Learning from lessons learned

How to preserve knowledge and improve relations to decrease additional costs and quality defects in new housing projects

Master's Thesis in the Master's Programme Design and Construction Project Management

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ABSTRACT

The construction of new housing depends on a wide range of different actors. Well-functioning relations are vital for project success despite this, challenges concerning relations are often overlooked for the sake of financial results. Price is considered the most important factor when tendering subcontractors, risking compromising other important aspects. Yet another factor impacting a project's outcome is errors. As all profit making organisations strive to increase profitability, these are essential to rectify, analyse and learn from. Previous research indicates that quality defects primarily occur due to organisational issues. It is challenging for construction companies to systematically monitor quality defects and capture lessons learned. The long-term perspective is often sacrificed for the sake of short-term success, impeding learning within and between organisations.

Through qualitative research, the authors have conducted a literature review of project organisations, common disturbances in projects, knowledge management, and main contractor-subcontractor relations in the field of construction management. Furthermore, a case study was conducted at a large construction company in Sweden. The study aimed to investigate how new housing projects in the construction industry can decrease additional costs and quality defects, through improved relation, as well as by implementing knowledge management systems.

The study indicated that the Company has to create a culture for prioritising knowledge transfer and capturing lessons learned. The challenge to monitor and analyse quality defects in the construction industry is evident, as neither main contractors nor subcontractors learn from previous mistakes to the extent possible. Implementing learning networks and conducting post project reviews (PPR: s) are recommended ways to foster knowledge exchange, and improving organisational learning. The study indicates a tendency for undervaluing design in early phases, resulting in defects and ambiguity in division of responsibilities. By adopting the long-term perspective, construction companies can increase their ability to create stable organisations and projects with higher predictability, hence increase the ability to predict which projects will be profitable and less troublesome in the future.

Key words: construction industry, collective learning, disturbances in construction
            projects, knowledge management, learning networks, lessons learned,
            main contractor-subcontractor relations, project organisations

Att lära av lärdomar

Att bevara kunskap och förbättra relationer för att minska merkostnader och kvalitetsbrister i nya bostadsprojekt

Examensarbete inom mastersprogrammet Design and Construction Project Management

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SAMMANFATTNING

Nyproduktion av bostäder involverar ett stort antal olika aktörer. Trots betydelsen välfungerande relationer har för ett lyckat slutresultat, förbises ofta dessa aspekter till förmån för kortsiktiga ekonomiska resultat. Lägsta pris anses vara den viktigaste faktorn vid upphandling av underentreprenörer, vilket riskerar att andra avgörande faktorer förbises. Ytterligare aspekter som påverkar ett projekts resultat är fel och brister. Då alla vinstdrivande företag strävar efter ökad lönsamhet är dessa nödvändiga att korrigera, analysera och dra lärdomar från. Tidigare forskning visar att kvalitetsbrister främst uppstår på grund av organisatoriska faktorer. Det är en utmaning för företag inom byggbranschen att systematiskt följa upp kvalitetsbrister och kunna dra lärdom från tidigare fel, då det långsiktiga perspektivet riskerar att förbises till förmån för kortsiktig framgång och hindrar lärande både inom och mellan företag.

Genom ett kvalitativt tillvägagångssätt har författarna genomfört en litteraturstudie av projektorganisationer, vanliga störningar i byggprojekt, kunskapshantering, och relationer mellan byggentreprenörer och underentreprenörer. En fallstudie har genomförts på ett stort byggföretag i Sverige. Studien har syftat till att undersöka hur bostadsprojekt kan minska merkostnader och kvalitetsbrister, dels genom förbättrade relationer, dels genom att implementera system för kunskapsåterföring.

Studien indikerade att företaget måste skapa en kultur där kunskapsöverföring och tillvaratagande av tidigare lärdomar prioriteras. Byggbranschen har en uppenbar utmaning i att systematiskt övervaka och analysera kvalitetsbrister, då varken byggentreprenörer eller underentreprenörer lär av tidigare misstag i den mån som är möjlig. Nätverk för lärande samt utvärderingar efter avslutade projekt rekommenderas för att främja kunskapsutbyte. Studien visade en tendens till att undervärdera viktiga projekteringsdetaljer i tidiga faser av byggprojekt, vilket resulterar i fel och en tvetydig ansvarsfördelning. Genom att anamma ett långsiktigt perspektiv kan byggföretag öka sin förmåga att skapa stabila organisationer och projekt med större förutsägbarhet, och därmed bättre kunna förutsäga vilka projekt som kommer bli lönsamma.

Nyckelord: byggbranschen, entreprenörsrelationer, gemensamt lärande, kunskapshantering, lärande nätverk, störningar i byggprojekt, tillfälliga projektorganisationer, lärdomar

Contents

Preface

This master thesis is part of the M.Sc. program in Civil Engineering of 120 ECTS, Design and Construction Project Management, at Chalmers University in Gothenburg. The study extends to 30 ECTS and has been conducted during the spring semester in 2016, at the Department of Civil and Environmental Engineering, at the division of Construction Management. The authors are fifth year graduates.

The study aims to examine, problematize and discuss how new housing projects in the construction industry, through improved relation between main contractor and subcontractor as well as implementing knowledge management systems, can decrease additional costs and quality defects.

First and foremost we would like to thank our supervisor Mathias Gustafsson, Associate Professor at Civil and Environmental Engineering, Construction Management at Chalmers University of Technology for great support, innovative ideas and important input during the process. Furthermore, we want to thank our supervisor at the Company, who has assisted with information and knowledge about the Company as well as and the opportunity to get in contact with important interviewees. Finally, we would like to thank all those, both employees at the Company and subcontractors, who have designated their time, knowledge and expertise to enable for us to conduct this master thesis.

Göteborg May 2016

Mikaela Landin Hellqvist

Anna Wetterberg

"A mind needs books as a sword needs a whetstone, if it is to keep its edge"

- George R.R. Martin, A Game of Thrones

1   Introduction

This chapter provides a background to the occurrence and origin of errors and defects in construction projects, explains the need for quality improvements in the construction industry, as well as describes the Company where the case study has been conducted.

1.1   Background

All profit-making organisations today strive to increase profitability, which is both an ownership requirement and a matter of survival on the market (Josephson, 2013). Companies within the construction industry are highly dependent on the profit margins of each project, why errors and shortcomings are essential to analyse due to their impact on organisations' profitability.

A new housing construction project involves several actors, and a wide range of different firms. Today, building contractors purchase services and goods for approximately 70-90% of their annual turnover (Arditi and Chotibhongs, 2005; Eom, Kim and Jang, 2015; Josephson and Lindström, 2011), and the trend is increasing. The largest companies cooperate with between 20 000 and 30 000 unique subcontractors and suppliers each year, making it a key issue to coordinate suppliers, subcontractors and purchases (Josephson and Lindström, 2011). Well-functioning relationships and subcontracting practices are of great importance to deliver successful projects (Arditi and Chotibhongs, 2005), however despite the large share of subcontractors in construction projects, the issues and challenges concerning subcontracting procurement and relationships are seldom analysed or prioritised to be improved (Arditi and Chotibhongs, 2005; Eom et al., 2015).

In construction of new housing, many projects are approved as completed even though errors and defects still remain (Boverket, 2007). A study made by Josephson and Lindström (2011) indicated that the average time spent on errors and shortcomings in projects after submission amounted to 8% of the working time, with customer service in the top of the list followed by the site manager. A similar study made by Boverket (2007) estimated that 15% of the working time is spent on finished projects, at the expense of involvement in new projects. The study further concluded that errors and quality defects in completed projects primarily occurs due to organisational issues, where leadership and motivation play important roles. In order to conduct a successful project, demarcation of different responsibilities have to be clearly defined and assigned, as well as making the project team engaged in order to be dedicated to the task (Antvik and Sjöholm, 2007). Factors such as time pressure and shortcomings in the design phase are contributing causes of errors, as well as lack of knowledge on how to perform a task, lack of instructions and lack of leadership (Boverket, 2007).

According to Josephson and Lindström (2011) it is a great challenge for construction companies to systematically monitor quality defects. Today, monitoring of quality occurs via inspections and audits in different forms on site. However, this information is seldom taken to a higher level in the organisation in order to be analysed. The entire industry faces the risk to lose a large share of knowledge due to retirements in the near future, and the need for proper knowledge management frameworks and mechanisms, such as the ability to analyse and capture lessons learned, is urgent (Shokri-Ghasabeh and Chileshe, 2014).

The case study for this thesis has been conducted at one of the largest construction companies in in Sweden, from now on referred to as "the Company". The Company has nearly 60 000 employees in the world, and is concentrated on construction and development of residential, and commercial real estate projects, as well as infrastructure projects, with home markets in Europe and USA.

1.2 Purpose

The study aims to examine, problematize and discuss how new housing projects in the construction industry, through improved relation between main contractor and subcontractor, as well as implementing knowledge management systems, can decrease additional costs and quality defects.

1.3 Specification of purpose

To achieve the purpose, three questions have been formulated to illustrate connections between the conducted literature review and the case study:

- How does previous research treat quality defects in construction projects, knowledge management concepts and main contractor-subcontractor relations?
- What is the general main contractor and subcontractor perspective, according to the case study, regarding quality deficiencies, knowledge management practices and relations?
- What improvement actions are there to suggest?

1.4 Method literature review

The theoretical framework was compiled of a literature research concerning project organisations, disturbances in construction projects, knowledge management in construction and main contractor-subcontractor relations. The authors initiated the literature review by screening the existing research concerning these topics. As the review focused on capturing different perspectives and pinpointing key characteristics within the construction industry, it first and foremost addressed scientific articles and books in the field of construction management.

2 Theoretical Framework

This chapter presents the literature review. To begin with, project organisations are discussed, framing challenges and disturbances in construction projects, and their impact on a project's outcome, in order to understand the prerequisites of the thesis. Thereafter knowledge management in construction organisations is investigated, mainly how knowledge is captured and transferred between and within organisations, to give an idea of what previous research proposes as best practice. Finally the relations between main contractors and subcontractors in the construction industry are investigated concerning common issues and challenges, in order to have a foundation to compare and analyse the case study in the thesis.

2.1 Project organisations

Projects are of temporary art (Antvik and Sjöholm, 2007), they exist during a limited period of time where for each project a new organisation is composed (Josephson, 2013). Temporary project organisations impact the entire company's organisation, and its ability to create effective processes (ibid.). A clearly defined project organisation with distinctive division of responsibilities is vital for project success (Antvik and Sjöholm, 2007). As a result of the temporary nature of construction projects and the composition of team members, the construction industry suffers from the consequences of discontinuity, which leads to organisational knowledge loss (Shokri-Ghasabeh and Chileshe, 2014).

Workings in project organisations have both advantages and disadvantages. Employees increase their ability to adapt to new situations and learn from colleagues with different experiences; however there is a significant challenge for organisations to develop efficient processes, which entails a large variation in results and procedures (Josephson, 2013). The construction industry relies on project based organisations, and therefore has to deal with the aforementioned challenge. Construction projects are often executed under time pressure with limited resources, and the requirement of being cost-effective (Knauseder, 2007). Organisations can reduce their costs in two ways according to Josephson (2013), either by using cheaper resources, which entails short-term success, or by developing more time efficient processes, which entails long-term success. The difficulties lies in combining these two, and several construction companies seem to choose the short-term strategy with no regard to measure or analyse variations or disturbances in projects (Josephson, 2013).

The construction business can be described in terms of processes, divided into three categories; the operation process, the support process and the management process (Josephson, 2013). The operation process (e.g. planning and execution) adds direct value to the customer, and if removed the product or service becomes incomplete. The support process (such as purchasing and engineering departments) is intended to support the operation process. It does not add direct value to the product but is a necessity to make the operation process function. The management process includes activities intended to make decisions based on the organisation's objectives and strategies. To operate effectively there must be balance between these three processes; too extensive management and support processes may hamper efficiency, however too meagre increases the risk of hazardous activities (ibid.).

The entire construction industry is highly dependent on suppliers and subcontractors to execute projects (Bower, 2010; Shimizu and Cardoso, 2002). Services and materials constitute about 90% of the total project cost (Hartmann and Caerteling, 2010), entailing the impact subcontractor performance have on whether the outcome of a project is successful or not (Arditi and Chotibhongs, 2005; Eom et al., 2015). Performance failure due to subcontractors may have a direct and severe impact on a project's profitability (Bower, 2010).

2.2   Disturbances in construction projects

Errors are unavoidable, and occur in all construction processes (Josephson, 2013). The costs of time loss due to errors and defects for a main contractor has been estimated to approximately 18 000 SEK per apartment (Boverket, 2007). Costs for other actors, resulting impact of the errors, or the cost of repairing errors are not included in these calculations. Single errors can have vast consequences, why it is important for organisations to understand the causes of errors and where they occur (Josephson, 2013).

