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Supply Chain Integration in the Swedish Construction Industry

A case study of the rental segment

Fredrik Hallberg and Marcus Mongéus

Supervisor: Ove Krafft
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Authors: Fredrik Hallberg & Marcus Mogéus

Supervisor: Ove Krafft

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Fredrik Hallberg

Marcus Mogéus

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Reading recommendations

In order to successfully complete a Master degree project there are a number of objectives that needs to be fulfilled. Not all of them are relevant to potential readers of the study. Therefore, reading recommendations that gives a comprehensive overview of the study and summarises the essential parts will be provided. In order to get a summarising version of the thesis we recommend the following chapters to be read:

Chapter 1: 1.2, 1.4 and 1.5

Chapter 2: 2.1.1 – 2.1.3, 2.2.1, 2.2.5 and 2.4.3

Chapter 3: 3.6.1 – 3.6.4

Chapter 4: 4.1 (*Introduction part*), 4.2 (*Introduction part*) and 4.3 (*Introduction part*)

Chapter 5: 5.1 (*Introduction part*), 5.2 (*Introduction part*) and 5.3 (*Introduction part*)

Chapter 6: 6

Chapter 7: 7.1 – 7.4

List of Abbreviations

BEAst	Byggbranschens Elektroniska Affärsstandard (the Swedish Construction Industry's Electronic Business Standard)
CI	Customer integration
CSC	Construction supply chain
CSF	Critical success factors
EI	External integration
II	Internal integration
NeC	Nordic e-Construction
NeR	Nordic e-Rental
SCI	Supply chain integration
SCM	Supply chain management
SCP	Supply chain performance
SI	Supplier integration

Abstract

The abstract aims to give a comprehensive overview of the entire thesis in order to provide the readers with an insight regarding the rationale behind the problem, methods used, findings and implications.

Background: Due to insufficient performance in terms of efficiency and productivity the construction industry has suffered from poor performance in comparison to peer industries. Previous researchers have explained the situation by deficient SCI (Supply Chain Integration) among entities in the value chains. The findings have concluded that SCI is a factor with significant influence over the outcome of firm performance. However, there is no coherent suggestion of methods that can provide solutions to the issues and thereby improve the situation.

Purpose: SCI in the construction industry has been a recurrent topic and the unison opinion is that SCI is a key success factor to achieve a higher level of overall performance. Although the mind-set of researchers are similar regarding the subject, no real suggestions towards improvement have been presented. The purpose with this study is first to confirm or reject that insufficient SCI is a reason to poor performance among supply chain actors in the construction industry. Second, by formulating hypothesis the objective is to enhance the understanding regarding the impact of different aspects that is expected to influence the outcome of SCI in the construction industry.

Hypothesis: The research question relates to SCI's impact on performance and in order to further investigate the influence of different factors three hypothesis have been formulated:

H₁ Insufficient SCI in the construction industry is a result of its project-based nature

H₂ Insufficient SCI in the construction industry is a result of the supply chain complexity

H₃ Insufficient SCI in the construction industry is a result of the unwillingness to acknowledge the need of change

Method: In order to test the hypothesis a qualitative study has been conducted. The study is of an abductive nature and performed in an exploratory manner. Eleven respondents from three different entities in the value chain are subjects to the empirical study and interviewed according to a predetermined interview guide. The study has been restricted to the rental segment and the possibilities to apply the findings to other segments and industries have been discussed in order to determine the transferability of the results.

Findings: The findings support that *construction supply chain complexity* and *unwillingness to acknowledge change* affects the outcome of SCI in the Swedish construction industry. Contradictory, *the project-based nature* is found to be an insignificant factor in the context.

Discussion: The findings can be used to guide future researchers against more relevant studies. By rejecting one hypothesis resources can be allocated more efficiently and focused towards finding the factors that is most determinant to the outcome of SCI.

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1. Introduction

The first chapter introduce the topic and the concerned organisations, with the objective to present a comprehensive background and substantial problem discussion, which carries out to a research question and associated hypothesis. Furthermore, the scope and limitations of the thesis, as well as the academic and industrial purpose of the study will be covered. An outline of the remaining thesis will conclude the chapter.

1.1 Background

The background focus towards introducing the main topic of the research, presenting an overview of the industry that have a central role in this study as well as the rationale behind the problems that the industry is facing. The objective is that the reader familiarise with the topic and organisation that will be recurring in the study, as well as the issues that motivate the research question and related hypothesis.

1.1.1 SCI

Current research identifies SCI (Supply Chain Integration) as a significant influencer that contributes to companies' ability to sustain competitive advantages (Zhao et al. 2013; Childerhouse & Towill, 2011). SCI enables alignment and synchronisation of internal, supplier and customer related processes. In addition, SCI empowers firms to explore new innovative solutions with the objective to increase their efficiency (Cecere et al. 2004). SCI is also a concept that involves information sharing among actors upstream and downstream in the supply chain (Chen et al. 2010; Zhao et al. 2013; Childerhouse & Towill, 2011). Fiala (2005) suggests that SCI should be defined as a measure that aims to reduce information delays and distortions. In turn that helps upstream actors in the supply chain to minimise the bullwhip effect and as a result mitigate consequences of poor supply chain performance. Bankvall et al. (2010) suggest that absence of well-executed SCI constitutes a root problem for companies that do not achieve top efficiency. A corporate environment with low efficiency is a product from insufficient coordination and communication among actors in the supply chain (Zhao et al. 2013).

The development of SCI and operational efficiency is widely different between industries. The automotive manufacturing industry and the retail industry illustrates examples that are already successful in operating efficiently and managing closely integrated supply chains (Aloini et al. 2012). However, other industries have encountered problems to adapt new operational concepts and implement measures to achieve better efficiency. The construction industry is identified as one of these industries (Briscoe & Dainty, 2005; Segerstedt & Olofsson, 2010). In order to identify why the construction industry is facing problems, extensive research has been conducted on the subject. Researchers have focused towards *the project-based nature of the sector* (Dubois & Gadde, 2002), *construction industry fragmentation* (Dainty et al. 2001), *separation of the design and production process* (Love et al. 2004; Briscoe & Dainty, 2005), *unwillingness to implement innovative solutions in order to obtain increased integration* (Briscoe & Dainty 2005; Bankvall et al. 2010) and *lack of coordination and communication* (Bankvall et al. 2010).

