



JÖNKÖPING UNIVERSITY
International Business School

Productivity Improvement in Wooden House Construction

BACHELOR THESIS WITHIN: Business Administration

NUMBER OF CREDITS: 15 ECTS

PROGRAMME OF STUDY: Civilekonom

AUTHOR: Andreas Ruus & Max Odehammar

TUTOR: Imoh Antai

JÖNKÖPING May, 2016

Bachelor's Thesis in Business Administration

Title:	Productivity Improvement in Wooden House Construction
Author:	Andreas Ruus Max Odehammar
Tutor:	Imoh Antai
Date:	2016-05-23
Subject terms:	Construction, Wooden house, Productivity, Lean, Implementation

Abstract

There has long been a continuous debate regarding the construction industry. Building costs are said to be too high, and many critics have complained about an industry considered to be very ineffective, underdeveloped and conservative. At the same time scholars have long presented philosophies, frameworks and ideas in response, but these initiatives do not seem to have gained traction. Studying the issues of productivity, one can indeed find a rich literature highlighting the problems and solutions. However, studies regarding how well the academic framework has been adopted by the industry are perceived as scarce, creating a shortage of research.

The purpose of this thesis is to explore how contractors within the Swedish wooden house industry approach productivity improvement. Through an exploratory research method, primary empirical data has been collected from on-site construction managers engaged in wooden house assembly.

The findings revealed an industry highly affected by the economic environment, project attributes and short-term thinking. The adaptation of frameworks for productivity improvement was found to have been implemented on an ad hoc basis, highly individualized and with few elaborated thoughts on improvement among respondents.

Acknowledgements

With a few words we would like to express our gratitude and appreciation to all people who helped and supported us through the journey of writing this thesis. Without your help and support this thesis would most likely still be stuck somewhere in the process.

We would especially like to express our gratitude to our supervisor and thesis examiner Anders Melander, Jönköping International Business School (Sweden), for all his advice, support and feedback. We would also like to express our gratitude to Smart Housing Småland for inviting us to their project and for all their help providing us with contacts.

To all members of the seminar group and our tutor Imoh Antai, thank you for all constructive feedback and helpful remarks. Last but not least, a very special thank you to all interviewees providing us with valuable data and thoughtful wisdom. Thank you.

Jönköping, 23th of May 2016

Andreas Ruus

Max Odehammar

Table of Contents

1	Introduction.....	1
1.1	Purpose.....	2
1.2	Research questions	2
1.3	Scope of the thesis.....	2
1.4	Structure of the thesis	3
2	Theoretical Framework.....	4
2.1	Overview of construction	4
2.1.1	Description of the industry.....	5
2.1.2	Costs.....	6
2.2	Productivity	8
2.2.1	Lean Construction	9
2.2.2	A project-based industry	10
2.2.3	ISO Quality Standards	10
2.2.4	Construction managers.....	10
2.3	Factors influencing construction productivity.....	11
2.3.1	Management and strategy	11
2.3.2	Manpower	12
2.3.3	Industry Environment	13
2.3.4	Effort and incentives	13
2.3.5	External Conditions	14
2.3.6	Summary	14
3	Methodology	15
3.1	Research Philosophy	15
3.2	Research Approach and Purpose.....	16
3.3	Research Design.....	16
3.4	Data Collection.....	17
3.4.1	Sampling method and access	17
3.4.2	The sample	18
3.4.3	Semi-structured face-to-face interviews	19
3.4.4	Conducting interviews	20
3.5	Analysing the empirical data.....	21

3.6	Time horizon	22
3.7	Research Ethics	22
3.8	Research trustworthiness.....	22
4	Empirical findings and analysis	24
4.1	Company and interviewee presentations.....	24
4.1.1	The Red Firm	24
4.1.2	The Blue Firm	24
4.1.3	The Yellow Firm.....	24
4.1.4	The Green Firm.....	24
4.1.5	The White Firm.....	25
4.1.6	The Black Firm	25
4.2	Controlling costs and handling waste.....	26
4.2.1	Results.....	26
4.2.2	Analysis.....	27
4.3	Retainment of expertise.....	29
4.3.1	Results.....	29
4.3.2	Analysis.....	30
4.4	Difference in perception between craftsmen and management	32
4.4.1	Results.....	32
4.4.2	Analysis.....	33
4.5	Activity planning.....	35
4.5.1	Results.....	35
4.5.2	Analysis.....	36
4.6	Worksite Organization	38
4.6.1	Results.....	38
4.6.2	Analysis.....	39
4.7	Quality control.....	40
4.7.1	Results.....	40
4.7.2	Analysis.....	41
4.8	Improvement process	43
4.8.1	Results.....	43
4.8.2	Analysis.....	44

5	Conclusions and discussion	46
5.1	Conclusions	46
5.2	Discussion and further research	47
5.3	Limitations and strengths of the study	48
6	References.....	49
7	Appendix.....	55
7.1	Topic Guide for interviews	55

Figures

Figure 2-1	Development of real estate cost 1992-2014	7
Figure 2-2	Costs in construction (2015)	8
Figure 3-1	The Research Onion (Saunders et al., 2009, p. 108).....	15

Tables

Table 3-1	Breakdown of interviews.....	18
Table 3-2	Company size definitions (Source: European Commission).....	19

1 Introduction

This chapter aims to provide the reader with a background, introduce the problems of the construction sector regarding productivity and shed light on the ongoing debate. The introduction also includes the purpose, scope and structure of the thesis.

For most countries, the real estate market is a fundamental part of the economy. Good housing opportunities and space for commerce are often pointed out as prerequisites to enable economic prosperity (Statens Offentliga Utredningar, 2015:48). In this view it is argued that demographic trends, workforce mobility and economic growth are closely interlinked with the availability of good housing opportunities. Still most countries struggle to balance the market and over the last couple of years the construction industry has been criticized due to the high, and increasing, costs of development. The industry is often talked about in ominous ways, described as corrupt, underdeveloped and very inefficient. Sweden is no exception, with recent statistics from the Swedish Census Bureau (SCB) showing a dramatic increase in the cost related to construction in a relatively short period of time (Josephson & Saukkoriipi, 2005; SCB, 2015).

Due to these circumstances several national and international initiatives have been initiated in order to resolve the concerns. Scholars have suggested that matters of expenditures, or costs, are central issues that cover almost all areas of the construction industry (Womack & Jones, 1996). Costs can further be addressed from a multitude of angles, but are most often discussed in terms of either an organizational perspective, through technical solutions or the legal environment. In a report by SCB and the Swedish Construction Federation (BI), it has been found that the cost of labour has a substantial impact on the total cost structure in real estate development, acquiring 21 percent of the total cost of production and a staggering 39 percent of the construction costs (Sveriges Byggindustrier [BI], 2015).

From this perspective, scholars have for long maintained the importance of improving productivity and over time a number of frameworks, philosophies and tools have been developed. However, hindered by a general conception of an industry that is unique and conservative, these initiatives do not seem to have gained traction, often entrenched in a paradox where efforts for improvements are seen as wasteful (Josephson & Saukkoriipi, 2005).

Through a brief review of the frameworks one will also encounter various interpretations where productivity, time and again, are said to be influenced by industry context. It has even been suggested that differences in interpretation not only depend on context, but rather on individual perceptions, influenced by background and profession (cf. Albriksen & Førsund, 1990, Johnston and Jones, 2004). Understanding that productivity and the ideas for its enhancement are of upmost importance, it could be argued that the inconsistency in understanding is problematic.

Since there is no clear distinction between construction in general and contractors in the wooden house industry the concepts and dilemmas discussed above also apply to the Swedish wooden house business (Lövgren & Rönnblom, 2008). Today most of the dwellings produced by this industry are prefabricated in segments and assembled on on-site (SOU 2008:68). Even though some of the companies offer turn-key solutions to their customers, due to the often small nature of the enterprises, the majority of the wooden house suppliers are dependent on separate contractors for the final assembly (Villaägarnas Riksförbund, 2013). In this sense, it could therefore be argued that a considerable amount of the cost to the end consumer must correlate with the efficiency of the contractors and in turn have a substantial impact in the wooden house suppliers (Cocozza & Ljunggren, 2008).

On this account this thesis therefore sets out to explore how contractors within the Swedish wooden house industry approaches productivity improvement. The objective is to understand, question and discuss how well the frameworks of the academic community corresponds with reality. The views on productivity and the industry will hence be scrutinized from a multitude of angles, terms will be explained and frameworks that are said to influence productivity identified. These frameworks will then be compared with reality through a qualitative study on construction site managers.

1.1 Purpose

This thesis aims to explore how contractors within the Swedish wooden house industry approaches productivity improvement on construction sites. The purpose is *to investigate the conditions and obstacles for productivity improvement in wooden house construction, in relation to academic frameworks*. In order to achieve this, the thesis have been outlined through two research questions.

1.2 Research questions

What are the major challenges facing the industry concerning efficiency and productivity?

How does major academic frameworks for productivity improvement resonate with current practice?

1.3 Scope of the thesis

The scope of this thesis is confined to the exploration of ideas and definitions that have previously been defined by the academic community. This thesis also specifically explores well-established theories and philosophies regarding improvement of the productivity within construction.

The primary source of information has been an extensive literature review, industry interviews and the help of our tutors.

The scope of this study is also confined to contractors responsible for the on-site assembly of wooden structures. The views have been collected from interviews with six individuals from different companies.

Due to practical limitations and the partnership with Smart Housing Småland, the empirical data gathered for this study have been geographically limited to Sweden and the regions of Småland and Västra Götaland.

1.4 Structure of the thesis

In the first part after the introduction, the reader is provided with an introduction of the study through a narrative on the construction industry. To enable a good understanding, this section starts with a broad description of universal challenges, makes a swift transition to a Swedish perspective and describes the wooden house industry. The first part also presents costs, contemplate productivity and summarise the main factors affecting productivity within construction.

In the second part the methodology is presented. Here an explanation of the method will be brought forth, as well as a reasoning on different approaches. This section also aims to provide the reader with an understanding of the authors' theoretical contemplations regarding data collection.

The third part is dedicated to the analysis of the empirical data. The objective is to pedagogically present the findings, analyse the results in relation to theory and provide the reader with new insights.

In the fourth and final part conclusions are made from the empirical data and analysis, and research questions answered. The final section also includes a discussion where implications are contemplated, limitations are presented and further research suggested.

2 Theoretical Framework

The first part of this chapter will give the reader a thorough understanding of the construction sector and clarify problems identified by literature in more depth. The second part discusses productivity as it applies to the construction industry. The third part will then present concepts and frameworks developed by scholars for the improvement of these issues.

2.1 Overview of construction

For a long time, there has been a continues debate regarding the construction industry. From an international perspective the industry seems to face the same set of challenges. Often pointed out for lagging behind economic development and not keeping up with social challenges at large, the industry is plagued by critics contemplating rising costs, poor quality and low efficiency (cf. Murray & Langford, 2003; Bröchner, 2011, Lind, 2006).

One of the main themes in the literature concerns the issue of cost. It is arguably getting more expensive to build and maybe even, according to some, too expensive (SOU, 2002:115). The reasons to these cost issues are said to be manifold. One example involves the increasing cost in the use of resources, which in turn is maintained as one of the reasons causing prices in construction to increase (SOU, 2002:115). Over time this issue has been contemplated by a great number of scholars, consequently highlighting the importance of improving productivity (Koskela, 2000; Murray & Langford, 2003; Bröchner, 2011). Through several articles, reports, books and debates, numerous theoretical and practical solutions to improve productivity have been developed. However, many reports still present a bleak image of the construction industry (Murray & Langford, 2003; Bröchner, 2011). In various reports it has been characterized as exceptionally slow reacting to recommendations, frequently portrayed as resistant to change and accused of not implementing an adequate number of solutions to problems (Jonsson, 2005; Latham, 1994; Murray & Langford, 2003). Often cited examples of this criticism can also be found in several articles from the United Kingdom including; the Latham report from 1994, *Constructing the Team*, the Egan report from 1998, *Rethink Construction*, and the Construction Excellence report from 2005, *Be Valuable*.

Sweden is no exception to global trends. Through several decades the public debate on construction costs have been intense and the improvement of productivity within the Swedish construction industry can be seen a lengthy battle (Lind, 2006). Starting in the early 1950s, the government published a comprehensive report on the issues of cost in constructing real estate. Through the national board of housing, building and planning the government even performed an experimental study whereby the same type of house was constructed in Malmö, Gothenburg and Stockholm to examine as to why building costs were higher in Stockholm (Bostadsstyrelsen, 1955; Lind, 2006). Although one can find earlier cases of reports with similar tendencies, the literature seems to hold that there has been a continuous stream of investigations concerning the construction

industry ever since the start of the post-war era (Lind, 2006). Over the years, reports have focused on issues concerning low competition, low productivity levels, high costs and low quality. At the turn of the millennium a set of widely debated reports were published, in 2002, *Skärpning gubbar* and in 2009, *Sega Gubbar*. The first report, among other things, heavily criticized the industry for poor quality, tendencies of corruption and a meagre cost development. The follow-up report of 2009, *Sega Gubbar*, gave notice that little had been done and an insight to that the Swedish construction industry in many aspects faced the same set of challenges as its international counterparts (SOU, 2002:115; SOU, 2009:6).

2.1.1 Description of the industry

The organization of the Swedish construction industry is very complex. The industry consists of a multitude of actors and it is not always easy to understand the relationship between entities operating within the sector (Josephson & Saukkoriipi, 2009). With regards to the wooden house sector, many people would probably think that the suppliers produce and assemble the structures, on site, from start to finish. However, the reality is quite the opposite. Today, most wooden houses are prefabricated in factories (SOU 2008:68). With this technique, the wooden industry has rationalized the business and increased volumes. Even if some of the wooden house producers still build using turn-key contracts, the majority of the structures are built by third party operators, i.e. construction contractors. The logic behind the third party assembly and construction is, among other things, due to insurance costs, risk and economic capacity (Cocozza & Ljunggren, 2008). Many of the companies within the wooden house industry thus supply houses to private customers but can also serve as subcontractors to large real estate developers like PEAB and Skanska (Lövgren & Rönnblom, 2008). In this sense there is no clear distinction between construction in general and the contractors of the wooden house industry. This is also why the term *construction* is used when contractors of the wooden house industry are discussed in this thesis.

Just as construction in general, the wooden house sector has experienced a rapid increase in demand after the downturn in 2008. Not only does the industry deliver single family homes at higher rates, but due to legislative changes and environmental trends, the sector has also experienced a partial shift in the demand for other types of structures. Only in 2013 the number of apartments built with a wooden frame increased by 35 percent compared to the previous year (Trä- och Möbelföretagen, 2015a). One logic behind the increase is the demand for modular housing. With the technique, large segments of a real estate projects can be pre-fabricated in a factory and then assembled on location to lower costs. However, even if there has been clear hike in this sector, managers within the industry are still faced with similar challenges as the rest of the construction industry. Again, one of the major challenges are the issues of productivity and costs. (Trä- och Möbelföretagen, 2015b).