Defects in construction projects can be attributed to all actors involved in the process. The study made by Josephson (2013) indicated that the main contributors to errors were due to production management issues, had origin in the design phase or were due to main contractors' and subcontractors' management. Furthermore, almost one fifth of the errors were due to material defects. Poor workmanship and execution of work tasks accounted for one fourth of the detected errors, where 7% of those could be derived from mistakes of subcontractors. Even though the study showed that management and workmanship defects are more frequent, mistakes with origin in the design phase are often more expensive and complicated to correct. The most expensive design defects concerned coordination between subcontractors, and the most expensive mistakes during the production phase could be traced to planning of the project, and its time scheduling. Boverket (2007) made a similar study, where organisational factors are stated to have a greater impact on the quality in construction projects than technical factors, and where none of the interviewees considered themselves as part of the cause to errors.

According to Antvik and Sjöholm (2007) the main reason why projects do not reach their goals is due to organisational issues, imprecise objectives and poor planning. The most significant factor to why projects succeed is due to good relationships between the various actors involved in the project (ibid.). When errors and defects occur, main contractors are forced to sort out responsibilities both towards subcontractors as well as within the own organisation's different profit units (Boverket, 2007). By developing methods for analysing defects, the possibilities to reveal deficiencies increase. In order to increase efficiency emphasis must be put on finding ways to visualise hidden costs and defects (Josephson, 2013) and very few business executives are aware of how extensive the costs of errors in the organisation actually are (ibid.).

The analysis made by Josephson (2013) showed that the stability of the project organisation had a significant impact on the end result. The pattern showed four recurrent main categories, displayed in Table 1.

Table 1   Categories impacting project outcome.

New vertical relations	Usage of previously unknown subcontractors
New horizontal relations	Two or more subcontractors have not worked together before
Project organisations not created in time	Key personnel are decided upon to late
Project organisations that change over time	Key personnel replaced over time, resulting in problems in division of responsibilities, uncertainty of previously made decisions, and stagnation of the project

Projects where new vertical and/or new horizontal relations occurred suffered from communication difficulties during the establishment of the new relations. Project organisations not created in time lacked important competencies in the design phase, necessary in order to decide on important technical solutions, or production planning (Josephson, 2013). Project organisations changing over time is common, and occurs due to various reasons (Antvik and Sjöholm, 2007). However, this causes challenges in division of responsibilities, as well as uncertainty of previously made decisions (Josephson, 2013). If the client organisation is changed it may result in significant complications, which indicate that stable organisations have less additional costs, and deliver better end products than changing one's (ibid.). Increasing personnel force in a project can as well hamper efficiency in the project team, due to the time and effort it takes to acquaint with it, understand its conditions, and create relations with new colleagues (Antvik and Sjöholm, 2007).

Josephson (2013) present three strategies to reduce errors in construction projects, and in practice all three strategies can be combined:

- Eliminating the causes of errors through proper risk analysis, developing methods for planning and management, as well as education and training of employees.
- Detect errors as soon as possible and correct them. This strategy is based on the assumption that the occurrence of errors cannot be totally eliminated. Implementation of warning systems, and encourage employees to react to errors, are ways of acting.
- Learning from previous errors by having the approach that the same mistakes tend to be repeated, and therefore work proactively to prevent the causes. By analysing errors organisations' gain the ability to correct the conditions that causes errors.

2.2.1   Causes to disturbances

In construction of new housing, the processes are relatively predictable and the more repetitive elements that can be identified, the better the conditions for developing efficient processes are (Josephson, 2013). Despite this, construction projects often lack in standardisations of solutions and tasks (Bower, 2010). According to Antvik and Sjöholm (2007) there is no such thing as a copy project; every project is unique even though parts may be similar to previous projects, with repetitive elements. Loosemore (2014) states "the under-valuing of design" (pp. 257) as a significant issue causing

errors, hence project specific characteristics always have to be taken into consideration even if the project resembles a previous one.

Despite the uniqueness of every project, there is much to gain by trying to identify repetitive elements, as it can reduce uncertainties and defects (Josephson, 2013). Although, in the standardization lies a challenge, as the projects with the most errors were the ones similar to previous projects (ibid.). Neither the complexity of the project nor the construction time had any significance to the errors that occurred. Josephson (2013) made a comparison between construction projects with the lowest versus the highest costs due to errors, which is presented in Table 2 below:

Table 2   *Comparison between the construction projects with the lowest versus the highest costs of defects (Josephson, 2013).*

Factor	Projects with lowest cost of errors	Projects with highest cost of errors
Product	"The unique project"	"The copy project"
Organisation	Design-build with good cooperation and previous experience from working together.	Design-build with a new organisation, short on staff, borrowed staff from other departments.
Process	Good progress despite several changes and reduced construction time, united action in design-phase in which the site manager was included. Site manager able to steer and control production on-site.	Troublesome project with stringent savings requirements, many changes in main contractor's organisation and usage of personnel from different departments.
Trust in site manager	High. Design-team were more involved in the work on site than previous, site manager had long experience and was perceived as clear and transparent.	Low. Site manager with long experience and success in previous projects, but inexperienced with the specific project type, impacting the possibilities to communicate with and inform the team.
The clearness of the task	Clear. Scheduled regular meetings, design-team included in building-process, site managers included in design-phase.	Unclear. Little contact between design-team and production. Site-manager not included in design, with an administrative role and low interaction with skilled workers on site.
Support for manager	Site manager with great power and authority. Proper staffing of site-management.	Production requested support, but did not receive any (for example more resources). Low tendering price.

According to Dave and Koskela (2009) the construction industry lacks to retain knowledge from previous projects and transferring it into new ones, and they mention changes in personnel force, separations of team members after completed projects, and lack of platforms for sharing and capturing knowledge as contributors to knowledge loss. They furthermore claim that many construction companies have established documentation processes, however they are often inadequate and do not include any functioning knowledge transferring mechanism. The industry has a need for knowledge

management systems to preserve, capture and spread knowledge in the organisation both during and after project completion (ibid.).

2.3   Knowledge management in construction

The concept of knowledge management involves several activities in order to create, capture, share and transfer knowledge (Khalfan, Kashyap, Li and Abbott, 2010). The concept seeks to store and use knowledge within an organisation to improve processes and performance. The organisational aspect of knowledge management concerns foremost the transferral of knowledge, as it is a key factor in gaining competitive advantage, which puts high demands on systems to organise and facilitate knowledge (Dave and Koskela, 2009).

Management of knowledge has been identified as crucial for successful construction projects, as it has turned out to be a defiance to preserve knowledge gained in one project and transfer it to another (Dave and Koskela, 2009; Josephson, 2013). The limitation of gaining new knowledge in the industry is to some extent due to a fragmented process that makes it difficult to access information and transfer it between different phases (Dave and Koskela, 2009; Knauseder, 2007). The characteristics of the construction industry, such as temporary project organisations and separated phases, are important to consider when investigating knowledge management. In temporary organisations, the long-term perspective is often sacrificed for the sake of short-term success, impeding learning in the organisation (Knauseder, 2007). The lack of organisational learning in the construction industry can be a barrier causing rework and errors to occur, as well as a factor leading to poor quality of the product, and low productivity in the process (ibid.).

Carlsson and Josephson (2001) conducted a study of four different housing projects in Sweden, and concluded the gained experience by project participants to be substantial. However the time for reflection and gathering lessons learned was lacking, which is an important aspect for long-term learning. In another study by Josephson, Knauseder and Styhre (2003) several different actors were interviewed, and similar results were found. A majority of the interviewees felt they lacked time to reflect about issues in the projects, and exchange knowledge and experiences with co-workers. The reasons for lack of time to reflect can be due to low interest among the actors, and/or the urgency for the organisation to transfer employees to the next project (Knauseder, 2007). This is an effect of the short-term perspective, where the result of each project is more prioritised than time for knowledge sharing and joint learning to gain a deeper, long-term understanding for the complexity of construction projects (Cheng, 2009; Styhre, Josephson, and Knauseder, 2004). Time for reflection upon experience has to be given during working hours in order to gain individual learning (Antvik and Sjöholm, 2007) as well as time to engage in knowledge sharing activities to create organisational learning (Shokri-Ghasabeh and Chileshe, 2014). Focus on organisational learning and knowledge sharing has to be implemented by top management, and passed down throughout the organisation to be fully deployed at all levels (Styhre et al., 2004).

According to Josephson et al. (2003), what hampers learning can be derived from the following:

- Learning happens in the moment
- Learning is not prioritised
- Learning equals problem solving, not preventing problems
- Learning is unsystematic

They further state that in most organisations, the economical results have higher priority than learning, which results in that learning only happens in the moment of action, instead of in a systematic way.

2.3.1 Collective learning

Fu, Lo and Drew (2006) define collective learning in a construction context as "the stockpile of knowledge of practitioners" (pp. 1019), which is highly characterised by the importance of personal contact between actors, such as main contractors and subcontractors. In the occurrence of individual learning, information is processed and interpreted on an individual basis into knowledge, whereas collective learning takes place in groups where the participants are connected by a joint purpose (ibid.). Learning is obtained in forums for human interaction, where individual knowledge and experiences can be shared, discussed and developed (Fu et al., 2006). A challenge with collective learning is the issue of giving members in a project time to acquaint with each other as well as the scope of the project, before addressing organisational learning (Knauseder, 2007). There are notable difficulties concerning the gathering and distribution of already existing knowledge in an organisation, and making it trackable (ibid.).

Nonaka, Takeuchi and Umemoto (1996) presents a knowledge creation model consisting of four modes of knowledge conversion by human interaction, see Figure 1, which can advantageously be applied to knowledge transfer and collective learning in the construction industry (Fu et al., 2006). The model is based on the theory that knowledge is created and developed, between tacit (internal) and explicit (external) knowledge, through social interaction (Nonaka et al., 1996).
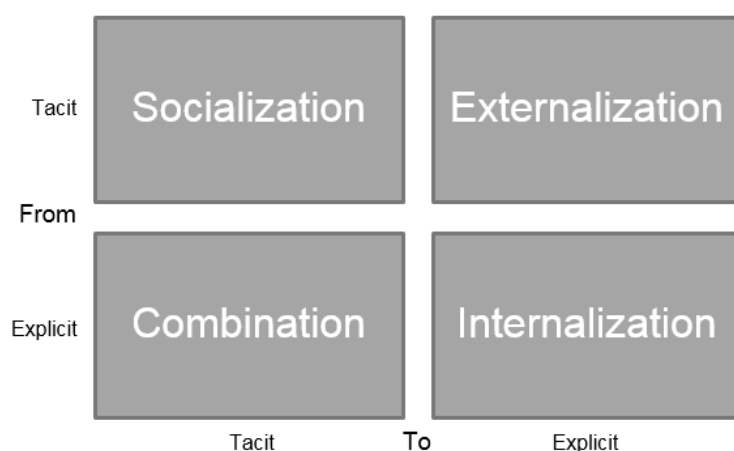

Figure 1   The four modes of knowledge conversion by Nonaka et al. (1996).

Socialization is sharing of experiences, which creates tacit knowledge, for example technical skills. Without having some kind of shared experiences, it is difficult to understand the thinking process of someone else (Nonaka et al., 1996). Hence, the transferred information and knowledge risk making no sense to the receiver, if sharing of experiences does not occur. Relationships that foster further cooperation between participants is one facilitator of socialization (Fu et al., 2006).

Externalization is conversion of tacit knowledge into explicit knowledge, obtained by commonly organised activities such as meetings and workshops (Fu et al., 2006), with collective reflection among the participants (Nonaka et al., 1996). Externalization is of great importance for knowledge creation, since it creates new explicit knowledge from existing tacit knowledge (ibid.).

Combination can be explained as new knowledge emerging from rethinking explicit knowledge through sorting, adding, combining, and categorizing already existing information (as for example in databases) (Nonaka et al., 1996). It represents the process of establishing a knowledge system, where new knowledge is created by conversion and combination of existing information (ibid.)

Internalization is learning by doing, where proper documentation is important to be able to internalize and re-experience individual experiences (Nonaka et. al, 1996). A way of creating re-experience is to compile customer complaints in a database, and send out the compiled information to the concerned departments every month, which will create a foundation for organisational learning (ibid.).

The construction industry has during the past years focused on systems maintaining explicit knowledge in organisations and creating best practices, to reduce time durations and costs of projects (Dave and Koskela, 2009). In this field, construction organisations have come far. The existing criticism rather concerns the preservation of tacit knowledge and experiences gained in every project, which is stored within the individuals and not within the company's core organisation (ibid.). Therefore, further in this thesis focus will be on challenges with managing tacit knowledge, and sharing experiences to improve projects and processes.

2.3.2   Learning networks in construction organisations

Learning network is defined in a construction context as "a group of practitioners sharing and understanding a finite domain of collective construction knowledge" (Fu et al., 2006, pp. 2021), and functions as platform, either physical or virtual, where collective learning is created (ibid.). Collective learning hence includes learning through networks, which should be encouraged by top management in order to put the accumulated knowledge into use. Otherwise, knowledge can get lost or be forgotten if not discussed within a near future (Knauseder, 2007). There are different types of networks that foster learning in the construction industry and Fu et al., (2006) mean that human interaction by learning networks facilitates and provides the participants opportunities to interact and exchange information, as well as increases the understanding of the importance of information sharing. Dave and Koskela (2009) concur; one of the most advantageous practices to capture and facilitate tacit knowledge is through socialization in networks.