One of the reasons that the construction industry is underperforming is due to its localness, and the fact that governmental subsidies as well as national and local regulations and cultures have protected the construction industry from globalisation and worldwide competition (Segerstedt & Olofsson, 2010). The construction industry is of great importance to the economic growth and constitutes up to 10% of the GDP in most developed countries (Khalfan & McDermott, 2006). Khalfan and McDermott (2006) further elaborate about measures that can enhance the construction industry performance and address the importance of innovation in SCI and how that will impact the efficiency for the entire construction industry. The emergence of technology has resulted in cost-efficient solutions called e-business, which has been developed in order to support integration between companies in the supply chain (Lee & Wang, 2005). E-business has been identified as an important breakthrough to achieve better SCI in the supply chain.

1.1.2 BEAst

The construction industry includes creation and development of buildings, houses and infrastructure with central features such as coordination of specialised and differentiated tasks on site (Dubois & Gadde, 2002). Segerstedt and Olofsson (2010) discuss the rental segment within the construction industry and define it as subcontracting and rental of expensive equipment and machines for all different types of projects.

Swedish companies, suppliers, transportation firms and other major stakeholders within the construction industry have recognised efficiency problems and the difficulties that arises with them. As a preventing measure a network aiming to further develop the construction industry's e-business was launched (BEAst, 2016a). The initiative resulted in the foundation of an organisation called BEAst, which operates with the purpose to act as a meeting place for everything that relates to e-commerce, B2B, EDI and e-communication in the construction industry. These digital solutions will facilitate and improve processes and performance within these areas. BEAst is shorthand for "Byggbranschens Elektroniska Affärsstandard", meaning "the Swedish Construction Industry's Electronic Business Standard" (BEAst, 2016a). The organisation is a non-profit with over 100 direct members, of which several are leading actors in the sector. Also several indirect members that are active through other construction industry organisations. BEAst's main objective is to exploit new standards, or improve already established methods, within the e-business area together with other Nordic and international organisations, primary focused on processes including procurement and logistics (BEAst, 2016a). BEAst operates as a mutual platform for companies in the construction industry to collaborate and utilise new or improved standardised processes as well as sharing these with other members within the organisation. An important factor that BEAst stresses is to support the construction industry and its suppliers with systems in effort to achieve possibilities to implement and share the usage of standardisation (BEAst, 2016a).

In the electronic network platform, various standards have been tested, e.g. relevant process description and tailored technical specifications to the construction industry (BEAst, 2016b). NeR (Nordic e-Rental) is one of the standards that have been developed. The outcome is a system that facilitates the entire renting process, from the company that rents the machine to a

construction company, including the flow of all relevant information. NeR includes five sub-processes that aim to provide improvements for all actors involved, (1) *simplified ordering and benchmarking of prices*, (2) *order processing through easier forecasting, ordering and confirmation*, (3) *supply management by better notification and reception of goods*, (4) *easier invoicing* and (5) *contact and handling of telephone communication* (BEAst, 2016c). Currently, the majority of machines and other rental gadgets are ordered the same day as they are required. The lack of forward planning is due to the absence of coordination and communication and becomes a barrier for suppliers to act proactively and properly forecast the demand. The result is volatile order quantities and infrequent order batches, which have a negative impact on all parties in the value chain. Bankvall et al. (2010) argues that the lack of coordination and communication are two of the root causes for insufficient efficiency in the construction industry and withholds future improvements. The main purpose of the NeR standard is to create standardised processes that will lead to a *general practice* for the entire construction industry and become useful for all members (BEAst, 2016c). BEAst believes that a less complicated standard will simplify coordination and enable a more cost-efficient process for actors in the supply chain. Additionally, new actors can join the network with e-communication and utilise the benefits.

1.1.3 Performance in the construction industry

Recent studies claims that the construction industry suffers from poor supply chain performance (Bankvall et al. 2010). Conclusions about the causes differ among academics, however the unison opinion is that the construction industry is arguably the least integrated compared to other major industrial sectors (Cheng et al. 2011; Fearn & Fowler, 2006). A recurring discussion addresses the unsatisfactory SCP (Supply Chain Performance) in the construction industry and suggests that as an explanation to the deficient results (Dubois & Gadde, 2000; Riley & Clare-Brown, 2001; Briscoe & Dainty, 2005). Furthermore Eriksson (2010) highlights the importance of improved SCP as a measure towards enhanced overall performance in the construction industry. SCP is heavily affected by the integration among actors in the supply chain and lack of communication, coordination or collaboration might have a substantial negative impact on the end result (Barlett et al. 2007; Adams et al. 2014). In addition, Humphreys et al. (2003) and Love et al. (2004) conclude that lack of coordination and communication are key explanatory factors to the poor SCP amongst construction companies. Besides communication, visibility and collaboration, SCI can be defined as information sharing enabled by significant investments in inter-organisational process development, joint decision-making and inter-firm relationship management (Mellat-Parsat & Spillan, 2014). Dainty et al. (2001) present a general opinion that SCI has a positive influence on overall SCP and should mitigate the performance issues. Consistently, Bygballe and Jahre (2009) state that improved SCP is a result of successful integration of supply chain actors and activities. Although past research has recognised SCI as a positive influence on SCP, the question of *what* should be integrated in order to solve the issues in the construction industry still have not been adequately treated (Bankvall et al. 2010).

1.1.4 Problems encountered in the construction industry

Problems in the construction industry were first recognised in the 1990s with the main objective to understand and characterise the deficiencies and propose solutions to improve integration (Segerstedt & Olofsson, 2010). The reason to examine CSCs (Construction Supply Chains) was due to lagging productivity and increased economic weight (Vrijhoef & Koskela, 2000). Different explanations of the CSC related problems have been suggested as the root causes (Cox & Ireland, 2002). The most frequently used are the *project-based environment* (Dubois & Gadde, 2000), *construction industry fragmentation* (Dainty et al. 2001), *separation of the design and production process* (Love et al. 2004; Briscoe & Dainty, 2005) and *lack of will to implement innovative solutions in order to obtain increased integration* (Briscoe & Dainty 2005; Bankvall et al. 2010). Other issues that the construction industry faces are *fluctuating demand*, *project-specific demand* and *uncertain production conditions*, which all have to be managed in a dispersed geographic area during a limited period of time (Dainty et al. 2001).

