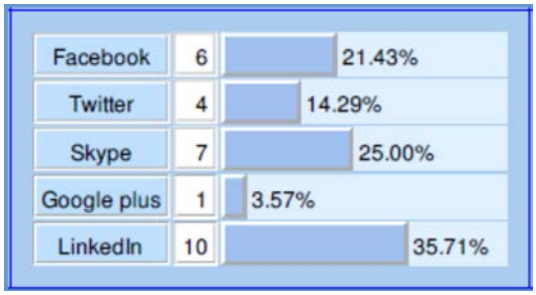


Table 12: An indication of channels used for work-related purposes; result from survey (Appendix 8.4.)

However, in general, the traditional FtF, telephone and e-mail dominated the communication both in private and working conditions.

Then again, there are those functional capabilities that should be considered. Shall we continue to use existing methods and artifact as e-mail, FtF and telephone? It has been stated in the introduction of the thesis that there is a need for improvements, and the

purpose of this thesis is to find new approaches to facilitating the communication among the stakeholders with the objective of innovation. The view of the author is not to reject existing technology, just to emphases the limitations and possibilities. These possibilities are stated by my interviewee that bigger firms are beginning to implement communications platforms that could also be supported by social networking:

> *"There are some of the bigger counselors' engineer firms that have made their own knowledge sharing's forum. As e.g. is the "brugernetwerket" (the user network). That is thought as an internal forum that connects external expertise actors to the network for discussing the art of engineering and future possibilities, etc. That could also have been locked forum on LinkedIn or Facebook. That could be a forum that could be utilized for brainstorming and knowledge sharing across time zones and without geographical limitations. This means for companies that have global activities gained new approaches that haven't been possible before" (Appendix 8.1.2).*

There are numerous possibilities in facilitating improved communication by managing the data on a portal that have the possibilities to make the interaction more transparent, and support for increased flow and collaboration between the stakeholders:

> *"I have also noticed that NCC has launched a program forum to facilitate and promote for integration and collaboration across competences as well as across organizational boundaries for product development. That is with a digital forum, to establish a dialog between the actors.*
>
> *LinkedIn is developing group forums that can be both open and closed and could be more business related. Where there is space to share knowledge and in higher degree more convenient for project management" (Appendix 8.1.2).*

These answers indicate that there is currently implementation of social networking. This indicates eventually initial implementations, as there are positive or facilitating factors related to those portals. There were also indications of optimistic possibilities

of the development of those portals, which could increase the acceptance and reduce the rejection of social networking:

> *"Yes I think there will be developed more application that is aimed to the AEC construction development processes. That is going to be a part of the digital construction. You will be able to have videos, 3D, plan drawings and other thing on the timeline to see how the construction grows over time. This will contain both data for the professional with knowledge demanding data and other that could be viewed by the official partners and other non-professionals. That is when it begins to be interesting when you can gather all the data into one single platform. To that system there could be e.g. webcam on the construction site, and the drawings from the architect, etc. by that it could be openness for all the shareholders" (Appendix 8.1.2).*

At the moment, the technological level of social, there could be a richness of different possibilities to communicate, video, blog, chat, sharing links, etc. This means that users have the flexibility to choose the channel that is appropriate for the communication. For example, if there is a need for support it is possible to; view who are online; ask question; and get the solution; alternatively, being redirected to ask one to many by publishing it on a social networking site, for all the group members to view. In that sense being a boundary object that; *"act as anchors or bridges"* [54] between different organizations to collaborate. These activities could be supported by Facebook, and then is the next question, is it robust enough to serve as boundary object?

> *"…robust enough to maintain a common identity across sites"* [54].

This shared identity could be the ability of e.g. Facebook to support inter-organizational collaboration to reach the organization's goal. Is Facebook robust enough for the AEC industry to maintain the collective goal for a construction case; *"support mutual subjectivities and aims"* [54].

There are several limitations, that have been stated earlier, as e.g. the lack of creating a profile of things as mentioned in 5.1 (appendix 8.1.3.), and creation of groups in groups. To serve as; ERP system is not reality yet; nor the method of indexing the

conversation by hash tagging and creation of metadata are as well as any connection to BIM model. Storing doc files are impossible although it is possible to create a doc. The division of data is then limited to e.g. the profile and timeline, to index the search. Creating new connection can be a trivial task, as there can be spam filtering on your request if you want to create a channel to communicate to a person that is not added as a friend. (It can although be positive as it filters out eventually spam posts).

There are ranges of applications or what is termed as twidgets that can be loaded into your Facebook site. Supporting or improving the robustness or the ability to serve as a common platform. Applications like Box.net, add E-mail application, if you have to send e-mail outside your circle of friend, calendar to remind you on work to do, document store applications, etc.:

> *"…I think there will be developed more application that is aimed to the AEC construction development processes. That is going to be a part of the digital construction. You will be able to have videos, 3D, plan drawings and other thing on the timeline to see how the construction grows over time. This will contain both data for the professional with knowledge demanding data and other that could be viewed by the official partners and other non-professionals. That is when it begins to be interesting when you can gather all the data into one single platform. To that system there could be e.g. webcam on the construction site, and the drawings from the architect, etc. by that it could be openness for all the shareholders. (Appendix 8.1.2)*

Additional applications or the widgets can be challenging in a maintenance process as replied by one of my interviewees; *"it can be very frustrating when Facebook makes updates, and changes the codes or the structure as it can deactivate the application."* Another threat to social-networking robustness is intellectual property protection, if the portal were too risky to communicate on without getting sued for sharing third party property.

Even though the possibilities and limitations have been referred to Facebook, or other common portals, it is in the author's mind not the issue of which portal to use, more the purpose of the social-networking site that is to improve the collaboration. The

development and adoption of new ICT solutions are in great acceleration, as the "Users" are getting better skilled to produce those applications, it can be difficult to select one particular platform. Therefore, could social-networking site as e.g. Facebook be ideal to select the methods, technology, actors and other content elements that are presumed by the organization to support the POP, in a manner of the attempted philosophical approaches of e.g. Lean and CE and pull desired solutions by negotiation.

This idea could be supported by the view of Lee (2007) of the boundary objects:

- *"Are possible predecessors of boundary objects"* [57].

This is understood by the author that social networking could pave the way for adoption of ICT solutions, BIM or whatever to be predicted by the team to serve the optimal process as a democratic process. The possibilities for all integrated actors related to the process giving access to the portal to express for example sharing needs, ideas and knowledge, views for the whole organization in a process of sensemaking.

In this sense in harmony with Giddens and Orlikowski philosophies or framework, that keep in mind the user's ability; the tacit force of the social intelligence to structure the POP with the facilitation of social networking.

5.3 Institutional conditions of interaction with technology(c)

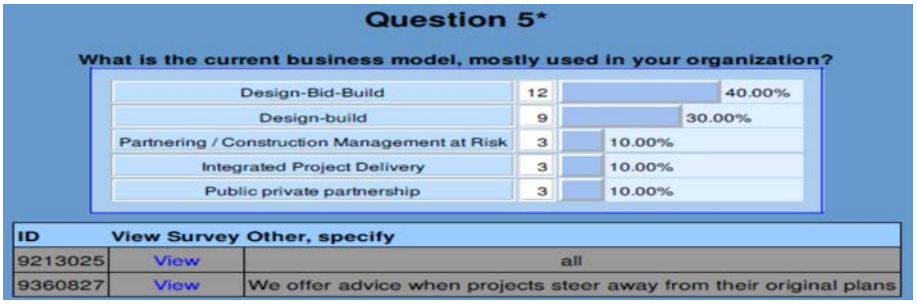
Organizational prescription how to use the hammer

To be able to view the big picture, it is in the author's opinion relevant to view Orlikowski (1992); "*institutional conditions of interaction of technology.*" These terms are describing the organizational condition that acts upon the actors in the AEC industry and in turn influences their norm to perform their work [53]. These conditions are interpreted by the author to have great influence on the opportunities to implement social networking as well as revealing some of the challenges that are conditioned by the institutional properties.

This part should be seen as more of a discussion than on analysis of the primary collected data. The author sees this as an opportunity to bring the thesis secondary data elements to be discussed and reflected as well with primary data collected. With the intention to create a clearer picture of the context and conditions in which social networking are gradually entering into. This is done with the aim to create better understanding for the opportunities and the challenges of social networking. By viewing the limitation of current conditions in the AEC industry as well as the opportunities it is interpreted by the author that those limitations can offer conditions that can give meaning to implement social networking.

In the introductory chapter and in the research context and literature review, there have been given descriptions of the AEC industry conditions. There have been reviewed the fragmented nature of the industry. The industry aims of improving the communication and collaboration between the actors by adapting philosophical methods from the "*other*" industries, e.g. Lean, CE and IPD (described in chapter 3.1.2). Reviewed developmental tendencies and pinpointing the understanding of the AEC industry needs for improvements. These elements will be reviewed shortly in gathered context with the primary data collection to discuss the conditions of the AEC industry, in which social networking is entering.

DBB is still dominating business process model, while the other industrial approaches as e.g. Lean and DB (described in chapter 3.1.1) have been adopted in much lesser degrees. Although it has been inspiring the AEC industry emphasis improved collaboration communication for long time. table 13 indicates the general overview of current business models in the AEC industry. DBB is seen as creating negative conditions for the collaboration, as it cuts up the process into sequences, turning the actors into "*poker players,*" and the project manager into "*poker dealer*" as stated by Uri Gal (2008).



Question 5*

What is the current business model, mostly used in your organization?

Design-Bid-Build	12	40.00%
Design-build	9	30.00%
Partnering / Construction Management at Risk	3	10.00%
Integrated Project Delivery	3	10.00%
Public private partnership	3	10.00%

ID	View Survey	Other, specify
9213025	View	all
9360827	View	We offer advice when projects steer away from their original plans

Table 13: Participants current business process model (appendix 8.4)

This creates a picture of the AEC industry that is seen as paradoxical by the author. That is both holding tight to DBB (described in chapter 3.1.1) for the process as well as adopting and being aware of more collaborative processes of e.g. Lean, CE BIM and IPD for many years. This could indicate challenges for social networking, as the industry is conservative and holding tight to the traditional approach of DBB.

Recently, the AEC industry has had considerable focus on solutions related to the concept of BIM, both from the objective view and the associated standardization, as well as the subjective view of the humans dealing with the technology. As the literature review states the implementation of new ICT trends as BIM, is a challenge, and not completed if understood to gather information from the stakeholders into the BIM model.

This can be interpreted as a relative process of success; however, there are indications of BIM being adopted to become a common indicator of ICT adoption in the AEC industry to improve the collaboration between the stakeholders see table 14, where

the 3D / BIM model is seen as the best solution as well as related standards to improve the collaboration.

3D / BIM model	11	57.89%
E-mail	0	0.00%
Telephone	0	0.00%
Meetings	1	5.26%
Social Media	0	0.00%
Online database	0	0.00%
Open standards	3	15.79%
Others specify	4	21.05%

Table 14: Respond from the survey, of what is predicted to be the best solution to improve the collaboration between the stakeholders in AEC construction process (Appendix 8.4.).

The issues related to the implementation of BIM are to get the process standardized, as e.g. noted by my discussion partners on LinkedIn (Appendix 8.2.1 Person 1, 2 and 5). This indicates the current industry and organizational influence to improve the collaboration. These conditions are further stated by my interviewee that predicts and sees BIM as a major factor to support the collaboration to fulfill the owner's requirements in a related construction process:

> *"This is supported and presented with the (BIM) model as a central point for the integration. By integrating the actors, there is possible to speed up the design and get it reviewed by the owner" (Appendix 8.1.1.)*

Related issues have been described, like lack of knowledge of the industry to handle the challenges, and in the meantime it is in the interpretation of the author of the thesis that the industry is in the status quo state. There is a great focus on BIM, but the implementation adoption levels are low, even though firms are equipped with the latest technology. The result of the slow adoption of BIM by the stakeholders could be indicated by table 15. This can either indicate that the client is not aware of the benefits of BIM or the client predicts

Poor	6	26.09%
Interested but don't make requirements	15	65.22%
Make demands of BIM deliverance for the facility management	2	8.70%

Table 15: Respond to the question of the client's awareness/consciousness of BIM, in general cases, to be? (Appendixs 8.4.).

BIM not to be ready yet. The client is eventually waiting for the technology to become standardized, in the term of interoperability between application and understanding the data translation with IFC and IFD standards.

This can be seen as an objective technological scope of *"hardware viewing"* as seeing the technology as "*the substitution of equipment for human labor*" [53].