According to Kululanga, McCaffer, Price and Edum-Fotwe (1999) "those firms who cannot remember their past failures are likely to repeat their mistakes" (pp. 217), and the authors argue that not only failure factors need to be taken into account, but organisations must also pinpoint success factors in order to create learning. Hence, the recommendations to gain and retain new knowledge should be done through learning networks and reviews of both failure and success factors in projects.

Working in construction projects often results in quick fix solutions and the necessity to make non-routine decisions, outside of the employees' fields of knowledge (Fu et al., 2006). Individuals can either seek information by themselves, or gain information and knowledge through learning networks from experienced practitioners. "Self-study" requires an existing database or platform of knowledge, from which relevant information can be assembled, while learning networks facilitate connections to those with experience from dealing with similar problems. Fu et al. (2006) conclude that frequent interaction, such as learning networks, promotes collective learning, which entails collective knowledge in an organisation.

2.3.3 Ways to capture lessons learned and knowledge creation barriers

One of the main sources of knowledge in the construction industry is gained experience from lessons learned by others (Shokri-Ghasabeh and Chileshe, 2014). Despite this, the industry suffers from inadequate processes for transferring knowledge and reflection of lessons learned. The difficulty lies in that knowledge and experiences gained from previous projects are stored in the minds of the project's participants, and not transferred throughout the organisation to create re-experiences (ibid.).

In order to foster organisational learning and transfer both results and lessons learned to future projects, organisations must collect and evaluate the available information in the organisation (Cheng, 2009). One of the most effective ways to capture lessons learned from previous projects is to implement post project reviews (PPR: s) (Shokri-Ghasabeh and Chileshe, 2014); a tool for systematic analysis of previous projects to increase performance in subsequent ones. The PPR should be carried out as soon as a project is finished, and include identification of both success and failure factors. If done correctly, they can form a base for future improved business processes (Knauseder, 2007). Shokri-Ghasabeh and Chileshe (2014) conclude that there is a significant correlation between an organisation's ability to capture lessons learned, and the ability to predict which future projects are feasible, and hence most likely to generate large profits. Despite the benefits of PPR: s, such as its influence on creating learning in constructions organisations, the PPR is seldom prioritised. Even though large construction companies have procedures for how to capture knowledge and lessons learned, only a minority preserve documentation from previous projects when entering into new projects (ibid.). However, Carrillo, Robinson, Al-Ghassani, and Anumba (2004) raise concerns regarding the PPR, and pinpoints challenges which may hamper its function, such as the time detention between the lessons learned and the actual recording of it, as project participants engage in new projects, and forget old ones.

Dave and Koskela (2009) differentiate between two types of knowledge management systems (KMS); the first generation of KMS consists of individuals sharing information and ideas by using tools such as email, written documents and intranets. The second generation emphasises collaboration between individuals, creating new knowledge in the organisation and foster innovation. This approach shall be seen as a social process, supported by efficient software systems for knowledge storage and transfer.

The key success factors for implementing proper knowledge management system according to the study made by Dave and Koskela (2009) can be derived to the following:
- KMS:s must be user friendly, comprehensible, and easy to retrieve information from
- Trust among participants foster knowledge sharing
- KMS:s must be given the same prioritisation as other business systems
- Knowledge management has to be integrated in the organisation's business strategy and be given equal focus by top management

There are several barriers for construction companies to capture lessons learned, and Shokri-Ghasabeh and Chileshe (2014) propose lack of employee time, lack of management support, lack of clear guidelines and organisational culture as barriers in their study. The authors state that lack of employee time is mainly a result of the stressful environment at the end of projects, which leads to lack of documentation of lessons learned, and difficulties in coordinating project members who already are engaged in new projects. Lack of management support is stated to have both a direct and indirect impact on knowledge sharing, which will extend the negative impact of others barriers as well as affect the implementation and creation of a knowledge management strategy. Management support is key for how employees perceive the importance of knowledge sharing, and for the individual's willingness to share and transfer information and knowledge. Clear guidelines on how to document lessons learned is identified as one of the most important tools for knowledge management strategies, which includes processes for how to transfer knowledge and information, whereas organisational culture is stated to be "an underlying factor causing most of the above mentioned barriers" (Shokri-Ghasabeh and Chileshe, 2014, pp.115). Fear of failure, reluctance to elevate difficult issues, and willingness to legitimate the past rather than dealing with future development are all said to have a major impact on a project's progress.

2.3.4 Information exchange

The construction industry is highly dependent on information being adequate and exchanged in time (Lam, Wong and Tse, 2010). A project requires interaction between various actors where cooperation and intercommunication occur at all levels of the organisation (Antvik and Sjöholm, 2007). There has been a rapid development of technical tools for information transmission in the past years, however it is important to remark that good collaboration does not come as a result of implementing IT-solutions, but rather from considering organisational issues develop methods to improve the organisation (Lam et al., 2010).

Dainty, Briscoe and Millett (2001) found that subcontractors perceive main contractors as unresponsive when it comes to giving accurate information at the right time. Performance satisfaction in main contractor-subcontractor relations is strongly

correlated to the way information is exchanged (Graca, Barry and Doney, 2015). Factors with greatest impact on performance satisfaction were efficient communication and conflict resolution, and trust influenced the way information was exchanged and shared (ibid.). Issues regarding information sharing have two sides; the sharer tends to sometimes overshare non-relevant information, and the receiver occasionally ignores shared information, which results in waste of time, and inability to keep up with time schedules (Lam et al., 2010).

2.4 Main contractor-subcontractor relations

According to Bower (2010), the construction industry has for many years been criticised for adversarial relationships. Main contractor and subcontractor relationships often encounter challenges during construction projects, and the hierarchy in a traditional project places the subcontractor in a subordinate position (Akintan and Morledge, 2013; Dainty et al., 2001). Several construction companies worldwide have begun to acknowledge the benefits of having long-term relationships with their subcontractors in order to increase efficiency in projects (Akintan and Morledge, 2013; Eom et al., 2015). However, ways to create trust are still lacking, and the relationships are therefore limited to a cooperative "per-project basis" instead of long-term trusting relations (Eom et al., 2015).

Learning is crucial for every organisation in order to keep up pace with competitors (Bower, 2010), and it is a necessity to have systems for learning. Framework agreement is one example of such a system for increasing trading of knowledge between different firms. A framework agreement is a long-term commitment, where parties pre-agree upon specifications, conditions and rates. The agreement itself is not a guarantee for future cooperation and may be non-exclusive (ibid.).

2.4.1 The tendering process and its challenges

The working relationship between a main contractor and a subcontractor is initiated during the tendering phase (Hinze and Tracey, 1994). When a main contractor is about to choose subcontractors for a project, several factors play part in the decision making. Examples are price and quality, whether the subcontractor is known, and how previous experiences are perceived. The main objective is to find the most cost effective subcontractor at the requested quality level (Eom et al., 2015). This urges an appropriate pre-qualification of subcontractors as well as a transparent and fair selection. Hartmann and Caerteling (2010) came to the conclusion that a known subcontractor, even with inconsistent performance in the past, have a more favourable position in the run for a project compared to a unknown subcontractor, as long as the main contractor perceive the bid competitive in the tendering process. It is further implied that from the main contractor's perspective, cooperation can be overseen if the result is acceptable. However, subcontractors are seldom assigned contracts on the sole basis of performance in previous projects, or due to the quality of their workmanship, as focus rather is on the lowest bid submitted (Bower, 2010; Eom et al., 2015).

Bids between subcontractors and main contractors are generally negotiated before the main contractor submits a tender to the client (Arditi and Chotibhongs, 2005). Although, there is an ongoing discussion in the literature concerning the phenomena "postaward bid shopping". Postaward bid shopping is when a main contractor, after being awarded the tender, tries to reduce the subcontractor's bidding price through new

negotiations or approaching other subcontractors, seeking a lower price (ibid.). If a reduction occurs, it will increase the main contractor's profit, but may however disfavour both the subcontractor by reduced profit and the client by reduced quality. Arditi and Chotibhongs' (2005) study indicated that subcontractors perceive postaward bid shopping to appear more frequently, than main contractors do. This is due to it being a more significant problem for subcontractors. In fact, Arditi and Chotibhongs (2005, pp. 871) argue that main contractors did "deny that postaward bid shopping is happening at all, possibly because this practice is considered a legal but unethical practice in the industry". Loosemore (2014) as well perceives the approach problematic, as it affects productivity and hinders innovation in the tendering phase. He further reveal in his study that subcontractors were afraid of showing their innovative ideas in the tendering phase, as main contractors might share them with competitors in order to secure the best solutions at the best price possible. If trust was more present in the relation with the main contractor, subcontractors would contribute more effectively to smart solutions for the benefit of the overall project (Loosemore, 2014).

Arditi and Chotibhongs (2005) conclude that postaward bid shopping have negative effects for subcontractors, and should only be practiced in the case of scope changes. Loosemore (2014) states that the whole tendering process should be revisited if the scope of the project changes to that extent, but rather recommends avoiding bid shopping of any kind. It is likely that postaward bid shopping results in remuneration of unqualified subcontractors who lack proper planning of the work, due to entering the bidding phase late (Arditi and Chotibhongs, 2005). Hence, the authors state that postaward bid shopping have several negative effects including diminish work performance and overall project quality, may promote adversarial main contractor-subcontractor relations, increase risk for legal disputes and insolvencies among subcontractors, and foster unfair competition.

Catch 22

According to the interviewed subcontractors in Loosemores' (2014) study, the first offer is seldom the best price, since they know a second round of bidding is to be expected, and described it as "a pointless and deceptive game on all sides which benefits no one" (Loosemore, 2014, pp. 254). In the study by Arditi and Chotibhongs (2005), about half of the interviewed main contractors, but only one fifth of the subcontractors, believed it was the subcontractor's responsibility to submit fair bids in order to counteract postaward bid shopping. The general main contractor view was that postaward bid shopping is a necessity for reaching the correct price level, whereas subcontractors justified the first, higher bid as a response to the often occurring postaward bid shopping, in need of a margin to reduce their price later on. Arditi and Chotibhongs (2005) suggest bid lists as the best way to avoid postaward bid shopping, where all competitors for the tender is presented, and that the main contractor not is allowed to change subcontractor, unless the scope is changed.

2.4.2 The production phase and its challenges

According to Loosemore (2014), subcontractors would prefer to engage in projects early on, to create an environment where solutions can be discussed and assessed by all actors to find the best solution. However, the hierarchy between the parties is distorted, subcontractors are dependent on main contractors' guidance and coordination, as well

as planning and scheduling of activities (Loosemore, 2014), whereas the main contractor have to have faith in the ability of subcontractors and that they will meet project specification (Hartmann and Caerteling, 2010). This has led to a presence of mistrust in the relation between subcontractors and main contractors (Loosemore, 2014; Hinze and Tracey, 1994). Subcontractors want to obviate the dependence, and therefore prefer to monitor the progress of a project themselves rather than relying on regular information notifications from the main contractor (Hinze and Tracey, 1994). Further, the majority of subcontractors consider the main contractor responsible for handling relations between different actors on site, as well as ensuring that the interests of subcontractors are acknowledged during negotiations with the client (ibid.). Receiving information at the right time is a profound issue, subcontractors' state that information often is delayed or only partly delivered; making it difficult to know what is expected (Loosemore, 2014; Hinze and Tracey, 1994). Part of the problem is time pressure, as subcontractors are tendered close to the initiation of the project.

Bower's (2010) recent studies indicate that early involvement of subcontractors in a project have several benefits, and it is stated to be "a major opportunity for cost savings and quality improvement" (pp. 11), suggesting that focus should be on building relationships, as it would increase the productivity of projects (Loosemore, 2014). Loosemore (2014) states that early involvement of subcontractors in construction projects foster trusting relationships, as well as provides time for subcontractors to contribute with innovative, and productivity increasing ideas. Trust influences the performance outcome in a positive way, and partners with trusting relations are more likely to generate higher profits in projects (Graca et al., 2015). It further entails relationships between parties to be built on reciprocity, and decreases the risk opportunistic behaviours (Costa e Silva et al., 2008; Graca et al., 2015). Barriers for trust in the relationship between main contractors and subcontractors can be concluded to delayed payments of subcontractors, disruptive changes in work plan and the issue of no joint decision making progress (Akintan and Morledge, 2013).

Graca et al. (2015) adopts the definition of trust as "the extent to which one partner is genuinely interested in the other partner's welfare and motivated to seek join again" (pp. 807). Trust enables better responsiveness when introduced to new information, and more flexible problem solving (Delbufalo, 2012; Hartmann and Caerteling, 2010; Manu, Ankrah, Chinyio and Proverbs, 2015). Cooperation for a longer periods entail more efficient communication and provides prerequisites to establish procedures in order to reduce the risk of errors (Josephson, 2013; Josephson, 2015).