Due to the characteristics of the construction industry, actors have to deal with complexities related to implementation of effective SCM (Supply Chain Management) initiatives, such as SCI. The circumstances lead to both inefficiency and unproductivity, that in turn results in increased costs and time overruns (Aloini et. al 2012).

Aloini et al. (2012) claims that *temporary multiple organisations* in the value chain are the foundation of the problems and a great explanatory factor to poor performance among actors in the construction industry. Temporary multiple organisations are described as a network of numerous different actors with adversarial relationships that become a source to obstacles in the value chain. These circumstances are not a recently discovered phenomenon, Briscoe and Dainty (2005) suggests that historically an economic advantage has occurred if each project is treated as an one-off venture where suppliers were leveraged towards each others in order to obtain short-term cost-reductions. However, the word *historically* should be emphasised, modern CSCs do not gain advantages by addressing each project in an ad hoc manner. In contradiction to theories that accentuate a one-off venture approach, Love et al. (2004) indicates that a holistic view is more favourable when CSCs are examined and evaluated. Vrijhoef and Koskela (2000) adopt a holistic view in order to study CSCs and seek root causes to the problematic situation, and present results that further support the advantages of using a holistic approach. The findings state that the root cause of any problem is rarely found in the actual activity that encounters them, but rather in a prior activity performed by another actor. In order to benefit from improved flow of goods and communication among actors in a sophisticated network, successful integration is a prerequisite (Arshad et al. 2014). The obstacles to achieve successful integration arise from distrust, different objectives and a lack of commitment, which eventually reduces the cooperation and collaboration and diminishes the possibility to exchange information (Crespin-Mazet & Ghauri, 2007; Tsanos et al. 2014; Love et al. 2004). The requirement of trust, common objectives and commitment explains why leveraging deals with different suppliers and constantly evaluate every agreement in a separate and monetary manner is counter-productive. In a project-based environment, project execution is an essential success factor and should thus be a subject of interest for

improvement in the construction industry. Contradictory, the relationship among actors is pervaded by a negative attitude towards interventions and implementation of measures that could align the procedures and enhance the overall performance within all parties in the value chain (Dainty et al. 2001; Briscoe & Dainty, 2005).

Efforts to adapt and improve SCI in the construction industry have focused towards project-specific measures rather than relationship-specific (Dubois & Gadde, 2000). Hence partnerships and collaboration are undermined and cause an under-utilisation of integration in the construction industry's supply chains (Bygballe & Jahre, 2009). SCM research highlights the importance of long-term buyer-supplier relationships in order to reach successful collaboration among actors in the supply chain, however there are limited studies on the actual impact and outcome of similar measures in project-based industries (Crespin-Mazet & Ghauri, 2007). Still, researchers claim that standardisation and integration of activities in the supply chain would improve the performance among supply chain actors in the construction industry (Bygballe & Jahre, 2009; Segerstedt & Olofsson, 2010; Vrijhoef & Koskela, 2000).

1.1.5 Supply Chain Integration in the construction industry

SCI in the construction industry address problems with inefficiency and unproductivity and refers to actions with the objective to enhance the flow of goods and information through improved communication, collaboration and coordination (Tsanos et al. 2014; Barlett et al. 2007; Adams et al. 2014). Problems with SCI in the construction industry relate to which activities, actors or measures that are most crucial in order to obtain the potential benefits of improved SCI (Bankvall et al. 2010; Zhao et al. 2013). The most recent suggestions to mitigate the problems include:

- *Improved information visibility* (Barlett et al. 2007)
- *Shared responsibilities, collaborative management, shared execution and performance measurements* (Adams et al. 2014)
- *A strategic approach towards encouraging cultural unwillingness to embrace changes* (Adams et al. 2014)
- *Joint decision-making and inter-firm relationship management* (Mellat-Parsat & Spillan, 2014)
- *Increased relevancy of delivery by considering customer's customers and their needs (e.g. preassemble parts)* (Childerhouse & Towill, 2011; Bankvall et al. 2010)

Arshad et al. (2014) acknowledge that successful implementation of SCI in the entire value chain can result in improved service levels, reduced costs and more efficient reactions to changes in customer demand. Accordingly, Tsanos et al. (2014) define a successfully integrated supply chain as a seamless business process that eliminates redundant activities. Such results would have a substantial impact on the negative aspects regarding inefficiency and unproductivity in CSCs.

A complex supply chain network is compounded by a substantial amount of intangible assets embodied in the employees, which requires alignment between operations and specific

entities in order to enable measures towards increased SCI (Adams et al. 2014). By involving suppliers and suppliers' suppliers in the decision-making process, actors downstream the supply chain learn about the end customer and improve the probability of a long-term relationship and the opportunity to understand and align the process (Arshad et al. 2014). Contradictory, if suppliers are only held on arms-length (no contact with second-tier suppliers and limited information exchange with first-tier suppliers) and no consistency exists in the relationship, the chances of successful SCI will diminish. In the construction industry, the latter scenario is the most common (Dubois & Gadde, 2000).

The importance of SCM in the construction industry has been acknowledged since the 1980s and a number of SCM initiatives have been launched. Although the actions differ compared to today, the objectives were in resemblance with more recent actions and related to waste reduction and value adding across the value chain (Aloini et al. 2012). Barney's (1991) Resource-Based View further confirms the influence of SCM on firms overall performance and possibilities to find and leverage competitive advantages. Recent research highlights the significance of SCI in order to achieve successful SCM initiatives throughout the entire construction industry and thereby increase the overall performance across actors in the construction industry. The rationale is that integration would entail information management and inter-firm collaboration (Arshad et al. 2014; Briscoe & Dainty, 2005).