When searching for a solution from the standardization work, by visiting the actual sites, pointed to the access that information was restricted. One of the participants joining the conversation; (Person 7, Appendix 8.2.1), argue for limitations of the international standardizing work presented on related homepages; difficulty to access data; badly updated data; and difficulties in understanding the data and further stated:

> "The IFD site and tech.ifd sites appear to be get even less attention (and traffic) than pages at bSI and bSI-tech sites. None of this is meant to disparage the good (and largely pro bono) work that many have done to improve quality and speed of information transfer and re-use in the AEC industry. These are just some observations that bear on the face that bSI projects present to the rest of the industry. The time lags in conveying progress, and (perhaps) the resulting lack of pressure that major software houses feel from end users" *(Person 7, Appendix 8.2.1)*

It is interpreted by the author that there are needs to view new opportunities for the industry to put the focus upon to create better conditions for the AEC industry.

There are new and additional approaches to influence the human agents, that is; social networking R&D for the industry. That is the focus and creating conditions for improved interactions to harness the collective intelligence.

The purpose of this view of the BIM is to expand the perspective of its limitations to provoke and consider approaches other than the 3D model / BIM to improve or support the POP. The reason is that the BIM technology and methods, to be utilized to its full potential, as well as related socio-technological issues indicated to be limited and the technological interoperability is not completed as well as its related standards. These issues make the AEC process dependent on human interaction.

This should be understood as the arrow "c" is indicating of the AEC industry/organization is unconsciously demanding or creating conditions that emphasize integrated approaches with BIM methods; that are not ready yet.

> *"According some comments, Finland is leader in BIM implementation. I've been working here over 10 years in company trying to push BIM knowledge to market and for example 90% of structural engineers work still in traditional methods (2d). Note! That's my opinion according my experiences. Public info may be different... (Appendix 8.4)*

This AEC institutional influence on humans and social networking is limited; there has been limited information to view. Although there seems there are some guidelines or standards to facilitate the different form of communication other than 3D/BIM.

> *For processes look at IDM (ISO 29481 part 1). For formal communications, Part 2 identifies the data structures needed. BS 1192:2007 contains the best thinking of using collaborative portals. (Appendix 8.2.1)*

The author gave up on finding these data, and predicts; if there are guidelines to support integrated holistic collaboration, then the access has to be open, and easily understood, to not be rejected or ignored.

This is just an example of how easy it is to reject the solutions, even though it might be the right one, and the author agrees with Orlikowski's (1992) statement of technology only comes into existence by the human using it.

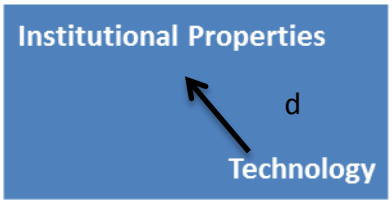
If it is not accessible or easily understood, there will always be limited usage. This will lead the discussion if this new type of communication can, with its emergence, change this environmental dilemma? This dilemma is predicted by the author that the organizational view is with the focus on BIM and ignoring other possibilities that could improve the implementation of BIM with integrated social intelligence by knowledge sharing motivated in the team to gain or reach the common goal.

These institutional properties that are acting upon the actors in the AEC industry are interpreted to be confusing. Being both conservatives stuck to old traditions as DBB, as

well as developing the collaboration in the direction of BIM, it is a diffused concept, difficult to manage, and not developed technologically in terms of standards. In addition, the author found no evidence of being the boundary object that can cover the whole community through a construction process at this stage. These limitations of BIM and what are predicted to be the industry's main aim in creating a condition for improved collaboration is rejected by the author. My arguments is there is a need to create conditions to investigate the possibilities of social networking, in addition from the bottom-up process as well as top down, as the conditions today give opportunities for viewing new approaches as social networking. This disability of common objectives for the AEC industry is considered to be great opportunities for social networking.

5.4 The institutional consequences of interaction with technology (d)

How the hammer affects the organization.



This section will as the former have greater emphasis on the discussion than analyzing the data.

When humans utilize the technology it acts upon the institutional properties. It either stabilizes existing structure, or it changes the structure. The latter is less frequent. The technology is seen as conditioned by the institutional properties of the organization, stated with Orlikowski (1992) who has adopted from Gidden's terms of "*signification"* (meaning), "*domination"* (power), and "*legitimation"* (norms) would be affected by the human's usage of technology.

This can be explained e.g. by the concept of BIM that is giving ("*signification"*) meaning for example by the concept to support the philosophical approaches of Lean, CE and IPD and/ or in terms of efficiency, effectiveness, collaboration and quality; ("*legitimated")* normalized with e.g. standards from buildingSMART or with national regulations; and by controlling ("*dominating*") the behavior of the users. These technological abilities of BIM can in fact support and reinforce the existing institutional properties that agitate the certain type of ICT solutions. Those institutional properties can be structured as buildingSMART, national supporting or regulating organizations.

The duality of *socio-technological structurational interaction* takes into account that the human does not always follow the rules and by therefore transforming institutional properties; for example, the digital deliverance regulation that was legalized in 2007 in Denmark. The aim was to reinforce and improve the inter-organizational collaboration. The regulations were changed into a new form of domination that changed the legalization into facilitation. This happens, for example, because of inability of the humans to follow the domination or regulations, having difficulties of giving the technology meaning; mastering the technology; or the technology or the standards were not ready.

This could explain the strategy shift in dominance emphasis; from legalization to facilitations role of those institutes that construct and presents the norms. The norms went from being legalized rules to being guidelines to facilitate the collaboration in the AEC industry. This means that the industry was released from the pushed regulations into the process of pulling the norms from the institutional properties. That is from a database of methods and standards that is supported by in this instance by bips and Cunecos in Denmark that is pulled after the industry needs for supporting guidelines [58].

This could be an example of institutional transformations, interpreted by the author that the institutional properties are in constant development, and changing the role and strategies of the institution in producing legitimate facilitations.

This level of facilitation can be pushed into databases for AEC construction teams to pull out the solutions that is predicted and negotiated by the team to serve the POP. This could be e.g. by using social networking, and then use of social networking to negotiate what is to pull out of those facilitated *signification, dominations and legitimations.* It is pulling out elements that give meaning, will be utilized and agreed upon in the construction case. This indicates the opportunities of social networking; that is the portal ability for the construction team to negotiate in a transparent manner what is best for the organization.

These negotiations should keep in mind that technology cannot be forced to be used, as there is free will of the humans to use technology. Therefore would it be beneficial for the team to integrate stakeholders to participate in the discussion what technology to use. Social networking could as well serve as a platform to share e.g. ideas, knowledge, negotiate on, express needs, requirements, and coordination.

It has been mentioned earlier in this thesis that social networking is emerging in the AEC industry. That is also evident as my interviewee states:

> *"My initial interest for social media started with of established collaboration with Byggecentrum to develop and to hold courses. Byggecentrum had discovered growing interest in the AEC field of using*

> *social media as well as lit confusions among actors in the AEC industry. Firm were beginning to use Twitter and Facebook's fan sites as others were utilizing the media to work professional with the media for knowledge sharing and for product development. As an example is how the social media is used for official incitements for cross organizational collaboration for developing standards and collaboration guidelines. From this it was thought it could be possibilities for AEC firms to use it"* (Appendix 8.1.2).

This could be an indication of an initial top down support institute for social networking. It could be seen as evidence of how the technology affects institutional properties that could be developed further to provide guidelines of how to utilize social networking as a form of example for ethics guidelines, overview of potential platforms and properties, courses in the usage or tutorials, demonstrate the benefits of using social networking or collaboration platforms, and guidelines for the project managers etc.

To conclude this discussion, social networking is beginning to have meaning in the AEC industry. To get to the level of utilizing social networking as boundary object, or inter-organizational collaboration platform with a social dynamic, there is need for top-down understanding. That is regulating or facilitations institutes, project manager and the owner to facilitate the usage and making the benefits of social networking transparent.

6 Conclusion & future research

The aim of this thesis was to cover a broad analysis of social networking and set it up in the context of AEC industry to view its opportunities and challenges. In doing so there have been made an analysis of the AEC industry, as well as social networking. The author has done his effort to ground his thought with data to support his interpretation of the AEC industry's willingness to improve.

That is the industry efforts in adopting, through a longer period, different philosophical approaches to improve the POP. This improvement is supported with new technological inventions and by the implementation of those different supporting technological solutions. As well there are new tendencies, willingness and even need of the industry of turning from DBB to IPD. The author has noticed the willingness of IPD to be co-located (that also fits to the method of Scrum). This co-location convention is as the author predicted the need of co-location of data as e.g. 3D model/ BIM as well as co-location of actors by the internet, by portals as social-networking service sites.

The actor's definition has been understood as the need for integration. This integration is not well defined by the AEC industry, but there are signs of the need to holistically integrate as much as possible and activate as much social intelligence as possible. This intelligence is dependent on the willingness of the actors to share knowledge. This knowledge can both be tacit and explicit; the challenge is then how to activate and present this knowledge. The thesis concludes that the actors are willing to share knowledge and have the support to do so. The current approach and development for centralizing data is not conducted through the concept of BIM, that is not ready yet nor are its standards adopted in the industry to be estimated as complete. In the meantime, the information flow is conducted with file structure databases and different kinds of tools utilized for communication. This centralizing of data is currently not optimal, as the information currently scattered and closed, making it very difficult for the organization to orientate. For collaboration, there is a need to be able to access

data for the cognitive process of human for creating knowledge. Therefore, it is concluded by the author the importance of this centralization of data flow can in great extent be supported by social networking, e.g. Facebook. If not suitable it can serve as a pre-boundary object to support the negotiation of an appropriate portal and other ICT solutions to support the collective intelligence. That is to activate social intelligence for facilitation of the collaboration and the integration of the shareholders in the industry. The conclusion is to emphasize that there is a need to view new approaches in addition to the concept of BIM, since the concept is not ready and do not support negotiation of the team members. These recent social-networking sites are constantly developing and people do use these portals. The modern times includes rapid change that need social intelligence to cope with, with help the of ICT solutions. This is an ongoing circle of socio-techno challenges that cannot be separated, to pull out the best of each element.

The modern times interpreted the world as liquid, and there are such rapid changes in the world that it is difficult for the flow to become solid [59]. This statement can in deed reflect the emphasis of the human to be creative and not rely entirely on standards and regulations and with support of boundary objects as social networking it could be seen as pre-boundary object to teach people to collaborate in more transparent manner and break the traditions of DBB, to be able to cope with the changes.

There are several limitations to this study. The first one is the authors limited involvement in the discussion on social-networking portals, where it is possible to gain much more knowledge from the members, for example, on LinkedIn. Secondly, the limited participation in the survey conducted; possible reasons were the presentation on LinkedIn and the number of questions. Thirdly, there could have been more interviewees, but it was limited by the author's view of possible interviewees. These interviews and the dialog were also limited by the author's language barrier.

The fourth limitation is and could also be interpreted as its strength. That is the research scope was broad, often lacked the focus and selecting the traditional paths. However, by introducing those two broad phenomena of AEC industry and social

networking together have the thinking of solutions and new approaches to accelerate the ICT usage for the benefits of POP without decreasing the human value and without any rigidness or lack of flexibility other than the authors own mental limitations.

Future research: This broad approach has revealed numerous opportunities for further research. First and foremost would be a longitudinal study relevant to investigate empirical implications of social networking in the context of AEC industry. The author suggests that the research focus on the technology as well as the human factors and the interaction of these two elements. However, the author has witnessed increased emphasis on socio-technological research approaches. As Arbnor and Bjerke [21] state; it is up to human nature what paradigm to design the research.

There are numerous approaches to increase our understanding of the adaptation of social networking and its utilization. The research could be related to social elements. Elements of e.g.; knowledge sharing, idea creation of the members, impact on POP, integration process and degree of participation, the process for new participants integrating into the process, identical changes of participants or behavioral changes, changes in the decision structures, ethical issues of what to communicate and how to handle the conversation, investigate the project manager's role and the impacts on the agility of the process. There is a plethora of research opportunities, and the AEC industry is the right playground to do so, as it has been stated as a dynamic network organization.

The technological aspect could be on the ability of the technology to support the AEC organization to achieve objectives, following the development of the technology to do so.

7 References

[1] W. J. Orlikowski, “Sociomaterial Practices: Exploring Technology at Work,” *Organization Studies*, vol. 28, no. 9, pp. 1435-1448, Sep. 2007.

[2] I. Wallis, L. Bilan, M. Smith, and A. S. Kazi, *Industrialised, Integrated, Intelligent sustainable Construction*. I3CON, 2010, p. 260.

[3] P. Aragon, “Reinventing Collaboration across Internal and External Project Teams,” *AECbytes*, vol. 28, pp. 1-5, 2006.

[4] P. Tilley et al., “Improving ICT Integration in Today ’ s AEC Industry : Recommendations & Guidelines,” *Culture*, 2001.

[5] A. J. E. of the N. A. of S. F. A. (NASFA); C. O. A. of A. (COAA); A. T. A. of H. E. F. O. A. G. C. of A. (AGC); and A. (AIA), “Integrated Project Delivery For Public and Private Owners,” p. 45, 2010.