2.5   Summary of theoretical framework

The theoretical framework has presented how previous research treats quality defects in construction projects, knowledge management concepts and main contractor-subcontractor relations. To summarize, construction of new housing projects involves and depends on a wide range of different actors. Although well-functioning main contractor-subcontractor relations are of great importance for conducting successful projects, challenges concerning relations are often overlooked for the sake of financial results. Price is what is considered key when tendering subcontractors, which risks compromising other important aspects, such as cooperation and quality. Another determinant of a project's outcome is errors and defects, and as all profit making organisations strive to increase profitability, these are essential to rectify, analyse and

learn from. The literature reviewed indicates that quality defects primarily occur due to organisational issues, and it is challenging for companies within the construction industry to systematically monitor quality defects and capture lessons learned. The following case study and analysis will reconnect to the reviewed literature, and investigate general main contractor and subcontractor perspectives regarding quality deficiencies, knowledge management practices, and relations, as well as suggest improvement actions to decrease additional costs and quality defects in construction projects.

3 Method

In the following text the approach and strategy for the report will be described. The base of the report is the theoretical framework concerning project organisations, common disturbances, knowledge management in the construction industry and main contractor-subcontractor relations. Data for the case study has been collected through interviews, and thereafter analysed in comparison with the theoretical framework.

3.1 Method outline

The thesis was conducted by a qualitative research method in order to enable continuous connections between theory and the case study. A qualitative approach emphasises words rather than numbers, with focus on the perceived interpretations of interviewed actors (Bryman, 2004.). The approach ensures that relevant data is collected through interviews, observations and conversations, and allows for continuous development of the theoretical framework over time (ibid.). The method chosen gave the prerequisites to develop an understanding of the existing research, frame questions and thus enabled an analysis of the collected data. An abductive research approach has been used, which enables a continuous iterative process between the theoretical framework, empirical data collected and interviews conducted (Dubois and Gadde, 2002), hence allowing for the understanding of the subject to gradually evolve.

3.2 Selection of case study

The Company was used as a reference for the thesis, in order to compare previous research theories to an existing company operating in the construction industry. The Company has two housing departments, from now on referred to as "Department X" and "Department Y", which were chosen as reference departments. Both departments currently face challenges on how to increase knowledge transfer and collective learning in the organisation, as well as reducing quality defects, which made them suitable as a representative case. Furthermore, the representativeness is amplified by the Company being one of the largest actors in the Swedish construction industry, with extensive processes and long-term experience from construction of new housing. A representative case aims to describe the circumstances that an everyday situation exhibits (Bryman and Nilsson, 2011). Based on this definition, the authors considered the case to be representative for a general application of learning from lessons learned in construction projects.

To decide upon suitable respondents, three previous projects of the Company were examined. To examine the projects allowed the authors to get a grasp of common defects and errors according to protocols and hence get a deeper understanding for possible answers during the interviews. All projects conducted 2012-2016 by the departments were compiled in an excel file, framing which subcontracting firms had been involved in each project, and the amount of the contracts. The criterions were that the projects should be considered difficult by employees at the Company, endured additional costs and labour hours after being approved as completed, as well as had subcontracting firms contracted who had been involved in several of the Company's projects. The number of projects was narrowed down to three, to keep consistency in the case study and for the authors to have a manageable amount of data to compile and analyse.

The case study was based on interviews with key employees at the Company and subcontracting firms, site visits, and to some extent free observations and informal conversations. The interviewed project participants had different professions, in order to give an overall picture about the perceptions and experiences of current ways of working. The analysis of the case study reconnects to the theoretical framework, and enables to answer the formulated questions.

3.3   Data collection and conducted interviews

A semi-structured method was used when conducting the interviews, as it enables open questions and allows for ideas and discussions from different perspectives to be brought up by the interviewee (Bryman and Nilsson, 2011). All interviewees received an outline of the question template prior to the interview, see Appendix II, in order to create an understanding for the purpose of the thesis and as a way for the interviewee to prepare and be given time for reflection of the subject. In total, sixteen interviews were held of which four were subcontractors and the remaining employees at the Company. A request to participate in the study was sent out to six subcontracting firms. A snowball technique for selecting possible interviewees was used, meaning that one person introduces suitable respondents (Taylor, Bogdan and DeVault, 2016). A purchaser and an installation coordinator at the Company started the snowball effect by contacting subcontracting firms and hence helped the authors to come in contact with the framed subcontractors.

The interviews lasted for about one and a half hour each, and notes were taken by the authors, a few interviews were recorded. All interviewees and responses were processed anonymously, and only the authors of the thesis had access to which respondent said what. Hence, professional titles or names are not recited in order to reduce the possibility to deduce the identity of the respondents. Subcontractors were in some cases referred to as "he", since all subcontracting interviewees were male. As the interviewees worked in different firms, departments and in different phases of the project cycle, the questions were adjusted to fit the respondents. However, all questions emanated from the question template.

Employees of the Company were chosen based on their participation in the examined previous projects and their employment, with specific knowledge in their profession, such as district management, project management, foremen, purchasers and installation coordinators, see Appendix I for a compilation. They had different perspectives and perceptions of tendering of subcontractors, the relationships between the Company and its subcontractors, and the actual outcome of the relationship on site, which entailed for a wide perspective in the data collected.

In order to define the scope and keep consistency in interviews, the subcontractors worked within the areas of plumbing, ventilation installations and electrical installations. As mistakes and errors derived from installations may have major impact on a project's profitability and progress, these areas of profession were decided to be suitable. The selection of interviewees was based on how frequently the subcontracting firms have been contracted in Department X's and Y's projects, and especially the subcontractor's' participation in examined previous projects.

The first interviews conducted were considered as exploratory, and aimed to give an initial insight in the Company's business and strategies. The site visits, free observations and informal conversations aimed to provide a better understanding of ways of working, and to create a basis for questions to the interview template.

3.4   Method reflection

The authors believe that the results from the case study may be applied to various actors of construction projects, hence is not limited to only installation works subcontractors. However, the choice of method and approach may have led to limitations of the appliance of the thesis. The authors believe that a better understanding of the Company, and its way of working, before initiating the literature research would have been ideal, as which theory to investigate would have been more salient. Regarding the interviews held, the choices of the interviewees' professions were discussed several times during the progress of the report. It was difficult to decide which professions were key roles as the literature track did not emerge from the beginning of the thesis, but rather became pertinent in the middle of the process. Two professions that might have provided interesting aspects are site manager and head of the Aftersales department. The site manager is responsible of pursuing the project during the execution of production, and therefore probably has important insight to share concerning the relations at site. The head of Aftersales on the other hand has information concerning feedback on errors detected after submission of projects, and could have contributed with information on how the Company works today, and how to improve the work in the future.

At two occasions, interviews were held with two respondents at the same time. If it were to be done again, the authors would have held the interviews one at a time, to ensure that all interviewees were able to speak freely.

The division of work has been equally divided between the authors of the thesis, and both have been equally involved in the different parts of the study.

4   Results

The results are presented in a chronological order based on a project's life-cycle. The case study describes the Company's tools and guidelines, and presents a compilation of assembled data from the interviews. Each subchapter commences with a description of how the Company depict their ways of working, and consecutive processes. It is followed by a summary of the interviewees' perception of the matter. The main focus is on actors participating in the production phase, and the cooperation between main contractor (the Company) and subcontractors.

4.1   Description of the Company

The Company is one of Sweden's largest construction companies, and focuses on construction and development of infrastructure, residential and commercial real estate projects. The Company has two housing departments, Department X and Department Y, which are the subjects of interest for the case study. Both departments focus on new construction of residential areas in the west of Sweden. After a project is completed, the Aftersales department takes over the responsibility of service and rectifications of the new housing project, and throughout the warranty and liability period. The purchasing department and the Aftersales department can both be considered as support processes to Department X and Department Y, and operate to support several different departments at the Company throughout the projects' life-cycle.

Department X has been running for several years, however in 2012, when the need for an extended workforce arose due to the intense market situation, the Company decided to initiate yet another department, namely Department Y. Department X is currently facing increasing costs due to errors and defects in projects, making Department Y aware of that they most likely will experience in the near future, as they recently finished their first projects. The Company have an internal system that describes their processes and preferred ways of working, according to steering documents and policies. The system aims to simplify the everyday work by providing employees information and templates of preferred work procedures. It concerns all core businesses of the Company, and describes all parts of a project's life-cycle.

4.2   The tendering process according to internal documentation

According to the internal system, there are several things of interest for the Company when deciding whether or not to participate in a tendering process. The district management is responsible for conducting regular market meetings, where projects are prioritised, and decisions are taken concerning possible tenders. Priority shall be given to a various number of factors, such as the relationship with the client, experience from similar projects, applicable concepts, complexity of the project, overall risks and opportunities, and the prevailing competitive situation. The boundaries and outlines for a project tender is set, and division of responsibilities is delegated at the beginning of the tendering process. Factors such as previous similar projects (reference projects), production competence to ensure cost-effective and feasible solutions, description of concepts, methods and drawings are considered. Materials and services that will be put on the market for competition, for example prefabricated foundations and ventilation systems, are decided.

4.2.1 Selection of subcontractors

The Company pre-qualifies all subcontractors in order to enhance the preconditions of the project. All potential subcontractors must perform a self-evaluation that fulfils both the Company's demands, as well as existing legal requirements. The Company have a supplier database (SDB), which provides information of the selection of preferred subcontractors and suppliers. SDB includes several indicators; the result of the pre-qualification and self-evaluation, creditworthiness and credit rating, eventual valid framework agreements, and a supplier evaluation where subcontractors are graded based on factors such as teamwork, quality and delivery time. It as well includes a risk assessment based on information from the Swedish Tax Agency. The project management is responsible for the selection of subcontractors, in accordance with assessments, purchasing prerequisites and specific project characteristics.

4.2.2 Tendering feedback mechanisms

The project management is responsible to forward the calculations from the calculation department to the production team, as well as to call for a meeting to review the tendering work with both production personnel and the one responsible for the estimations made. According to the internal documentation, this aims to create an understanding for the project's economical plan among the team on site.

The project management thereafter summons to a production preparation start-up meeting, where personnel from the calculation department, participating in the tendering process, should attend to explain the tender and its estimations to the production staff. Preferably, a separate review of the calculations shall be conducted, to describe the pursuance of the project, and the intended purchasing process. Risks and opportunities of the project, and tasks and/or resources in need of monitoring shall be presented as well and district, project, or site management shall be responsible of following up the decisions, and ensuring that the monitoring is conducted.

4.3 The tendering process based on interviews

In the process of selecting subcontractors, previous experiences of subcontractors play part; however during tendering negotiations, the most important factor is to find the right price, according to two purchasing respondents at the Company. In order to examine previous experience of a subcontractor's performance, one respondent stated to examine the evaluations in SDB to consider factors such as cooperation and quality of the tasks executed, and asks colleagues to get an idea of the collaboration in previous projects.

It was stated by a purchase interviewee not to be uncommon for the subcontractors to submit a higher price instead of declining a tendering request due to lack of, as the subcontractors want to be considered for the next project. The respondent stated that if the subcontractors cannot engage in the project, it would be better to decline directly as it would save time for everyone involved. The interviewed subcontractors did not agree with this statement, and claimed to be able to decline tendering invitations if the project were not in their interest. The relationship with main contractor were stated to be more business-like than before, making it easier to be honest from the beginning, and reject if the timing or the scope of the project were not unsuitable.

Several subcontractors highlighted the importance of working with reliable main contractors. One stated that payment routines of main contractors are of great importance if he were to engage in a project or not, and emphasised that the Company offers secure payments, vital for smaller companies. Another respondent stated that tendering prices are dependent on the project organisation presented from the Company. For example, if the subcontractor perceived previous experiences of the presented organisation as lacking in continuity and flow, or having poor leadership, it would indicate a need for an increased safety margin, which would result in a higher price.

A majority spoke of the price as a factor either increasing or decreasing the sense of responsibility. If a subcontractor perceived the accepted price as fair and were awarded the contract, the responsibility towards the whole project would increase. Subcontractors particularly spoke of price pressure as a quality and economical hazard, as the negotiation concerns their profit margins, which is a matter of survival on the market for smaller firms. Respondents from the Company, to some extent recognised the risks of intense price pressure. One stated that even though the utter responsibility lies on the subcontractors to know their limits, it is not good to contract firms which have been forced down too low, as it may risk the outcome of the project. It seemed to be a shared opinion that the firms awarded contracts on lowest price usually missed important aspects in the tender. However, several interviewees stated it to be common for the Company to negotiate down submitted prices after a tender was won, and one interviewee from the Company argued that it is nothing wrong with doing a retake with the subcontractors in order to ensure that the best price is given. A subcontractor claimed to not change his offer in the case of a retake, as he did not want to contribute to an unhealthy and dishonest relationship. Another stated that the first price given was the best, and claimed to not bargain with the profit margins, as they are already low. Yet another subcontractor stated that the constant price bargaining after a tender is won, is typical for the region. He stated "it is worse and more common here compared to others parts of Sweden", and therefore concluded that perhaps it is not strange if the first price is higher than necessary. The interviewee further stated that he is cautious not to reveal everything in the tender, such as technical solutions, due to fear of losing the tender, and that the solution is handed to another subcontractor with a lower price. Other subcontracting firms concurred, and claimed to not reveal all ideas until contracts have been signed. The fear of not being credited for a presented solution was stated by all subcontractors to hamper innovation in the tendering phase.