The recognition of SCI's importance has led to an increased interest in how construction companies can integrate their supply chains (Bankvall et al. 2010). Previously mentioned suggestions (e.g. *information visibility, shared responsibilities and joint decision-making*) refer to outcomes of certain actions, while Khalfan and McDermott (2006) propose actual methods that should have a positive impact on the SCP. In order to enhance motivation and mitigate unwillingness to adapt to new circumstances, implementation of construction industry innovation is suggested as a method. In addition an extended use of KPIs (Key Performance Indicators) is suggested to reward standardisation and performance measurement, which should lead to increased physical flow of goods (Khalfan & McDermott 2006). The results of initiatives towards enhanced integration are positive and indicate both performance improvements and an extended competitive advantage (Arshad et al. 2014).

In summary, the construction industry suffers from poor performance (Bankvall et al. 2010). Based on findings from recent literature regarding the subject, the root cause is hypothesised to be deficient SCI (Dubois & Gadde, 2000; Riley & Clare-Brown, 2001; Briscoe & Dainty, 2005), which leads to inefficiency and unproductivity (Eriksson, 2010). The issue has been recognised for many years, however the topic has not been addressed with adequate research and suggestions for improvement until recently (Bankvall et al. 2010; Bygballe & Janthe, 2009). The most frequently mentioned measure to manage the problems regarding SCP refers to SCI (Segerstedt & Olofsson, 2010; Dubois & Gadde, 2000; Barlett et al. 2007; Adams et al. 2014). Integration among supply chain partners is suggested to improve through enhanced communication, collaboration and coordination. The results from increased integration are a better-facilitated supply chain with increased physical and information flows (Tsanos et al. 2014; Barlett et al. 2007; Adams et al. 2014; Khalfan & McDermott, 2006). Despite the

resemblance in the need of integration among supply chain partners, there is a distinction in the opinions about what has caused the deficient SCI and the greatest obstacles towards finding a solution (Bankvall et al. 2010).

1.2 Problem Discussion

The problem discussion will elaborate on the presented problems that the construction industry is encountering. The discussion will eventually result in a motivation for further research and lead the readers towards the purpose that the results can fulfil.

Economic weight and lagging productivity were the trigger points that forced researcher to further investigate the performance in the construction industry (Vrijhoef & Koskela, 2000). The construction industry is a target of interest for the society due to its magnitude (approximately 10% of GDP in developed economies) and socio-economic value. A functioning construction sector is a prerequisite for expanding economies and efficient actors can foster both the housing situation as well as new infrastructure initiatives (Khalfan & McDermott, 2006). Accordingly, an underperforming construction sector can be disastrous and cause problems with long-term economic growth (Aloini et al. 2012).

Researchers have acknowledged the underperforming construction sector for decades (Segerstedt & Olofsson, 2010) and defined inefficiency and unproductivity as the main issues (Aloini et al. 2012). The construction industry relies heavily on project execution and work with complex material demands and efficient processes. Toyotas groundbreaking production system in the 70s with lean initiatives, kanban and just-in-time illustrates the effects of highly efficient processes in a complex value chain (Sugimori et. al. 1977). The implementation of Toyotas production system radically changed the automotive industry. Although the construction industry differs from the automotive industry in several aspects, the example illustrates the importance of streamlined processes that reduce waste. The results of an inefficient and unproductive construction sector are budget slips, delays and compromised quality (Love et al. 2004; Love, 2002). Due to the magnitude of the construction industry, negative results have great impact on the future economic growth and overall quality in terms of both the infrastructure and housing situation.

An analogous situation is applicable when SCM is evaluated in the construction industry. There are no arguments against the need of well-implemented SCM, and most researchers agree that the course to improved overall SCM is increased SCI (Zhao et al. 2013; Adams et al. 2014). The issues arise during the discussion of how enhanced SCI is supposed to be obtained and which questions should be addressed. For example, Cheng et al. (2011) refers to communication, transparency and information sharing through solutions such as EDI as the main cause, while Briscoe and Dainty (2005) highlights the importance of trust among partners and Crespín-Mazet and Gauri (2007) emphasises the short-term nature of relationships due to the project-based structure of the construction industry.

In conclusion, the issue is not to determine whether a problem exists or what the symptoms are; it is to define the greatest contributors to the problems and what can be done in order to

mitigate the effects of them and thereby improve the performance of the entire construction industry. The problems can be generalised across the construction industry and applied to all involved entities (Bankvall et al. 2010; Adams et al. 2014; Eriksson, 2010). Hence, actions towards improvement are mutually beneficial and should have a positive impact on all actors. The Swedish non-profit organisation BEAst operates with the ambition to address the efficiency and productivity issues that have been a recurring subject in the background of this study (BEAst, 2016a). With the objective to standardise routines and communication across the construction industry, BEAst seek to align processes in the entire value chain. The outcomes might result in effective reduction of waste and inefficient working methods. In 2010 BEAst launched the initiative NeR, which focused towards the rental segment (Fredholm, 2009). The initiative was divided into two parts: (1) a process description, and (2) a business transaction description. Together they aimed to enforce a standardised method of exchanging information between actors, which should enhance and support collaboration (Fredholm, 2009). However, the initiative failed and neither of the involved actors is using the NeR standard today.

Although a solid measure that adequately addresses the issues that the construction industry has encountered and suffered from for decades were presented, the implementation failed. Despite the consequent attention paid to analogous problems (Cox & Ireland, 2002; Dubois & Gadde, 2002; Dainty et al. 2001; Love et al. 2004; Briscoe & Dainty, 2005) and the absence of tangible actions towards them (Barlett et al. 2007; Adams et al. 2014; Childerhouse & Towill, 2011; Bankvall et al. 2010), an initiative that seem to highlight a spot-on problem, is ignored. The outcome causes a belief that there is a deeper problem embedded in the construction industry than merely a lack of knowledge or a complex nature.

The motivation to further investigate the problems in the construction industry is twofold:

- *First, the problem at hand is well formulated; however there is limited research that addresses the underlying reasons that causes the problems.*
- *Second, as a spot-on solution, focused towards a SCI problem is suggested, none of the involved actors seize the opportunity or collaborate towards a common goal. Additionally, the solution treats only a narrow segment of the construction industry and did not require substantial investment of time or capital.*

1.3 Purpose

The study aims to fulfil both an academic and industrial purpose. The following section strives to explain the purpose of both entities, how they can be obtained simultaneously and why this study is important.