[6] A. Kiviniemi, “Requirements management interface to building product models,” Stanford University, 2005.

[7] Q. Hao and W. Shen, “Change management in construction projects,” *the Management*, pp. 387-396, 2010.

[8] R. Senescu, G. Aranda-Mena, and J. Haymaker, “Relationships between project complexity and communication,” *Design Process Communication Methodology*, no. January, p. 14, 2011.

[9] C. Ibrahim and S. Costello, “Key Practice Indicators of Team Integration in Construction Projects: A Review,” *ipedr.com*, vol. 15, pp. 230-235, 2011.

[10] O. Kalny, “Enterprise Wiki: An Emerging Technology to be Considered by the AEC Industry,” *AECbytes Viewpoint*, vol. 31, pp. 1-5, 2007.

[11] D. Holzer, “Are you talking to me? Why BIM alone is not the answer,” *of the Fourth International Conference of the*, 2007.

[12] P. Morrell, “BIM to be rolled out to all projects by 2016 ,” *Architects Journal*, 2011. [Online]. Available: http://www.architectsjournal.co.uk/news/daily-news/paul-morrell-bim-to-be-rolled-out-to-all-projects-by-2016/8616487.article. [Accessed: 31-Jan-2012].

[13] D. Smith, “Open BIM Standards are the foundation of Interoperability,” in *Building*, 2011.

[14] F. W. Klaus-Dieter Thoben, “S UPPORTING D ECISION M AKING AND C OMMUNICATION IN A C ONCURRENT E NGINEERING E NVIRONMENT :,” *Symposium A Quarterly Journal In Modern Foreign Literatures*, no. June, pp. 23-34, 1998.

[15] J. Votano, M. Parham, and L. Hall, “BIM project execution planning guide,” *Chemistry &*, vol. 2, p. 127, 2004.

[16] Sectoral e-Business Watch, *The European e-Business Report 2008*, 6th ed. Luxembourg: Luxembourg: Office for Official Publications of the European Communities, 2008, 2008, p. 306.

[17] J. Mazewski, “Military Uses Social Media for Communication - Mobiledia,” *Mobiledia.com*, 2011. [Online]. Available: http://www.mobiledia.com/news/88929.html. [Accessed: 29-Jan-2012].

[18] K. Knibbs, “Facebook, Twitter Aid Sinking Ship Passengers - Mobiledia,” *Mobiledia*, 2012. [Online]. Available: http://www.mobiledia.com/news/124364.html. [Accessed: 29-Jan-2012].

[19] J. Mingers, “Combining IS Research Methods : Towards a Pluralist Methodology,” *Information Systems*, vol. 12, no. 3, p. 89, 2001.

[20] J. Kuada, “Research Methodology A Project Guide for University Students By,” *Readings*, pp. 1-89, 2011.

[21] I. Arbnor and B. Bjerke, *Methodology*. London: Sage publications, Inc., 2009.

[22] C. Katsanis and C. Davidson, “Horizon 2020: Network Organizations in the AEC Industry,” in *Berkeley-Stanford CE&M Workshop: Defining a Research Agenda for AEC Process/Product Development in 2000 and Beyond*, 1999, pp. 1-6.

[23] C. Eastman, P. Teicholz, R. Sacks, and K. Liston, *BIM handbook*, 2nd ed. New Jersey: Wiley Online Library, 2011, p. 648.

[24] C. Hendricson, “What Is Construction Project Management?,” *PM Hut*, 2008. [Online]. Available: http://www.pmhut.com/what-is-construction-project-management. [Accessed: 16-Nov-2011].

[25] Young H. Kwak, Randall Bushey, “Construction Management at Risk: An Innovative Project Delivery Method at Stormwater Treatment Area in the Everglades, Florida Young H. Kwak, Ph.D. 1 and Randall Bushey, P.E. 2,” *Water Management*, p. 6.

[26] S. Fisker, *Anlægsteknik 2*, 2nd ed. Lyngby: Polyteknisk Forlag, 2007.

[27] "Iteration - Definition and More from the Free Merriam-Webster Dictionary." [Online]. Available: http://www.merriam-webster.com/dictionary/iteration. [Accessed: 18-Nov-2011].

[28] Lean construction institute, "What is Lean Construction," 2012. [Online]. Available: http://www.leanconstruction.org/whatis.htm. [Accessed: 18-Nov-2011].

[29] scm-institute.org, "Sample of book chapters on Relationship-Based Business Model | Processes in supply chain management," 2011. [Online]. Available: http://scm-institute.org/Our-Relationship-Based-Business-Model.htm. [Accessed: 17-Oct-2011].

[30] G.Sohlenius, "Concurrent Engineering," *Concurrent Engineering*, vol. 11, no. 3. pp. 187-199, 01-Sep-2003.

[31] S. Flight, "CONCURRENT ENGINEERING GUIDELINE FOR AEROSPACE," *Practice*, pp. 1-6.

[32] W. Quan and H. Jianmin, "A study on collaborative mechanism for product design in distributed concurrent engineering," *2006 7th International Conference on Computer-Aided Industrial Design and Conceptual Design*, pp. 1-5, 2006.

[33] A. Kusiak, *Concurrent Engineering: Automation, Tools and Techniques*, 1st ed. New York: John Wiley & Sons, 1992, p. 611.

[34] C. Eastman, P. Teicholz, R. Sacks, and K. Liston, *BIM Handbook: A Guide to Building Information Modeling for Owners, Managers, Designers, Engineers, and Contractors*. John Wiley and Sons, 2008, pp. 399-400.

[35] N. Gu and K. London, "Understanding and facilitating BIM adoption in the AEC industry," *Automation in Construction*, vol. 19, no. 8, pp. 988-999, Dec. 2010.

[36] T. Groups, "CIB Priority Themes CIB Theme : IDS – Integrated Design Solutions," *Solutions*, no. May, pp. 2008-2009, 2008.

[37] A. Moum, C. Koch, and T. I. Haugen, "What did you learn from practice today? Exploring experiences from a Danish R&D effort in digital construction," *Advanced Engineering Informatics*, vol. 23, no. 3, pp. 229-242, Jul. 2009.

[38] M. Mengoni, S. Graziosi, M. Mandolini, and M. Peruzzini, "A knowledge-based workflow to dynamically manage human interaction in extended enterprise," *International Journal on Interactive Design and Manufacturing (IJIDeM)*, vol. 5, no. 1, pp. 1-15, Oct. 2010.

[39] J. Luft and J. Luft, "The Johari window, a graphic model of interpersonal awareness," *Proceedings of the western training laboratory in group development*, 1955.

[40] U. Gal, "Boundary matters: The dynamics of boundary objects, information infrastructures, and organisational identities," Case Western Reserve University, 2008.

[41] A. M. Kaplan and M. Haenlein, "Users of the world, unite! The challenges and opportunities of Social Media," *Business Horizons*, vol. 53, no. 1, pp. 59-68, Jan. 2010.

[42] J. Strickland, "Is there a Web 1.0?," *HowStuffWorks*, 2008. [Online]. Available: http://computer.howstuffworks.com/web-101.htm. [Accessed: 01-Mar-2012].

[43] OECD, "Participative Web and User-Created Content," *Policy*, no. 2006, p. 128, 2007.

[44] J. U. Henrikson, "The Growth of Social Media: An Infographic | Search Engine Journal," *Search Engine Journal*, 2011. [Online]. Available: http://www.searchenginejournal.com/the-growth-of-social-media-an-infographic/32788/. [Accessed: 12-Dec-2011].

[45] T. Wailgum, "Like It or Not, Here Comes the Facebook-ization of ERP | CIO Blogs," *Cio*, 2010. [Online]. Available: http://blogs.cio.com/thomas_wailgum/14887/like_it_or_not_here_comes_the_facebook_ization_of_erp. [Accessed: 30-Nov-2011].

[46] K. N., Peter Moore, "From Social Networks to Collaboration Networks: The Next Evolution of Social Media for Business," *Forbes*, 2011. [Online]. Available: http://www.forbes.com/sites/karlmoore/2011/09/15/from-social-networks-to-collaboration-networks-the-next-evolution-of-social-media-for-business/.

[47] A. M. J. Bughin, M. Chui, M. Global, and S. Results, "How companies are benefiting from," *McKinsey Quarterly*, vol. 17, no. 1, pp. 1-9, 2009.

[48] E. Campbell, "Welcome to the sixth annual BrandZ Top 100 Most Valuable Global," *Most*, vol. 6, p. 54, 2011.

[49] D. Spector, "Here's How To REALLY Use LinkedIn | LinkedIn," 2011. [Online]. Available: http://read.bi/bzJCUO. [Accessed: 29-Nov-2011].

[50] K. Carney, "5 Reasons Why the AEC Industry is 2 years behind in Adopting Social Media | Plannovation," *cubitplanning*, 2010. [Online]. Available: http://www.cubitplanning.com/blog/2010/06/5-reasons-why-aec-industry-is-2-years-behind-adopting-social-media/. [Accessed: 12-Dec-2011].

[51] J. H. Kietzmann, K. Hermkens, I. P. McCarthy, and B. S. Silvestre, “Social media? Get serious! Understanding the functional building blocks of social media,” *Business Horizons*, vol. 54, no. 3, pp. 241-251, May 2011.

[52] L. Leydesdorff, “The Communication of Meaning and the Structuration of Expectations : Giddens ’ ‘ structuration theory ’ and Luhmann ’ s ‘ self-organization ’,” *Journal of the American Society for Information*, pp. 1-44, 2010.

[53] W. J. Orlikowski, “The Duality of Technology : Rethinking the Concept of Technology in Organizations,” *Organization Science*, vol. 3, no. 3, pp. 398-427, 1992.

[54] S. L. Star and J. R. Griesemer, “Institutional Ecology , ’ Translations ' and Boundary Objects : Amateurs and Professionals in Berkeley ' s Museum of Vertebrate Zoology , 1907-39 Institutional Ecology , ' Translations ' and Boundary Objects : Amateurs and Professionals in Berkeley ' s Mu,” *Museum*, vol. 19, no. 3, pp. 387-420, 1989.

[55] G. C. Bowker and S. L. Star, *Sorting things out: Classification and its consequences*. The MIT Press, 2000.

[56] A. Larsson, “Making sense of collaboration: the challenge of thinking together in global design teams,” *Proceedings of the 2003 international ACM*, 2003.

[57] C. P. Lee, “Boundary Negotiating Artifacts: Unbinding the Routine of Boundary Objects and Embracing Chaos in Collaborative Work,” *Computer Supported Cooperative Work (CSCW)*, vol. 16, no. 3, pp. 307-339, Apr. 2007.

[58] Skovgaard, “cuneco - center for produktivitet i byggeriet - cuneco,” *bips*, 2011. [Online]. Available: http://cuneco.dk/artikel/cuneco-center-produktivitet-i-byggeriet. [Accessed: 20-Mar-2012].

[59] Z. Bauman, “Liquid Modernity.” Polity Press, p. 232, 2000.

[60] M. T. D. K. Smith, *Building information modeling : a strategic implementation guide for architects, engineers, constructors, and real estate asset managers*. New Jersey: John Wiley & Sons,, 2009, p. 183.

[61] S. Boddy, Y. Rezgui, G. Cooper, and M. Wetherill, “Computer integrated construction: A review and proposals for future direction,” *Advances in Engineering Software*, vol. 38, no. 10, pp. 677-687, Oct. 2007.

8 Appendix

8.1 Interview

8.1.1 Free flow interview taken with BIM coordinator and designer on-site.

Interview conducted was taken in Aalborg the 17 of February 2012. The interviewee is hired as a construction architect in an architecture office firm. Size of the firm is about 20 employees.

How do you consider the organizational structure of the firm? Is it hierarchic or is it flat?

> *It is very flat in its structure. There are persons that have their special knowledge area, that focus upon their tasks, but the collaboration, and we try to help one another as much as we can. All general conclusions are taken on employees meetings were all can contribute to the decision's making.*

If you are in need for support, then you can easily contact your coworkers? How is that process? Is it in person or do you utilize any particular tool for this support?

> *We do communicate both internal and external. Face to Face, but also we use Skype. I use Skype, e.g. I collaborate with actor in Copenhagen, and we have collaboration's partners in Norway with the same artifact. It works quite well, to say.*

We in my education have used Skype a lot during my education.

> *Yes, it is remarkable how easy it is to get in contact to persons, and it saves a lot of time. However, this has to be used in with responsibility not to interrupt one another too much during the work.*

Is there any communications guide who is used in the concern of internal and external type of communication? What is allowed to say, as sensitive information?

No, but we have made some considerations in resent meetings. We want to communicate as smart as possible. E.g. it could be vice to control the e-mails in certain time of the day. That is to save time due to the interruption of workflow and working rhythm. Checking e-mail could then be in the afternoon, and the morning time could be more concentrated to the actual work. However, in general, there is better to contact a co-worker to gain needed information instead of using time consuming methods of finding the information by on your own. This is up to you.