The common opinion from subcontractors and production personnel seemed to be that price was prioritised over quality of the work executed. One respondent believed the Company chased money at the wrong end, for example buying products of lower quality at a lower price, indicating that the mind-set of the Company is short-sighted. The respondent exemplified by speaking of the climate in the west parts of Sweden, which often demands acid resistant screws, however not standard in projects. The acid resistant screw is more expensive than the standard type, but the costs of replacing each screw in a project, as well as mending corrosion damages is more expensive than taking the extra cost for accurate materials from the beginning. Another respondent spoke of hypocrisy and double standards, that the Company claimed to value quality over quantity, but subcontractors and suppliers are still contracted on lowest price. However, opinions differed and respondents from the purchasing department as well as some

subcontractors believed the climate was changing, and soft values, such as good cooperation and quality are valued higher today than before.

4.3.1 Feedback on purchases made

Respondents from the purchasing department as well as several other respondents acknowledged the necessity of a feedback mechanism on purchases made. A majority stressed the importance of transferring information and knowledge back to purchasing concerning what worked well and what did not. However, according to the interviewees, feedback has seldom been given. One respondent from the Company stated that feedback was received only when something went bad, however not in any organised way. Further, the respondent stated that "they [the Company] talk about having experience feedback meetings but that has not happened very often", and would like for the meetings to be between the project organisations as well as together with the purchasing department. One interviewee stated that "one may overhear from others if something went wrong in a project, then of course you try to find out more".

Several interviewees spoke of the importance of functioning electives, which may otherwise hamper quality during the production phase, as well as after submission. One respondent accentuated the benefits the Company would gain by offering electives from one brand only, or minimising the range of options (concerning the same type of products), since it would simplify the handling of warranties and material defects. An example given was water taps not compatible with basins, resulting in complaints from customers, and a time consuming and costly rectification process. If, for example, kitchen fronts have been problematic, measures have to be taken to follow up and ensure they are either rectified or removed from the list of choices. This has to be forwarded to the ones in charge of purchasing and writing agreements.

4.3.2 Knowledge sharing start-up meetings

Several interviewees acknowledged the necessity of subcontractors' involvement in the early stages of the project, in order to avoid shortcomings forced to be resolved on site. According to interviewed subcontractors, crucial issues are often brought up too late in projects, and they wished for a knowledge sharing start-up meeting, where the site management team, the Aftersales department and the subcontractors should attend. Today, the Aftersales department is supposed to have audits of drawings together with Department X, as a way to create learning and transfer knowledge in the organisation through discussing common issues and errors. One respondent at managerial level stated "we cannot do as we do today, it obviously does not work", when discussing knowledge transfer mechanisms in the organisation. The respondent furthermore stated to be positive towards developing a better relationship between Department X and the Aftersales department, to create a culture where experience sharing is important for everyone involved. However, the respondents from the Aftersales department described a recent occasion when they were invited to attend an early audit of drawings. The meeting was scheduled close to the submission of documentation, which resulted in that no changes could be made in accordance with their suggestions. One of the respondents stated "I was probably called for show rather than for my expertise in the matter".

A majority of the respondents from the Company stated that they recently have started to, or have plans to, implement more meetings to involve the Aftersales department.

According to one respondent, more emphasis is put on decreasing warranty costs and errors, since many have acknowledged their impact on the profitability of projects.

4.4 The production phase according to internal documentation

The production phase shall be initiated with staffing key employments, and a thorough review of the prerequisites from the design phase, which forms a base for steering and planning the project. The project management is responsible for collecting experiences from other projects with similar construction methods, customer demands and conditions, which is said to improve the ability to create successful projects. The Company have a database for technical solutions and production methods, describing how specific elements should be planned, and implemented to obtain productivity, quality and safety. Foremen and site managers are responsible for the methods to be implemented on site.

According to the internal system, every decision and agreement shall be documented, either in a diary, a protocol or an email, and collected in a common place. Possible options are either in a traditional folder structure on the Company's hard drive, an external web based platform, or an internal project platform. The latter is offered to each project by the Company, stated to facilitate information and document sharing.

4.4.1 Production meetings

The project management shall assemble the site manager, estimation, project engineers and the purchasing coordinator for an internal production start-up meeting, with the aim to go over the project in detail. Decision concerning what shall be done before production start, and what has to be followed up for feedback are taken, along with the division of responsibility.

Each project is obliged to have a start-up meeting with all subcontractors, where the agreements and prerequisites are reviewed, and risks and counter-actions are discussed. The site manager is responsible during the execution of the project for conducting coordination meetings with subcontractors, in which the timeframe is revisited. The frequency of the coordination meetings increases if the work methods and/or the products are identified as critical.

4.4.2 Planning

The district and project management shall together ensure a good start for the project, through careful preparation and planning, proper staffing, organisation and goals. The start-up activities are time demanding, however form the foundation for a successful project start. An outline of the timeframe shall be set before initiating the production phase, and thereafter updated on a monthly basis, or when changes occur in the project. A proper timeframe increase the efficiency and insights of risks and opportunities in projects. A quite new technique used in some projects is "pulsing-scheduling" on site, meaning that the same operation is performed periodically in a paced flow. The aim is to create a consistent production, where any deviations become clear as the entire subsequent element is affected.

4.5   The production phase based on interviews

All interviewees mentioned the need for the right composition of personnel on site during the execution of a project, a working environment characterised by openness, and a joint drive to deliver a successful project. They further stressed the importance of having a diverse group on site, with a mixture of personalities, competencies, experiences and ages. The composition has to take the long-term perspective into account, so that one project does not end up with the "leftovers", and a single-minded group due to the uniformity of the participants. Respondents in leading positions claimed that the constellation can affect the tone on site, therefore the project organisation is discussed, and often preliminary decided upon in the early stages of a project. An open dialogue is necessary in order to get to know each other, which also creates the right prerequisites for collaboration. One respondent stressed the importance of responsiveness and having a helping attitude, not only looking to the contractual documents and declare "that is your responsibility, solve it". This statement was agreed upon by several interviewees; on site it is crucial to see to the whole project, and have a holistic view and not a tunnel vision, so that everyone is given time to perform their tasks. The climate on site used to be featured by an "us and them"-thinking" according to one subcontractor, but it was further stated that is has changed during the past years.

The interviewees at the Company working in production concluded that relations on site are very important to consider. A respondent in a leading position stated to believe personal relationships as advantageous, as it enhanced learning. However, the respondent argued for variation in the organisation from project to project, as the learning would increase if it took place in different group constellations. Leadership plays an important role for the tone set and relationships on site. If the site manager has an authoritarian "macho" way to lead, several issues will follow according to one respondent from the Company. The project has to be steered in the right direction, although not in detail, as the subcontractors are experts in their own fields. The respondents from subcontracting firms stated that the project organisation is of great importance for project success, and one subcontractor claimed that if he had an established relation with the site manager from a previous project, it is easier to address problems on site. Good relations between different actors are crucial as the respect for others' working conditions increases. However, one of the interviewees stated that "you do not have to be best friends; it is about money and nothing personal".

Several subcontractors argued that it usually becomes problematic if site managers do not take part in the design phase. There is an impending risk that site managers have different opinions than what is decided, which could lead to misunderstandings and communication difficulties on site.

4.5.1   Personnel turnover

Interviewees from both the Company and the subcontracting firms concluded that projects dealing with substantial personnel turnover are likely to encounter difficulties during the execution of the project. Although, one interviewee in a leading position at the Company partly disagreed, and argued that it is not as simple as to say that difficulties are due to changes in the project organisation, but rather stem from earlier in the project. The respondent highlighted that personnel turnover may as well be a reaction to difficulties during the project, and that consequences of difficulties may lead to that employees quit, which can initiate further turnover. It is not uncommon to

change the project organisation as the demands change over time, but the consequences have to be thoroughly considered. In a project the Company is about to engage in, the client have requirements on presenting key personnel and their potential alternatives, to minimise the negative effects of personnel turnover during project execution. The idea is good, however it is not possible for every project due to the limitation of resources, an interviewee stated.

The implications of staff turnover depend on where in the project organisation it occurs. Several employees at the Company have experienced changes in the client organisation during projects. As key personnel quit, it often requires a discussion between the new parties concerning previous decisions made, if documentation is inaccurate. Questions that have been agreed upon might have to be revisited if it comes to a disagreement where it is one's word against another's. The majority of the respondents claimed that the documentation of decisions often is failing, and that they have to improve the processes for it. One respondent stated that "we tend to be good at it [documentation] when everything goes well, but later on if it goes wrong we are left without actual documentation of what has been said", and it would have been favourable if everything had been in writing, as declared in the standard contractual form ABT 06[1].

If the project organisation on site changes, the consequences can affect relations and collaboration between the different actors. If the site manager is replaced it will significantly impact the project; the continuity and flow is disrupted with risk of eliminating the sense of community that has been created, according subcontractor interviewees. One respondent at the Company concurred in the statement, and explained the difficulties when key personnel quit as hampering relations on site. The responsibilities have to be reallocated within the project organisation, which can lead to confusion and frustration among subcontractors, if the communication paths are unclear and the subcontractors uncertain of whom to turn to with their questions. In larger projects, subcontractors stated that they expect to become more efficient and get gaining effects as the project progresses, through repetitive tasks and routinization. However, according to one respondent's experience, if the site manager is replaced during a project, the gains does not occur until late (or at all) in the project, with the consequence of subcontractors not reaching the expected profit.

One interviewee working in production at the Company said that difficulties due to a change in subcontractors' personnel force can impede the progress of the project. It is time consuming to introduce new personnel to routines and explain the prerequisites of the context, as projects often are under intense time pressure and in need of keeping costs down.

4.5.2   Reference projects

Some interviewees have participated in projects where essential documents have been copied from a previous one, referred to as a reference project. Two of them mentioned the implications of using a reference, the first issue concerning the definition of a reference, and the second concerning decisions and prerequisites not in line with the reference project, and the documentation thereof. In the definition of a reference, it has to be clearly decided upon what is included in the term, which parts of the projects that are to be identical, and which parts are rather guidelines for the new project. It was

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[1] General Conditions of Contract for Design and Construct Contracts for Building, Civil Engineering and Installations Works

further stated to be crucial to agree on which documents that are the contractual basis for the reference. If changes were made in the previous project the agreement cannot leave room for interpretations, such as whether or not the changes shall apply for the new project. The interviewees advocated the importance of clearly defining the term reference, and whenever decisions are made in deviation from the reference project, they have to be clearly documented to prevent future disagreements.

One interviewee discussed the term reference projects, and gave an example of a project in which documentation was copied from a previous project. The client requested a project similar to one just finished and wanted to expedite the initiation. The plan was for all documentation to be the same, such as frameworks and descriptions, decreasing the time lapse of the design and planning phase, and advance the initiation of the project. However, the documentation was not as specific as they thought, and several project specific characteristics were not taken into account, causing disputes and disagreements to arise.

4.5.3   Division of responsibilities

All respondents acknowledged division of responsibilities as a key factor for project success, and as a recurring challenge. When interviewees were asked to relate to previous troublesome projects, this factor was highlighted in nearly each interview. There is an impending risk that no one takes the full responsibility for the entire component and its functionality unless it is assigned, and hence responsibilities fall between the cracks. Two respondents recently participated in a project characterised by problems. After completion, the newly built houses turned out to be defect, and water leaked into the apartments. Detail specific drawings were missing, which the respondents claimed to be due to time pressure in the design phase and in that moment justified with "we have done this before, and know how to do it". In order to understand how the leakage could have occurred, the respondents made their own detail specific drawing on the problematic area. Several different actors had partial responsibility in the same production element, but no one saw to the bigger picture, nor the functionality of the element. Therefore, the respondents accentuated the importance of project specific details drawings, as the consequences can have severe impact if they are overlooked. When several actors are involved in one component, coordination is required in order to ensure the proper execution. They further stated that without applicable details, the quality of the work performed cannot be confirmed, even though the task has been done several times before in other projects. It is time consuming to sort out responsibility, respondents spoke of major email exchange, and eternity loops in the process, and several stated to prefer gathering the affected actors physically on site, and solve errors in half an hour instead of spending weeks on email correspondence or telephone calls. One respondent further stated that the sense of responsibility increases when meeting face-to-face.

The majority of respondents raised concerns regarding division of responsibilities when the Company is responsible for purchasing materials, and subcontractors responsible for the assembly. The subcontractors were strongly negative to this occurrence, both due to ambiguous division of responsibilities, and that negotiating the price on materials is one way to increase their profits. One subcontractor stated that he would not agree to enter a contract under those terms. Interviewees from the purchasing department at the Company stated that this approach has become less frequent as it entails negative effects, and is not economically viable in the long run.

Demarcation lists

Demarcation list is one way of sorting out responsibilities early on in a project, and is an appreciated tool according to several interviewees. The list is a contractual agreement, and revisions of it entails for reimbursements, meaning that the parties must agree on a compensation to be paid for changes. A demarcation list is available on the Company's intranet, however Department Y have created their own version, which the respondents believed to be more accurate. The compilation of the demarcation list coincides with when the tendering requests are sent to subcontractors. It aims to visualise which actor is responsible for which parts, as well as whether the responsibility concerns connections, functions, execution, delivery of materials and/or assembly. Employees at the Company compile the list, and subcontractors are encouraged to meddle in if they believe something is missing.