Focusing on cost, issues of productivity have been maintained and pointed out to be poor. According to literature, the potential cost improvements in Swedish construction have been emphasized not only by scholars, but also by practitioners. In two reports, the estimated

improvements were said to be around 20-35 percent, calculated on total production costs (Sörqvist, 1998; Josephson & Saukkoriipi, 2005). In another investigation, commissioned by the Swedish Ministry of Enterprise and Innovation, it was estimated that yearly gains of around 2 percent could be seen as viable (Statskontoret, 2010). These reports have further coincided with the general view of practitioners' which have estimated their possible gains in the region of 2-3 percent on an annual basis (Landin & Lind, 2011).

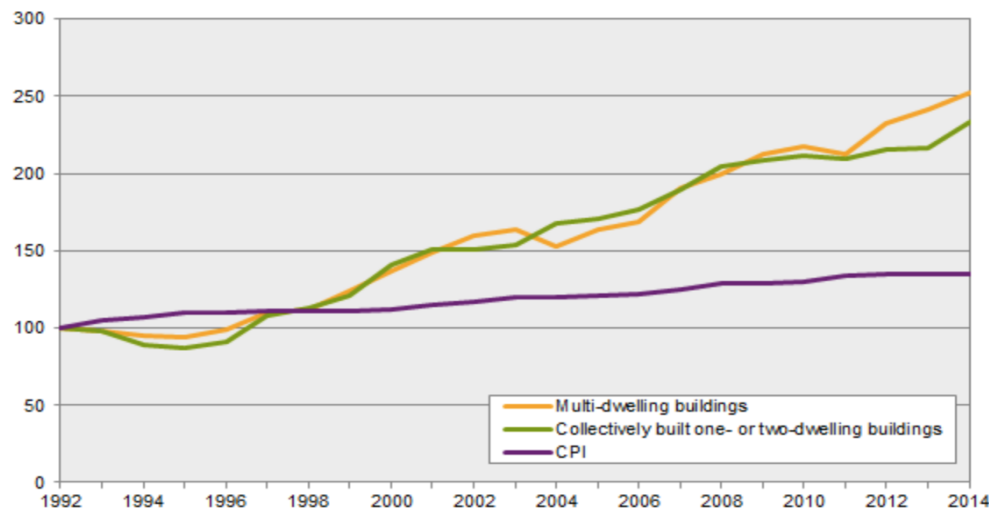
In this context, some critics have questioned why the construction industry have not been able to match the progress of productivity seen in many other industries, especially in automotive manufacturing (Landin & Lind, 2011). In answering the question of why the construction industry have not followed the progress of other industries, solutions prescribed by academia often focus on the feature of the industry and the people within. However, through a literature review on the subject it is clear that issues of *cost* are central and that two areas are brought forth by the academia for the conception and prescription of remedies, namely *productivity and fragmentation* (Polesie, 2011).

2.1.2 Costs

Recent statistics [Figure 2-1], released by the SCB, also indicate that the cost of developing new real estate have increased rapidly over the past few years (SCB, 2015). The factors behind this development are claimed to be both indigenous and exogenous, however the recent refugee crisis that struck Europe, and especially Sweden during the past year have led to an even greater strain on an already stressed market (Boverket, 2016). In a recent report by the SCB (2015), it is stated that the construction industry is not keeping up with the demand, and in an another report by the national board of housing, building and planning it is estimated that there will be a need to build a staggering 700 000 dwellings until 2025 (Eriksson & Gustavsson, 2015).

Building price index with deduction for allowances* and CPI

Index 1992=100



* The allowances vary greatly between the years which contributes to variations of the Building price index

Source: SCB

Figure 2-1 Development of real estate cost 1992-2014

The building price index illustrates the price development for newly developed real estate of equal value. The index is based on statistics for construction costs and is adjusted for quality differences and regional distribution. This index is also a part of the statistical report BO 26 (SBC, 2015).

Studying the actual cost of construction projects, it becomes evident that there are numerous opinions and ways of calculating the resources needed for a dwelling to be built. However, the reasoning in this thesis is based upon reports from SCB and the Swedish Construction Federation (BI, 2015). According to these institutes the cost of development can be divided into two segments [Figure 2-2]. *Total cost of production* refers to the cost when all elements of a construction project is summarized. Here the institutes have taken into account, not only construction costs, but also the value added tax and the cost to acquire land. With this logic, the cost to develop a project can fluctuate greatly due to the variation in land prices and location. *Construction costs* on the other hand, gives a more isolated breakdown to the cost of the actual construction. With a clear breakdown between machines, materials and labour cost, this segment give clear insights to the factual cost of labour.

Adding up the numbers from the table below it becomes evident that the costs of labour have a substantial impact on the total cost structure, representing 21 percent of the total cost of production and a staggering 39 percent of the construction costs. These numbers thus further underscore the importance of an effective labour force.

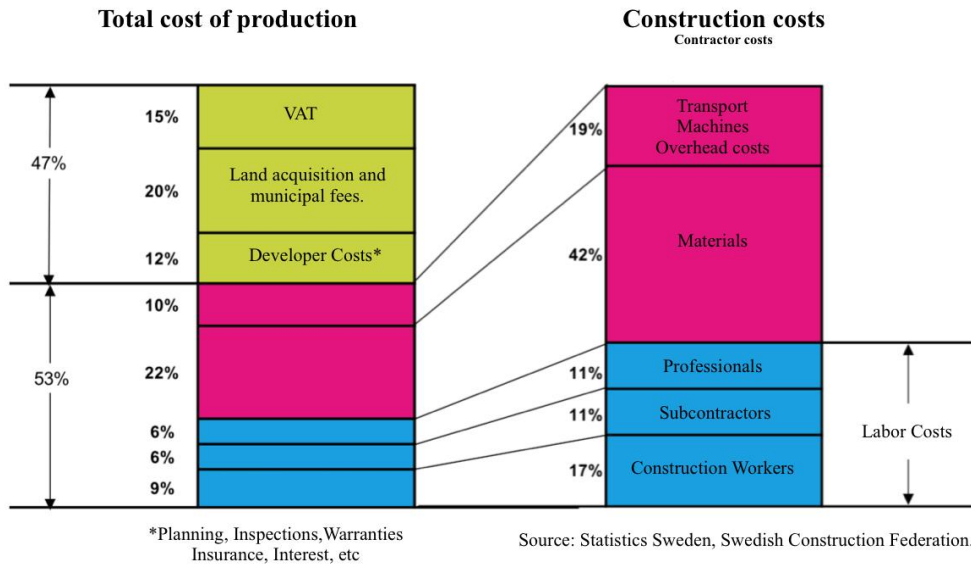


Figure 2-2 Costs in construction (2015)

Total cost of production refers to the aggregated sum of all elements in a project; land acquisition, planning, municipal fees, controls, inspections, guarantees, insurance, interest, construction costs and value added tax (VAT). The total cost of production in a real estate project can therefore be divided into; Construction costs (contractor cost), Developer costs, Cost of land and Taxes (BI,2015).

Cost of land and construction costs are substantial elements of the total cost of production, and both have increased in share over the past years. Construction costs refer to soil and excavation work, assembly of the building and preparation of the property. The construction cost also include instalment costs for electrical works, heating and cable television. Developer cost refers to planning, interest and the developers' administration (BI,2015).

2.2 Productivity

When investigating productivity, one common misconception according to scholars is the belief that construction workers use their time to the physical construction or assembly. Studies have shown that this is not necessarily the case. Instead workers spend most of their time on what is called wasteful behaviours i.e. movement between sites, waiting or attending unnecessary meetings etc. (Landin & Lind, 2011). Considering that construction workers are seen as the entities that actually add physical value to a construction site, scholars argue that companies should direct their attention towards production planning and how to optimize work flows. Overall the literature empathizes the importance to focus on process designs (Landin & Lind, 2011).

Within construction, the term productivity refers to the relationship between inputs and outputs (Borcherding & Liou, 1986). Even though inputs and outputs might differ among industries, and within the same industry, productivity is generally defined as the average number of direct labour hours required to install one unit of material (Rowlinson & Proctor, 1999).

Scholars have shown that a reduction in overall labour cost through improved productivity can lead to considerable cost savings (Sanders & Thomas, 1991). Although the industry is subject to inconsistent factors, both internal and external, achieving better productivity still requires detailed studies of the actual cost of labour. In this sense the industry does not only need to improve its cost awareness, but the management also have to get a better understanding the fundamentals of labour processes (Haas, Borcharding, Allmon, and Goodrum, 1999). Often individual craftsmen will have different factors influencing their productivity levels, however since the iron triangle of cost, quality and time tend to be the main concern of most management teams, attention to detail is often disregarded (Rowlinson & Proctor, 1999).

2.2.1 Lean Construction

In reviewing the literature, a common concept touched upon is that of lean construction (cf. Josephson & Saukkoriipi, 2005; Landin & Lind, 2011; Polesie, 2011). Widely accepted as increasing productivity, the principles of lean are derived from techniques used by Japanese manufacturers and are focused on the elimination of waste (Arantes, Ferreira, and Costa, 2015; Wee and Wu, 2009; Womack, Jones, and Roos, 1990). Lean has since been adapted to construction, arguing that traditional methods of management create unnecessary waste (Koskela, 1992). The core of the lean philosophy is the definition of customer value, using pull systems to ensure an even product flow through activities deemed value-adding (Womack, 2002). The focus on value and the elimination of non-value adding activities is therefore synonymous with the elimination of waste in production. Waste in lean can in general terms be thought of as either pure or forced (Bodek, 2006; Ohno 1988). That is, waste can either be purely unnecessary in which case it should be eliminated in its entirety, or necessary in that it is a required part in production but is not seen by the customer as adding value to the product. For instance, quality inspections carried out on real-estate might be mandated or necessary, but do not directly add value and are not noticed by the end customer.

Aiding in the facilitation of flow is the control and reduction of defects in the production cycle, is the concept known as *autonomation*. This is an extension of Total Quality Management, in which a functional management system promotes a view of quality and cost management throughout the organization: from design to production and beyond, with Japanese experience suggesting most workshop problems can be solved with simple quality control (Ho & Fung, 1994).

The foundation of lean is hence that of continuous improvement of processes (Berger, 1997). *Kaizen*, as it is referred to in the original Japanese, is thus not associated with any specific technique, but is rather embedded within all lean methods, as a way of thinking. The application of lean to construction has been slightly less straightforward than in manufacturing, with the nature of construction being that of a project-oriented activity rather than a comparatively constant process, meaning lean implementation have entailed the creation of project-oriented tools (Salem, Solomon, Genaidy, and Minkarah, 2006; Eriksson, 2010; Ballard, 2000).

2.2.2 A project-based industry

Project attributes entail a loose constellation of actors in an operation with a defined start and end, in a temporary location (Maylor, 2010). The average development project within construction is often carried out by a loose constellation of actors and according to literature, in most cases, an almost unique combination of contractors and sub-contractors come together in several stages to complete each project (Wild, 2002; Egan, 1998). Subsequently, construction projects have over time become more self-sustaining and are today said to have few links to top management or even other projects (Anheim, 2003). Within this context, many professional categories are involved and which is further claimed to be one the reasons as to why the industry is so uncertain, complex and inefficient (Latham, 1994; Murray, 2003; Jonsson, 2005). Construction projects specifically are further distinguished from manufacturing by using on-site production and assembly, with the finished product unable to be moved, and the components to be installed thus greatly affected by site conditions (Salem et al., 2006). These factors create a great deal of uncertainty in comparison to manufacturing, where a process can much easier be improved upon in a comparatively controlled environment.

2.2.3 ISO Quality Standards

Separate from lean, another widely used framework worth mentioning is the ISO 9000 series quality management system. This framework is a system of certifiable standards developed by the International Organisation for Standardisation, aiming to assist in the creation of quality management systems in order for companies to meet published quality standards, to which participants are audited to ensure conformity (Martínez-Costa, 2009; Prajogo, 2011). The system is widely adapted, with usage rates in some places reaching market saturation levels (Sampaio, Saraiva, and Rodrigues, 2009). Like lean production, the framework aims to increase quality through standardisation and continuous improvements (Tsim, Yeung, and Leung, 2002). Differing, however, in its implementation in being to a greater extent a formalised system of compliance assurance, whereas lean is a set of principles by which the capabilities of the workforce are utilized in combination with organizational techniques to increase output with fewer resources (Katayama & Bennett, 1996). The system is widely criticised in regards to dubious benefits, with perceptions of being a paper-driven, bureaucratic process in which most managers focus on maintaining the certificate (Poksinska, Dahlgard, and Antoni, 2002). Indeed, a reverse correlation might exist between quality improvements and certification, in that organisations with the capacity and motivation to improve seek out certification post factum (Dick, Heras, and Casadesús, 2008).

2.2.4 Construction managers

The abundance of actors in the construction industry has lead scholars to focus on single transactions and costs in specific activities. (Dubois & Gadde, 2000) In an industry, with such project oriented attributes and decentralized power structure, scholars have found that construction managers play a key role (SOU, 2002:115, Styhre & Josephson, 2006). Project managers within construction are hence recognized as dealing with a constant flow of information facing challenges such as; complex structures, rules, regulations, short time-spans, simultaneous processes and

varying technical solutions (Dubois & Gadde, 2000). The identification of site managers critical to coordination has also led literature to present several ideas for the improvement of productivity. However, the reports have had a tendency to suggest solutions from a top down perspective, often without consideration to implications from an on-site point of view. The perspective is also argued to be some of explanation to the lack of willingness for change and the adaption of solutions presented in so many reports (Polesie, 2011).

Hence, in line with this thesis it has been argued by literature that there needs to be further research on the implementation of management principles by on-site managers. As the literature describe them as key characters for project success, on-site management might as well be one of the indispensable factors to increased productivity within construction (Styhre, 2006).

2.3 Factors influencing construction productivity

Literature also shows that workers and management have strong opinions, regarding factors affecting their daily productivity. In general, researchers find a great variety of factors that drive and influence labour productivity. However, even if the spread of factors tends to be quite wide, there are still patterns of factors that are repeatedly mentioned in the literature (Rojas & Aramvareekul, 2003). In the next section the thesis will therefore look closer at the main factors and opportunities for labour productivity consistent through the literature, expanding upon what has been conceptualized by Rojas and Aramvareekul (2003).

2.3.1 Management and strategy

The first area concerns management systems and strategies. It incorporates management skills such as equipment management, material handling, scheduling and quality control. Management skills are often seen as one of the most important aspects in determining construction labour productivity. According to some researchers, the importance of competent management should come as no surprise since it is so often cited as one of the major factors for productivity (Rojas & Aramvareekul, 2003). Others scholars, such as Halligan, Demsetz, and Brown (1994) argue that most issues compared to management can be seen as subordinate. In this logic, a manager will essentially be able to add, reallocate, change working methods and modify schedules. This will in turn effect the workload, dilution of supervision and crowding of workers which are common issues lifted by members of the construction community.

Scheduling is another factor often put forth as important in determining labour productivity. According to Cooper, Sparks, and Fried (1997) the scheduling, especially of overtime, may generate a negative effect on the motivation and physical strength of workers. Another issue concerns materials and equipment management. Researchers such as Thomas, Sanvido, and Sanders (1989) have identified numerous areas with potential for improvement; inefficient distribution, running out of materials, multiple handling and materials improperly sorted or marked are just to mention a few adverse tendencies due to poor management.