Have you considered other media like Google+ or Facebook?

It is rather clear that there are many opportunities associated with this new media, and we are already using those media in some degree. We have a homepage to broadcast new relate to the firm. We use also LinkedIn and Twitter to give status update and relate to articles of the firm. We are going to have been meeting to discuss the possibilities of using the homepage as a central point for the information flow, were we can gather those media into one place. From there is should be possible to share information to Twitter and LinkedIn. We use also video as screen casting.

How is it with the two-way communication, e.g. the contact to the customer or the client?

The homepage is providing the opportunities to get in contact to the firm, where the customer can easily get in contact. It is through one-way communication. Therefore, we use LinkedIn and Twitter to get into discussion.

The AEC industry is in my view dynamic in creating new contacts?!

Yes, we are always getting into contact to new actors.

Can you tell me a little more about the external communication?

We are not much utilizing the social media. So therefore we communicate more on personal meetings and in the field. We arrange tours for actors that are interested, in particular, sustainability constructions, to explain the concept and show a real construction case. For knowledge generation for the internal actors, we look much over to Germany where there has been a growth in sustainable housing research and development.

Do you have any strategies of investing the possibilities of social media networking sites as Facebook or Google+?

LinkedIn is our main social-networking application, but Facebook is in itself also interesting, as you get to another type of people. This will be discussed on the next meeting, how we communicate to people. Homepage is more one-way communications, and social media give us completely different interface to communicate to people directly.

Facebook has been used by larger architect firms to create user-generated content. That is to open up channel to get inspiration from the fan site?! However, I don't think it is used to be a platform for a construction case, not necessarily because of technological limitations, but more of the image of the site.

Yes, it is true, as this site is used for leisure and amusements. I can easily understand that people get annoyed if there are too many announcements on the portal, as this is more for leisure. Maybe this is just how you conceive this.

Yes, this is maybe this collision of leisure activities and work-related activities. That is you are bringing into the working life and leisure and vice versa. Google+ is it something that you use?

Google+ is something that I have tried, but I haven't seen the light yet. It has without doubt some elements, like those circles that could be helpful in sharing information selected group of people. These are maybe the

possibilities that Google+ has contra Facebook and LinkedIn. However, what is your opinion? Have you any knowledge how these things work out?

I can clearly see the possibilities with e.g. Facebook. However, there is some limitation that is a problem. That is mainly two aspects. The first is that it is not developed to have a non-human domain, secondly the metadata. As with Twitter and e.g. Projectplace where you can instantiate, and classify the information into categories. That could be e.g. design discussions, in particular, field. That is all the information about windows could be tagged into windows discussions.

When it comes to the dialog in the construction process, as e.g. if there is central model that has been updated from you site, or you have discovered a failure, how is it communicated to the rest of the stakeholders?

Internally, we can write revisions comments about the model. If it is between other partners, it is typically communicated with mail, or personally. There has been a recent case, where we have used Dropbox. It sends out messages if there are any new updates, and it is easy to see if there have been added or revised files. This is maybe not used for big construction cases, but if there are small cases, then it is optimal to file sharing.

What about windows live is it something that you know?

No it is not a platform we have been using.

How do you consider your firm to be up to date when it comes to adoption of recent technology, and how is it for the individual to suggest for adoption of new technology?

It is my impression that we are well capable in adopting new technology and approach it with positive minds. This is something that is in our interests for not getting behind, so this is the continuous process. If there is an internal actor who wants to test new artifacts or have a good idea, we

listen, and then we take a discussion. If we can see potentials or want to test, we take the discussion and test the idea. This is supported with our flat organizational structure, and takes these discussions on a lateral basis. This is something that for me is very positive as I work with BIM and development. There are lots of things to discuss on these meetings, and this discussion can also be on Skype. These meetings are scheduled once a month, where we all meet. The subjects can be about strategy consideration, about our clients, etc. and there is usually time for discussing technological possibilities and how we communicate to the world, are there any interesting possibilities to grab? Should we update the homepage? Shall we use Skype for meetings, instead of flying to Copenhagen? So we really want to keep a focus on the possibilities that can serve our firm.

How is it for the organization in the communication when the information are shattered, as e.g. with mail, telephone calls, etc.? How do you control and store those information, to ensure who said what, when to whom and why?

This is a field that we are continuously trying to be better to handle and store the information on a particular place. We take meeting references. However, I can follow you, of this information are shattered, someone receives information and there are agreements; this can be forgotten; another actor takes over the case, and this causes problem. This is common to all firms; there is something that got lost in the communication. We try as well as we can store these information as well as possible in the construction case; file structure. This information are on our servers who are stored in three different locations and are all synchronized. In all construction cases, we have agreed file structure divided into general themes. Those databases are open for internal actors.

How is it for the actors to find these information?

No usually not, but if not there is easy to take Skype call. This is quite facile as we are with this flat organizational structure and somewhat small, there

is an example just few steps to get into contact to the person that has the desired knowledge. It could be more difficult for bigger firms that are with more top down structure and more professional divided.

What about the cross organizational communication?

This can be trickier, if there is engineer who sends me an email that is concerned to a large group, then it is up to me to bring it further to the other actors. This can be forgotten. If there is important mail, then it is of course stored in the file structure. However, occasional agreements and discussion are not necessarily brought to the others.

What about the client, as there is often a gap between what he has ordered and what is being delivered. (Kiviniemi model is being presented)

This is supported and presented with the (BIM) model as a central point for the integration. By integrating the actors, there is possible to speed up the design and get it reviewed by the owner.

What if the client wants to follow the discussion and the construction process? It is my own personal experience of the customer to involve them self deeply into the construction process?

It is a very different degree of how wants to be involved with the construction case.

I presented my idea of using social networking as e.g. Facebook as a central platform for the conversation flow between the actors. Could you see the client to be part of that discussion?

Both yes and no, then it should be in a closed forum. For me, it is almost as e-mail correspondence. You have similar possibilities of transmitting information among the shareholders. However, using e-mail is through more like one-way communications as the social networking is more like platform. Even though there are some possibilities, I think e-mail will exist

continuously and in person. We are interested in the development and are willing to discover, and we are in decent touch over the possibly that the various platforms can offer. As "Byggeweb" has many possibilities as a platform; to create distinct groups; overview over the shareholders; forum; chat; revisions overview; tagging, etc. I have a decent overview and knowledge about this platform, as I wrote the bachelor report of the concept, and it is in my concern excellent platform. The file structure is standardized, and then you know what you are accessing in every new construction case that makes it easier to figure things out. This could be a challenge when you are using other platforms, and create confusion in the collaboration.

What about the forum on the "Byggeweb" is it utilized by the construction team. Does the client participate on the platform?

Yes, it is, in bigger construction cases the forum is used. The Byggeweb is well manageable in the concern of access control. You can invite single actors or create a group.

Have you experienced stiffness in the conversation on this portal compared to the spontaneous writing on the Facebook?

Yes, I think is because of pre understood role of the media, and what you can allow yourself to use the media. As with "Byggeweb", there are many concerns of the actors what they communicate on the portal. The actors strive to keep all the material well documented and verified, to prevent later issues that could make them responsible for failure. However, I think this will be different as the younger generation is used to work with distinct kinds of media at school, and it will be gradually adopted in firms.

8.1.2 An Interview conducted with chief consultant for analysis and strategy.

Interview was conducted with one of “leading experts” in communication in Denmark, employed in relatively big consulting firm: “one of Denmark's largest strategic design and “Communications Company”.

I started to introduce my idea of using social networking as Facebook in the AEC construction to start the conversation.

The implementation depends on the experience of utilizing the new media for PR and marketing in advance, as well as using web applications for the dialog between the stakeholders. For bigger organizations that have communications departments, then Facebook is maybe not the right media, as the view of Facebook is the social site that is used to contacting friends and the family. Therefore, could there be some other type of social media that could be better suited to support the firm interests. In that sense, LinkedIn or systems that are developed in house, that could be more suitable. Developing tool for brainstorming or knowledge sharing that could be relevant to the AEC industry.

My initial interest for social media started with of established collaboration with Byggecentrum to develop and to hold courses. Byggecentrum had discovered growing interest in the AEC field of using social media as well as lit confusions among actors in the AEC industry. Firm were beginning to use Twitter and Facebook's fan sites as others were utilizing the media to work professional with the media for knowledge sharing and for product development. As an example is how the social media is used for official incitements for cross organizational collaboration for developing standards and collaboration guidelines. From this it was thought it could be possibilities for AEC firms to use it. Before implementing SM for the AEC construction firms, there is a need to make business- and marketing considerations. That that concern what to tool to choose, Facebook, LinkedIn, Twitter or own systems. There is a need to take a look of the current business process and consider the firms communications strategies,

target groups and how you want to catch them. That is giving the SM opportunities to be the collaboration framework to support business, development, brainstorming and knowledge sharing.

This demands human resources to support this process. There is should be to have sort of a communications-department at the firm, at least to have key persons that have the competences and the willingness to utilize the social media. This could be challenging for smaller type of firms, were there neither a time nor even the competences for using SM.

There should be easy for AEC smaller companies to implement SM as Facebook to create improved flow in the communication? That create dynamic in the dialog among shareholders in the construction process as well increasing the creativity? Where there could be a little stiffness in the collaboration on LinkedIn, as being more professional?!

That's true, LinkedIn is developing group forums that can be both open and closed and could be more business related. Where there is space to share knowledge and in higher degree more convenient for project management. That is from being more profile related to job search to more business forums. In a similar way has Facebook started to develop in the direction of supporting firms. The Facebook image is more based on sharing amusing experiences among friends and the family, etc. by posting videos, pictures, and comments.

It's is maybe the content that has created this image, but as a communications channel and the richness of technical possibilities for the communication?! What is your opinion about that?

Precisely, that is the positive thing about social media that gives you great value. That is you get many free applications that could be expensive for in-house development for smaller firms. That gives small firms in the AEC industry some advances that haven't been possible earlier.

Have you any insights into the experiences of those in-house applications that have been developed? That is in the concern of integration, or cross organizational collaboration?

I do not have complete overview, but I know that the bigger companies are using the most common social media tools. I have also noticed that NCC has launched a program forum to facilitate and promote for integration and collaboration across competences as well as across organizational boundaries for product development. That is with a digital forum, to establish a dialog between the actors.

I have a little problem to understand the implementation of these in-house made solutions for the integration process. That is the construction industry is known to have many small firms that make dynamic relationship to other companies?!

There is some of the bigger counselors' engineer firms that have made their own knowledge sharing's forum. As e.g. is the "brugernetwerket" (the user network). That is thought as an internal forum that connects external expertise actors to the network for discussing the art of engineering and future possibilities, etc. That could also have been locked forum on LinkedIn or Facebook. That could be a forum that could be utilized for brainstorming and knowledge sharing across time zones and without geographical limitations. This means for companies that have global activities gain new approaches that haven't been possible before.

Here Byhus, we use Podio that we often use as project management and knowledge sharing's tool for partially as an internal platform. There on we create groups for particular working processes where we share information about e.g. strategies and another group that cover the aspect of e.g. internal communication as well as social media. You can access those groups where you can access a different kind of information that has been created for the group members. That is the members can access data as contacts, calendars, sign into seminars, as well as the member, you can add knowledge and receive information and tools. This could be seen as living

organism that survives even though some actors resign the group, and continuously crow in time. On this portal, we can also link external actors, e.g. customers, collaboration's partners and experts for different tasks and projects. It is, in my opinion, similar group tools as Podio that is, with comparable capabilities as Facebook and LinkedIn is in increased mean to be used for business purposes and collaboration. There will be more of those tools in the future for product development. This will also be the case for the AEC industry, where there are often little resources for developing their own platforms with similar capabilities as Podio, Google+ or whatever it can be. This could be like mini Facebook.

I have a little problem about these tailor maid tools that are maybe more related to static relationship across organizations, like Business to Business type of platforms. In that sense, the construction industry is highly networking organizational dependent. That is there are constantly shifting collaboration bounding's, like ever-changing customers, new actors to collaborate with, both professionals and non-professionals, that could be difficult to train in the using not known applications, that could cause implementations issues?! While the applications as Facebook is maybe well known by users, even though it has some technological limitations. (This was so badly formulated statement or question by the interviewer that it went into wrong direction; it should have been more in the direction of implementation challenges.)

Yes it is correct there are still elements that are lacking; I think Facebook will be developed further as is being debuted on the stock marked. By that there will be resources for further development of the platform as they have announced to support in higher degree the professional business service that have other vice been supported by LinkedIn or similar type of social networking sites. There are without doubt technological limitations with Facebook today, in the concern of business to business area, but it will without a doubt developed further for more professional support.