Respondents from the Company claimed that in the best of worlds the demarcation list would be reviewed with the entire production team; however time is seldom designated for it. One respondent stated to attempt to coordinate the list with the estimation department, to reduce risk of responsibilities falling between the cracks. However, several of the subcontractors raised concerns regarding the demarcation list, stating that it often is subject for individual interpretation, leading to communication difficulties on site, since the site manager seldom participates in the initial discussions of the demarcation list. The subcontractors wished for the site manager's involvement early on, and claimed that efficiency would increase notably if already agreed issues did not have to be agreed upon again during the execution. One respondent stated that "it's such a terrible horse trading sometimes, you would be surprised", when addressing the challenge of solving disagreement on site

Even though the demarcation list can be perceived as general and should apply for all projects, differences are still present. The demarcation list has to take project specific characteristics into account in order to fulfil its purpose of declaring the division of responsibilities. When the demarcation list is copied from one project to another, without adjustment, it becomes problematic. Copied documents from previous projects do not apply fully and therefore the sense of responsibility decreases, leaving many questions without answers. It imposes problem solving on site, requiring additional hours when the declaration of expectations is lacking. One respondent gave an example of a project in which the drainage pits were not included in the demarcation list, and it became very troublesome to sort out the boundaries for different actors' obligations.

4.5.4   Communication and information exchange

The subcontracting respondents receive information from various actors during the duration of the project. In the production phase the main information channel is through the management team on site, foremost the site manager. Most of the communication concerns the overall project crucial parts, such as planning and greater changes. The daily project planning is done during the coordination meetings by workers on site. According to one respondent, the key to a good project is efficient communication, both during the design phase and the production phase. To succeed, documents have to be clear and leave no room for interpretations, and much is gained by having a good relationship and a direct dialogue.

One subcontractor respondent stated that due to the size of the Company, and diverged business areas, it is difficult to receive answers from the Company within a reasonable

timeframe. In smaller firms, the communication routes are short and the hierarchical levels are few, making it easier to have a direct dialogue. According to the respondent, the Company's divergence endangers the holistic view of a project and reflects the feeling of lacking internal communication at the Company. The respondent described an example of a project where a project specific question had been transferred between six employees at the Company, remained unsolved for a couple of weeks, and then returned to the person where it begun. The respondent stated that "it undoubtedly seems like they [employees at the Company] do not talk to each other at all, which is a big dilemma for us subcontractors. It takes such a time getting a response, or even just figuring out who to talk to". He further stated that it is impossible for a subcontractor to spend the same amount of time on one subject, as their resources are limited.

4.6 Project closure according to internal documentation

To gain knowledge of completed projects, the project management shall summarise a project's economic outcome by comparing the production estimation, costs and budget to the actual outcome. Experiences from the project shall be discussed during an internal project closure meeting, in which responsibility for activities before the handover are assigned, to ensure all obligations are completed in time. Lessons learned shall be discussed, with the aim to preserve the knowledge and experiences gained in the project, and to transfer them to new projects. Both the site management and skilled workforce shall attend, and receive a copy from both the meeting, as well as a protocol from the final inspection afterwards.

The site manager shall conduct a follow-up meeting with subcontractors, to preserve joint experiences, and transfer them to next coming projects. If the procurement has been carried out by a specialist purchaser, he/she shall also be invited to the meeting. The meeting shall be documented and distributed to those concerned.

4.6.1 Supplier evaluation

The project management shall ensure that an evaluation of subcontractor performance is done in SDB after delivery of services. The assessment consists of twelve questions and should be made by the employee with the most knowledge of the supplier's performance. The e-mail is sent either when the invoice exceeds one million SEK, or for selected production critical resources where the invoice exceeds 100 000 SEK.

4.6.2 After project closure

After a project has been submitted, the responsibility is relocated to the Aftersales department. A service manager from the department handles communications with customers as from the completion date, hence the more information the Aftersales department have about the projects, the better the handover process, and ability to answer customers' questions become. The department holds knowledge of common errors, and provides the Company with lists such as "Error prevention of shortcomings in apartment buildings" and "10+ error list".

An important part of the Company's continuous improvement is to evaluate all the projects, based on occurrences and how the customer queries are handled. The evaluation is used for improvements in future projects in the pursuit of increasing customer satisfaction.

4.7 Project closure based on interviews

The majority of the respondents from the Company stated that they seldom receive any feedback after a project's closure, nor have valuable tools to assimilate lessons learned. One respondent working within production stated "we talk to each other, there is no other system". Another interviewee claimed that no feedback has been received from previous projects in any structured way. The respondents mentioned to overhear comments about projects from co-workers, but that it is a matter of subjective thinking based on individual interpretations. Instead, they wished for feedback after a project's closure to include customer satisfaction, economical result, and a summary of the warranty issues.

Likewise, the subcontractor respondents wished for more feedback, stating that benefits would be generated if early feedback meetings are implemented, as the scope of the project is somewhat clear early on. One respondent stated that some feedback is given during the execution of projects, mainly face-to-face from the site manager. All subcontractors highlighted the importance to receive face-to-face feedback and have a dialogue, as it provides the opportunity to respond. One further stated that filling out a form was too rigid and stiff, and that "you might not dare to give honest feedback", as written feedback can be misinterpreted. Another respondent concurred, and said that charts and forms do not give any constructive feedback of how things actually worked, nor leave room for improvement. Furthermore, he said that "they [The Company] do a lot of measurements such as customer satisfaction, but that does not concern me. I want to receive face-to-face feedback on my firm's performance and how we can become better". According to another subcontractor, when no feedback has been given during the project, frustration tends to build up at the final inspection when errors have to be solved, and that is when the "logrolling" between parties begins. Being contracted again was considered positive feedback, as it was proof of good results in previous projects according to one subcontractor. However, the respondent believed that many issues could be solved by better communication and dialogue, as silence is hard to interpret. All interviewed subcontractors accentuated the importance of the possibility to engage in a constructive dialogue, as well as the opportunity to meet criticism in order to create understanding between the parties.

4.7.1 Knowledge sharing closure meetings

The internal documentation describes the process of closure-meetings that shall take place after the projects are finished. The interviewees stated that time is seldom assigned, and the meetings do simply not take place. Several of the respondents stated that they gain knowledge and experiences on their own initiative, by seeking for others with experience of the same task or type of project. A majority wished for experience meetings, or other forums for knowledge exchange. Time pressure in projects is stated to be one of the most significant reasons for not having closure meetings, and it is explained by one respondent that when a project is nearly finished it often overlaps with a new one, which demands full attention. Furthermore, people are often more motivated to put their energy on something new rather than to solve issues in "finished" projects, which is a matter of company culture.

In the current situation, several of the subcontractors claimed much is still to be desired when it comes to receiving and giving feedback. They wished for feedback meetings with the entire management team, as well as other subcontractors. Further they stated

to believe that feedback meetings had to be close to the project's closure, otherwise there is a risk of personnel turnover, and the actual issues or success factors might be forgotten. One interviewed subcontractor stated that "when we attend the two year inspection, only a fraction of those who actually were involved in the project participate", implying that the level of valuable feedback during these meetings is low. However, several of the respondents highlighted the importance of be given time for reflection.

Nearly all interviewees' requests closure meetings in order to summarise the project, the arisen challenges, and to have the opportunity to give feedback. According to the interviewed subcontractors, these meetings would to a high degree be of interest to the respondents' firms to gain knowledge of what has worked, and what the Company considered as potential development areas in next coming projects. Closure meeting is suggested to be declared in the contract, which both the interviewed subcontractors and several of the interviewees from the Company were positive to. One interviewee raised concerns regarding having too many restrictions in the contracts, however today there are no contractual consequences for not attending the closure meetings.

4.7.2   After project closure

Working with the problems occurring after a project's completion puts great demands on all actors involved, both on employees from the Company's Aftersales department, as well as on subcontractors. If a project has several issues after completion, it will "reflect badly on the whole Company as nonchalant and dishonest" an interviewee from the Aftersales department stated. Several of the respondents viewed the division of responsibilities as one of the most crucial factors for an efficient correction process of errors after a project's completion. A respondent from the Aftersales department claimed that when problems occur after a project's completion, how fast they are resolved depend on the personnel involved. Some subcontractors take great responsibility, and resolve the error immediately, whereas others are more prone to dissociate, and make themselves unreachable. This is time demanding, especially when subcontractors have to be "hunted down" to own up to obligations. The view is shared among several of the respondents at the Company, which stated that the Company has to become tougher towards subcontractors, as time spent on sorting out division of responsibilities generates tremendous amounts of hidden costs. However, one respondent stated that it probably is cheaper for the Company in the long run to correct defects and errors themselves, than spending time on figuring out whom to contact, and wait for it to be resolved. Some respondents suggested to initiate framework agreements with certain subcontractors they perceive as good collaborators, as the tendering phase today allows for subcontractors with lacking performance in the past be awarded new contracts.

The interviewed subcontractors requested more clarity and transparency from the Company regarding the rectification process, and stated that a uniform system to report errors during a project is lacking. The current approach is stated to make it hard to know who is responsible for correcting the error, who has been contacted, if the error has been resolved, or still requires attention. Interviewees from the Company stated that the client decides which error reporting system to be used after a project completion, and each client have their own. The systems differ significantly according to the interviewees at the Company, who claimed they cannot impact the client's choice, as it is established in the client organisation. However, the interviewees from the Company

agreed with the subcontractors regarding the rectification process. They spoke of having to do the work twice, as information has to be filled out both in an external system as well as the project specific Excel-file. One subcontractor argued that the inconsistency makes it difficult to control errors, and the risk of errors not being corrected increases. The subcontractor further claimed that the Company lacks follow-up mechanism for error correction, and several respondents wished for some kind of summary list of all defects concerning them. One respondent highlighted the fact that due to the warranty period usually being five years, it is of great importance to have a functioning system with structure.

4.7.3 Sharing experiences within the organisation

Sharing error reports and lessons learned within the Company, and compiling statistics of errors and defects is perceived as difficult, and associated with fear of harming the Company brand if they would end up in the wrong hands and get published. One respondent believed that people in general find it difficult to talk about wrongdoings in projects, and referred to it as a "shame pillow", a statement endorsed by several other respondents. Another respondent talked about an internal hierarchy and people being self-righteous; no one wants to admit errors made, on the account of seeming unsuccessful. However, the respondent emphasised that it should not be about blaming specific individuals, but rather improving jointly, and create platforms where problems are visualised, and failure and success factors can be analysed in order to contribute to learning. This has to permeate the entire organisation, everyone affected has to have the opportunity to receive as well as to give feedback, one respondent stated.

Learning together

Today each individual possess their own lessons learned, and apply them in subsequent projects, however the collective learning or learning by other's mistakes in an organised way is lacking. Several respondents stated that it is difficult to share lessons learned to others who have not been involved in the same project, which is why an efficient and effective knowledge-transfer mechanisms is requested. Department X has begun to implement learning groups among site managers, and have discussed the possibilities to do the same among foremen. A respondent at managerial level stated to encourage site managers to visits similar projects, which would be positive for foremen to do as well. A foreman thought of this to be useful, however stated that it can be difficult to allocate the time needed, with heavy workload and short staffed projects. An idea suggested a respondent at managerial level was to gather employees from similar finished projects in a group and create a list with the "10 most crucial challenges and solutions" for this type of project. The joint view seemed to be that lists and documentation of the most common mistakes would be useful, however needs to be supplemented by face-to-face meetings in order to discuss the underlying factors of and solutions to errors occurring, as well as creating relations.

4.7.4 Long-term relationships

An interviewee at the purchasing department at the Company stated that the project organisations wished for long-term relationships with subcontractors, but argued that it is difficult to achieve without losing competition on the market. If a few subcontractors always were contracted for the Company's projects, the others would eventually decline to take part in the tendering process, as they are never remunerated. The respondent claimed to have a group of subcontractors which are always requested to take part in the tendering process, but tries to diffuse the requests to ensure that all subcontractors

perceive they are in the loop, and make the effort of handing in a proper tender. One subcontractor claimed that the Company considers their relationship on a per-project basis, which can be derived from that a more long-term perspective decreases the margins of profit. The respondent stated to believe that partnership would be a better way to go, as the risks should diminish, the collaboration become better and the quality of the product increase. Even though certain projects would not be as profitable as today, other "disaster" projects could be avoided according to the subcontractor.

An interviewee in a leading position at the Company stated to believe in long-term relations, by engaging in partnering projects for example. Several of the interviewed subcontractors were positive to partnering projects, and stated that it increases trust and openness. They claimed that long-term relationships would be appreciated, and argued that the end product would become better if they worked in a closer collaboration. Different actors would be able to exchange information and knowledge more easily, without the fear of losing a tender and technical solution to an opponent, if a partnership was initiated. If the experience is positive, it would generate higher profit for both the Company and the subcontracting firms, and the foundation for future collaboration would be laid. Some of the interviewed subcontractors claimed to prioritise tenders from the Company, as they consider their relation beneficial and as a long-term cooperation.