The construction industry has encountered problems and suffered from unsatisfactory SCP for decades (Bankvall et al. 2010). Several SCI attempts have addressed the issue, but failed to improve the current situation. The purpose of the study is to examine how the implementation of sufficient SCI measures can increase performance among actors in the construction industry. By examining this, the study will investigate current risks and problems in CSCs. The results will be compared to existing research and thereby support the academia to exploit not yet found knowledge.

Based on the problem discussion, this study also aims to understand if the absence of sufficient SCI processes and lack of standardised methods, dependent on high construction industry fragmentation (Dainty et al. 2001), are root causes for poor performance. Furthermore, the separation of the design and production process (Love et al. 2004; Briscoe & Dainty, 2005) will be examined. These problems are seen as obstacles in order to sustain competitive supply chains in the construction industry. However, there has not been any research that examines if the identified problems provide a hands-on explanation to the construction industry's underperformance in terms of efficiency and productivity. Therefore the purpose of this study is to wider understand the problems for insufficient SCI in the construction industry as well as cover the gap in current research that Segerstedt and Olofsson (2010) and Crespin-Mazet and Ghauri (2007) stress. The gap refers to deficient results in terms of knowledge regarding the discontinuous exchange in project-based industries. Furthermore the research strives to examine if Dubois and Gadde's (2002) conclusions of relationship complexity is still relevant. Lastly, the study aims to examine the construction industry's attitude towards change, which has been identified by both Briscoe and Dainty (2005) and Bankvall et al. (2010) to be a major issue when trying implement unconventional SCI initiatives.

The construction industry is an important industry for society and several areas of improvement regarding the SCP have been identified. The summarised purpose is to address the areas, fill the gap presented in current research and provide knowledge about the issues that several researchers highlight as most relevant (Segerstedt & Olofsson, 2010; Zhao et al. 2013; Crespin-Mazet & Ghauri, 2007). Additionally, the study will support companies in the construction industry to address existing operational problem and suggest important areas to focus on in order to implement alternative initiatives. The insights will encourage the construction industry to exploit the absence of high SCP and offer better results to their customers. Also, the study aims to support BEAst and the construction industry in general to further develop initiatives, methods and processes to increase the construction industry's operational efficiency and stay competitive to peer industries. Conclusively, the research will try to present findings generalisable across the construction industry as well as applicable to analogues industries.

1.4 Research Question

The research question is based on existing literature and the situation where the symptoms of an underperforming construction industry are somewhat obvious, but the reasons for these symptoms are undefined or inconsistent. The objective is to present a research question that addresses an adequate problem, which has not been treated in a resembling manner before. Subsequently, three hypotheses will be presented with the objective to give further depth to the research question and address specific issues that partly could explain the problem at hand.

The rationale behind the research question is that the construction industry undoubtedly is suffering from poor performance, which leads to increased costs, delays and questionable quality. Academic research points to inefficiency and unproductivity as the reason to the underperformance. In turn, the inefficiency and unproductivity is a result from lack of integration among actors across the value chain, which motivates an assumption of that as the root cause to insufficient performance. In order to investigate whether the assumption is correct the following research questions is set to be answered:

Is poor performance in the construction industry related to absence of sufficient SCI among actors across the value chain?

The research question is complemented by three hypotheses, with the objective to possibly exclude any of the assumptions to why the construction industry has failed to implement successful SCI. By testing the hypothesis separately and either reject or confirm them, a conclusion of whether or not they can be excluded from further research is possible.

A recurring issue has been the project-based nature of the construction industry. It is a factor that distinguishes the construction industry from other, better-developed, sectors. The first hypothesis aims to test whether this actually is an issue for actors in the value chain, or if the argument has been used as an explanatory factor due to limited knowledge regarding other explanations. The objective with the hypothesis is to reach a scenario where the outcome can guide future research towards more relevant studies that supports the development of the construction industry. If the hypothesis is rejected, future researchers can allocate resources towards formulating different hypothesis and explore new areas related to the issue. On the other hand, if the hypothesis is confirmed, a scenario where an in-changeable variable explains a great part of the research question and future researchers can focus towards measures that mitigate the problematic situation. This constitutes the rationale behind H₁ and has resulted in the following formulation:

H₁ Insufficient SCI in the construction industry is a result of its project-based nature

Similarly to H_1 , the objective with H_2 is to address the operational aspects of CSCs. The compound of CSCs and the relationship between entities results in a short-termed and sub-optimising mind-set disregarding a comprehensive overview with a long-term approach. H_2 aims to test if the environment leads to inefficient processes that in turn complicate the implementation of initiatives with characteristics similar to NeR. The outcome can be used to either encourage a change of CSC actors mind-set, or disregard the situation and focus towards measures with higher significance in terms of relevance to the topic. H_2 is formulated as follows:

H_2 Insufficient SCI in the construction industry is a result of the supply chain complexity

The construction industry is conservative and favours conventional measures over innovative solutions. The third hypothesis aims to address the attitude of actors in CSCs. Previous research has focused towards problems related to H_1 and H_2 and neglects the importance of efficient change management in order to successfully implement initiatives that aim to reduce inefficiency and unproductivity. The objective with the hypothesis is to determine whether or not more resources and focus should be devoted to study the attitude of actors in CSCs. Thus, H_3 is formulated as follows:

H_3 Insufficient SCI in the construction industry is a result of the unwillingness to acknowledge the need of change

1.5 Scope

The main frame for the research is the Swedish construction industry wherein SCI will be studied. The paper will examine SCI between large companies in the construction sector. The entire value chain will be analysed from a supplier, construction company and impartial point of view. To investigate the problem a case study will be conducted, focusing towards the rental segment in construction supply chains, where SCI initiatives have been tested (BEAst, 2016c). In 2009 BEAst developed a standard (NeR) in order to improve the integration processes in CSCs. However, the initiative failed. Understanding the failed attempt and which problems that occurred will give useful insight in today's SCI problems and help analysing potential risks that the construction industry are facing today as well as measures to mitigate these.