During the thesis I have been about thinking about concepts like "Facebook of things", were you can gather as much of the information that is crated on single

platform. There is this limitation of Facebook domain service as being just for human. That is it is not allowed to establish profile of AEC construction case. I was in that case thinking of the timeline in Facebook could in that case be useful to gather the elements of the communication in one single place, but not as I think it is today, shattered and fragmented on different locations. That is to be able to review the decision process later on in the process.

Yes I think there will be developed more applications that is aimed to the AEC construction development processes. That is going to be a part of the digital construction. You will be able to have videos, 3D, plan drawings and other thing on the timeline to see how the construction grows over time. This will contain both data for the professional with knowledge demanding data and other that could be viewed by the official partners and other non-professionals. That is when it begins to be interesting when you can gather all the data into one single platform. To that system there could be e.g. webcam on the construction site, and the drawings from the architect etc. by that it could be openness for all of the shareholders.

There has been such a big focus on the concept of BIM and 3D model but not at the dialog.

Yes that true, there is there are both dialogs on the construction site and between the designers. These dialogs are maybe not delivered to the construction site and to the project manager. It could be relevant to share the knowledge between segments and levels. There are whole lot of communication that is not to be found that could maybe been gathered in a better way.

8.1.3 Telephone interview with Facebook "user" site developer 6. Januar

„It is not wise to make Facebook site yet as Facebook of thing, as the it is not approved by the Facebook Inc., and it could close the profile. Then it would be possible to make fan site, but it has security limitations as either being completely open to everyone or

the management of members is controlled by all members. It is although possible to control the members by geological placement. Groups have the limitations of data sharing and it is not possible to add group into the group, which means issues of management of the conversation. He states: “although it is possible to overcome some of these stated issues by skilled programming“. Then he stated: “the Google + would better shout to solve these problems. “

8.2 Discussion on LinkedIn

8.2.1 Discussion 1

> ***"While I wait for the buildingSMART standards to be completed, I'm putting my focus on communications portals to facilitate for better building process?! Anyone know about reports in that direction?"***

Person 1 • *"For processes look at IDM (ISO 29481 part 1). For formal communications Part 2 identifies the data structures needed. BS 1192:2007 contains the best thinking on using collaborative portals. It contains both process and data standards. Do you have something particular in mind when you say that buildingSMART standards are incomplete?*

Ifc2x4 is better than Ifc2x3, but not radically different. IFC_Infra aims to extend IFC to cover infrastructure but one of the first deliverables will (probably) be recommendations to use the existing model fully. IFC parametric is allowing the transmission of product, bridge and building rules."

Person 2 • *"The IFD Library for BuildingSMART may be one of the standards you are waiting for. As long as this library is not publicly accessible you can take a look at Semantic Concepts (http://www.semanticconcepts.nl) which gives free access to the Dutch part of that library."*

The author • *"Thanks person 1 and 2, I've already read IDM (ISO 29481 part 1). Though there was some parts I thought were a bit difficult:*

- *For my knowledge background and*
- *The limit of time to spend on it and*
- *Maybe cognitive limits.*

There are some elements and Management communication is an element that is worth to take a look at for my masters report and I think BS 1192:2007 could be informative, which I've unfortunately have to pay for:(

My main goal is to improve the communications, not in terms of bits and bytes in models, but the general communication between the building actors.

When I say the buildingSMARTS products are incomplete, I mean, even though it is technically in place, they haven't been implemented to the field, which is not in use as far as I know. I'm not talking about IFC, but rather IDM and IFD.

But I'm very curious about the phase the implementations of buildingSMART is in, and if you know about any empirical cases about IDM or IFD then it should be interesting to read.

My idea is: "Is it possible to use as example Facebook or Google+ to bring this inhomogeneous group of actors that is part of the buildings process periphery to improve the building process, by establish portal group for each building case?"

That is: you can:

- *Ask,*
- *Give instruction*
- *Gather ideas*
- *Needs or general communications issues, in more open forum for all stages of the building process. That is more social perspective and implementations issues rather than the technical aspect.*

But I'm convinced about the buildingSMART is the only real global effort that can improve today's business processes in the building industry, that must be what the building industry is waiting for?!

But I'm not at the stage jet to see how to combine IDM exchange requirement (ER) to communications portal and that to the BPMN process mapping diagram. And I'm not sure it it is the right way? But thanks for your comments and I'll take a look of the Semantic concepts, but is the development at the stage to be compatible to IFD?"

Person 1: *"IDM recommends that you start with a business process diagram in BPMN because it uses swim-lanes for each role. Where the process lines cross between swim lanes is where there is an ''exchange requirement". Document the data that must exist*

to be transmitted. The ER may be composed of other ER's , some large such as 'exchange spatial layout' and some small such as 'exchange electrical demand equipment'. The technical specification will be FP functional parts (in IFC: 'all objects with electrical device properties', in a proprietary BIM model it may be more tedious 'lights, receptacles, fans, motors, pumps, cookers, showers....').

Discussion can be through social media: Social communications are often better than email, because they discourage attachments and informal decisions. Evidence (models, reports, issues) should flow through the collaborative cloud (BIM servers, extranets, document sharing services). The open BIM Collaboration Format, or other formats supported by vendors (Navisworks XML, Projnet XML, agcXML RFI) allow structured comments to be shared. Then the conversation should be about those."

Person 3: *"Public social networks are for sharing pictures of your cats (or handbags), chatting about last night's soap opera or generic business discussions like this one.*

- *SharePoint,*
- *IBM Connections and*
- *Confluence are examples of social networking platforms that are more appropriate for use in the enterprise, and can be locked behind corporate firewalls away from the gaze of competitors and potential future clients."*

The author: *"My intention is to check out the interaction and respond of the industry to new technology. What are the limits of communications portals for the building enterprise?*

Example:

- *How to control and gather information in a holistic building process; possible to control the information and gather information?*
- *There are both social and technological issues that should be considered!*
- *However, my interests are how the building industry reacts to new technological possibilities, in these case communications portals and the and how it will interact to the actor's frameworks, prejudges, routines, power and so on.*

- *What kind of portals do already exist, or is there as BIM repositories, that could bring those actors together, with included communications portal included? Person 1 pointed that the conversation about open BIM collaborations should be on open formats or and vendors supported formats?*
    - *Is it enough, or how can we bring all these actors, together in one holistic working process?*
    - *How can we support user integration, and how can we ensure the owner that he is getting what he is asking for as a final result?*
    - *How can we gather information for all the actors who are in the periphery of the process?*
    - *Is there a need for any opinion from the owner or the user, during the building stages, what are the juristically limits?*
    - *How can we make the data more suitable for data mining? Who said what, when and why, and so on?*

The main straight of Facebook is how many people are using it, and the limit of time to gather network that ranges over the whole spectrum of the building; the users, designers, manufactures and entrepreneurs, owners and facility managers.

Are there other portals that have the same capacity or actually?

What are the limitations of each portal, what are the criteria for appropriative portal?

Which can contain all the aspect of holistically design process? Can it possible contain both the technological and the social factors?

About the model or technological issues:

- *I haven't seen jet any open BIM servers or repositories,*
- *and I can't see all the users in the process using BPMN and ER.*
- *I haven't seen IDM; BPMN in use or ER,*
- *I haven't seen IFD.*
- *I don't know about if any country is already using national standard that is implemented.*

- *I can't see, except the designers and other specially trained software users, using Navisworks XML, Projnet, or other software that is in common use at the designers.*

I have even found it difficult to convince my ex clients to use Autodesk design review, as simple as it is, but of course, it depends on how professional the client is.

So my focus is how to bring the enterprise actors in holistic/BIM process? I'm looking forward to and optimistically to the future, and I'm convinced there is many good thing cooking in the standard issues, buildingSMART and cloud computing, that I surely think will open up for BIM innovations.

We have to shift the focus from the design stages to the holistically view where there are needs and requirements. There have been complaining from the Danish building owners' organization, that the focus has been too much on the design phase in the BIM discussion. Central actor in standardizations work has pointed out the big bam boom is in the drift phase, where the users and owners operate. So how can we activate these actors, and how can we make the process more open, (not meaning open file formats) to be part of the design phase?

I'm totally into buildingSMART and there will always have to be ontological agreements between all the actors, but not only from the designer's point of view.

- *Kiviniemi states: "BIM is 80 % new way of collaborate and 20 % new technology.*
    - *BIM is not just a technological issue," so where are these 80 %?*

If we presume he is right!? I'm convinced if it is not all about the technology then it must be the social factors? I think there will be no real success with BIM if we don't take into account the other stages than just the design phase. This BIM process depends on the owner and the users.

If we take and look at the building process from the view as a social act done by inhomogeneous group of people, and the result of the process is where we are all consumers with different experience. Is it valuable knowledge that should be used?

So for mine point of view, what are the technical or social limits or advance for this new technology?

How can we use it for the benefits of the project or the building industry as a whole?

As we probably all know, or as I perceive it: the building industry is suffering: economically, qualitative and it process is not as efficient as it could be.

- *What can you do with communications portal?*
- *What are its limits?*
- *Is it possible to use it in practical purposes?*
- *Can it be as part of BIM process?*
- *Is there any tool already available or is it urging to develop a new software that is designed to its context?*

Maybe Confluence is the answer? Thanks for the tips Person 3. Maybe it is more professional than Facebook, but lacking the spreading and familiarity to the whole. Are there opportunities in communications portals, as an integrated tool in learning organization? Sharing knowledge and better collaboration?

There are numerous issues-, ethical, power, ownerships, juristically, implementations etc.

However, the several limits; as both person 1 and person 2 has commented on; the information is too unstructured or too social. And as project manager it should be considered if this kind of social media could be disturb the work process.

I'm not sure if I this make any sense but this is mine thought at this point. There are many different views how to facilitate for better collaboration in the building industry, and that is what is quite interesting.

Good guidelines:

- *Text to Database*
- *E-Mail to Portal Work flows*
- *Unstructured to Structured Data*

•Knowledgeable Workers to Knowledge Management

•Stove piped Disciplines to Collaborative Teams (Davis,2007) (http://www.digitalvis.com/)

Person 4 • *"Hilmar, your latest post is somewhat off the original post but the most direct question that needs addressed by the industry. Owners and the community at large, I'd argue, need to drive the requirement and use of BIM. Unfortunately, similar to the advent of CAD, when there isn't a great push from that camp implementation drags in the marketplace. I would argue it is the responsibility of those who realize the inherent and future benefits of BIM demand their use where and when they can. Any project using public funds would be one place to start; others include corporations where one holds stock, associations you belong to, etc."*

Person 5 • "Hilmar,

Thanks for the attribution on the guidelines. I am also the NA- IDM Technical Chair for BuildingSMART Alliance. As you see those guidelines were 2007. I have posted some other formulas and focus points before. In the US OmniClass is the development of our structured language that supports both human and machine communication. The requirement for a BIM Execution Plan we developed in the VA BIM specs further allows a team to match up Use, Skill, Actors, Phase, and Technology. By arriving at a structure for communication early in the project based upon well-defined project outcomes, a team can spend less time on trying to communicate and more time communicating.

We developed and Object/Element Matrix for project data needs that allows for rapid development of project level IDMs. Sometimes you just need to get the job done. These are all tools that help us arrive at a common understanding faster, which then allows us to work in a more social way."

The author • *"Thanks Person 5*

Great input, I'll take good look at your guidelines... BIM is for my as social as technological phenomenon."

Person 6 • *"To me good communication is equivalent to good collaboration. In order to put the stated problem above into a reasonable chunk I think we should be looking how multidisciplinary AE firms are utilizing this communication/collaboration principle within their organization. This could be a start maybe be to find ways of in the form of best practices."*

Person 7 • *"A little off-topic, but as a result of tracking back some of the comments above: buildingSMART International, on whom Hilmar waits, is a good example of the limits of a web portal and the pages it accesses *if it is not actively maintained and updated*. Parametric IFC, to which Person 1 refers above, is described at* http://buildingsmarttech*. Org/future-extensions/ifc-future-extensions/project-proposals, as of just a few days ago, as a proposal (PA 1). Its own page describes quite a bit of work that has been done, including a 2007 test, and a 2008 presentation. There are a few too many acronyms on the presentation slides for me to be able to dope out the context of that presentation, (ECPPM, SWOP (Semantic Web-based, Open engineering Platform), and PMO (maybe Parametric Model Ontology?). But the point is that there is nothing on bSI's website (presumably the authoritative source) about "PA-1" to indicate that parametric IFC (presumably an outgrowth of the 'SWOP" project) is being used anywhere. IFC-Infra has no distinct presence at bSI's site at all; only a mention on the "PA-1" page.*

The IFD site and tech.ifd sites appear to be get even less attention (and traffic) than pages at bSI and bSI-tech sites. None of this is meant to disparage the good (and largely pro bono) work that many have done to improve quality and speed of information transfer and re-use in the AEC industry. These are just some observations that bear on the face that bSI projects present to the rest of the industry, the time lags in conveying progress, and (perhaps) the resulting lack of pressure that major software houses feel from end users.