5 Analysis

This chapter concludes the findings from the reviewed literature and the case study in a discussion and an analysis. The discussion is divided into three subchapters, following the chronological order of a project's life-cycle, and is structured according to the research questions presented in the introduction chapter.

5.1 The tendering phase and early stages

To determine whether a project is successful or not, success must first be defined for the stakeholders involved. As Jha (2013, pp. 4) states "there is no universal definition of success and there is no standard methodology to measure it", hence opinions of what a successful project is may diverge. A construction project involves a wide range of different actors, and success may therefore be related to the perspectives and objectives of each stakeholder. In short, the goal according to the Company's executive team is to have the best profitability and be the biggest actor in the construction sector, while creating societal value. An interviewee from the Company stated a successful project is delivered on time and to the right price. These arguments can imply that making savings when tendering subcontractors is crucial to fulfil the Company's objectives, and that the risk of overlooking other parameters, is present in the pursuit for the lowest price possible.

The interviews indicated a joint main contractor-subcontractor perspective where low tendering prices are prioritised. Discussions with various respondents concluded price to be the most important factor when tendering subcontractors, and the authors could deduce scepticism towards this approach. However, there are other factors to consider in order to accomplish profit-generating projects, such as cooperation and quality in workmanship, which the presented literature shows evidence of, and hence a low price does not have to be the best way to reduce costs in the long run. Some respondents stated to use the supplier database (SDB), and seek advice from co-workers, to get an idea of the collaboration in previous projects. Nevertheless, the conclusion drawn by Hartmann and Caerteling (2010) validates the approach that price often is considered conclusive, regardless previous performance. As several interviewees have experienced, subcontractors and suppliers get re-awarded contracts, despite previous shortcomings in performance and quality, which further can be an indication of price mattering over other parameters. It can be discussed whether or not the relationship today is built on reciprocity, and intense bargaining of tendering prices seem to be interpreted by the subcontractors that their previous performances do not matter.

5.1.1 A long-term versus a short-term perspective

It was stated during a couple of interviews that good previous experiences of the subcontractor play part in the choice of subcontractors, but a submitted price is almost always negotiated to be decreased. There is a visible discrepancy concerning main contractor's and subcontractor's perspective regarding the tendering process, which confirms the approach Arditi and Chotibhongs (2005) refer to as postaward bid shopping. One interviewee stated the construction climate in the region to be a factor causing the constant price bargaining. Respondents from the Company to some extent recognise the risks of intense price pressure, however not to the same extent as subcontractors. It can be discussed who has the utter responsibility for the occurrence of postaward bid shopping; should the subcontractors offer their best price from the beginning, knowing they have no room for negotiations, or should main contractors

accept first prices, with the risk of accepting a price too high? It can be concluded that the "winners" of postaward bid shopping are main contractors, since the reduced price increases the main contractor's profit, decreases the subcontractor's safety margins, and risks to deliver a product of less quality to the client. Josephson (2013) argue that companies within the construction industry are highly dependent on increased margins and profits of each project, however Arditi and Chotibhongs (2005) state that postaward bid shopping increases the risk of remunerate unqualified subcontractors, which is an argument why main contractors should reconsider the approach.

Subcontractors believe relationships in the industry to be more business-like today than before, thus facilitating the ability to be honest and straightforward. However, many still speak of a fear of revealing too much information before signing contracts, with the risk of ideas being shared with competitors, who can submit a lower price to win the tender, in line with the study of Loosemore (2014). Since all interviewed subcontractors have previous experience of losing suggested technical solutions to another subcontractor, perhaps the entire construction industry should join forces to decrease these approaches, to increase innovation in the tendering phase and entail an overall industry development. The authors of this thesis argue for a long-term perspective, where values such as cooperation, quality in tasks executed and knowledge management mechanisms must be given priority in order to increase project profitability. As the subcontractors highlighted, fair prices enhance the sense of responsibility toward the overall project, and would in the long run increase overall project quality.

5.1.2 Feedback on purchases made

Almost all of the respondents acknowledged the importance of an efficient feedback mechanism on purchases made. What especially was a subject for discussions were functioning and realistic electives. By gathering the project organisation, the purchasers and the Aftersales department, well-functioning purchases can be narrowed down, and the non-functioning be eliminated to reduce risk of the same difficulties being repeated. The Aftersales department possess knowledge of how well the electives have worked after project closure, hence accounts for a long-term perspective of functioning electives. Several respondents claim to not receive feedback in any structured way on purchases made, which can be seen as remarkable due to the fact that building contractors purchase services and goods for approximately 70-90% of their annual turnover (Arditi and Chotibhongs, 2005; Eom et al., 2015; Josephson and Lindström, 2011), and that services and materials constitute about 90% of the total project cost (Hartmann and Caerteling, 2010). Hence purchases made have a great impact on the outcome of projects, and the overall project quality in the organisation. Therefore, the authors believe it would beneficial for the Company to implement proper feedback mechanisms.

5.2 The production phase and project execution

According to the literature reviewed, single errors during the life-cycle of a project can have vast consequences, such as delays of project delivery, and additional costs long after the completion of a project. In order to prevent adverse impact on the project's profitability, and the entire organisation, it is important to monitor detected defects and errors, and analyse patterns to understand their origin and root causes. To reduce errors and quality defects in projects, as well as to facilitate progress the Company's way of working has to be proactive, both during the design phase and the execution of the

project. One interviewee highlighted the importance of encouraging subcontractors to inform about ambiguities and errors, and further stressed the importance of subcontractors knowing that they will get paid for rectifying errors. According to the respondent, the Company has to be responsive to criticism and willing to take a greater cost in the beginning of a project if defects later on can be reduced.

5.2.1 Start-up meetings

A majority of the respondents acknowledged the necessity of efficient start-up meetings to avoid shortcomings later on. Josephson et al. (2003) argue that economical results have a higher priority than learning, which is concurred by several of the respondents, stating that knowledge sharing meetings seldom takes place. Since Department X have decided to implement start-up meetings, where both the Aftersales department and the on-site project organisation are invited, the possibilities to learn from each other and avoid previous mistakes are perceived to enhance. The meetings can also be considered a tool visualising the importance of knowledge sharing in the Company's culture. However, the meetings have to be arranged at the right time to fulfil their purpose to capture and implement the knowledge of the present actors. The general view drawn from the interviews is to give and receive feedback face to face, since it will increase the possibilities to respond to questions and criticism.

5.2.2 Planning and time scheduling

Poor planning of a project and an inadequate time scheduling are the most expensive errors in the production phase (Josephson, 2013), and common causes to why a project does not reach its goals (Antvik and Sjöholm, 2007). A foreman at the Company said "you build the house at least three times, before you actually build it", indicating the crucial role planning plays for gaining the right prerequisites for everyone on site and the progress to be successful. The subcontractor respondents stressed the importance of the time schedule being proactive with room for changes, which is confirmed by the literature. A too tight schedule can disrupt the flow of activities in the production, causing delays, frustration and low moral on site, a statement supported by employees in production as well as among subcontractors. All subcontractor respondents were very positive to use a pulsing-scheduling on site, which is stated to enhance a consistent production and visualise deviations. However, it puts high demands on the management team on site, as well as support functions to actively work with developing the Company's processes.

5.2.3 Division of responsibilities

The interviewees stressed the importance of responsibilities being clearly defined, in order for all actors to know who to turn to in different matters, as well as being a foundation for sorting out economical claims among different firms. Antvik and Sjöholm (2007) state division of responsibility as vital for project success, and the Company's use of demarcation lists is appreciated among several respondents. However, the list can be subject for interpretations, and lead to misunderstandings on site if not anchored among all participants. The list has to take project specific characteristics into consideration to fulfil its purpose, and should not be copied from previous project without revision. One department at the Company have created their own version of a demarcation list, which the respondents stated to be more efficient than the one on the intranet. This indicates inconsistency between projects, and the fact that the departments do not share ideas within the organisation, or lack a forum to do so.

In order for responsibility to be clarified, proper drawings and detail specifications have to be made in the design phase. Otherwise, the consequences can be severe, as important elements in the production risk falling between the cracks. Two respondents discussed a troublesome project suffering from water leakage after completion, resulting in large costs for the Company. They believed the actors involved did their best, however without detail specific drawings the entire element was not considered, nor its function. No one had the overall responsibility, and the workers on site had to solve the situation to the best of their ability. Even though this element has been built several times before in various projects, the disruption implies the necessity of proper drawings and details of element in all projects, especially in elements connecting different actors. Loosemore (2014) states the under-valuing of design as a significant cause of errors to recur, and as one of the respondents stated, "This [not producing proper details] is not the correct way to make cost reductions". The occurrence as well shows evidence of barriers to learning in the organisation, namely that the learning is not prioritised, it happens in the moment, and in an unsystematic way.

5.2.4 Information, documentation and feedback

In order for successful planning, subcontractors emphasized the importance of clear communication paths, as well as correct and relevant information derived from the Company, which is accentuated in the literature. Substandard documentation can lead to uncertainty and disagreements concerning decisions taken, which several interviewees have had experience of. According to the Company's internal system, documentation should be a priority in each project, however several of the interviewees stated that documentation often is substandard. The lack of documentation is not a problem as long as a project runs smoothly, as one respondent stated, however if a project encounters problems the documentation is crucial in order to steer the project in the right direction, and to avoid or to resolve disagreements, which can be time consuming and lead to delays.

The documentation is not only important for a project's progress, but also for learning in the organisation. It is said to be difficult to share lessons learned with others, and hence a knowledge transfer system is requested. Learning happening in the moment, and not captured is one hinder Josephson et al. (2003) mention as hampering learning. Through proper documentation and follow-ups learning from previous errors, such as causes and enablers, is possible and can prevent errors from reoccurring (Josephson, 2013). Documentation of the most common mistakes would be useful, but has to be supplemented by face-to-face dialogue. Subcontractors stated to strongly prefer face-to-face dialogue, which creates understanding between parties.

5.2.5 Teams on site

The composition of a group sets the tone of the working environment, and several interviewees from the Company stressed the importance of having the right persons and competencies on site. Subcontractors stated tendering price to be dependent on the project organisation presented, which further implies the importance of the right personnel composition. Respondents at leading positions in the Company stated that the composition is well thought through with a long-term perspective in mind, and the organisation decided early in a project. Even if this is the case, several interviewees have experienced great personnel turnover in projects, which has had negative impacts on the project. The turnover is sometimes inevitable due to changing demands over

time in a construction project, however it has to be handled with caution. Several interviewees perceive turnover of staff as a major challenge on the progress of a project. It can inhibit creation of relationships on site, affect collaboration between actors, and result in stagnation in the project (Josephson, 2013). The latter becomes even more evident if the site manager is the subject for replacement, which some of the subcontractors were prone to point out. They stated that a turnover often results in frustration due to confusion of the project organisation, and the uncertainty of division of responsibility among Company employees on site. Once again, the importance of an unambiguous division of responsibility is addressed.

The general conclusion amongst the interviewees from the Company is that if a project experiences personnel turnover, the transition has to be thoroughly planned, in order to not affect the stability of the project. If a role is to be replaced, time have to be given for the new employee to get versed in the project and its organisation. There are projects where personnel turnover have resulted in a better work environment on site, indicating that changes do not always have to be troublesome. However, when a change in the project organisation occurs, there has to be a plan concerning both time and action for how to implement it.

All respondents conclude that the working environment has to be open and responsive, with a helping attitude. Good relations entail trust on site, and increase understanding and respect among the actors. A trustful relationship increase the receptiveness to new information as well as flexibility when encountering problems (Delbufalo, 2012; Hartmann and Caerteling, 2010; Manu et al., 2015), two common occurrences in a construction project, why a well thought out team on site is paramount. The mixture of ages and different backgrounds can foster learning among colleagues, and hence broaden the project's perspectives. It is however important that all projects are given equal prerequisites concerning personnel and competence composition, so that one project does not end up with a single-minded group due to the uniformity of the participants.

5.3 Project closure and improving organisational learning

The temporary art of construction projects creates knowledge barriers to overcome, and requires organisations to preserve and transfer knowledge in order to operate efficiently in a market with high intensity. The entire industry stands before a major knowledge loss, mainly due to retirements (Shokri-Ghasabeh and Chileshe, 2014), which further fortifies the argument to preserve and transfer existing knowledge within construction organisations. However, derived from both the reviewed literature and the case study, to preserve and transfer knowledge as well as capture lessons learned is most often lacking due to high time pressure and the involvement in new projects. In combination with none of the interviewees in Boverket's (2007) study addressed themselves as part of errors occurring, and that many respondents in this case study spoke about fear of admitting errors and failures, it indicates a lack of self-awareness in the industry with tendencies to blame others, and an unwillingness or lack of knowledge in how to analyse and capture previous failures. However, analysing success factors is as important to gain knowledge of what makes a project successful, and Kululanga et al. (1999) argue that reviewing both success and failure factors, and implementing learning networks, is vital to retain knowledge in an organisation.