The principles of lean are in terms of management applied to scheduling in using Last Planner, a method based on improving the predictability of planning, and reducing variability, so that the likelihood of completing the project on time is increased (Ballard, 2000). Indeed, experience in using the system has indicated improvements in the ability to deliver on time and on budget, in some cases leading to dramatic increases in profit (AlSehaimi, Fazenda, Tzortzopoulos, and Koskela, 2014; Ballard & Howell, 2003a). This entails utilizing a pull system in planning, to ensure prerequisites for any given activity are met before moving it forward in the schedule (Ballard, 2000). The system has an element of continuous improvement in that progress is tracked in terms of the percentage of tasks completed, after which reasons for recurring failures are identified and addressed.

In this category quality control also stands out as one of the issues most commonly raised in studies on productivity. The absence of quality control and assurance programs are often cited to influence productivity. Here, the adverse effects can be linked to the need for reworks which could have been prevented with proper planning (Rojas & Aramvareekul, 2003).

Underlying the ability to conceptualize and notice the efficiency of processes is the lean concept of transparency, or the ability of a production process or its parts to communicate with people, ensuring aspects of the process are visible (dos Santos, Powell, Sharp, and Formoso, 1998). One component of ensuring transparency is the 5S framework, promoting worker involvement and autonomy in improving production activities, and initiating a change in worker attitude (Jaca, Viles, Paipa-Galeano, Santos, and Mateo, 2014; Gapp, Fisher, and Kobayashi, 2008). Sometimes referred to as *housekeeping*, the framework helps workers efficiently organize their workplace to avoid wasted space and time in a way easy to observe, an orderly workplace facilitating process transparency thus helping further improvement by making sources of waste more visible.

2.3.2 Manpower

The second category consistent through literature concerns manpower. In this division researchers highlight aspects such as motivation, education, training, experience and seniority. In the literature scholars contemplate about the relative importance of knowledge and motivation. Although researchers seem to differ in their views, it can be argued that quality and diversity of work performed by an individual worker have more importance than the average number of years within a specific field of work (Rojas & Aramvareekul, 2003). The literature also finds that specific activity training can result in improved productivity. Due to the inherent uniqueness of each construction development, workers often face new situations which call for some degree of adaption to new techniques. Hence, specific activity training refers to education provided to workers before initiating a particular task. Overall, the literature emphasizes the importance of education in a broader context. It is argued that even though experience, activity training or even motivation can result in greater productivity, these cannot replace the need of a solid education (Rojas & Aramvareekul, 2003). Relating to the principles of lean, Berger (1997) stresses that in a process of continuous improvement, manpower is important as the process involves organizational

members of all levels, meaning a method for participation therefore needs to exist that includes the contributions of anyone regardless of skill or place in the hierarchy.

2.3.3 Industry Environment

The third division concerns the environment. Here, authors empathize factors like; adverse weather conditions, industry uniqueness, working conditions, activity interactions and subcontractor integration. On this subject the literature finds that working conditions and the uniqueness of the industry have a tendency to affect worker morale, and hence productivity. It is argued that conditions on a construction site are very different from, for instance, manufacturing. This might also be why adverse weather conditions is frequently cited for labour productivity losses in the literature (Christian & Hachey 1995; Thomas, Riley, and Sanvido, 1999).

Another issue concerning the environment refers to processes. Since the industry is often categorized by the fragmentation among various contractors, researchers often point at interactions between the contracting parties to provide answers to many of the shortfalls in construction productivity. One example of this problem illustrated by Howell, Laufer, and Ballard (1993) who show that a change in work methods might have very little effect on installation rates if the materials needed are insufficient from the start. Lean construction addresses this problem in advocating for joint problem-solving, harmonization between contractors and subcontractors, and thus the creation of cooperative relationships (Eriksson, 2010)

2.3.4 Effort and incentives

The fourth category concern motivation among employees. Here scholars stress the importance of a satisfactory work environment. According to (Bruzeliuss & Skärvad, 2004), a culture that encourage workers to actually make continuous efforts is pivotal for the improvement of productivity. Following this reasoning it is stated that individuals who are not engaged in the process of productivity will have few incentives to spend effort improving it (Mustapha & Naoum, 1998). Hence, it is concluded that goals intended to increase productivity, under adverse circumstances, instead may lead to a loss of motivation. The PDCA technique of work method experimentation, often synonymous with lean production, aims at empowering the workforce in creating a culture of critical thinking, and an inclusive environment where the expertise of the workforce is utilized (Berger, 1997).

A topic closely related this concern the question of piecework wages. The method, whereby workers are paid by individual performance, are by some said to be in line with the interests of the industry (Pekkarinen & Riddell, 2004). In so workers try to complete more work in less time, improving productivity. However, due to the project attributes of the industry, scholars have questioned the viability of the scheme. Instead of contributing to productivity it has been proven that individual workers instead have a tendency of working as fast as possible, disregarding quality and use of materials, which is the opposite of the intended purpose (Saukkoriipi, 2004).

2.3.5 External Conditions

The final major category put forth by literature concerns external conditions (Rojas & Aramvareekul, 2003). Conditions in this category refers to scope changes and the economy. Scope changes often take shape in form of change orders. The effect from these orders on labour efficiency and productivity have been contemplated by several authors. In a study by (Thomas & Napolitan, 1995) the authors studied the loss of efficiency from changes in construction planning. In three different case studies they found an average loss of 30 percent in efficiency when sudden changes were undertaken. This is of special importance from a lean flow perspective, in that changes introduce an element of variance and is thus detrimental to successful project delivery (Ballard & Howell, 2003b).

Across the literature the economy is also lifted as an important factor in the role as a driver of labour productivity. One example of how the economy can affect productivity is exemplified with the use of economic cycles. Argued by (Rojas & Aramvareekul, 2003) the strong economic expansion at the end of the 1990s, experienced in most countries, lead to shortfalls of skilled labour in many regions. Explained by the fact that contractors were forced to hire suboptimal workers, the authors try to provide an answer as to why it is not unusual to observe a drop in productivity among the labour force in the construction industry.

2.3.6 Summary

In structuring the relative importance of the accounts above, literature provides us with many answers. However, there seems to be a general agreement that issues concerning management and manpower are identified as two of the key areas with the greatest potential to affect productivity (Rojas & Aramvareekul, 2003).

Altogether, it is argued that increased productivity can be achieved if management show a greater caution to the various factors effecting labour productivity. Whether these factors concern the work method, equipment and materials, skills of education and training or motivational factors, it is claimed that all can have an influence on productivity (Josephson & Saukkoriipi, 2009) Common for all contractors is the need to develop an understanding of what adds value, and eliminate processes that do not. The ability to do this, according to (Josephson & Saukkoriipi, 2009), does not only create a more effective enterprise, but will also generate new opportunities to develop better business ideas and essentially a competitive edge.

3 Methodology

In this chapter methods used to construct the thesis will be described and defended. The authors will also describe the sample, the philosophy behind the interviews, as well as the processing of data.

3.1 Research Philosophy

The basis for any research is the assumptions on which it is built, its research philosophy. In this regard, the concepts forming the foundation of this study are based on the model of the research onion [Figure 3-1], as presented by Saunders, Lewis, and Thornhill (2009). This model highlights important aspects to consider in designing a study, although additional aspects have been added that are not visible in the model.

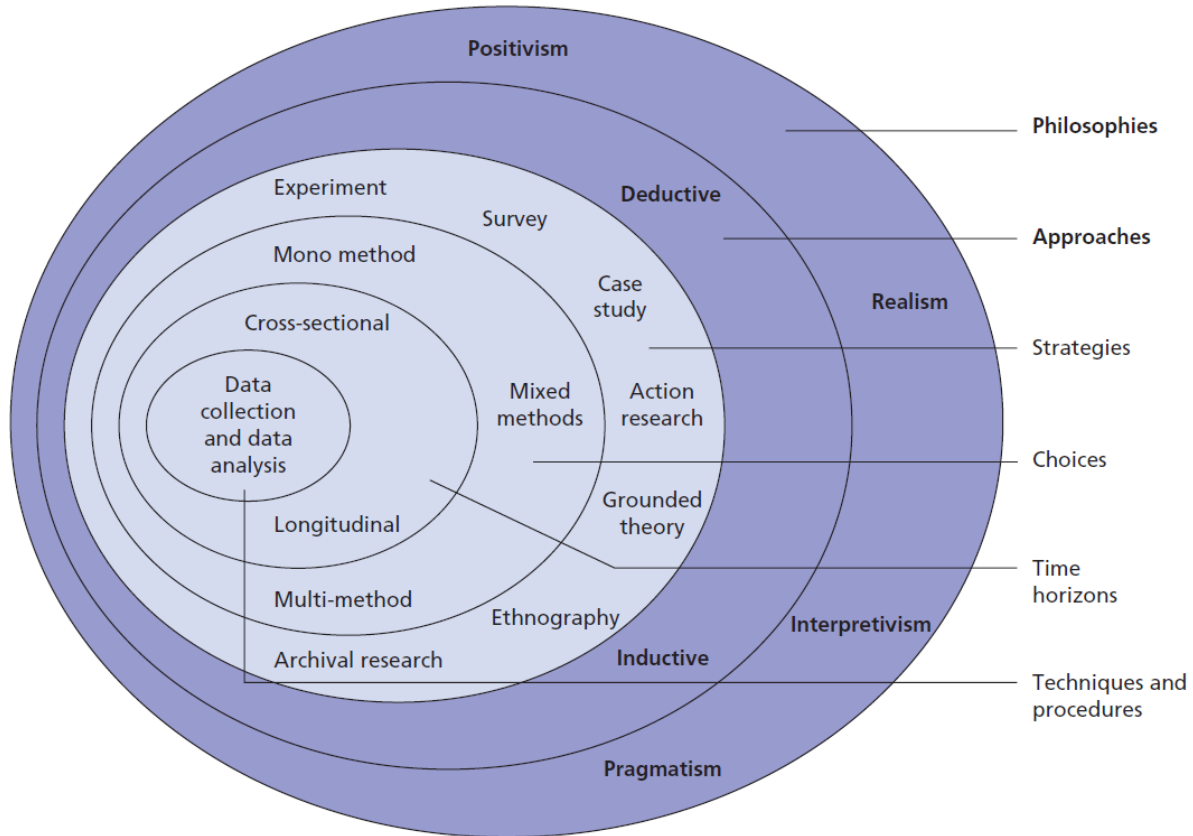


Figure 3-1 The Research Onion (Saunders et al., 2009, p. 108)

Due to the social nature of what is studied by this thesis, an *interpretivist* stance was taken. Interpretivism emphasizes the fact of humans as social actors, highlighting that the interpretations of individuals play significant role in the meanings given to social actors and roles (Saunders et al., 2009). It follows therefore that it is inappropriate for research of people to be approached in

the same way as research of inanimate objects. The complexity of organizations in general, and the construction industry in particular, thus means it is suitable to adopt an interpretivist position.

The concept of research philosophy can be further explored through the aspects of *ontology*, *epistemology*, and *axiology* (Saunders et al., 2009). Ontology is concerned with the nature of reality, with an interpretative position maintaining that social reality is socially constructed, subject to subjective interpretation, through social constructions of language and shared meanings. Subjective meanings and social phenomena are thus suitable as providers of knowledge, epistemology dealing with how knowledge of reality is acquired. Finally, axiology refers to the roles of values in research, interpretivism asserting that researchers cannot possibly be separated from what is researched, the values of whom unavoidably influences interpretation.

3.2 Research Approach and Purpose

In line with the purpose of this thesis it was deemed appropriate to not be limited to either induction or deduction. As opposed to deductive reasoning, where a result *B* is reached by deducing it from the precondition *A* through the application of a rule *R*; and inductive reasoning, where the rule *R* is learned by seeing numerous examples of *A* and *B*; *abductive* reasoning is inferring the precondition *A* from the result *B* and a rule *R* (Menzies, 1996). The application of the concept of abduction on this thesis is gaining a pre-understanding of the field through a review of previous research, and relating observations made to the knowledge acquired (Svennevig, 2001). Abduction is applicable since the purpose of this thesis is not to deduce a result of the current state of affairs, nor is it an attempt to create new theory from disparate sets of data, but rather to make a contribution by relating the current situation to theory.

The study conducted is of an *exploratory* kind as it is an inquiry into the precise nature of the problem (Saunders et al., 2009), something not immediately clear from previous research as the problem introduces the conditions of a specialized industry. An exploratory study implies a degree in flexibility and adaptability throughout the course of the research process.

3.3 Research Design

In order to gather in-depth data on the chosen topic a *multiple case study* strategy was deemed appropriate, with case studies being the empirical studies of phenomena within their context using multiple sources of evidence (Robson, 2002). Case studies are examples of a qualitative approach to research, in which the data consists of information in a non-numeric form that is created by interactive and interpretative processes (Saunders et al., 2009). The method is suitable for investigating the *how* and *why* aspects of phenomena (Yin, 1989), which is in line with the purpose of this thesis in that the aim is to examine *how* the industry relates to productivity improvement, and the rationale of *why* they act in a certain way. That is, the focus of the empirical part of the thesis is not finding *what* frameworks or which schools of thought are applicable in this sense as this has been made apparent through a review of existing literature; nor is it a study into *who* specifically is implementing certain forms of frameworks; or *where* certain types of actions take place. These lines of questions are better left to alternative forms of research designs, such as

experiments or surveys. Conducting multiple case studies is appropriate if an overview of the phenomena is to be gained, as it is not limited to a single organization.

3.4 Data Collection

3.4.1 Sampling method and access

For the data collection it was decided to follow a purposive sampling method. In doing so, suitable interviewees and cases were found in order to meet the objectives and to further answer the research questions (Saunders et al., 2009).

The initial sampling process started with interviews that Anders Melander, course examiner and part of the Smart Housing Småland project, had booked within the project. From these first interviews a better understanding of the industry was gained in addition to ideas of whom to contact and where to find potential candidates. Thus, interviews with senior management within the Green Firm was mainly used to get a better understanding of the entrepreneurial breakdown. Together with Anders Melander, the representatives from the companies were then able to provide five potential contractors for further contact. These were then investigated further through their corporate websites. In the end three of the contractors matched our criteria.

For the data collection the method of convenience sampling was used (Saunders et al., 2009). This method is conducted through a scanning of business magazines, local newspapers (physical or online), including other publications, in order to find additional candidates. To increase the chances, the search engine Google was also used to survey the regional market of contractors. This method eventually resulted in 10 companies which were investigated further. It was soon realized that access to the contractors would become harder than expected. In general, many companies seemed very busy and difficult to contact. During the process of conducting interviews the search for potential candidates was therefore concurrent with our interview sessions. Through a method of snowball sampling interviewees were asked if they could provide contacts of colleagues or acquaintances sharing a similar profile at the end of each interview. This method is often seen as very useful in situations where a population is hard to identify (Saunders et al., 2009).

From earlier experiences conducting research it was known that it would be wise to contemplate the method of approach. In a literature review on business research and through contacts with senior researchers it was found that a dual approach would be most suitable. In this sense the initial contacts were to be made through emails followed by phone calls. In the e-mail, information on the theme of the study, an explanation of the relevance was enclosed. I was believed an initial email would prepare potential candidates to form an opinion, minimizing the feeling of pressure and hence the risk of declining. However, even if an email in some cases could have been seen as enough, it was felt that a phone call would distinguish the request through the noise of busy e-mail accounts and in so increase our response rate.