8.2.2 Discussion 2

LinkedIn discussion: "Why BIM can't be more and more transparent, and less and less complicated?"

Person 1 of the participant hidden • *Hilmar,*

I wish I could persuade you to refocus your thesis toward the impact of Global Socialism on the construction industry. Social media is just a tool. How the tool works is already well known and is not nearly as interesting as what the tool is being used for. A thesis on Social media in the construction industry is like writing about the bricks rather than the building.

LEED, BIM, Sustainable, Green...these terms have almost nothing to do with performance, efficiency, and a better environment. These are Globalist/Socialist processes which are antithetical to Free Market Capitalism and individual enterprise. Whatever these terms may mean in a literal sense, their Socialist definitions are most certainly being used to foist a shift in paradigm.

To illustrate my point, consider the politically correct definitions of these terms with their literal definitions. BIM for example. (Building Information Model) in its simplest definition it's an apolitical concept. However, the Socialists cannot accept the literal definition because it does not facilitate a Socialist agenda. They insist that BIM must be defined as a process. You see, without that process definition, the Building Information Model is a serious threat to their ideology. It could be used objectively rather than subjectively. Capitalism and Objectivity are poison to Socialism and Subjectivity. LEED is another diabolical Socialist system. I can barely speak about it without profanity.

LEED Certified..! Please!! All that means is that the project is a Socialist approved process and that objective and verifiable analysis was not the basis for evaluation.

Author • *"Thanks for that person 1, very informative. BIM, LEED and Sustainable, and Green and so on are current trends of the building research and development. It is in human nature to work on improvements for the majority. Maybe improved efficiency is not in favor of the capitalist that earn money on all the mistakes made in the business. I guess I'm highly social thinking and with global awareness. I cannot see that we are in*

the age of capitalism, with these crises going on in the world. However and anyway, we can be on the right and on the left, but for me this is envisioned democracy. The social media is just one brick in making better decision, or maybe it is a diffusion of responsibility?! I don't know. My background is cross-sectional education, and I really don't know all the answers, so I agree to mister initial conversation actor to keep the process open and as transparent as possible for better sense making. Without openness, you cannot collaborate. That should be the paradigm shift for the suffering construction business. Or what are the right solutions, status quo?."

8.3 Boundaries object literature collection.

year	name	paper/book	Field	Organisation	boundary object	Allan Fong	Uri Gal	wiki	me
1987	Law	Social construction of technological systems: New directions in the sociology and history of technology,						x	
1989	Star, Susan; Griesemer, James	Social Studies of Science	Social science	Museum of zoology	Diagrams, California map, Collecting forms	x	x	x	x
1991	Henderson, K.	Flexible sketches and inflexible data bases: visual communication, sonscription devices, and boundary objects in design	Design	Engineering firm	Sketches, Drawings, CAD	x	x		x
1996	Clark	Using language						x	
1997	Carlile	Udnerstanding knowledge transformation in product development: Making knowledge manifest trhough boundary objects						x	x
1998	Henderson, K.	The role of material objects in the design process: a comparison of two design cultures and how they contend with automation.	Design	Engineering firm	Sketches, Drawings, CAD			x	x
1998	Wenger, Etienne	Communities of Practice: Learning, Meaning, and Identity.						x	
1999	Ackerman and Halverson	Service "Organizational Memory: Processes, Boundary Objects, and Trajectories."	Service	Telephone hotline group	Written notes	x	x		x
1999	Bowker, G. C.; & Star, S. L.	Sorting Things Out: Classification and Its Consequences			classification		x	x	x
1999	Henderson, J. C. & Venkatraman, N.	Strategic alignment: Leveraging information technology for transforming organizations						x	x
2000	Garrety & Badham	The politics of socio-technical intervention: an interactionist view						x	x
2000	Star	Infrastructure and ethnographic practice						x	
2000	Wenger	Communities of practice and social learning systems						x	x
2001	Briers & Chua	The role of actor-networks and boundary objects in management accounting change: a field study of an implementation of activity-based costing. Acoounting organisations & society						x	x
2001	Karsten, H., Lyytinen, K., Hurskainen, M. & Koskelainen, T.	Crossing boundaries and conscripting participation: Representing and integrating knowledge in a paper machinery project.						x	x
2002	Carlile	Product development "A Pragmatic View of Knowledge and Boundaries: Boundary Objects in New Product Development.	Product development	Automobile desing and ma	Drawings, automobile parts, scedule	x	x		x
2002	Yakura,	Charting time: Timelines as temporal boundary objects						x	
2003	Bechky, B. A	Sharing meaning across occupational communities: The transformation of understanding on a production floor.						x	x
2003	Subrahmanian et. al.	Infrastructure and ethnographic practice						x	x
2004	Carlile	Transferring, translating, and transforming: An integrative framework for managing knowledge across boundaries						x	x
2004	Gunaratne et al.	Software develpment (slide from 2007)	Software development	R&D facility	Storyboard Prototype	x			x
2004	Pawlowski & Robey,	Bridging user organisations: Knowledge brokering and the work of information technology professionals.						x	
2004	Sasped & Salter,							x	
2005	Lee, C.P.	Between Chaos and Routine: Boundary Negotiating Artifacts in Collaboration.						x	x
2005	Bowker	Memory practices in the sciences							x
2005	Levina, N.	Collaborating on multiparty information systems development projects: A collective reflection-in-action view.						x	
2005	Levina, N. & Vaast, E.	The emergence of boundary spanning competence in practice: Implications for implementation and use of information systems.						x	
2006	Gasson	A genealogical study of boundary-spanning IS design						x	x
2008	URI GAL	BOUNDARY MATTERS: THE DYNAMICS OF BOUNDARY OBJECTS, OBJECTS, INFORMATION INFRASTRUCTURES,AND ORGANISATIONAL IDENTITIES	collaboration	Entreprise	information systems, 3D models, INFORMATION INFRASTRUCTURES				x
2007	Lee, C.P.	Boundary Negotiating Artifacts: Unbinding the Routine of Boundary Objects and Embracing Chaos in Collaborative Work.						x	x
2010	Kimble, C., Grenier, C., and Goglio-Primard. K.	Innovation and Knowledge Sharing Across Professional Boundaries: Political Interplay between Boundary Objects and Brokers.						x	x

Figure 20: Collection of Boundary Object literature

8.4 Survey

Results for survey: Social Media in the AEC-construction industry

Page: 1/5

Introduction

This is a survey, that is aimed at employed actors in the AEC-industry that have joined the group "BIM experts".

There are so many new things changing the world, Social Media is having huge impacts on our personal life's and our working life.

What can Social Media do for us in the AEC-industry?

I'm Student of Aalborg University, currently working on my master thesis in CST in Building informatics.

More specifically, I would like to address the following issues:

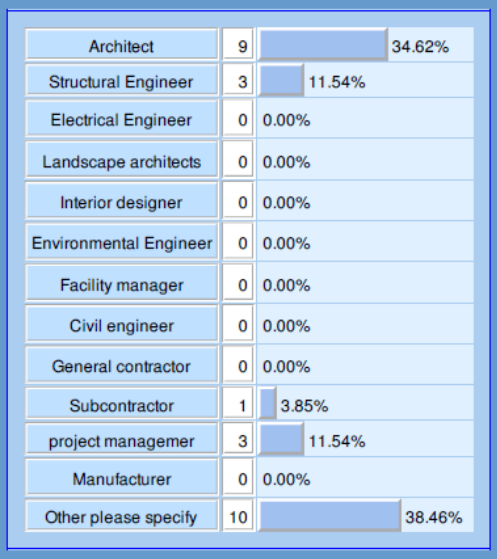
•Primarily, to find out if Social Media could be used as "tool" to improve the internal collaboration and between organizations and its stakeholders.
•Secondly, to find the benefits to use Social Media to support the implementation of BIM.

I hope you have 15 minutes, to answer these questions it will help alot...

THANKS & REGARDS
Hilmar Th. Valsson

Question 1*

What is your role in the organization?



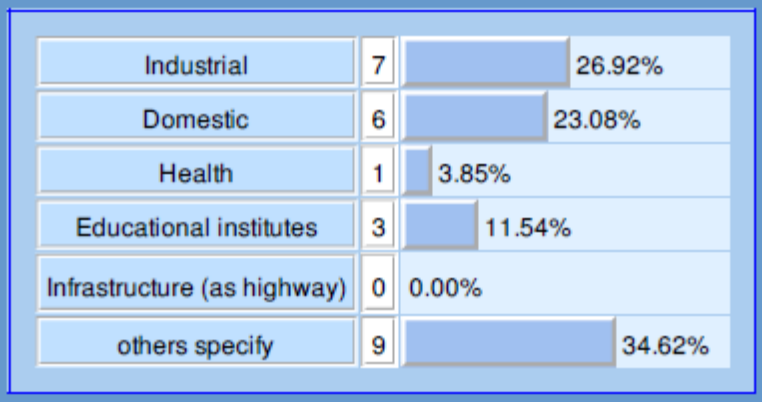
Architect	9	34.62%
Structural Engineer	3	11.54%
Electrical Engineer	0	0.00%
Landscape architects	0	0.00%
Interior designer	0	0.00%
Environmental Engineer	0	0.00%
Facility manager	0	0.00%
Civil engineer	0	0.00%
General contractor	0	0.00%
Subcontractor	1	3.85%
project managemer	3	11.54%
Manufacturer	0	0.00%
Other please specify	10	38.46%

Other, please specify

BIM Coordinator
BIM koordinator
Supplier of process management software for the construction companies to build to monitor progress and create a digital handover/fm library
ARCH. DESIGNER
GDL developer
Construction Architect
As a background, sructural engineer, but lately mainly in development projects or as model quality manager for constructor.
Research engineer
Technology and services provider for efficient construction delivery methods.
BDM

Question 2*

What is your organization main construction projects?

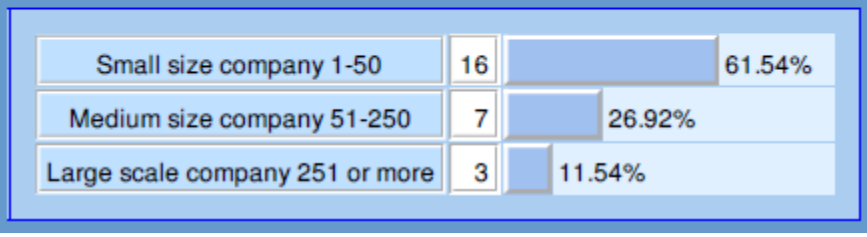


Industrial	7	26.92%
Domestic	6	23.08%
Health	1	3.85%
Educational institutes	3	11.54%
Infrastructure (as highway)	0	0.00%
others specify	9	34.62%

ID	View Survey others, specify	
9174345	View	Indusril Educatioal Health
9213025	View	All
9226171	View	All except infrastructure
9233057	View	COMMERCIAL
9259147	View	General architecure
9320703	View	Novo Nordisk, LEO, Lundbeck
9352880	View	Leisure
9360827	View	Construction disputes
9362606	View	Public sector...government, healthcare, education...

Question 3*

The size of your company in number of employees?



Small size company 1-50	16	61.54%
Medium size company 51-250	7	26.92%
Large scale company 251 or more	3	11.54%

Question 4*

What is your geographical location?

North America	9	34.62%
South America	2	7.69%
Asia	2	7.69%
Europe	12	46.15%
Australia	0	0.00%
Africa	1	3.85%

Question 5*

What is the current business model, mostly used in your organization?

Design-Bid-Build	12	40.00%
Design-build	9	30.00%
Partnering / Construction Management at Risk	3	10.00%
Integrated Project Delivery	3	10.00%
Public private partnership	3	10.00%

ID	View Survey	Other, specify
9213025	View	all
9360827	View	We offer advice when projects steer away from their original plans

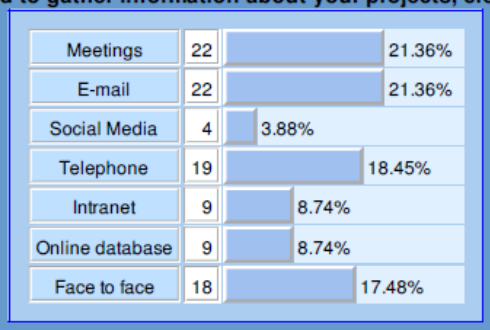
Question 6*

How do you consider the complexity of the project that you are working on? E.g. geometrical complexity, number of stakeholders, quality standard ect.

Low	2	7.69%
Middle	17	65.38%
High	7	26.92%

Question 7*

What methods have you used to gather information about your projects, created by other stakeholders?