The scope implies that there are some delimitations to the study. First, other countries or industries will not be investigated. That would make the study too extensive as well as inaccurate due to the magnitude of integrating multiple countries. Second, the focus will be restricted to the Swedish construction industry and the Swedish development results and only use that as a source of information. This becomes a limitation since the Swedish construction industry is expected to be in the forefront of construction development and thereby might encounter different problems than less developed industries (Segerstedt & Olofsson, 2010). Narrowing down to only examine the rental segment has positive sides, such as the fact that

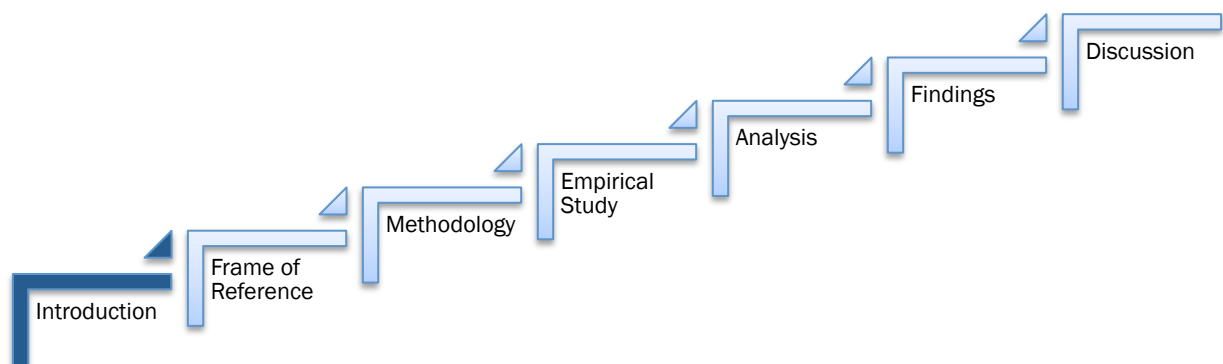
the study will provide specific results and insights. This choice can also become a limitation. As stated, only focusing on the rental segment can have implications on the findings since they may not fit to other segments. Further this study will only examine the operational processes and relationships between main contractors, suppliers and industrial organisations. The rationale is that main contractors are identified as *owners* of the CSC, suppliers are identified as the stakeholder that can improve the SCI and industrial organisations can provide a holistic and impartial view over the processes. Also, these are the drivers of the standardisation initiatives. Other stakeholders have been identified in the theory, although the ones mentioned above are identified as the most suitable for the purpose of this study and most important in an operational construction industry context.

1.6 Outline

In order to find an answer to the research question and test the hypothesis the study will follow a pre-determined structure of:

- *Frame of Reference*
- *Methodology*
- *Empirical study*
- *Analysis*
- *Findings*
- *Discussion*

Each chapter describe a certain step in the process and will start with an ingress that introduces the entire chapter, followed by another ingress in every sub-chapter that aims to prepare the reader for more specific content. As a conclusion every section will be summarised and highlight the most important findings. By following this structure the ambition is to prepare the reader of what is next, as well as wrapping up the most important content before the next section is treated.



2. Frame of Reference

The second chapter covers the theoretical frame of reference and addresses adequate literature that is essential to use as a foundation in the upcoming analysis. The objective is to introduce the fundamental content of the study in relation to the research question and hypothesis as well as prepare the reader with the basic models and theories that constitute the reference point in the empirical study. In order to properly test the hypothesis, a prerequisite is to present relevant material that motivates the rationale behind them. The chapter consists of four sub-chapters that separately treat the construction industry, SCI and BEAst. Each sub-chapter addresses their main topic in regards of the research question and hypothesis. Eventually the reader will be provided with a comprehensive insight to the basics of the subject and sufficiently prepared for the following chapters of the study.

2.1 Characteristics of the construction industry

The following section will address the characteristics of the construction industry and aim to go deeper into the factors that distinguish the sector. Based on the background and problem discussion three main factors have been defined; (1) the project-based environment, (2) construction supply chain complexity, and (3) unwillingness to commit to changes in the construction industry. Each factor is treated separately and in most extent related to the hypothesis, with the objective to provide a solid basis for further study.

2.1.1 Project-based environment

The construction industry is not compounded as a usual value chain. Rather than repeatedly assembling the same products, in the same manner, at a static location, the construction industry is project-based and therefore non-predictable regarding demand of supplies, assembling order and location (Scarborough et al. 2004). The characteristic of a project-based environment is that each undertaking requires creation of a temporary system, designed to meet the differentiated and customised demand for that particular assignment (Sydow et al. 2004). Facilitating the flow of goods and information in a project-based supply chain becomes more complicated compared to a conventional supply chains (Cox & Ireland, 2002; Dubois & Gadde, 2002). Implications with communication and coordination as a consequence of the distinctive nature is the rationale behind H_1 *Insufficient SCI in the construction industry is a result of its project-based nature* and assumed to be a significant influencer to the inefficiency and unproductivity across the construction industry.

Besides the issues concerning communication and coordination among supply chain partners, CSCs have remained contested, fragmented and adversarial, which further increases the difficulties of improving efficiency and productivity (Chan et al. 2004). Chan et al. (2004) argue that effective SCM could maximise the business value and enhance the procurement of products and services that would mitigate the problems. However, a common issue in project-based environments is that there is no coherent strategy and the focus is restricted towards short-term acquisitions without a holistic view or long-term approach (Cox et al. 2004).

Furthermore Chan et al.'s (2004) study highlight CSFs (Critical Success Factors) in a construction project and the most significant factors in a successful construction project are:

- *Project-related factors*
- *Procurement-related factors*
- *Project management*
- *Project participants related factors*

In a project-based environment all of the above factors are uncertain and non-predictable. The outcome is a negative impact on the complexity of operations in the construction industry and further escalates the difficulties of communication and coordination.

Project-based related literature has addressed the problem of underperformance in the segment and as a solution highlight the importance of exploiting the benefits of learning across the organisation (Scarborough et al. 2004). The problem at hand is to overcome the barriers in order to capture knowledge, share that within the organisation and eventually apply it to similar projects (Prencipe & Tell, 2001; Ayas & Zeniuk, 2001). In addition, know-how of operational excellence and project execution is tacit and therefore difficult to transfer (Sahlin-Andersson, 2002). Instead of using existing knowledge within the company, a common phenomenon is the *re-invention of the wheel*. The phenomenon refers to the effort of solving a problem with non-existing knowledge rather than apply conventional methods that have a proven track record.