3.4.2 The sample

Table 3-1 is a summary of the information regarding the samples used in the research. Since confidentiality was guaranteed to respondents, both interviewees and companies are presented with an alias. Firms are presented with regards to size and industry, while interviewees are presented according to their role within the specific company. In the table also include the type of interview, as well as length and date. Additional information concerning the companies and the candidates is presented in the beginning of the empirical findings section.

Firm	Size of the firm	Industry	Alias of the interviewee	Role in the firm	Type of Interview	Date and Length
The Green Firm	<i>Small</i>	<i>Wooden house /Components</i>	<i>Baldur</i>	<i>Managing Director</i>	<i>Face-to-face</i>	29-02-2016 <i>1h 45m</i>
The Black Firm	<i>Large</i>	<i>Construction /Developer</i>	<i>Freyr</i>	<i>Project Manager</i>	<i>Face-to-face</i>	21-03-2016 <i>0h 40m</i>
The Red Firm	<i>Large</i>	<i>Construction/ Developer</i>	<i>Vidar</i>	<i>Project Manager</i>	<i>Face-to-face</i>	23-03-2016 <i>0h 40m</i>
The Blue Firm	<i>Medium</i>	<i>Construction</i>	<i>Odin</i>	<i>Construction Manager</i>	<i>Face-to-face</i>	31-03-2016 <i>1h 19m</i>
The Yellow Firm	<i>Medium</i>	<i>Construction/ Logistics</i>	<i>Tyr</i>	<i>Site Manager</i>	<i>Face-to-face</i>	04-04-2016 <i>0h 47m</i>
The White Firm	<i>Medium</i>	<i>Wooden house /Developer</i>	<i>Heimdall</i>	<i>Construction Manager</i>	<i>Face-to-face</i>	22-04-2016 <i>1hr</i>

Table 3-1 Breakdown of interviews

Table 3-2 is a description of the definitions of company size as according to the European Union, as utilized in Table 3-1.

Company category	Employees	Turnover (or) Balance sheet total	
Large	>250	≥€250m	≥€43m
Medium	<250	≤€250m	≤€43m
Small	<50	≤€10m	≤€10m
Micro	<10	≤€2m	≤€2m

Table 3-2 Company size definitions (Source: European Commission)

3.4.3 Semi-structured face-to-face interviews

Due to the qualitative and exploratory nature of this study, a set of semi-structured interviews was conducted to gather data (Stake, 1995; Saunders et al., 2009). In accordance with the method, all interviews had a starting point from a list of prepared questions focusing on organization and productivity. Hence, when interviewing the candidates, questions were divided into four general topics: (1) Planning processes, participation and costs. (2) Organization of materials and activities (3) Defects and reworks (4) Continuous improvement and internal learning, as well as the general perceptions of costs and waste. The semi-structured interview is often used within business research and builds upon themes and pre-determined questions that a researcher wants to uncover (DiCicco-Blom & Crabtree, 2006). However, the main objective of the interviews conducted was to understand the thought process and the general knowledge in areas of the research, without it being explicitly mentioned. In this sense the ambition was to motivate the interviewee to talk freely, contemplate questions and expand upon ideas, without focusing directly on specific questions. Using this technique often led to new insights during interviews, a different angle or approach put forth by an interviewee consequently could give a more holistic understanding and thus lead to more improvised questions. Hence, the semi-structured method enabled an understanding of the multiple cases in more depth and according to their unique settings (Saunders et al, 2009). Due to the different experiences of respondents, the method of altering data collection is also encouraged in order to take advantage of the inherent uniqueness (Stake, 1995).

The logic behind using face-to-face interviews was the belief that these would be most suitable for this specific study. Not only would this technique provide more engaged and in-depth knowledge, but also a creative and open discussion which would make interviewees more willing to open up (Saunders et al., 2009). In using face-to-face interviews, it also became apparent that the right technique had been chosen since it was noticed how differently respondents could interpret questions.

3.4.4 Conducting interviews

In preparation for all interviews, comprehensive research was performed on the interviewees and the relating companies. Company reports were searched as well as previous employment and education. Doing this enabled the building of a solid foundation of information which would help in conducting the interviews more effectively. Since only between 30-40 minutes of interview time was requested, one of the major challenges was to manage the time and use it wisely. Hence, being able to show knowledge about the industry and a credibility would save time to expand on more detailed questions and in-depth information. With regards to preparation, Saunders et al. (2009) emphasizes planning in order to obtain confidence, demonstrate credibility and to prevent poor performance. Here, one of the arguments for proper research is to have a sound knowledge of the companies or individuals interviewed. Saunders et al., (2009) argue that this knowledge will help a researcher overcome the hurdle of the above mentioned reasons through a demonstration of credibility and confidence.

Saunders et al. (2009) also stress that researchers can promote credibility by providing interviewees with relevant information prior to an interview. It is argued that a possibility to retrieve additional information may benefit the validity or the research as a whole. In this study information was therefore sent by email to the interviewees prior to the interview was taking place. The content introduced the researcher's ideas and also gave an idea about the main topics that were to be covered during the interview session. Using this technique gave an opportunity for the candidates to reflect on the organizational structure. However, in this email it was decided not to include any specific questions on our topics. Since the objective was to understand the thought process and the general knowledge, it was believed that any explicit questions before the interviews therefore could risk to alter the impression of knowledge. When contacting the candidates, flexibility concerning time and place for interviews was retained. The reasoning behind this was not only a belief that it would be easier to obtain more interviews being flexible, but also that the importance of conducting interviews in locations where candidates could feel comfortable. Using this philosophy, it was hoped to avoid any potential negative impacts on responses, which is likely to occur if respondents do not feel at ease (Saunders et al., 2009).

All interviews started with an introduction of the researchers and of the study, followed by an explanation of the setup, which had also been described in the email sent out prior to the meeting. Following the brief introduction, candidates were asked to present themselves, their profession, education and their role within the firm. To stress the voluntary engagement of the candidate, permission was also asked before recording interviews, and a clarification of how the data collected would be processed was offered. Furthermore, it was explained that there was no obligation to answer sensitive questions. Saunders et al. (2009) highlight the importance of these first minutes of a conversation. This initial moment is seen as essential to the outcome of the interview and the interviewees' trust in the researchers. Hence, by having a thorough but relaxed explanation of all the above mentioned aspects, the aim was again to strengthen credibility and the level of confidence among candidates.

A lot of effort was brought into the design of the interview questions. From the literature review the aim was to construct short and easy-to-understand questions, but that at the same time questions that would stimulate contemplation rather than a short answer. Through a careful topic guide assembly, interviewee bias was hoped to be mitigated. In this sense situations where candidates would provide answers believed to be in our interest rather than truthful thoughts was tried to be avoided (Saunders et al., 2009).

All interviews were built upon the same structure. Taking turns, one author was responsible of taking notes and observing the candidate, while the other asked questions in a continuous conversation. Shortly after each interview answers given and the observations made were reflected upon. From these reflections it was not only possible to correlate the data collected with the frame of reference, but also to draw patterns among the previous interviews, slowly composing findings. The interviews were by and large conducted in Swedish, with only a few exceptions. Using Swedish was considered most natural since both researchers and candidates were native Swedes. The exception concerned an interview, mentioned above, arranged by Anders Melander where an additional researcher with German heritage had to use some English in his communication. In composing the empirical findings, quotes from Swedish were then translated into English in the way deemed most accurate to convey meaning.

3.5 Analysing the empirical data

The analytical process started with a transcription of all audio-recorded interviews and written notes. This resulted in approximately 70 pages of raw data, which then had to be organized and simplified. This process is often referred to as data reduction where irrelevant information is removed (Miles & Huberman, 1994). Following this procedure, data was organized in accordance with the interview topics and a procedure of coding was started. Coding is a method whereby gathered information is coded or labelled in order to find patterns or symmetries in the answers (Malhotra, Birks, and Wills, 2012; Saunders et al., 2009). For instance, in the interviews it was found that a question concerning on-site costs or waste could provide answers ranging from an engineers' perspective, a workers' experience or even in the view of a CEO etc. In order to handle this divergence, answers were colour coded with similarities and reoccurring tendencies. According to Malhotra et al. (2012), this process can help a researcher to structure, manage and retrieve data most essential before continuing with the process of analysis. The method resulted in sub-categories which were later merged according to the categories (1) Controlling cost and handling waste, (2) Retainment of expertise (3) Difference in perception between craftsmen and management, (4) Activity Planning, (5) Worksite Organization, (6) Quality Control, (7) The Improvement process.

Initial findings related to the sub categories were written down in the empirical findings section. These were then revised several times to remove recurrent information without any value to the thesis. The process of saving the best quotes and descriptions resulted in a shortening of the

empirical findings which were then analysed across cases and the theoretical framework. Finally, conclusions were drawn from the analysis and empirical findings.

3.6 Time horizon

When conducting research there are generally two ways of approaching the time perspective. In Saunders et al. (2009) these are defined as longitudinal and cross-sectional studies. Considering that this study was conducted over a four-month period, the application of a longitudinal study did not seem viable. Another pressing fact was that participants were most likely not able to devote the time needed for this kind of study, especially considering that there were troubles arranging initial interviews.

Consequently, a qualitative, exploratory, cross-sectional study was constructed. With this method participating candidates were interviewed in particular moments on organization and productivity within construction. According to (Saunders et al., 2009), a cross-sectional study is applicable when researchers want to study a particular phenomenon at a specific point in time or when there is a time constraint.

3.7 Research Ethics

As this study entails information that might be regarded as sensitive by interviewees, anonymity was offered to protect the identities of participants, ensuring interviewees would talk freely and honestly about the issues covered. A guarantee of confidentiality is argued by Jacobsen (2009) as necessary if information touches upon sensitive information. After noticing some hesitation in this regard by potential participants early on in the process of setting up interviews, it was decided that an offer of anonymity would be extended in all interviews. Consequently, while the authors of this study are able to identify and trace data to original sources, the report available to the public does not offer that possibility. Transcripts and recordings were thus only used to analytical purposes and are not available for public consumption.

3.8 Research trustworthiness

The concept of trustworthiness is applied in research to address and evaluate the quality of chosen methods and techniques, as suggested by Lincoln and Guba (1984) to define the solidity of research. The concept consists of four elements, addressing different aspects of the quality of research.

Credibility concerns the confidence in the truth of the findings, the focus of this concept being the establishment of a match between constructed realities of research participants and those realities represented by researchers (Lincoln & Guba, 1984; Sinkovics, Penz, and Ghauri 2008). Lincoln & Guba (1984) argue for the utilization of triangulation to establish credibility, using multiple sources of data to produce a deeper understanding of phenomena. Thus, credibility in this study was established in collecting data using interviews and analysis of corporate information.

Transferability refers to the applicability of findings to other contexts, adequate detail in describing a phenomenon ensuring that a reader can evaluate the degree of transferability to other situations

(Lincoln & Guba, 1984). To this end, descriptions of participating individuals and companies, and the background to which the study is conducted, were described to such an extent as to enable readers to determine the applicability to other contexts.

Dependability relates to the consistency and repeatability of findings, the research also being conducted in a trustworthy way so as to not involve obvious data errors (Lincoln & Guba, 1984; Jacobsen, 2009). The study should hence be able to be conducted again with the same results (Richards & Morse, 2007). The utilization of semi-structured interviews does not guarantee repeatability, in that values and experiences of researchers and interviewees, as well as environmental factors, influence the outcome and progression of interviews. The description of the background of participants is hoped to alleviate this concern, enabling repeat studies to be conducted under similar conditions.

Confirmability regards the degree of neutrality of findings, covering the extent of findings being formed by respondents rather than being biased by the interests and motivations of researchers (Lincoln & Guba, 1984). In this regard, questions asked were endeavoured not to steer interviewees to preconceived conclusions.

4 Empirical findings and analysis

In this chapter, interviews with the candidates are presented alongside an analysis, in conjunction with the theoretical framework. Divided into different topics, the logic of which is presented in the methodology section, empirical data is presented in a structured manner and concluded with a comparison of the empirical findings and the theoretical framework.

4.1 Company and interviewee presentations

4.1.1 The Red Firm

The Red Firm is a large business enterprise and an economic association in the form of a co-operation, whose main objective has been to promote construction, develop properties and to influence the construction politics. Today, the enterprise has a large portfolio of properties under its administration including: housing associations, office spaces, industrial complexes and public establishments. The candidate Vidar works in a local section of this association. With a degree in construction engineering he has a solid experience working as an on-site manager. Coming from a professional background employed by small enterprises and sub-contractors, he is today responsible for the supervision of a multitude of property developments, including wooden houses, and the subsequent sub-contractors.

4.1.2 The Blue Firm

The Blue Firm is a medium sized corporation operating in the administrative regions of Jönköping and Västra Götaland. The main business of this firm is to develop new properties and provide maintenance services. With a long history in areas outside of construction, the Blue firm is today an expanding company with a focus on wooden structures. The candidate Odin started his career as an asphalt paver and later earned a degree in engineering. With over ten years in heavy construction, such as concrete and rail, Odin recently switched to the Blue Firm working as a supervisor.

4.1.3 The Yellow Firm

The Yellow Firm is a medium sized enterprise within construction and transport services. Located in the Jönköping region, the company operates throughout southern Sweden. Overlooking the logistics operations, the business model is to provide heavy duty machinery to the construction industry and services of ground preparation. The candidate Tyr is one of the younger interviewees. With a brief academic background of two years, Tyr has a technical degree and have worked with the Yellow Firm for the past three years as project manager.

4.1.4 The Green Firm

The Green Firm is a small wooden house supplier and contractor located in Småland. The company have a long tradition in the production of wooden structures and single family housing. Although the firm offers customers different delivery options and turnkey solutions, the business model is predominantly focused on the production of pre-fabricated housing segments. Hence, a house from

the Green Firm is often produced in their factory and then assembled by a third party on the location for construction. The candidate Baldur is since January 2016 the managing director of the firm. With a background in several other industries, Baldur have held many positions such as marketing director, location manager and team leader.

4.1.5 The White Firm

The White Firm is considered a medium-sized enterprise but one of the largest wooden house producers in Sweden. The company has a long tradition in the production of wooden structures. The White Firm also provides a wide range of delivery options to their customers and has well-established sales and development agencies around the country. The manufacturer also has its own subsidiary providing construction and assembly services, however due to the relatively large production, many of the structures are assembled by third party contractors. Heimdall is one of the White Firm's construction managers. Located in Jönköping, Heimdall has a background working for a major construction company. This is where he received most of his formal training. However, Heimdall also has a 2-year technical degree in construction.

4.1.6 The Black Firm

The Black Firm is a large sized multinational construction and real estate corporation. The Black Firm has a wide array of operations stretching from pure real estate, commercial buildings to industrial complexes and infrastructure. Due to the size of operations the Black Firm has several regional offices, whereof one is located in Jönköping. In relation to the wooden house industry the Black Firm often uses producers of wooden structures as suppliers for many real estate developments. With this business model the Black Firm buys pre-fabricated structures from smaller entities and then uses its own manpower for assembly and development. The candidate Freyr works for the regional office in Jönköping and has a degree in construction engineering. Freyr has worked for the company for the past 5 years and is working as a project manager.