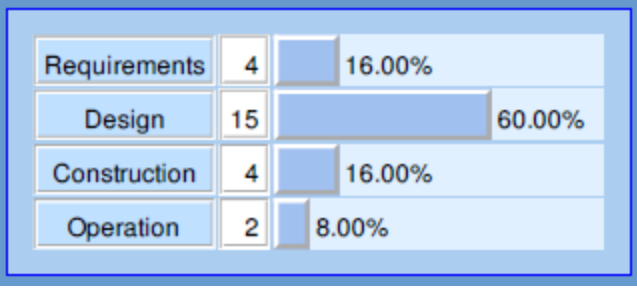


Others, specify

Skype, BIM software collaboration add-ons.
DMS
Information can be found quite vastlu from internet, but even its significant, considering fluent workflow in project I believe personal contacting (phone, meetings) are vital for succesful project.
Cloud technologies

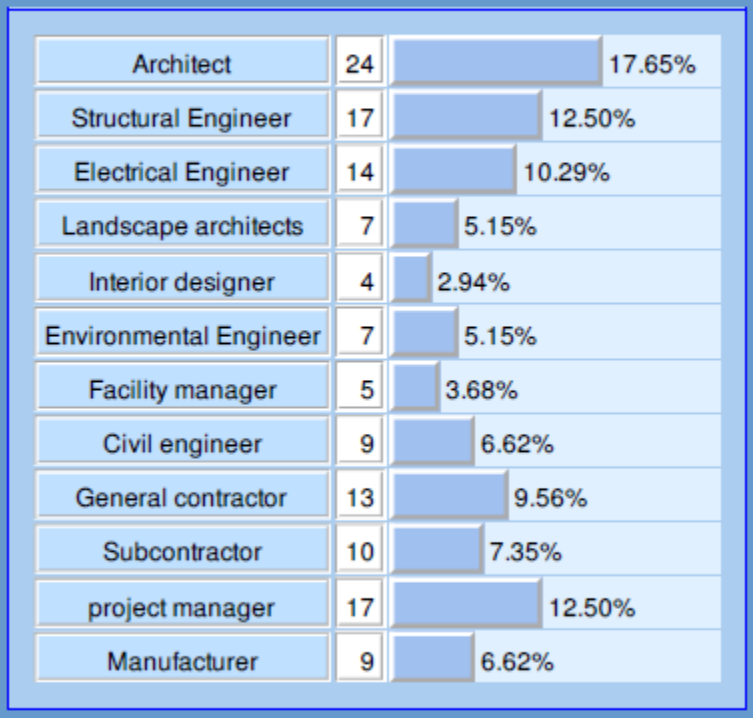
Question 8

In your current project, on what stage or phase are you in?



Question 9*

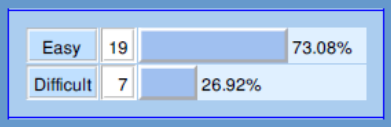
Which actors have been involved in your latest and current project until this point?



ID	View Survey	Other, pleas specify
9213025	View	HVAC engineer

Question 10*

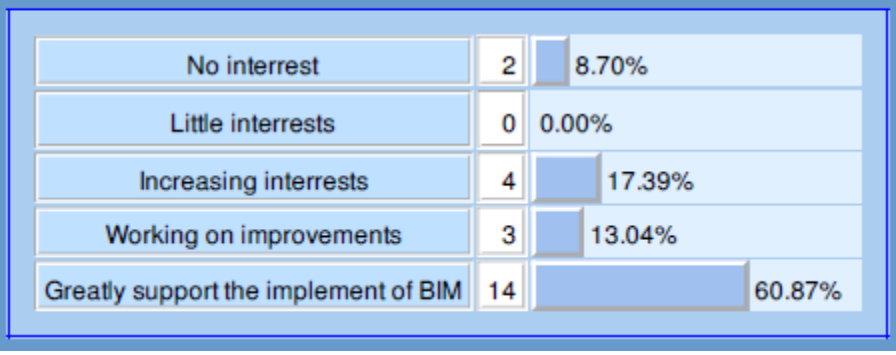
How easy or difficult has it been for you to gain an overview of the actors that are generally involved in your construction cases?



ID	View Survey	Additional comments
9213025	View	Provided the building owner is willing to move some of the budget towards the front of the project
9226171	View	Fairly easy as they are relatively small

Question 11

What is your company's awereness about BIM at the top management level?

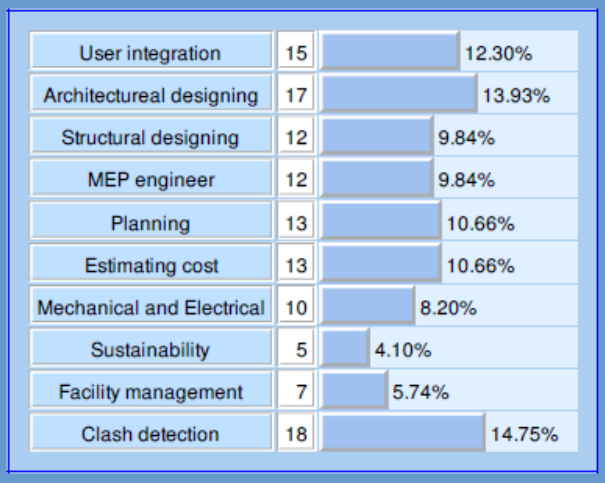


No interrest	2	8.70%
Little interrests	0	0.00%
Increasing interrests	4	17.39%
Working on improvements	3	13.04%
Greatly support the implement of BIM	14	60.87%

ID	View Survey	Additional comments
9213025	View	Since 2001
9354641	View	We've been reseller and distributor of various BIM software among the years (AceCad, Bentley, Autodesk...)

Question 12*

If your company has been using BIM, how has it been used in a particular project?



User integration	15	12.30%
Architectureal designing	17	13.93%
Structural designing	12	9.84%
MEP engineer	12	9.84%
Planning	13	10.66%
Estimating cost	13	10.66%
Mechanical and Electrical	10	8.20%
Sustainability	5	4.10%
Facility management	7	5.74%
Clash detection	18	14.75%

ID	View Survey	Others, specify
9213025	View	Environmental analysis, Energy consumption analysis, purchasing, progress monitoring, snagging

Question 13*

What is your opinion of the awareness level of the stakeholders in the industry, about BIM? 1 is poor, 10 is excellent

	1	2	3	4	5	6	7	8	9	10	Responses	Total
Owner	13.04%	17.39%	30.43%	8.70%	4.35%	8.70%	4.35%	8.70%	0%	4.35%	23	20%
Architect	17.39%	0%	0%	0%	8.70%	17.39%	17.39%	4.35%	30.43%	4.35%	23	20%
Engineer	13.04%	4.35%	4.35%	8.70%	4.35%	8.70%	26.09%	13.04%	13.04%	4.35%	23	20%
Contractors / subcontractor	17.39%	21.74%	0%	17.39%	4.35%	13.04%	13.04%	0%	4.35%	8.70%	23	20%
Facility manager	21.74%	17.39%	4.35%	17.39%	8.70%	13.04%	8.70%	4.35%	0%	4.35%	23	20%

View Survey	Additional comments
View	Most view BIM as 3D software...aka Revit, Archicad, Bentley, etc. vs. efficient facility life-cycle management processes supported by digital technology. This is due to the marketing by the 3D visualization software vendors and their lack of life-cycle management knowledge.

Question 14*

What do you think about the clients awereness/consiousness of BIM, in general cases, to be?

Poor	6	26.09%
Interested but don't make requirements	15	65.22%
Make demands of BIM deliverance for the facility management	2	8.70%

Additional comments

This vary lots from case to case and form individuals. Even with bigger contractors one person can make big impact how the project will be handled.
Many public sector Owners are beginning to require BIM... but the requirements are inconsistent.

Question 15

How do you consider the implemenation of BIM to be in the AEC industry?

Slow	9	39.13%
Moderate	11	47.83%
Fast	3	13.04%

Additional comments

Adoption has been slow, but is accelerating in the past year or two.
But growing exponentially
According some comments, Finland is leader in BIM implementation. I've been working here over 10 years in company trying to push BIM knowledge to market and for example 90& of structural engineers work still in tarditional methods (2d). Note! Thats my opinion according my experiences. Public info may be different...
Paul Morrell has set UK to be BIM ready by 2016. See his maturity model
BIM requires a culture change... major hurtle to overcome!!!

Question 16

What do you consider to be the most benefical factor, for improving the implementation of BIM

Increased awerness of the owner	10	43.48%
Increased awerness of the facilitets manager	2	8.70%
Increased communication in the firm	0	0.00%
Increased communication between different teams	11	47.83%

Additional comments

Communication is no doubt one of the keys. But as well I believe that the constructiion process itself should be also modified to better support BIM. Not to use new tools to get old kind of results, but develop and get something new.
Collaboration and the resulting efficiencies relative to life-cycle facility management.

Question 17*

What is your general perception of the communication style in the projects, you are involved in?

Open	13	68.42%
Bureaucratic	6	31.58%

Question 18

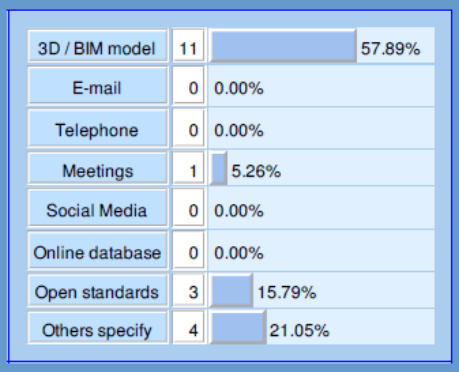
How do you consider your accessibility to the other team members that are working on an AEC constructing case?

Slow responses	9	47.37%
Quick responses	10	52.63%

ID	View Survey	Additional comments
9362606	View	All our clients use IPD and JOC.
9403265	View	Our firm has almost all disciplines under one roof so collaboration is easier.

Question 19*

What do you think is the best tool to improve the collaboration among the stakeholders?

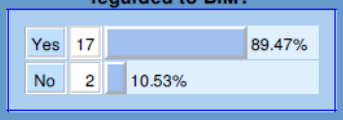


3D / BIM model	11	57.89%
E-mail	0	0.00%
Telephone	0	0.00%
Meetings	1	5.26%
Social Media	0	0.00%
Online database	0	0.00%
Open standards	3	15.79%
Others specify	4	21.05%

View Survey	Others, specify
View	A new way of doing "projektweb" based on open standards and social media (web 2.0). I would love if one day we could have a free alternative to byggeweb supported by the government.
View	I believe that social media can be import, but at least in Finland thats not the case yet. And I don't believe that it will replace the need of face to face meetings or telephone. The contrary, if the project team knows each other from the beginning, after that they can use any method for communicating.
View	co-location offices help as well
View	Standardized taxonomies, definitions, terms, benchmarks, cost data bases ....

Question 20*

Would you step out of your element and support other organizational team members, in a construction case, to solve problems, that are regarded to BIM?

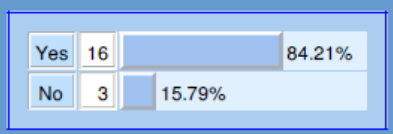


Yes	17	89.47%
No	2	10.53%

ID	View Survey	If your answer is no, please elaborate your reasons.
9190563	View	I would do it for free if it gets the problem solved.
9360827	View	Only if allowed by my organization

Question 21*

If your answer was "yes" If your think it would be accepted accepted from the management?



Yes	16	84.21%
No	3	15.79%

If your answer is no, please eleborate your answer
With good reasoning. Not promising miracles, giving hard facts, starting with small and expanding and developing when getting experiences

Question 22

If your answer is "yes" to question 21 decided to help, how would you prefer do so?

Face to Face	8	47.06%
Virtually: (Facebook Youtube Google plus TeamViewer skype)	6	35.29%
Telephone	3	17.65%

Question 23*

If you would like to support other team members, what kind of tool or channels would you choose to use to do so?

Social Media (as Facebook twitter LinkedIn youtube skype)	1	5.26%
TeamViewer or other remote control desktop sharing and file transfer between computers application)	6	31.58%
Virtual reality as Second life	1	5.26%
E-mail	1	5.26%
Telephone	0	0.00%
BIM tool	8	42.11%
Suggestion for other tool	2	10.53%

ID	View Survey	Suggestion for other tool
9213025	View	Project work place or DMS in combination with ArtrA
9362606	View	Cloud based platform.... secure, tracks all changes, ability to control level of viewing....