According to the literature, implications with project-based companies are the insufficient transfer of knowledge, both inter-organisational and intra-organisational. Inabilities to share learning's and develop established methods cause recurring mistakes and re-invention of the wheel, which further increases the problems with inefficiency and unproductivity. In reference to H₁ the assumption is that the project-based nature might cause insufficient SCI. The objective with SCI is to enhance communication and coordination among actors in the supply chain (Cecere et al. 2004; Aloini et al. 2012). Integrating partners, both within and outside the organisation should, in accordance with Scarborough's (2004) findings, enhance performance and mitigate issues solely related to the project-based environment.

2.1.2 Supply Chain Complexity

Fearne and Fowler (2006) have presented findings concluding that CSCs are one of the least integrated supply chains compared to other major sectors. The inferior integration is hypothesised to be the foundation of the inefficiency and unproductivity (Tsanos et al. 2014; Barlett et al. 2007; Adams et al. 2014). The rationale behind the assumption is that CSCs are highly complex due to the compound of products needed and systems used. Implications related to execution of supply chain improvements and alignment of processes is greater in the construction industry than other sectors (Sydow et al. 2004). The problematic environment further increases the issues of converting theoretical solutions into practical use and overcome efficiency and productivity related problems.

The desired outcome of SCI is increased quality, lower costs and minimum time to service that eventually would enhance the overall performance (Bröchner, 2005; Vrijhoef et al. 2001; Vrijhoef & Koskela, 1999). However, in order to reach the desired outcomes, coordination and integration across entities is critical. Coordination and integration would result in information sharing, which is a key component for tight integration and optimisation of project management (Bröchner, 2005). The implications arise when some entities in the value chain are excluded from the flow of information. In CSCs, a scenario that involves exclusions occur more frequently than in a less complex environment. Davis (2008) suggests that trust is a mediating factor to decreased information flow. The issue with his approach is the contradictory measures. Davis (2008) implies that confidential information sharing, length of relationships and willingness to customise would increase trust and thereby enhance integration and flow of information. However, benefiting from this is nearly impossible since all suggestions are prohibited by the structure of CSCs (Sydow et al. 2004). Another factor that has influence over the ability to transfer information is the issue of where a problem is caused and when that same problem is detected. A common situation is that one supplier detects a problem, but the same supplier has no responsibility for processes in relation to the issue. The problem is rather caused by a prior actor (Vrijhoef et al. 2001; Vrijhoef & Koskela, 1999). The situation is a result from difficulties to communicate in a complex environment as well as inefficient communication methods.

Control and management of key processes are two crucial factors in order to operate a supply chain efficiently (Barker et al. 2000). The rationale behind the magnitude of these factors is that they concern essential aspects, including *information and material flow*, *product development* and *order fulfilment* (Bröchner, 2005). These are all critical elements in supply chain execution and involved in the process from production of raw material, transportation through suppliers and eventually to the final point of consumption (Barker et al. 2000). The structure of CSCs escalates the overall issues highlighted by Barker et al. (2000) and addresses the composition of entities. A conventional CSC is composed of three tiers; (1) Main contractors, (2) Tier-1 Suppliers (3) Tier-2 Suppliers. Most construction work is delivered by the main contractor – resulting in two tiers of management activities that are exposed to risk (Department for Business, Innovation & Skills, 2013; Briscoe & Dainty, 2005; Xue et al. 2007). An example of issues that arises due to the extended risk exposure is procurement of single projects based on competition among tenders with the objective to find the most cost-efficient proposal, without long-term incitements (Department for Business, Innovation & Skills, 2013; Cox et al. 2004; Crespín-Mazet & Ghauri, 2007). As a consequence, inefficient procurement management in tier-1 and tier-2 has a negative effect on costs related to each project, meanwhile it reduces the opportunity to benefit from aggregated volumes and scale efficiency. In conclusion the Department for Business, Innovation & Skills (2013) highlights three main reasons to the complexity:

- *Relatively high transaction costs related to procurement, bidding and administration.*
- *Increased levels and complexity of management and coordination of activities.*
- *Reduced opportunities to drive out waste and reduce cost through supply chain aggregation and volume purchases.*

The reasons mentioned above are highly relevant to the research question and address the issues concerning inefficiency and unproductivity from a point of view where SCI could be a significant influencer. Thus, H₂ is motivated and an examination that determines the relevance of CSC complexity as a cause to deficient SCI is required.

2.1.3 Unwillingness to change

Construction companies' continual underperformance was recognised in the 90s (Segerstedt & Olofsson 2010). Although extensive research has been made concerning the topic (Briscoe & Dainty, 2005; Bankvall et al. 2010; Adams et al. 2014), no best practice has been implemented. The problem at hand is not a lack of the number of suggestions, or the differentiation of them. Rather it is the absence of will to use them and utilise their potential advantages. Inefficiency and unproductivity have been highlighted numerous times, as well as the consequences of increased costs, decreased quality and time overruns (Vrijhoef et al. 2001; Vrijhoef & Koskela, 1999). Still, conventional methods are continuously favoured among a vast majority of construction actors. BEAst and their NeR-initiative provide one of the best illustrating cases of the implementation issues.

NeR focus towards standardisation and alignment of processes in the rental segment and aims to effectively reduce waste and inefficient working methods across the value chain (BEAst, 2016a). The initiative is divided into two parts: (1) a process description, and (2) a business transaction description. Together they aim to enforce a standardised method of exchanging information between suppliers and contractors in order to enhance and support collaboration (Fredholm, 2009). The measures address problems that have been recurring in this study, i.e. *transaction costs* (Department for Business, Innovation & Skills, 2013) and *flow of information* (Barlett et al. 2007). By describing the process, information from suppliers is visible to subsequent actors that can use the information to improve order fulfilment and diminish procurement errors, while simultaneously decrease transaction costs and labour-intensive administration work. Although NeR appears as a solution that would be beneficial for all members in a construction network, the initiative failed due to an unsuccessful implementation where no actors engaged and committed to the standards presented by BEAst (Fredholm, 2009).