4.2 Controlling costs and handling waste

4.2.1 Results

Baldur

Baldur stated that there needs to be an effective production or that they would risk being driven out of the market. Regarding where most improvement can be achieved, Baldur argued that administration is where costs can be cut and that procedures can be more effective and swift. On the question of cost, he further explained that the construction process today often is more expensive than the house itself. (Personal communication, 2016-02-29)

Freyr

According to Freyr costs are handled and controlled through a calculation process whereby managers try to budget all aspects of the project i.e. how much material and labour that will be needed. However, on this account he also described that the budgeting often is done through scheme of aggregated posts and that this tend to result in a loss of control. He argued that managers often do not have the control they should and that a solution would be better systems where the planning of construction sites should be based on activities and not on aggregated material use. Regarding waste Freyr defined it as activities preformed or materials used that do not lead to any value for the end consumer. He believed that there is a substantial amount of wasteful behaviour and that the industry has a long way to go. Although Freyr did not know how much waste there is he concluded that estimates of materials is the main problem, either there is too much or too little. (Personal communication, 2016-03-21)

Heimdall

Heimdall stated that costs are controlled through various schedules but that the main point is to have the right things, in the right place, at the right time. He further deliberated on the subject and argued that costs can be thought of in terms of how much material or labour that is used, but that an equally important factor of cost is how these are utilized. Continuing his reasoning he said that in terms of pure waste, wrong measurements and sizes are often identified at first glance, but that displaced materials in the long run tends to get spoiled due to unnecessary movements.

Regarding the reflections on costs and waste, Heimdall concluded that the industry is in need of a systematic approach and that the industry often misses out on the details. In this sense he argued that while the cost of materials might have a fixed price on paper, many people disregard the fact that items often consist of many compounded costs which are not accounted for. Hence, someone has to order, measure and deliver materials. (Personal communication, 2016-04-22)

Vidar

Vidar of the red firm also explained that different types calculation schemes are utilized to estimate and retain costs. In his view, expenditures can be saved in the process of recruiting sub-contractors. Regarding costs Vidar hence stressed the importance of procurement and that a lot of costs in a construction project can be retained trough a thorough recruitment process of crafts workers.

Deliberating further on the subject, he contemplated the importance of systematic approach, or method, in the establishment of a construction site. Relating to the question of waste Vidar stated that a lot of waste can be avoided if managers can get a proper control over logistics and material handling. Consequently, he the importance to receive the material in time, in the right amount and the correct format.

However, while Vidar called for a systematic approach, he also admitted that the project attributes of the construction industry is a major obstacle for its implementation. (Personal communication, 2016-03-23)

Odin

Odin stated that the firm uses an internal business system to estimate costs during construction projects. He described the system as a shopping list whereby components are calculated. However, regarding the accuracy of the system, it was explained that he still has to rely on intuition, sometimes adding ten percent or more on individual orders. Regarding costs, Odin also explained that it is difficult to make precise estimates when much of the costs relate to tendering.

Regarding waste Odin emphasized the wasteful behaviour among workers. Contemplating a wide range of issues, he argued that craft workers often take more materials than they need and that materials often tend to be spoiled due to the lack of tidiness. He also stated that waste always will be an issue of some sort but that the cost awareness among workers is poor and problematic. (Personal communication, 2016-03-31)

Tyr

Tyr explained that he always has documents with cost estimates on the construction site and that these provide him with information regarding the disposition. In a contemplation of how to minimize waste he stated that it could be done through several ways but stressed the importance of material- and time management. Tyr also stated that one of the major problems on many construction sites is to have the right paperwork. In this sense he argued that he frequently has to solve issues that could have been solved in the projection and planning of a project. (Personal communication, 2016-04-04)

4.2.2 Analysis

Regarding perceptions of cost the interviews confirmed much of the findings found in the literature review. Coinciding with the literature, many contractors did not only affirm the problems associated with increasing building costs, but they also showed an agreement to potential improvements. In this sense many views were in line with the estimated improvements put forth by Josephson & Saukkoriipi (2005).

In terms of how calculation tools were utilized it became evident that there was a broad usage of different calculation programs and schemes disregarding the size of the individual enterprise. However, it was noted that the tools often were used to make rough estimates and that they were

highly individualized. At the same time many of the interviewees complained about how difficult it seemed to be optimizing material volumes and logistics.

” ...In my opinion the industry does not have the oversight and control that you would expect [...] Volumes are often messy [...] often you will find that there is too much or too little” (Vidar, personal communication, 2016-03-23)

As with the optimization, the question of negligence also took a similar expression. Here, all contractors were well aware about the problem of damaged materials. The problem had been identified, but a remedy or solution was seldom expressed.

“...I mean that the industry is trying to find systems, but then we have the problem of real estate construction, every building is unique” (Vidar, Personal communication, 2016-03-23)

When analysing the results some interesting patterns emerged. In this sense the literature has shown that both scholars and the industry itself, for decades, have not only debated the problem, but also provided practical tools (Murray & Langford, 2003). This study consequently found that the logics of the frameworks could be traced to many of the tools to which the contractors referred, cohering to lean and ISO (Koskela, 1992; Prajogo, 2011). The contractors did in other words seem to have a wide array of tools at their disposal in order to tackle the problems.

However, due to the fact that tools were either not precise enough or to the problems of implementation, cherry picking among the respondents seemed to be abundant. In this regard many of the contractors seemed to rely on intuition and personal experience instead to industry recommendations, and no evident consensus among the contractors of how to handle the issues was found.

In this regard, comparing much of the theoretical framework with reality became counterintuitive. Many respondents thus asked for more chance and more systematic ways of working, in so going against the ideas of Latham (1994) of an industry resistant to change. At the same time the managers often seemed to have much of the material needed to enable a change.

In concluding remarks, the study hence found that there might be some truth to the problems of a project based industry, but while asking for a change, much of the material put forth seemed poorly implemented and one could ask if it even was read.

4.3 Retainment of expertise

4.3.1 Results

Freyr

Concerning the retainment of expertise, Freyr stated that the question probably could be answered in several ways. Referring to himself he explained that his employer offered tailored career paths and mentorships. He also described that paths to a large extent depend on personal preferences and how far one wants to reach. While Freyr described how his employer tries to retain expertise through promises of personal careers and development, he also clarified that this offer probably only applies to employees which are not crafts men.

Regarding the construction workers, the story was quite different. Freyr explained that the Black Firm relies on short term contracts and staffing agencies to optimize operations. Hence the Black Firm follow business cycles where they hire workers at will. He even described how his employer have created a subsidiary through a foreign staffing agency to handle the highs and lows in the market for construction.

According to Freyr this practice is problematic. He argued that a lot of goodwill enjoyed by the company are due to the workers and that much of the expertise which can be seen as a competitive advantage actually follow the individual worker. (Personal communication, 2016-03-21)

Heimdall

Responding to the question, Heimdall described how he actually discussed the issue with a colleague the day before. His colleague worked for a contractor following a philosophy of keeping construction workers and the stream of projects constant.

Heimdall stated that he could see many positive attributes of working in this way. Pointing towards quality aspects, he argued that a retainment of construction workers would enable work to become more effective. However, at the same time he admitted the practice is very rare and that most contractors are subject to business cycles. Heimdall also highlighted the risk of construction companies taking on too many projects during building booms, in so he argued that they risk losing control of their sub-contractors and hence quality. (Personal communication, 2016-04-22)

Vidar

Vidar stated that contractors probably do what they can to keep construction workers. He explained that there have been several cases where companies have taken on projects that do not result in any profit, but stated that this probably would not be viable in the long run. Continuing, it was described how labour costs are such a large part of the expenses and how most companies probably will have to discharge workers even though they know vital competence will be lost.

Vidar also stated that the problem is an industry where everybody acts the same and suggested that the issue is political. He argued that the industry today only plays by the rules but that politicians have to act in order to create incentives where long-term thinking is credited. (Personal communication, 2016-03-23)

Odin

Odin instantly remarked that there is a difference in the public treatment between large contractors and smaller entities. He argued that the major companies often can hire and fire at will, while the small companies get into trouble when they act the same way. Odin also pointed toward the divergence in understanding between different departments in a company. In this sense he argued that top management tend to have a focus on numbers and not on people. He stated that business people focus economics and adjust manpower thereafter. (Personal communication, 2016-03-31)

Tyr

Tyr explained that the construction industry is very fluctuating and that workers are hired and fired on a continuous basis. He also added that white collar workers do not have to worry about job security in the construction industry. Tyr continued and described a trend in which staffing agencies are becoming more dominant and short term contracts the norm.

On a personal account, Tyr said that he would organize things differently. Continuing, he explained that he would try to create continuity, establishing long term relationships with customers, but that it is difficult due to labour costs. Tyr explains that he, like everyone else, is very exposed to business cycles and that he today almost exclusively utilizes short term contracts.

Regarding the retainment of expertise and the development of the industry, Tyr stated that he would rather hire more permanent workers than having to rely on staffing agencies. He believes that this would provide many benefits to the industry. As a manager he would then be able to develop personal relationships, get to know his workers, and in so doing, optimize the productivity. Today, he contemplated, that you do not know who you will work with and that it can take weeks before you are properly aquatinted with one another. (Personal communication, 2016-04-04)

4.3.2 Analysis

Regarding retainment of expertise, the study found that the economic environment seems to have a great impact how well knowledge can be preserved by contractors. This is something that goes in line with the ideas of Rojas & Aramvarekul (2003). It is not that knowledge per se is affected by the environment, but rather that knowledge inherently follows the individual. Coinciding with the findings of Josephson and Saukkoriipi (2005) regarding labour cost, it was found that many of the interviewees found a difficulty in balancing large wage costs and keeping order books full. Especially for smaller entities this fact was seen as a struggle. Hence, in line with literature (Wild, 2002; Egan, 1998), a picture of a construction business relying more and more on temporary hiring became apparent as entities create subsidiaries as a means to handle the economic changes.

"I mean the cost of wages is a very large part of the cost structure in a business [...] you do what you can, you do not really want to fire people and you know it is hard to get them back". (Vidar, personal communication, 2016-03-23)

In this view, many of the contractors contemplated about the potential loss of knowledge and the difficulty working with many of the change and progress strategies seen as the essence for

productivity improvement in the frame of references (Womack et al., 1990). At the same time many of the interviewees were painstakingly aware that a lot of the core competence of their businesses are in the hands and minds of their employees.

“It is problematic. In my opinion a lot of our goodwill is due to our staff taking responsibility. Without them we are exposed, I really think it is our competitive advantage since so much of what we do depends on what is in our heads. (Freyr, personal communication, 2016-03-21)”

However, even though the findings suggested an increased use of short term contracts, the study found that some of the respondents utilized a different approach with a philosophy to keep employment within the company for as long as possible. Although these contractors admitted that the approach could be a struggle, there was still an economic reasoning behind the idea whereby competent workers was seen as a competitive edge.

“I would rather have hired than rented people [...] If you get someone from a labour broker you have no clue what he has done before and you do not know his personality and so forth. And then it takes like a week before you have gotten accustomed to each other, by then you have lost a lot of time.” (Tyr, personal communication, 2016-04-04)”

When analysing the result, the study found that the industry seems to be torn between two rationales. From one perspective the managers, backed by a multitude of scholars described earlier, understands the importance of retaining expertise and how it can improve their productivity. At the same time, all of the respondents described an industry acting in the opposite direction, also implying an acceptance of circumstances. However, the results gave insight to that the lacking implementation of frameworks might actually be due to external factors. In this sense the interviewees gave an impression that most contractors today only follow the rules, that it is hard to go against the environment, and that a greater chance is needed, suggested explicitly by Vidar as political.

4.4 Difference in perception between craftsmen and management

4.4.1 Results

Heimdall

When asked about the perception on productivity between craftsmen and management Heimdall stated that there should not be any variation the understanding, arguing that projects have to be well planned from start, minimizing the risks of misunderstandings. However, he was quick to empathize that he said *should*, and that reality often is very different. Through an example he then conceptualized how management and craftsmen often work with different rationalities.

In an example Heimdall then explained how a manager can conduct calculations for the usage of drywall. From a top down perspective the rationality is that a manager has to account for budget concerns and that these calculations will enable precise estimates. However, from a down up perspective, and in the view of the craft worker, the same pieces of drywall just have to be mounted - quickly. With this reasoning Heimdall then explained that how a craft worker can disregard material use, use half of a sheet of drywall and then dispose the rest, creating a shortage.

When asked about where this division occurs, Heimdall stated that the dividing line tends to be drawn with the construction site manager, adding that the gap between workers and management probably is too great in many aspects. (Personal communication, 2016-04-22)

Vidar

Vidar also believed that craft workers should be a part of the planning process and communicate their thoughts. He argued that the industry can do better and stated that workers often have considerable amounts of practical knowledge which managers with an academic background do not possess. At the same time, he found that workers have a tendency to only recognize practical aspects of a project and that there needs to be a balance since the management have to focus, not only on practical issues, but on costs, time constraints and legal frameworks.

Contemplating how logics and perceptions could be bridged, Vidar stated that instructions in paper format rarely result in the intended effect. Through an example Vidar further described how a problem can be identified and instructions written, but that workers nevertheless put the instructions a side and do as they always have done. In this sense Vidar argued that most workers do not take the time to read instructions but that forums and discussions probably is the way forward. (Personal communication, 2016-03-23)

Odin

Odin stated that communication and perceptions often tend to converge in his role as a construction manager. He also described that there is a constant pressure from the workers beneath and management above. Workers often focus on materials, machines and details, while the top management is concerned about time frames and quality. In Odin's view meetings are for the sake of dialog, but foremost to keep workers happy. Regarding the actual decision making, Odin explained that it is a matter between him and higher management.

He also stated that the integration between different professions in a construction project can depend on how contracts are formulated. On this account however, Odin will often only receive a production plan with a set time frame and a description of the project, leaving him fascinated by the technical specifications and how timeframes are set by higher management. (Personal communication, 2016-03-31)

Tyr

Tyr described the construction industry as highly divided. According to him top management usually has a very theoretical approach where projects often are viewed in terms of blueprints. Continuing on this thought, Tyr stated that, construction managers are the ones that have to deal with all the problems. He further described how details and ideas often fail to reach top management.

While Tyr understood that it is unfeasible to keep track on all details in a construction company, he still argued for higher management to have sufficient insight in order to make proper decisions. In this sense Tyr stated that he all to often find himself in situations with problems correlating to management decisions.

Contemplating why this is, Tyr meant that many managers often take on high positions too early, and that while they might have an education and a theoretical knowledge, they usually do not have any practical knowledge of how the industry actually works. (Personal communication, 2016-04-04)

4.4.2 Analysis

Regarding the divergence in understanding, the study found that there often is a disparity regarding how construction is perceived and also that information and communication often tend to accumulate in two distinct camps.

” ...usually people up top tend to be very theoretical. They often have blueprints in front of them, they point out where houses should be built and conclude that it is just to construct. [...] We who work as construction managers are the ones that have to deal with all the problems. We see everything in details.” (Tyr, personal communication, 2016-04-04)

Hence, contractors explained that professionals and workers often tend to look upon issues with different sets of eyes. While employees with an academic background do not necessarily always have a practical knowledge, workers might better understand where the day to day improvements can be made, but in turn not the larger picture. According to the respondents the communication often stays on the construction site or in the office of professionals whereby the construction manager often takes a role of an intermediary.