Question 24*

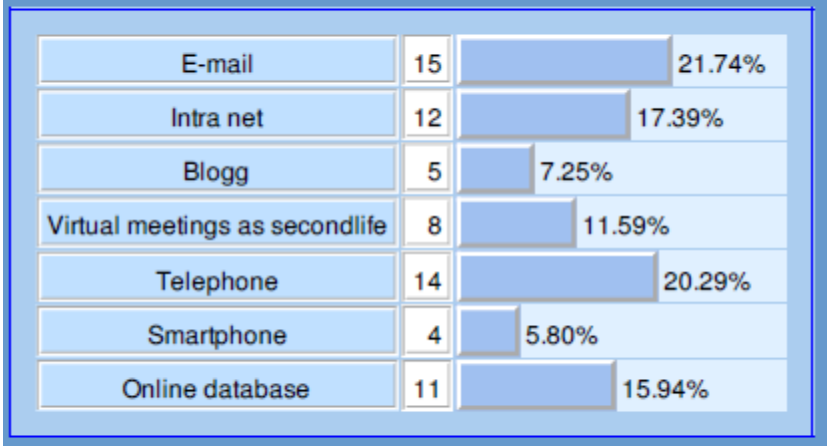
Do you think it is common to help other organization members about problems regarded to the BIM usage?

Yes	14	73.68%
No	5	26.32%

ID	View Survey	Additional comments
9190563	View	BIM is about cooperation, therefore, it may be necessary at times.
9362606	View	If you understand BIM.. yes.

Question 25*

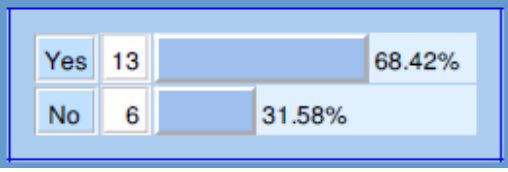
What channels do you use at work?



ID	View Survey Other	
9213025	View	See 23
9362606	View	Cloud technologies.

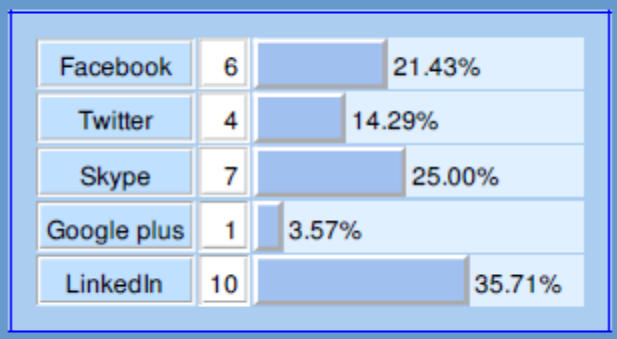
Question 26*

Have you ever used Social Media for communicaton for the purpose related to your work?



Question 27

If "yes" in question 26, which channels are you using for work related purpose?



ID	View Survey Other communication tool	
9354641	View	Mainly software related tools, just "learning" to use Linked in.

Question 28

If "no" why are you not using Social Media?

Text Answers (7)
n/a
no need for it yet.
Why should you use a social media when you can collaborate over the table*?
I USE IT TO GET INFO IDUCTRY WISE NOT PROJECT WISE.
it is not widely used in the AEC industry
The most effective tools now are incorporated in our BIM software as add-on extensions. These tools are specifically designed for such collaboration. It seems unlikely that more effective tools would come out of social media.
Not common practice, probably not professional.

Question 29*

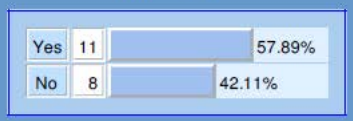
What channels are you using for private purpose in degree of 1 is little 10 is much. 0 is not used the tool.

	0	1	2	3	4	5	6	7	8	9	10	Responses	Total
Facebook	31.58%	5.26%	5.26%	0%	0%	10.53%	0%	5.26%	10.53%	5.26%	26.32%	19	10%
Twitter	52.63%	10.53%	5.26%	0%	5.26%	0%	10.53%	5.26%	5.26%	5.26%	0%	19	10%
Skype	26.32%	10.53%	0%	10.53%	15.79%	5.26%	5.26%	0%	10.53%	0%	15.79%	19	10%
Google plus	68.42%	15.79%	5.26%	5.26%	0%	0%	0%	0%	5.26%	0%	0%	19	10%
LinkedIn	10.53%	0%	5.26%	10.53%	10.53%	5.26%	5.26%	0%	21.05%	10.53%	21.05%	19	10%
Youtube	26.32%	5.26%	10.53%	10.53%	10.53%	5.26%	5.26%	10.53%	5.26%	0%	10.53%	19	10%
Smarthphone	31.58%	0%	0%	0%	0%	5.26%	10.53%	5.26%	5.26%	10.53%	31.58%	19	10%
Telephone	10.53%	0%	0%	0%	0%	5.26%	21.05%	5.26%	31.58%	0%	26.32%	19	10%
E-mail	10.53%	0%	0%	0%	0%	0%	10.53%	5.26%	26.32%	5.26%	42.11%	19	10%
Virtual reality	73.68%	0%	5.26%	5.26%	0%	5.26%	5.26%	0%	0%	0%	5.26%	19	10%

ID	View Survey	Other communication tool
9182331	View	BIM software add-ons.
9360827	View	if virtual reality is computer games, then 8.

Question 30*

Do you think it would be a good idea to use Social Media as communication channel to integrate the stakeholders in a construction process?



Question 31

What is your opinion of Social Media as Facebook in construcion process? Can you explain your answer in question 31?

ID	Text Answers (11)	View
9885352	n/a	View
9403265	I think the creation of project groups within a social media site could be a fast and efficient method of communicating common information to all team members instantly. It could be a better method than routing emails to various team members.	View
9367529	it is surpufluous. currently E-mail works as this communication tool.	View
9362606	Facebook as it is is not appropriate for construction. The combination of BIM and Cloud computing, however, enable "Facebook for Construction, Operations, and Maintenance".	View
9360827	I think there are better ways of communicating than facebook for construction projects.	View
9354641	In Finland generally, Facebook and Twitter are considered mainly as private media, not work related. But there are other tools that have more work related status. Also in some softwares these are combined, for example start page is extranet page for users etc. Thats of course were narrow scope, but as an idea seem to work.	View
9352880	One should be social and the other professional.	View
9233057	I DON'T FEEL FACEBOOK IS THE PROPER CHANNEL FOR THIS PROCESS. TO FACE BOOK IS MORE PERSONAL I THINK LINKEDIN AND TWITTER IS A BETTER CHANNEL.	View
9213025	Worthless	View
9182331	My personal use of Facebook is limited to interaction with family & friends. I have privacy concerns regarding using Facebook for other purposes. I think there are better tools.	View
9177963	Contractors are opposed to technology and changes from traditional practice	View

Question 32*

Do you think you could use Social Media to:

	Yes	No	Responses	Total
Support other organization in their use of BIM method	63.16%	36.84%	19	25%
To gather information's about the tools of the "others"	73.68%	26.32%	19	25%
For gathering ide's of other stakeholders?	78.95%	21.05%	19	25%
Increase the awareness of the stakeholders of the benefits of using BIM	89.47%	10.53%	19	25%

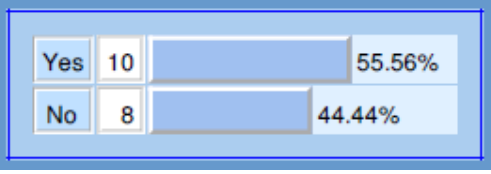
Question 33*

Are you using Smartphone

Yes	13	41.94%
No	5	16.13%
As a part of my work	6	19.35%
As a part of my private life	7	22.58%

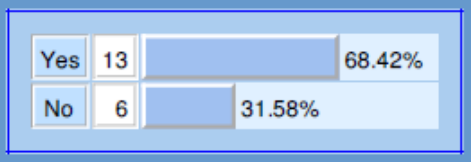
Question 34

Are you using Social Media on your Smartphone, as e.g. Facebook, google plus or LinkedIn?



Question 35*

Do you think Social Media could be convenient for supporting the implementation of BIM



	View Survey	Any comments?
63	View	Wouldn't be able to use BIM software
41	View	I believe BIM implementation needs visibility as largely as possibly, so also in Social Media
06	View	As noted above.

Question 36*

What do you think could be the obstacles that hinder Social Media to gain it place in the AEC constructing process? The scale from 1 to 10 is how much you aggre. One is little ten is much.

	1	2	3	4	5	6	7	8	9	10	Responses	Total
It is not the tradition	10.53%	5.26%	0%	0%	15.79%	0%	15.79%	15.79%	15.79%	21.05%	19	6%
Lack of the stakeholders knowledge and usage of Social Media	10.53%	5.26%	5.26%	10.53%	15.79%	5.26%	21.05%	0%	5.26%	21.05%	19	6%
Overload of information	15.79%	0%	0%	10.53%	21.05%	5.26%	5.26%	21.05%	10.53%	10.53%	19	6%
Stealing time from work	15.79%	10.53%	5.26%	10.53%	15.79%	0%	15.79%	5.26%	10.53%	10.53%	19	6%
Legal barriers	21.05%	0%	5.26%	10.53%	10.53%	10.53%	15.79%	10.53%	5.26%	10.53%	19	6%
It doesn't change anything	21.05%	15.79%	10.53%	0%	21.05%	15.79%	5.26%	5.26%	0%	5.26%	19	6%
I don't whant to blur my social and work life	15.79%	0%	5.26%	0%	15.79%	5.26%	5.26%	10.53%	15.79%	26.32%	19	6%
It will not help the team to find solutions	36.84%	5.26%	10.53%	0%	21.05%	5.26%	5.26%	5.26%	0%	10.53%	19	6%
Difficult to make decisions	15.79%	10.53%	5.26%	10.53%	21.05%	10.53%	5.26%	5.26%	0%	15.79%	19	6%
Difficult to agree on which Social Media should being used	15.79%	5.26%	0%	0%	21.05%	5.26%	15.79%	21.05%	5.26%	10.53%	19	6%
People don't share their knowledge	26.32%	0%	10.53%	0%	21.05%	15.79%	0%	10.53%	5.26%	10.53%	19	6%
It will not improve communication among stakeholders	21.05%	15.79%	0%	10.53%	15.79%	15.79%	5.26%	10.53%	0%	5.26%	19	6%
Hard to keep stakeholders engaged with Social Media	15.79%	0%	0%	0%	31.58%	10.53%	5.26%	10.53%	5.26%	21.05%	19	6%
There is no communications structure	10.53%	0%	0%	5.26%	31.58%	5.26%	5.26%	15.79%	10.53%	15.79%	19	6%
It is not actual because of the limits of business processes	15.79%	0%	10.53%	10.53%	26.32%	0%	10.53%	10.53%	0%	15.79%	19	6%
BIM is not social problem but technical problem	21.05%	5.26%	5.26%	0%	10.53%	5.26%	15.79%	15.79%	5.26%	15.79%	19	6%

Question 37

Do you think Social Media could be helpful in the facilities management, to dig for information about decision that have been made during the requirement, design and construction phases?

Yes	13	68.42%
No	6	31.58%

Question 38*

What kind of meetings are you involved in?

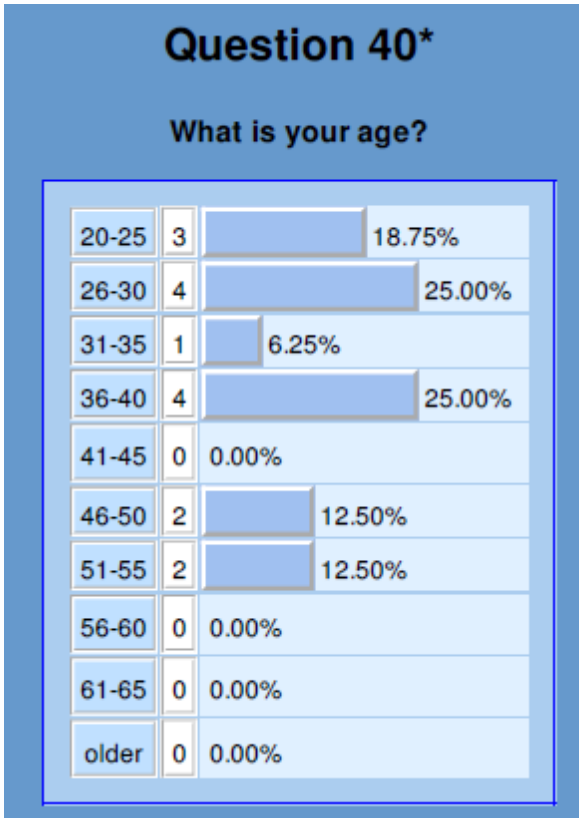
Start up	11	29.73%
Problem solving	15	40.54%
status review	11	29.73%

Question 39*

Do you think some of this meetings could be held on Social Media, as e.g. Skype, Facebook or Google plus?

Yes	11	68.75%
No	5	31.25%

ID	View Survey	Additional comments
9190563	View	not at facebook it is too personal


Question 40*
What is your age?
20-25 3 18.75%
26-30 4 25.00%
31-35 1 6.25%
36-40 4 25.00%
41-45 0 0.00%
46-50 2 12.50%
51-55 2 12.50%
56-60 0 0.00%
61-65 0 0.00%
older 0 0.00%