Several respondents stated to be forced to make non-routine decisions, and solve issues by quick fix solutions, sometimes outside their own area of expertise. This can be linked to the information sharing processes at the Company; the internal system to some extent provides standardizations and routines, but still many seek for information "on their own". Fu et al. (2006) conclude "self-studies" to require an existing database from which relevant information can be retrieved, while learning networks facilitate connections to those with experience from dealing with similar problems. Learning networks are ready to be implemented within some disciplines at the Company, which is both requested and perceived as beneficial to increase the learning in the organisation. However, some respondents have raised concerns regarding the difficulty to find time to engage in such networks, making it even more vital for top management to accentuate the importance of them.

5.3.1 Analysing defects in order to increase efficiency

Several respondents have acknowledged contradictions concerning visualising hidden costs and errors; no one wants to present bad results or be associated with failure, however by not exposing recurring errors the opportunity to learn from them decreases. Josephson (2013) stresses the importance of finding ways to visualise hidden costs and defects in order to increase efficiency, and as the authors of the thesis argue for, in the long run increase project profitability. Styhre et al. (2004) state that for organisational learning and knowledge sharing approaches to be fully implemented in the organisation, it first needs to be a prioritisation for top management. Combining the fact that few business executives are aware of how extensive the costs of errors in the organisation actually are (Josephson, 2013), it strengthens the argumentation for the need of proper processes to analyse patterns of origin and root causes of errors.

5.3.2 Information exchange and systematic transfer

There are aspects of knowledge and information sharing to consider; sharing to extensive or non-relevant information can lead to low interest for all information shared; hence the receiver ignores important data. Lam et al. (2010) state this to result in time waste, and inability to keep up with time schedules. As respondents from the Company stated, subcontractors have to be "hunted down" to own up to obligations, whereas the subcontractors stated the Company's rectification process to be unsystematic. By efficient standardised ways to transfer such information, the contradictions can be over won. Yet another suggestion would be for the Aftersales department to have the possibility to evaluate subcontractors in SDB on their performance during the warranty period, as this would give insight of the subcontractors' rectification process.

5.3.3 Challenges of a fragmented process

Dave and Koskela (2009) and Knauseder (2007) argue that the fragmented process of conducting a construction project is one cause to the challenge to learn from others, and results in communication difficulties. The case study showed evidence of lack of feedback mechanisms between various departments, such as purchasing and production, and an underlying idea that those not on-site are somehow detached from the reality of construction projects. Subcontractors stated to sometimes perceive it to be difficult and take a long time to receive answers from the Company, due to their separation of different disciplines. Josephson (2013) stresses the need for organisational processes to be balanced, whereas to extensive support processes, such as purchasing, may hamper the actual efficiency in a project. With the aforementioned, it is reasonable

to argue for a better communication between departments, and increased understanding for each other would simplify the communication chain.

One interviewee at managerial level at the Company believes temporary project organisations increase the employee's abilities to adapt to new situations. Meanwhile, the literature review shows evidence of the challenges project organisations encounter to develop efficient processes, which entails a large variation in results and procedures. The case study reveals difficulties to standardise processes for knowledge transfer and information sharing, as well as challenges to combine learning for the future with intense time pressure in projects and the volatility of projects.

The "construction industry" is not one single industry (Bower, 2010). It can rather be seen as a variety of different market areas overlapping each other, where it in theory may be a uniform knowledge, but in practice the knowledge is concentrated to the specific market area (ibid.). Hence, better understanding for other disciplines, improved relations, and knowledge sharing ought to be vital for companies within the construction industry, operating in an increasingly intense market, with high demands on profitability and efficiency. Efficient post project reviews, as suggested by Shokri-Ghasabeh and Chileshe (2014), are one way to transfer knowledge from one project to another. PPR can be considered as a tool for systematic analysis of previous projects, and provide a base for future improved business processes. However, as reviewed in the literature, PPR is seldom prioritised due to time pressure, engagement in new projects and lack of understanding the gain of them, despite their major benefits for increasing knowledge and capture lessons learned in organisations. The Company's has stated in their internal documentation that PPRs should occur after every project closure, however few of the respondents in the case study claimed to ever have attended such a meeting. A majority wished for feedback after a project's closure, as well as tools to assimilate lessons learned which they believed would benefit the Company as well as the subcontracting firms, to execute projects more successfully and deliver a better end product.

6   Conclusion

This chapter presents the conclusions of the master thesis, derived from the analysis, and compiled into four main categories. Thereafter, recommendations for further research is provided.

6.1   Knowledge management and feedback

The construction industry faces several challenges to preserve, capture and transfer knowledge, within and between organisations. It is concluded that learning in the industry is unsystematic; it happens in the moment and consists of problem-solving instead of preventing problems. Learning is not prioritised as employees cannot allocate the time, and guidelines and support from top management is lacking. Based on the interviews, the Company has to create a culture in which knowledge transferral and gaining experience from others are considered important, and which allows for mistakes to be made in order to learn. A step on the way to become more systematic is to create learning networks for knowledge exchange, to encourage meetings between different groups of actors, which the Company have implemented to some extent with site manager groups. PPR is another arena for knowledge exchange and feedback, not only within the organisation but between organisations, which should be performed after each project. For the implementation to be successful, the top management has to lead the way, and ensure it permeates the whole organisation.

6.2   Errors and quality defects

The challenge to systematically monitor and analyse errors and quality defects in the construction industry is evident. Information regarding deficiencies, failures and success factors are seldom taken to a higher level in organisations to be analysed, and combined with the lack of feedback mechanisms, neither main contractors nor subcontractors learn from mistakes made in previous projects to the extent possible. Nevertheless, errors are unavoidable. The most common errors were difficult to compile in a list, solely based on the number of interviews conducted for this thesis. The conclusion is however that organisational factors are implied to have a greater impact on the quality in construction projects than technical, and the general view concludes that poor management, poor planning and intense time pressure are the most contributing causes to errors and defects in construction of new housing. However, the authors believe much can be gained by monitoring and analyse errors and costs, in order to have a factual basis instead of subjective opinions concerning where and why errors occur. It is recommended that the Company investigate the possibilities to implement a system for error reporting, which can foster re-experience and capture lessons learned. As stated in the literature, organisations that forget their past failures will most likely repeat the mistakes, hence analysing errors and defects are vital for all construction companies in order to be profitable, and to reduce the future loss of knowledge due to retirements, in an increasingly intense market.

6.3   The importance of design and adequate documentation

The authors conclude that there is a tendency in the early phase of a construction project to undervalue the design, which often results in defects, and counteracts the overall quality of a project. There is an increasing demand for the industry to become more efficient due to time and price pressure. However, this should rather entail for

development of efficient processes, than decreasing the time frame and making short cuts in the design phase. Even though tasks are repetitive, and the perception of having done something before exists, detail specific drawings are crucial in order to ensure quality of all elements, and to create a common understanding of the project's concept. Before using a previous project as reference, the definition of it has to be unambiguous, and clearly defined. The previous project should be completed before the initiation of the new one, and its documentation revised to fit the new project. With thorough documentation, the expectations and the division of responsibility become clearer for the actors involved.

6.4 A long-term perspective

Long-term relationships with subcontractors may be seen as a strategic asset, and can have great impact on both economic outcomes, as well as the quality of the work performed. However, it is subject to uncertainty, derived from the volatility of construction projects and the constant necessity to balance competition for the best price and maintaining relations. The general conclusion from the literature reviewed is that price is considered the most important factor when tendering subcontractors (Bower, 2010; Eom et al., 2015; Hartmann and Caerteling, 2010), with the risk of compromising quality as well as decrease the sense of responsibility toward the overall project, which is confirmed in the interviews. The discrepancy between main contractor's and subcontractor's perspective regarding the tendering approach postaward bid shopping is evident. Negative aspects, such as the increased risk of remunerate unqualified subcontractors (Arditi and Chotibhongs, 2005), and hamper innovation in the pursuance for the lowest price possible, have to be carefully evaluated and taken into consideration by main contractors.

Organisations may reduce costs, and increase profitability in different ways. Cheaper and less resources entail short-term success, while developing efficient processes to reduce construction time and capturing lessons learned entail long-term success. The authors believe by adopting the long-term perspective, construction companies' increase their ability to create stable organisations and projects with higher predictability. Hence, it is not the profitability in each project that is paramount, but rather delivering products of consistent quality, making the grand total of all projects' profits higher, and decreasing the risk of loss-making projects. The authors of the thesis believe the short-term perspective makes it harder to predict future project's profitability, due to not assigning time for knowledge capture and cogitate lessons learned, hence risking repeating the same mistakes. Several researchers (Cheng, 2009; Styhre et al., 2004) conclude that the short-term perspective leads to the single result of each project being prioritised over knowledge sharing and joint learning. One of the most remarkable findings in Shokri-Ghasabeh and Chileshe's (2014) study were the correlation between possessing and documenting lessons learned, and effectively select feasible projects to bid for.

Derived from the aforementioned, the authors of the thesis conclude that a long-term perspective would increase profitability and overall knowledge in the organisation. By being able to learn from wrongdoings in past projects, understand where and why problems arise, and handle subcontractor relations, organisations increase their ability to predict which projects will be profitable and less troublesome in the future. Hence, knowledge transferral, as well as monitoring and analysing errors and defects entail success in a competitive and intense market.

6.5   Recommendations for further research

The conclusion of the thesis inclines that implementation of post project reviews encounters hinders today, due to time pressure and engagement in new projects. Therefore ways to overcome these barriers to create opportunities to capture lessons learned should be examined. For further research the authors suggest to explore systems suitable for the construction industry, to increase knowledge of errors and their causes, and identify potential development areas. The research has to consider the characteristics of the industry, such as the fragmentation of the process, temporary organisations and the involvement of several different actors and firms, in order to enhance the overview of the problems and capture existing knowledge.

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Appendices

Appendix I – List of respondents' professions

Different professions among the respondents
Free conversations and interviewees from the Company: Aftersales Service Technician Aftersales Service Coordinator Building Physicist Design Management District Management District Purchaser Foremen Installation Coordinator Procurement Specialist for Installations Project Management Regional Procurement Manager Supplier Management Quality Manager *Installation subcontractors:* Project managers and CEO:s Each subcontracting firm has participated in 10 of the Company's projects since 2012.

Appendix II – Interview Templates

This appendix provides a selection of the questions asked during the interviews conducted. The questions have been adapted to suit the respondents' professional role.

General question template

Background Questions
What is your profession?
 	
Current situation
Is your current project similar to previous conducted projects?
Which installation-subcontractors have been involved?
    • Do you have previous experience from working with them?
    • Have the different subcontractors worked together before in other projects?
When was the project organisation decided upon?
Have the project organisation changed during the execution period?
    • Why? Where there any consequences?
 	
Disturbances, construction project
What is a disturbance for you?
    • Most common, most costly? Why do they occur?
Which of these disturbances have the greatest impact on the project?
    • What do you do to prevent these disturbances?
What are the key factors for a successful project?
Can you mention a project you consider successful versus one less successful?
    • Why?
    • How have the divisions of responsibilities been planned and functioning?
    • How do you ensure that nothing falls between the cracks?
    • Which lessons do you bring into new projects?
 	
Installation specific questions
What generates highest additional costs in projects concerning installations?
What do you consider as challenges/risks concerning cooperation between the Company and installation subcontractors?
How is the quality of workmanship ensured on site?
Are there any recurring problems concerning installations?
 	
Feedback and knowledge transfer
Do you receive feedback after and during a project/on your executed work?
    • How do you receive it? From who?
Do you give feedback?
    • How do you give it? To whom?
 	
Future
How do you think cooperation between the Company and subcontractors can be improved, to decrease additional costs?
Which is the best way visualise errors and defects in an organisation to be able to learn from them?
How would you like to receive feedback in order to improve from it?

Purchasing specific questions: Purchasing and Quality Issues

When speaking of installations, how do you proceed when you are making a purchase?
    • What parameters are important? Why?
    • The balance between previous experiences versus price?
    • Is it common for prices to be negotiated after tenders are won?
    • Do you see any negative effects concerning price negotiations?
How do you know/ensure the quality of the purchases made? (Subcontractors and material suppliers)
    • How do you get that information?
    • How to ensure that the purchase worked well?
    • Who do you contact to examine/control quality?
Which tools are used for reducing quality defects in the projects?
    • Do they work? How do you apply them to your work?
How do you/the Company work to spread knowledge of purchasing specific issues within and between organisations concerned?

Subcontracting specific questions

Background Questions
Can you tell us about your Company?
    • What is your business model? (Own designers, buying services etc.)
What is your professional role?
 	
Current situation
Which factors are important for you when deciding to engage in a tendering-process?
If the Company sends a tendering-request, for any reason not in your interest, how you respond?
Would you say that cooperation with the Company is relationship bounded?
What is in your opinion the most important factors to have in a tender?
In a project with intense price pressure, what is common to haggle away?
    • What are the possible impacts?
Can you describe your work during the project?
    • From whom you receive information? Suggestions for improvement?
    • How do you see your collaboration with the Company?
        • Long-term perspective or per project basis?
How can the Company facilitate for your firm?
Does it differ in any way to work with the Company compared to other main contractors?
 	
Feedback and information transfer
Do you receive feedback from the Company after a project's closure?
How do you give feedback to the Company?
How would you wish to receive feedback from the Company?