“As a white collar employee or construction manager you do not always have a practical knowledge, hence you have to make use of the competence within the firm. But craft workers often

only tend to see the practical aspects, while I have to account for budgets, guidelines and regulation” (Vidar, Personal communication, 2016-03-23)

On this account the study found that the divergence goes against the principles of lean and the ideas promoted by Berger (1997), stressing the importance of participation and involvement of all members in an organization regardless of skill or place. At the same time, it was found that the interviewees were well aware how the differences might affect productivity as proposed by Polesie (2011), but that the ideas about causes were widespread.

In an assessment of the causes, the study found perceptions to have a close correlation with the economic environment, also brought up in the segment on *retainment of expertise*. In this sense the difference in understanding can be argued to reflect the employment stability. Hence, the reasoning is that white collar workers tend to have a more stable employment situation compared to their blue collar colleges (craft workers). In this sense, the reasoning is that white collar professionals will naturally have more incentives to focus on improvement issues while blue collar workers often have a short term focus, transitioning from project to project. This reasoning is also something that coincides with the study of Bruzelius and Skärvad (2004), highlighting company cultures.

Hence, as illustrated by Heimdall: A professional can work with tools and schemes for the exact planning of materials, they can estimate expenses and assembly times. However, just as professionals work with their logic, a worker will make sure to rationalize this workload, which is not always in line with management planning.

4.5 Activity planning

4.5.1 Results

Freyr

Freyr described the planning process and the integration of actors as dependent on the situation, but said that the traditional way is having a site manager using calculated amounts and times on which to base activities that can then be put into order. He also stated that, although the planning might depend on the individual, site managers always have a planning process before projects. Freyr also explained that the operative stage involves a visual planning phase with the relevant actors and that this included the usage of post-its to facilitating collective planning. This was also said to be based on Last Planner, however lacking the feedback component, which Freyr himself uses and is in the process of trying to implement. (Personal communication, 2016-03-21)

Vidar

Vidar explained that better contracting, along with a selection of appropriate methods, is a key to increasing efficiency on a construction site. He stated that the integration between actors consist of time coordination and planning meetings. Vidar further described that work teams and subcontractors often are contracted after a successful tendering procedure, after which production schedules are collectively created. Continuing, he also stated that activities are optimized after each initial project calculus and offer, where activities are scrutinized for more efficient methods, keeping the agreed intended result in mind.

Elaborating on the process, it was also described how production schedules enable managers to see flows throughout a project and that weekly meetings can be arranged for coordination. In addition, Vidar described the work-set as a widely used tool, in which actors discuss activities and surrounding factors such as budget, scope, intended result, working conditions, logistics etc.

He further stated that the size of an organisation can affect the scope of planning. In this sense it was argued that larger contractors tend to have more resources and hence dedicated staff for planning, whereas smaller actors often have staff with generalist roles. (Personal communication, 2016-03-23)

Odin

According to Odin the planning process consists of a general list of construction durations for any given activity. He explained that the structure had been used since the turn of the millennia, although with much being added to it in terms of moisture and air proof construction, safety regulations, piecework wage etc. He also described how more tasks had to be done in the same amount of time, which had made craftsmen unhappy as they are expected to do more without getting extra pay.

He continued explaining that the planning process is contextual, but in the case of piecework craftsmen, a team leader will decide together with craftsmen who does which task, although the plan itself is based upon the aforementioned list of construction durations.

Odin also emphasised that coordination between contractors is important in reducing waste and that this is something that is facilitated during subcontractor meetings. (Personal communication, 2016-03-31)

Tyr

Tyr described that weekly meetings are conducted with the main contractor in which events such as incoming materials and deliveries are discussed. He explained that the planning tools used can vary and that they often rely on the main contractor's tools in any given project. Tyr also highlighted that there often can be situations where an excess of materials is being delivered, and that the problem often is due to the lack of responsibility by project managers. (Personal communication, 2016-04-04)

Heimdall

Heimdall described the planning process as mainly based on delivery schedules, after which activities and further deliveries are planned. However, due to the small scale of projects, Heimdall expressed that he did not see detailed tools as necessary, that is, beyond having a master plan subdivided into a weekly schedule. According to Heimdall it was seen as fairly obvious how deliveries could be planned, and related activities executed, with the plan being developed together with the general contractor.

He explained that the activities and detailed planning are scheduled by the general contractor, with the master delivery schedule as a basis and the general contractor selecting subcontractors. In this sense, Heimdall therefore saw little reason for craftsmen and subcontractors having to influence, rather being responsible for the correct interpretation of blueprints. (Personal communication, 2016-04-22)

4.5.2 Analysis

The complexity and project-based nature of the construction industry is illustrated in its approach to activity planning. The methods used was described by interviewees as highly dependent on the company, and indeed individual project managers. This apparent fragmentation of methods supports the view of project managers as playing a key role as according to Styhre and Josephson (2006), the experience of project leaders also having been raised as an issue in effective planning. Common amongst interviewees was the description of the utilization of pre-calculated material volumes and unit times as a basis for activity planning. The correct application of these was, as mentioned in a previous segment, described as problematic.

“The designers just write in the tender that construction time is ten months, and that is made up by someone without a clue as well. They probably looked in some table – the building is this big, it will take this many hours.” (Odin, Personal communication, 2016-03-31)

One important aspect of planning mentioned, was the degree of coordination between contractors. To this end, the industry tends to use work set and subcontractor meetings, with various degrees of cross-organizational integration in the planning process. Described as important in the reduction

of waste, this is in line with lean literature, stressing the role of cooperative relations in increasing productivity (Eriksson, 2010). Another factor in affecting the level of detail of activity planning was described to be the size of the projects, along with the resources available to the company. Major contractors thus seem to be at a relative forefront of adopting methods, and can serve as a point of dissemination to other actors.

One example was the application of some aspects of Last Planner in the Black Firm as mentioned by Freyr. However, he also made the observation that the implementation of the method was incomplete, in that the central aspect of continuous improvement as described in literature (Ballard, 2000) was missing. This exemplifies the practise of cherry-picking as described earlier, in which actors seem to selectively decide on which elements of methods and frameworks to apply, without regard to a deeper understanding or a holistic perspective. Rather, the proper application of methods is left to individual project managers.

“I have tried to get it implemented, I used to work with it before” (Freyr, Personal communication, 2016-03-21)

4.6 Worksite Organization

4.6.1 Results

Freyr

Regarding the organisation of materials and activities, Freyr stated that there had been a partial implementation of 5S, with visualisation of where tasks are to be carried out or not. He also explained that this practice had been seen as something completely new at his firm and that there was little awareness of the actual concept further than its practical measures. Nevertheless, Freyr also explained that where it had been implemented, subcontractors had seen it in a positive light. (Personal communication, 2016-03-21)

Vidar

In Vidars experience, a common way of organizing the worksite was through the worksite layout plan. With this plan it was explained that flows of materials and logistics are described and that the document is changed successively as the project goes on. Hence, Vidar further explained that the layout plan was to create a common understanding of how a construction site should be organised. However, he also stated that this practice probably does not refer to smaller contractors and that smaller projects such as single-family housing construction, utilise a planning that is more ad hoc, being verbal rather than documented. (Personal communication, 2016-03-23)

Odin

According to Odin, site organisation of the Blue Firm was also conducted using a worksite layout plan, where the location of materials and equipment are detailed. However, Odin stated that the result from planning was quite mediocre. One of the issues were said to be the size of the worksite affecting to what extent materials and disposals could be organised.

Odin also explained that deliveries are checked beforehand to avoid having to store excess materials, with storage preferably being inside to avoid damage. In conclusion, cleaning was raised by Odin as the biggest issue in that there is widespread sloppiness amongst craftsmen and that this is a major problem for the site organisation. (Personal communication, 2016-03-31)

Tyr

Tyr described the organization of the worksite as being based on a blueprint detailing locations of disposal management, materials and parking etc. He also explained that smaller projects tend to disregard this planning and that the organisation is instead conducted on an ad hoc basis. According to Tyr, cleaning and tidiness was seen as major problem. In this sense it was explained that there is a silent rule of everyone cleaning up after themselves but that is rarely being followed. Continuing on this thought, Tyr pointed towards piece wages as a reason to the behaviour. He stated that the wage structure lead to craftsmen trying to accomplish as much work as possible avoiding any labour which they are not paid for. (Personal communication, 2016-04-04)

Heimdall

For Heimdall, the organization was based on experience rather than the usage of worksite layout plans. In this sense some aspects of the organization were planned on a daily basis, such as the

placement of debris. On the other hand, the placement of materials is organised in cooperation with the delivery driver, making sure that material is placed in such a way that users know where to find it. Heimdall stated that the organisation of materials and activities is a key aspect and that bad planning often can cause problems further down the line with regards to accessibility and the working environment. He also added that new subcontractors will often require assistance in this process as they do not yet have the experience to do it themselves. (Personal communication, 2016-04-22)

4.6.2 Analysis

The issue of an orderly workplace is treated in literature in relation to the efficient use of time and materials, being as time spent looking for tools or having to reorder lost materials represents time and effort not spent on value-adding activities (Landin & Lind, 2011; Norman, 2006). This seems to have resonated with interviewees, with two main aspects being raised: layout planning and cleaning.

The study found that worksite layout planning was widespread, common tools being used in its facilitation. The efficacy of this method is seen as highly contextual, however, further emphasizing the project-based nature of construction (cf. Maylor, 2010). In this regard it was noted that the tendency to create formal plans decreased along with the size of the project.

A lack of cleaning was brought up as a major issue, clearly identified as a source of waste on construction sites, the result being a disorderly worksite where materials are poorly managed. Another issue as raised from a lean perspective is the impact on transparency, disorderliness and poor visibility of processes making sources of waste less apparent. The observation of dos Santos et al. (1998) then still seems to hold true in that the principle of transparency is scarcely applied in construction. The adoption of methods addressing this issue seems, however, to have been initiated by major contractors, by which they are introduced to affiliated subcontractors. A key concern in the cleaning efforts was the perceived sloppiness of craftsmen, being individually responsible for cleaning up after themselves.

“One example is that when the snow melted here, it looked like a complete disaster, with things everywhere, debris and the like. You know, people are generally pretty sloppy with cleaning, I would say.” (Odin, Personal communication, 2016-03-31)

A factor in the perceived disinterest in keeping the worksite clean and organized was said to be the impact of piecework wages. In line with Saukkoriipi (2004), piecework wages are seen to bring about several non-value added costs. There thus seems to be a pattern of efforts on this issue being a product of personal responsibility given to individual craftsmen, and their subsequent incentives to meet expectations.

4.7 Quality control

4.7.1 Results

Freyr

On the subject of defects and reworks, Freyr contemplated that there is little in terms of detailed descriptions of the work processes to follow, but rather a description of expected results. In this sense, it was explained that there are really no instructions or guidelines to follow and that much of the preventative measures therefore have to be in the hands of the individual.

Freyr hence concluded that craftsmen are important for properly executing a task and that engineers who do not have practical experience often have to rely on the knowledge of the craftsmen and the accuracy of instructions, something that may not be applicable in any given situation. (Personal communication, 2016-03-21)

Vidar

Vidar described that the company tries to prevent defects through a set of controls that are to be brought up during work set meetings. The controls are also usually done at critical stages of the construction process. Continuing on, Vidar described how the responsibility for controlling defects and reworks mainly falls on management and that managers have to be present correcting issues as they go. In conclusion Vidar stated that the application of self-checks intended for workers often tend to become a product of paperwork and that he hopes for an improvement in how they are understood and applied. (Personal communication, 2016-03-23)

Odin

Odin explained that anything not suitable for visual inspection is to be subject to self-checks performed by workers, but that this often is poorly managed and thus requires the attention of a supervisor. He contemplated that efforts to improve construction always will depend on individuals and that lot of workers involved in construction today are lazy. Odin then continued on a rant where he stated that there probably were some kind of formal text on how to deal with matters of defects and reworks, such as ISO, but that he did not actually know what it said. When questioned further, Odin showed a binder and explained how it contained material about quality, but that it was just one of many such binders of formalized text and routines. Hence, instead of actually using the material, Odin found it more effective to communicate closely with his staff through work set meetings.

He also viewed piece wages as problematic since they, according to him, cause craftsmen to work too fast. Odin stressed that this does not necessarily have to lead to a lack in overall quality, as construction workers take pride in their work, but that it could be an issue in conducting formal checks and routines. (Personal communication, 2016-03-31)

Tyr

Although being certified according to the ISO-9000 series, Tyr noted that the application differs depending on the project. With smaller projects, it was explained that there tend to be an unwillingness to create the paperwork required, partly because it is seen as too costly. Conversely, it was stated that projects of greater importance tend to focus on critical activities through the creation of a plan of control. (Personal communication, 2016-04-04)

Heimdall

Heimdall stated that controls for damage and compliance is done on a few occasions, the first being during the frame assembly of a house. This is then followed by two inspections at the end of the project, in the form of a control inspection followed by a final inspection, between which there is time to correct any issues found. Continuing his thought, Heimdall saw the matter of controls as a sense of necessitated responsibility as any mistakes made will lead to having to correct issues later on. In Heimdall's opinion, the size of a firm could also be a factor negatively impacting the responsibility taken by any given labourer in that anonymity leads to indifference. He also raised the question of whether the piece wage system undermines the level of quality as the pace of work increases. Although the company was ISO certified, Heimdall had not noticed this in any aspects regarding defects and reworks, adding that frameworks like that often tends to become a product of paper. (Personal communication, 2016-04-22)

4.7.2 Analysis

Quality control is raised in literature as a central issue, the implementation of quality control initiatives influencing productivity (cf. Rojas & Aramvareekul, 2003; Ho & Fung, 1994). It was found that the fragmentation of the industry and its project-based nature here plays a part in how controls are applied, an apparent trend being that control in smaller projects is to a larger extent localized to critical stages. The lack of clear and accessible instructions for any given activity has led to a reliance on the experience of craftsmen. Indeed, Rojas and Aramvareekul (2003) does suggest experience to be a major driver of productivity, and given great variance and unpredictability in tasks, this is likely to continue being the case.

Formal control is consistently described to be the responsibility of management, underlining the importance of the role of construction management in projects as found by literature (Styhre & Josephson, 2006). One contributing factor to the degree of necessitated participation of management and supervisors on this issue, is highlighted by Odin:

“Everything you cannot inspect visually, you will have to write self-checks on. It is handled quite poorly here, so I have assigned the task to my subordinate, since I cannot be bothered with it myself.” (Odin, Personal communication, 2016-03-31)

As with the case of keeping an orderly worksite, there was an issue of motivation in relation to the personal responsibility put on individual craftsmen. Again, piecework pay schemes were brought up as problematic in their relationship with tasks not counted towards a craftsman's wage, e.g.

formalised control systems beyond value-adding activities. Unlike the issue of cleaning, the question was raised if the increased work pace really does have an impact of end product quality, professional pride being argued as a compensating factor. This was, however, a point of contention and uncertainty. Indeed, Saukkoriipi (2004) tends to suggest a decrease in quality and a higher material usage rate. Another interesting aspect was raised by Heimdall:

“Unfortunately, the larger the company and the more employees, the less personal responsibility for any individual craftsman. [...] In my opinion, the more anonymous a craftsman is, the sloppier...” (Heimdall, Personal communication, 2016-04-22)

A consistent theme on the subject of quality control was the implied bureaucracy, and the creation of what is seen to be a mere product of paperwork. On this note, the ISO-9000 framework was found to be adopted by companies, with a questionable degree of implementation. A notable quote illustrated a lacking understanding and commitment to the framework:

“I am sure there is some nice text on how to deal with this, like I said we are ISO-certified, but I do not actually know what it says.” (Odin, Personal communication, 2016-03-31)

Consistent with Poksinska (2002), a situation has occurred where there seems to be a lack of understanding of the objectives and process of the framework. Studies on the effects of motivations for ISO 9000 adoption have found that the framework is most beneficial if motivations for adoption are internal, and that external motivations in fact have a detrimental effect on successful implementation (Sampaio et al., 2009; Poksinska, 2002). Further, failing to adopt the framework as a true resource has a tendency to make it a costly liability. These studies shed some light over the perceptions of the interviewees of the processes as being relatively futile, in that it is likely the adoption of the framework was based on faulty motivations. That is, if the reasons for adoption are based on external motivations such as its use as a marketing tool, a lack of integration with company processes will have failed to produce quality benefits.

4.8 Improvement process

4.8.1 Results

Freyr

In Freyrs experience, he did not find that there is any organisational learning. He stated that, what could be seen as learning is rather focused on occasional meetings between managers in which experiences can be shared on what does and what does not work. Continuing, Freyr explained that this enables managers to discuss and learn from each other and that networks can be created providing guidance in future projects.

Freyr also described that improvement processes are not formally in place, but are rather implemented by individual project leaders not wanting, as it were, to continuously reinvent the wheel. He also stated that there are those who believe individuals learn from their mistakes. That is, there is no feedback process on positive and negative outcomes in a given project, but that learning outcomes are retained on an individual level. Freyr hence continued and explained that there is no system for retrieving knowledge when it is needed and that it would be hard to find such methods. In concluding remarks, he stated that using work set meetings might be useful, but highlighted that different projects have different circumstances. (Personal communication, 2016-03-21)

Vidar

Vidar described that learning is somewhat of a generational issue, in that people do what they have always done. In an example he described that a task description can be written by management, but that these are often put aside in favour of *the old ways*. Instead, Vidar believed that a better way would be to collectively decide on how to proceed with tasks during meetings, and then go for execution. Contemplating on the matter, Vidar stated that it is normal to have weekly meetings to raise issues, discuss problems and how to solve them, but that feedback is forgotten when projects are completed, as focus shifts from the old project to the next. Hence, Vidar believes that better routines could be achieved through a system where feedback from old projects can be applied to new ones, adding that knowledge currently tends to become a product of paperwork, that is simply forgotten. (Personal communication, 2016-03-23)

Odin

To the question of continuous improvement, Odin simply referred to the aforementioned binders with text. Quite sarcastic he stated that he assumed that there was something written about improvement processes and admitted that it was too much text for him to take in. Odin also saw the question of improvement and learning as a personal matter, stressing that individuals have a personal responsibility in their development. (Personal communication, 2016-03-31)

Tyr

Tyr explained that workers often have a personal drive for quality, to not make mistakes and that they take pride in what they do. However, he also explained that there is sense of an older generation being set in their ways. In a description of how his company work with the issue, Tyr

stated that the trend is an increased documentation on the worksites, helping to keep track of what needs to be done. He also described that learning is done partly through education during off seasons, and partly through personal discussions, with younger generations being more keen on adopting new methods. There is however, as Tyr noted, no deliberate strategy of improvement, besides catchwords lacking in precision, meaning improvement happens ad-hoc. In a personal remark Tyr stressed the importance of being aware of how competitors work, and adopt what is perceived to be useful methods. (Personal communication, 2016-04-04)

Heimdall

Heimdall noted that workers' opinions and suggestions will not affect projects as they are undertaken but that these will have to be brought up in debriefing sessions. In the sense of wanting to spend a minimal amount of effort and therefore wanting to avoid past mistakes, he referred to laziness along with wanting to have satisfied customers as sources of personal improvement. Regarding the difference between generations, Heimdall expressed that older generations tend to be stuck in their ways. In conceptualizing the distinction, he described a situation of an old craftsman refusing to do anything but install isolation while there are newcomers who are too dependent on modern methods and tools, complaining about broken nail guns and forgetting about hammers. (Personal communication, 2016-04-22)

4.8.2 Analysis

In being a project-based industry, the construction sector has intrinsic issues in continuously iterating and applying experience (Salem et al., 2006). Every project being unique, the process of learning is continually restarted. An environment has thus been described by interviewees in which organizational processes for productivity improvement were either missing or dysfunctional.

''I do not really see improvement as being worked with, beyond personal experience. But not as an organization. [...] There is no real feedback on which projects or activities that were successful, and why.'' (Freyr, Personal communication, 2016-03-21)

In lean production, methods are designed with a component of continuous improvement, so that processes can be incrementally iterated upon in the effort of eliminating waste (cf. Salem et al., 2006; Eriksson, 2010). This presupposes a degree of repeatability, in that in order to improve upon a process, one must be reasonably certain of the outcome of any given change. The industry's drift towards pre-fabrication is therefore in line with lean thinking, in that parts of production is moved to a more controllable environment. However, while interviewees voice a need for repeatable routines and instructions for work methods, efforts have seemingly fallen flat, tending to just result in products of paper.

''... I can look in this binder, surely there is some nice text about it. I mean, there probably is, but you know, ten binders with text. You cannot keep all that in your head. [...] There are just too many papers!'' (Odin, Personal communication, 2016-03-31)

Ergo, as a consequence of the complexity of construction, instructions are made either too vague or too numerous and inapplicable. The industry norm was therefore found to be reliance on personal experience, and facilitation of learning processes of individuals. This is arguably one of the major factors in why experience in accordance with Rojas and Aramvareekul (2003) is such an important driver of productivity. This in turn means, as mentioned by Bruzelius and Skärvad (2004), that a culture of encouragement needs to be in place in order to improve upon the expertise of the workforce. In this regard, interviewees voiced different perceptions on how learning is approached by individual craftsmen. While one position is that craftsmen are imbued with a professional pride and therefore strive for personal improvement, an alternative opinion was that of many craftsmen being too lazy to truly want to improve. One aspect commonly raised in this regard was the stubbornness of older craftsmen to keep to old methods. The concept of work method experimentation to create a culture of critical thinking, as according to Berger (1997), was here for the most part an unfamiliar concept to the interviewees.

5 Conclusions and discussion

In this chapter conclusions based on the analysis in the preceding chapter will be presented. A discussion will then follow on implications of the findings, along with ideas for further research and the limitations of this study.

5.1 Conclusions

The main purpose of this thesis was to explore how contractors within the Swedish wooden house industry approach productivity and how well their thoughts resonate with the framework of the academic community. The main body of the study was thus structured around two questions aimed at examining *challenges concerning productivity improvement* and the *correspondence between theory and practice*. A multiple case study of 6 managers within construction was conducted and in the following section the main findings will be presented.

The study first and foremost found an industry highly affected by the economic environment and defined by its project attributes. In line with previous studies, an environment was presented in which the industry suffers from uncertainty of processes and a lacking ability to utilize and retain expertise. These attributes have contributed to companies being highly dependent on human capital, unable to integrate experience within the organizational framework itself. In this sense, project managers have emerged as key actors, as individuals a deciding factor in how project execution is approached. In this regard many of the contractors rely on intuition and personal experience instead of industry recommendations and no evident consensus among the contractors of how to handle the issues was to be found. Further, an issue of integration and motivation was highlighted, in that there are problems in aligning the perceptions and efforts of managers and craftsmen.

It was established that a majority of the interviewees complained about poor precision of methods, wasteful behaviours, and clashing logics, while at the same time asking for more systematic ways of working. When analysing the results some interesting patterns emerged. Previous literature has thus shown that both scholars and the industry itself has for decades not only debated the problem, but also provided practical solutions. This study consequently found that the logic of solutions as put forth has partially found its way to industry practitioners, and elements can be recognized in the perceptions and methods of the industry. The contractors do in other words seem to have a wide array of remedies in order to tackle the issues of productivity.

However, due to the fact that tools often are perceived as not precise enough or due to problems of implementation, selective application is abundant. In addition, to the extent that available solutions are applied, there is an apparent lack of understanding of the full contents and intended outcomes. In this regard, there is also a question of motives and commitment to the applied concepts. Larger actors, while to a higher degree seeming innovative in the adoption of solutions, do not seem as organizations to be an exception to this phenomenon.

Overall the study found that project characteristics of the industry are held to be the underlying cause to many of the issues contemplated. Nevertheless, similar to the identification of productivity problems, the reasoning of respondents had a tendency to stop at problem recognition. There was thus a lack of contemplations on how to circumvent the project attributes, beyond that major problems can be ascribed to the how frameworks are implemented.

5.2 Discussion and further research

The process of writing this thesis did not only fulfil the purpose and provide answers to the research questions, but also brought forth many other notions and implications not evident from start. Hence in this section the thesis will therefore bring attention to matters reaching beyond the purpose, though believed to be of interest for the academic community, Smart Housing Småland and industry practitioners. The discussion will also provide a contemplation on strengths and weaknesses, as well as suggestions for further research.

In studying the construction industry and the problems of productivity, it became very clear that research on the matter has a long history and that academic contributions are abundant. A broad range of solutions have been presented, ranging from software changes to company culture. However, studying the material, issues contemplating implementation became apparent, or rather the lack thereof. In this sense it was found that while many scholars often provide thorough frameworks, they rarely touch upon how solutions are to be applied.

Ergo, in line with the findings of this study, highlighting a great ambiguity regarding implementation and understanding, it can be concluded that scholars while providing answers, tend to neglect aspects of *pedagogy*. Continuing on the problem of implementation, practical solutions provided by the academic community were also focused towards individual entities (cf. ISO 9001). Considering the fragmentation of the industry, this is found problematic. Not only due to the fact that there is a myriad of construction companies, but also in the light of an unsteady workforce, transitioning from project to project. Accordingly, the study therefore holds that these conditions are some of the reasons of the poor implementation and vague understanding. Contractors hence adopt fragments of concepts and disregard theoretical reasoning, while craft workers transcend among employers, forming individual logics.

Concluding that the issue of understanding and implementation often is a matter of communication, the study therefore suggests the academic community to critically evaluate how the frameworks are perceived by its intended recipients. In this sense, it is believed that much of the theoretical frameworks would be of more use in an earlier stage of application. In short, the suggestion implies that ideas on how to improve productivity and efficiency should be moved to the education phase of individuals working within construction.

Accordingly, the idea is for the academic community to build a reasoning within the construction community where a construction worker or engineer would have similar perceptions of productivity no matter background or status. In this sense, not ten binders of frameworks but rather

ten maxims understood by all. Hence, with this philosophy it is believed that many of the issues regarding a project based industry could be circumvented, enabling a better traction for the ideas and solutions presented by the academic community. Thus, in the words of Odin;

“... I can look in this binder, surely there is some nice text about it. I mean, there probably is, but you know, ten binders with text. You cannot keep all that in your head. [...] There are just too many papers!” (Odin, Personal communication, 2016-03-31)

5.3 Limitations and strengths of the study

Regarding the limitations of this study, it can firstly be acknowledged that the complexity of the industry provides many more layers suitable for interpretation than could be covered in this bachelor thesis. With that said, the authors also understand that the last word on productivity improvements is far from reached. However, in conducting this exploratory study it was hoped that the results would add to the cohesive whole, providing important insights to the industry from an outside perspective.

In terms of methodical approach, the scope of the thesis has also been restrained in terms of timeframe, academic guidelines and geographical area. In this sense the allotted time of four months compelled the choice of conducting a cross-sectional study. Hence, in taking a *snapshot* of the industry it is understood that the results will not provide any information on trends, an element which could have been possible conducting a longitude study. Although, worth to mention is that this aspect was compensated for through a thorough presentation of the historic development in the frame of references. The academic guidelines of a maximum of twenty thousand words also implied that the sample size of interviewees had to be contained being a qualitative study. In this regard a lesser word constraint would have meant a larger sample size and hence more grounded results.

The limitations of the study also entailed the geographical area. In this regard, the study was formed in cooperation with Smart Housing Småland focusing on regional development, meaning that the study was conducted on practitioners located in the same area. Although the cultural differences in relation to location are believed to be quite small, the authors still reserve for possible geographical differences.

That being said, with interviews having been perceived as open-hearted and honest, findings are believed to have been representative of conditions in the industry, the results of this study therefore being seen as a contribution. Further, with many of the project-based attributes being shared across industries, it is also believed that these findings could have applicability beyond the construction sector.

6 References

- AlSehaimi, A.; Fazenda, P.; and Koskela, L. (2014). "Improving construction management practice with the Last Planner System: a case study." *Engineering, Construction and Architectural Management*, Vol.21(1), p.51-64.
- Anheim, F. (2003). "Importance of the Project Team to the Creation of Learning Within and Between Construction Projects." In: Atkin, B.; Borgbrant, J. and Josephson, P. -E (ed.) *Constuction Process Improvement*. Cornwall: Blackweel Science Ltd.
- Ballard, G. (2000). "The last planner system of production control". Ph.D. thesis, Univ. of Birmingham, U.K.
- Arantes, A.; Ferreira, L.; and Costa, A. (2015). "Is the construction industry aware of supply chain management? The Portuguese contractors' perspective." *Supply Chain Management*, Vol.20(4), p.404-414.
- Albriksen, R. and Førsund, F. (1990). "A productivity study of the Norwegian building industry." *Journal of Productivity Analysis*, Vol.2(1), p.53-66.
- Ballard, G. and Howell, G. (2003a). "An update on last planner." *Proc., Int. Group for Lean Construction 11th Annual Conf. (IGLC-11)*, IGLC, Blacksburg, Va., p.11-23.
- Ballard, G. and Howell, G. (2003b). "Lean project management." *Building Research & Information*, Vol.31(2), p.119-133.
- Berger, A. (1997). "Continuous improvement and kaizen: standardization and organizational designs." *Integrated Manufacturing Systems*, Vol.8(2), p.110-117.
- Bodek, N. (2006). "What Is MUDA?" *Manufacturing Engineering*, Vol.137(1), p.77-82,84
- Borcherding, J. and Liou, F. (1986). "Work sampling can predict unit rate productivity." *Journal of Construction Engineering and Management*, Vol.112(1), p.90-103.
- Bostadsstyrelsen. (1955) "Trestadshusen." *Kungl. Bostadsstyrelsen Skrifter*, nr, 20, Stockholm.
- Boverket. (2016). "Stort underskott på bostäder för nyanlända." Boverket. Available at: <http://www.boverket.se/sv/samhallsplanering/bostadsplanering/bostadsmarknaden/bostadsmarknaden-for-olika-grupper/nyanlanda/> [Accessed 2016-05-12]
- Bröchner, J. (2011). "Statlig utredarkritik av svensk byggbransch - det långa perspektivet." In: Landin, A. & Lind, H. (eds.) *Hur står det egentligen till med den svenska byggsektorn? Perspektiv från forskarvärlden*. Kalmar: Lenanders Grafiska AB.
- Bruzeliuss, L. and Skärvad, P. (2004). *Integrerad Organisationslära*, Lund: Studentlitteratur.
- Christian, J. and Hachey, D. 1995. "Effects of delay times on production rates in construction." *J. Constr. Eng. Manage.*, Vol.121(1), p.20-26.

- Cocozza, A. and Buskas Ljunggren, A. (2008). "Procurement of subcontractors in the Swedish construction industry." Master Thesis. Kungliga Tekniska Högskolan, Sweden.
- Construction Excellence. (2005). "Be Valuable: A Strategy for the Future In: Be Valuable." London. *Construction Management and Economics*, Vol.24, p.521-528.
- Cooper, C; Sparks, K, and Fried, Y. (1997). "The effects of hours of work on health: a meta-analytical review." *J. Occup. Organiz. Psy- chol.*, Vol.70(1), p.391-408.
- Dicicco-Bloom, B. and Crabtree, B. (2006). *The qualitative research interview*. Medical Education, Vol.40(4), p.314-321.
- Dick, G.; Heras, I; Casadesús, M. (2008). "Shedding light on causation between ISO 9001 and improved business performance." *International Journal of Operations & Production Management*, Vol.28(7), p.687-708.
- Dos Santos, A; Powell, J; Sharp, J; and Formoso, C. (1998). "Principle of transparency applied in construction." *Proc., 6th Annual Conf. of the Int. Group for Lean Construction (IGLC-6)*, IGLC, Guarujá, Brazil, p.16-23.
- Dubois, A. and Gadde, L. (2000). "Supply strategy and network effects - purchasing behaviour in the construction industry." *European Journal of Purchasing & Supply Magagement*, Vol.6, p.207-215.
- Egan, J. (1998). "Rethink Construction." London: Department for Environment, Transport and the Regions.
- Eriksson, B. and Gustavsson, R. (2015). *Behov av bostadsbyggande. Teori och metod samt en analys av behovet av bostäder till 2025*. Karlskrona: Boverket.
- Eriksson, P. (2010). "Improving construction supply chain collaboration and performance: a lean construction pilot project". *Supply Chain Management: An International Journal*, Vol.15(5), p.394-403.
- Gapp, R; Fisher, R; and Kobayashi, R. (2008). "Implementing 5S within a Japanese context: an integrated management system." *Management Decision*, Vol.46(4), p.565-579.
- Haas, C; Borcherdig, J; Allmon, E; and Goodrum, P. (1999). "U.S. construction labor productivity trends, 1970-1998." *Center for Construction Industry Studies, Rep. No. 7*. Univ. of Texas at Austin, Austin, Tex.
- Halligan, D; Demsetz, L; Brown, J; and Pace, C. (1994). "Actionresponse model and loss of productivity in construction." *J. Constr. Eng. Manage.*, Vol.120(1), p.47-64.
- Ho, S; Fung, C. (1994). "Developing a TQM Excellence Model." *The TQM Magazine*, Vol.6(6), p.24-30.
- Howell, G; Laufer, A; and Ballard, G. (1993). *Interaction between subcycles: one key to improved methods*. *J. Constr. Eng. Manage.*, Vol.119(4), p.714-728.
- Jaca, C; Viles, E; Paipa-Galeano, L; Santos, J; and Mateo, Ricardo. (2014). "Learning 5S principles from Japanese best practitioners: case studies of five manufacturing companies." *International Journal of Production Research*, Vol.52(15), p.4574-4586.
- Jacobsen, D. (2009). *Vad, hur och varför? – Om metodval i företagsekonomi och andra samhällsvetenskapliga ämnen*. Lund: Studentlitteratur.

- Johnston, R. and Jones, P. (2004), "Service Productivity- Towards Understanding the Relationship Between Operational and Customer Productivity." *International Journal of Productivity and Performance Management*, Vol. 53(3), p. 201- 213.
- Jonsson, J. (2005). "Förstudie om produktivetsfrågor." Luleå tekniska Universitet. Luleå: Samhällsbyggnad / Produktionsledning.
- Josephson, P. and Saukkoriipi, L. (2005). *Slöseri i byggprojekt. Behov av förändrat synsätt*.
- Josephson, P. and Saukkoriipi, L. (2009). *31 rekommendationer för ökad lönsamhet i byggandet – att minska slöserier*. Available at: http://www.cmb-chalmers.se/publikationer/31_rekommendationer.pdf [Accessed 2016-02-07]
- Katayama, H; Bennett, D. (1996). "Lean production in a changing competitive world: a Japanese perspective." *International Journal of Operations & Production Management*, Vol.16(2), p.8-23.
- Koskela, L. (1992). "Application of the new production philosophy to construction." Stanford, CA: Stanford University.
- Koskela, L. (2000). "An exploration towards a production theory and its application to construction." Doctor of Technology, Helsinki University of Technology.
- Landin, A. and Lind, H. (2011). *Hur står det egentligen till med den svenska byggsektorn?*. Lund: Avdelningen för byggnadsekonomi, Institutionen för byggvetenskaper, Lunds universitet, Sweden.
- Latham, M. (1994). "Constructing the Team." In: HMSO (ed.) *Final Report of the Government / Industry Review of Procurement and Contractual Arrangements In The UK Construction Industry*. London.
- Lincoln, Y; Guba, E. (1984). *Naturalistic Inquiry*. Newbury Park: California, Sage Publications, Inc.
- Lind, H. (2006), *Bygg och boendekostnader i ett historiskt perspektiv*. In: Sax, U. *Familjebostäder flera kapitel i svensk bostadspolitik*. Stockholm: Stockholmia.
- Lövgren, F. and Rönnblom, J. (2008). *Industriellt köpbeteende - En fallstudie inom branschen för prefabricerade trähus i Sverige*. Master Thesis. Luleå tekniska universitet.
- Malhotra, N; Birks, D; and Wills, P. (2012). *Marketing research. An applied approach*. Fourth edition. New York, NY: Pearson Education Limited.
- Martínez-Costa, M; Choi, T; Martínez, J; and Martínez-Lorente, A. (2009). "ISO 9000/1994, ISO 9001/2000 and TQM: The performance debate revisited." *Journal of Operations Management*, Vol.27(6), pp.495-511.
- Maylor, H. (2010). *Project management*. Harlow, England: Financial Times Prentice Hall.
- Menzies, Tim. (1996) "Applications of abduction: knowledge-level modelling." *International Journal of Human-Computer Studies*, Vol. 45(3), p.305-335.
- Miles, M. and Huberman, M. (1994). *Qualitative Data Analysis*. Second edition. Thousand Oaks: Sage Publications.
- Murray, M. (2003). "Rethink Construction: the Egan Report". (1998). In: Murray, M. & Langford, D. (eds.) *Construction Reports 1944-98*. Oxford: Blackwell Science Ltd.

- Mustapha, F. and Naoum, S. (1998). 'Factors influencing the effectiveness of construction site managers.' *International Journal of Project Management*, Vol.16, p.1-8.
- Ohno, Taiichi. 1988. *Toyota Production System: Beyond Large-Scale Production*. Boca Raton: CRC Press.
- Pekkarinen, T. and Riddell, C. (2004). *The impact of piece rate contracts on wages and worker effort: Evidence from linked employer-employee data*.
- Poksinska, B; Dahlgaard, J; and Antoni, M. (2002). 'The state of ISO 9000 certification: a study of Swedish organizations.' *The TQM Magazine*, Vol.14(5), p.297-306.
- Polesie, P. (2011). *Improving productivity in construction: a contractor perspective*. Licentiate. Chalmers university of technology, Sweden.
- Prajogo, D. (2011). 'The roles of firms' motives in affecting the outcomes of ISO 9000 adoption.' *International Journal of Operations & Production Management*, Vol.31(1), p.78-100.
- Richards, L. and Morse, J. (2007). *Read me first for a user's guide to qualitative methods*. Thousand Oaks: Sage.
- Robson, C. (2002) *Real World Research: A Resource for Social Scientists and Practitioner-Researchers*. Second edition. Oxford: Blackwell.
- Rowlinson, M. and Proctor, S. (1999). 'Organizational Culture and Business History.' *Organization Studies*, Vol.20(3), p.369-96.
- Rojas, E. and Aramvareekul, P. (2003). *Labor Productivity Drivers and Opportunities in the Construction Industry*. *Journal of Management in Engineering*, Vol.19(2), p.78-82.
- Salem, O; Solomon J; Genaidy, A; and Minkarah, I. (2006). 'Lean construction: from theory to implementation.' *Journal of Management in Engineering*, Vol.22(4), p.168.
- Sampaio, P; Saraiva, P; and Rodrigues, A. (2009). 'ISO 9001 certification research: questions, answers and approaches.' *International Journal of Quality & Reliability Management*, Vol.26(1), p.38-58.
- Sanders, S. R. and Thomas, H. R. (1991). 'Factors affecting masonry productivity.' *Journal of Construction Engineering Management*, 117(4), 626-644.
- Saukkoriipi, L. (2004). *Perspectives on non-value added activities: the case of piece rate in the Swedish construction industry*. Available at: <http://iglc.net/Papers/Details/329> [Accessed 2016-04-15].
- Saunders, M; Lewis, P; and Thornhill, A. (2009). *Research methods for business students* (5 ed.). Harlow: Financial Times/Prentice Hall.
- Sinkovics, R; Penz, E; and Ghauri, P. (2008). 'Enhancing the trustworthiness of qualitative research in international business.' *Management International Review*, Vol. 48(6), p.689-714.
- Sörqvist, L. (1998) *Poor Quality Costing*, Doktorsavhandling No. 23, Kungliga tekniska högskolan, Avdelningen för Materials Processing Production Engineering, Stockholm.

SOU 2002:115. Skärpning Gubbar - Om konkurrensen, kvaliteten, kostnaderna och kompetensen i byggsektorn. Stockholm.

SOU 2008:68. Byggprocessutredningen. Bygg - helt enkelt! betänkande. Stockholm: Fritze.

SOU 2009:6. Sega gubbar. Statskontoret. Stockholm: Bygghuset.

SOU, 2015:48. Bostadsmarknaden och den ekonomiska utvecklingen.

Stake, R. (1995). *The art of case study research*. Thousand Oaks, London, New Dehli: Sage.

Statskontoret. (2010). *Att mäta produktivitetsutvecklingen i anläggningsbranschen*, 2010:19, Stockholm.

Styhre, A and Josephson, P. (2006). "Revisiting site manager work: stuck in the middle?" *Construction Management and Economics*, Vol.24(5), p.521-528.

Styhre, A. (2006). "The bureaucratization of the project manager function: The case of the construction industry." *International Journal of Project Management*, Vol.24, p.271-276.

Svennevig, Jan. (2001). *Abduction as a methodological approach to the study of spoken interaction*. Norskrift, 2001, 103: 1-22. *Svensk bostadspolitik*. Stockholmia Förlag.

Thomas, H; Sanvido, V; and Sanders, S. (1989). "Impact of material management on productivity—a case study." *J. Constr. Eng. Manage.*, Vol.115(3), p.370–384.

Sveriges Byggindustrier [BI]. (2015). *Fakta om byggandet 2015*. Sveriges Byggindustrier. Available at: https://publikationer.sverigesbyggindustrier.se/Userfiles/Info/491/FoB_2015.pdf [Accessed 2016-03-01].

Swedish Census Bureau. (2015). *Byggnadsprisindex med avdrag för bidrag* samt KPI*. Available at: http://www.scb.se/sv/_Hitta-statistik/Statistik-efter-amne/Priser-och-konsumtion/Byggnadsprisindex-samt-faktorprisindex-for-byggnader/Byggnadsprisindex-BPI/12486/12493/26943/ [Accessed 2016-03-05].

Thomas, H. and Napolitan, C. (1995). "Quantitative effects of construction changes on labor productivity." *J. Constr. Eng. Manage.*, Vol.121(3), p.290–296.

Thomas, H; Riley, D; and Sanvido, V. (1999). "Loss of labor productivity due to delivery methods and weather." *J. Constr. Eng. Manage.*, Vol.125(1), p.39–46.

Trä- och Möbelföretagen, (2015b). *TMF i siffror*. Stockholm: TMF. Available at: http://www.tmf.se/statistik/statistiska_publicationer/tmf_i_siffror [Accessed 2016-03-02].

Villaägarnas Riksförbund, (2013). *Bygga nytt hus*. Villaägarnas Riksförbund. Available at: http://www.villaagarna.se/Global/Dokument/Kunskapsbanken/Informationsskrifter/Anlita_entreprenor_hantverkare/Bygga%20nytt%20hus%202013.pdf [Accessed 2016-03-15].

Trä- och Möbelföretagen. (2015a). *Trähusdagarna: Branschutmaningar framöver - såväl tekniskt som politiskt*. Stockholm: TMF. Available at: <http://www.tmf.se/press/nyheter/nyhetsarkiv-2015/trahusdagarna-branschutmaningar-framover-saval-tekniskt-som-politiskt> [Accessed 2016-03-02].

Tsim, Y; Yeung, V; and Leung, E. (2002). "An adaptation to ISO 9001:2000 for certified organisations." *Managerial Auditing Journal*, Vol.17(5), p.245-250.

Wee; S. (2009). "Lean supply chain and its effect on product cost and quality: a case study on Ford Motor Company." *Supply Chain Management: An International Journal*, Vol.14(5), p.335-34.

Wild, A. (2002). "The unmanageability of construction and the theoretical psycho-social dynamics of projects." *Engineering, Construction and Architectural Management*, Vol.9, p.345-351.

Womack, J. (2002). "Lean thinking: Where have we been and where are we going?" *Manufacturing Engineering*, Vol.129(3), p. L2.

Womack, J. and Jones, D. (1996). *Lean thinking*, Simon and Schuster, New York, NY

Womack, J; Jones, D; and Roos, Daniel. 1990. *The Machine That Changed the World*. New York: Free Press.

Yin, Robert K. 1989. *Case study research: Design and methods*. Sage publications.

7 Appendix

7.1 Topic Guide for interviews

In the interviews, a topic guide was used as a point of reference to guide discussion. The conversations then allowed to evolve with follow-up questions and elaborations that were individual to each interview, depending on the context. The original guide being in Swedish, this is a translation.

- Please tell us about yourself and what you work with.
- Could you please describe how issues of cost are approached on construction sites?
 - How would you define waste on construction sites?
- What is your planning process and who is involved?
 - How do you view the relationship and integration of activities?
 - What planning tools are used?
 - How would you describe the general organization and distance of power on construction sites?
 - How is the question of working hours viewed?
- How is materials and activities organized spatially?
 - How is cleaning and the sorting and placement of materials approached?
- How are defects and reworks prevented?
 - How are quality controls, process follow-ups and eventual flaws approached?
- How is internal learning and improvement processes structured?
 - How aware are you of changes in methods and processes in the industry?
 - Looking back, how has the development of processes been the last few years?
 - How are the questions of education, expertise improvement, and the will to adopt new methods and techniques approached by contractors?
- Please describe how contractors and the industry in general approaches the question of changes in the economy, layoffs, and a lack of manpower – how does this affect expertise?
- Based on our discussions, how would you describe the how things have progressed so far, and what potential do you see for the future?
- Are you familiar with lean methods? Last Planner? 5S? PDCA?