The explanatory character of the case derives since it addresses a problem that is generalised in the entire sector (Aloini et al. 2012), as well as provides a spot-on solution ready to be implemented (BEAst, 2016a). The solution is not overly complicated or non-user friendly, nor does it have any obvious disadvantages that could effect participating actors (Fredholm, 2009). With the considerable problems encountered in the construction industry and lack of adequate solutions, NeR appears as a no-brainer to use. However, the implementation of the

initiative still failed. The outcome supports the assumption that there are an underlying factor, besides the construction industry environment or characteristic of the supply chain structure, which leads to inefficiency and unproductivity. Dealing with employees increase the risk of human error and implementation of non-conventional methods requires persuasion and influence in order to adopt unproven methods.

2.2 Segmentation of the construction industry

Not only are CSCs operating in a complex environment, additionally the structure is highly fragmented. The situation demands better understanding of key stakeholders and their characteristics. In CSCs there are three key stakeholders; (1) Suppliers, (2) Main contractors, (3) Clients. This chapter will focus towards further elaboration of the characteristics and objectives of those three stakeholders.

2.2.1 Structure of the construction industry

The construction industry has been stated as problematic and fragmented (Baiden et al. 2006; Aloini et al. 2012; Campagnac & Winch, 1998; Hoobs & Andersen, 2001; Thompson et al. 1998; Crespin-Mazet & Ghauri, 2007; Bankvall et al. 2010 & Department for Business, Innovation & Skills, 2013). Segersted and Olofsson (2010) explain the problem as a consequence of high volatility of market demand, which has increased fragmentation between companies that provide subcontracting and renting of expensive equipment. Furthermore, Love et al. (2004) explains the fragmentation of CSCs with the temporariness of projects. The one-off nature of the product is also considered to be a major influencing factor. In order to increase SCI, three dimensions are identified as imperative; (1) Internal Integration, (2) Supplier Integration and, (3) Customer Integration (Zhao et al. 2013). Qrunfleh and Tarafdar (2013) conclude that strategic partnerships are an important factor for companies in order to enhance their overall operational performance and supply chain responsiveness. Extended partnering is a CSF in CSCs and can be improved by undertaking in client and supplier driven strategies (Segersted & Olofsson, 2010; Briscoe & Dainty, 2005; Vrijhoef & de Ridder, 2005).

Briscoe and Dainty (2005) have conducted research regarding the construction industry's stakeholders and found that long-term relationships as well as full involvement of main contractors and key suppliers at the earliest point are determining for the project's operational success. Also, all participants in the supply chain should focus on integrated management to achieve better SCP (Vrijhoef & Koskela, 2000; Bankvall et al. 2010). Cheng et al. (2011) exploits a supply chain collaborator framework based on the buyer-supplier relations that highlights the importance of interaction between main contractors and suppliers, especially in order to establish trust between supply chain actors. Arshad et al. (2014) argues that trust among supply chain partners is the foundation for collaborative relationships and increased SCP.

2.2.2 Main Contractors

Main contractors are often the only actor with responsibilities concerning quality control, therefore they are recognised as the foremost accountable over construction projects and CSC procedures (Briscoe & Dainty, 2005). Additionally, main contractors are also accountable over control of risk factors and important projects decision (Aloini et al. 2012). The importance of long-term relationships between actors in the construction industry is recurrently highlighted, however main contractors seems to completely disregard the situation and rather frequently change suppliers (Briscoe & Dainty, 2005). The consequence is absence of strategic information sharing and feedback, which leads to imbalanced power in the supply chain and dependence on main contractors. The dependence can be used in order to extort suppliers and create a situation with competing tender offers solely based on pricing (Cox & Ireland, 2002).

Vrijhoef and Koskela (2000) argue that accountability over impact on the supply chain activities and performance should be a responsibility for the main contractors. The rationale behind this suggestion is that poor performance from main contractors can affect the entire CSC. Poor performance by main contractors often originates from poor planning and insufficient coordination on behalf of themselves (Love et al. 2004). In addition, the effects influence the resource planning that suppliers do. The Department for Business, Innovation & Skills (2013) illustrates the importance of vertical integration, where main contractors should take the overall accountability and act as an integrator. Acting as an integrator is found to be an outcome from their involvement in both the design and realisation process (Crespin-Mazet & Ghairu, 2007). Segerstedt and Olofsson (2010) found that one key success factor is the selection of suppliers. Additionally, management of these relationships are crucial in order to obtain sufficient project performance and high operational efficiency.

2.2.3 Suppliers

Partnering with suppliers is an effective method to develop a lean CSC (Eriksson, 2010). A CSC where suppliers start to involve themselves at an earlier stage in the project would enable them to learn about the end customer's requirements (Cox & Ireland 2002; Bankvall et al. 2010; Cheng et al. 2011; Adams et al. 2014; Mellat-Parast & Spillan 2014; Segerstedt & Olofsson 2010). Another mediating aspect would be increased involvement in the decision-making process with the objective to understand main-contractors situation and interpret the sort of decisions that result in more efficient application of resources (Arshad et al. 2014). The suggestions align with Vrijhoef and Koskelas (2000) findings about suppliers and their possibility to take more responsibility over logistics and inventory in order to obtain an overview of the supply chain.

According to the Department for Business, Innovation & Skills (2013) the relationship between main contractors and suppliers have frequently been an issue that can be linked to a number of different factors determined by the nature of the case. A general problem is the lack of involvement from suppliers. Fearne and Fowler (2006) use the same argument to explain why projects are treated as a series of sequential and predominantly separate operations where individual suppliers have little stake and/or commitment for the long-term

success of the project. Furthermore, Fearné and Fowler (2006) argue that suppliers' main focus often is to achieve high utilisation rates for their own operations, where little or no attention is paid to planning their operations according to their customers' schedule. A short-term focus is contradicting to measures that aim to increase supplier integration through continuous improvement (Zhao et al. 2013). Supplier integration can mitigate the risk for schedule slips, lower customer satisfaction and therefore have a positive impact on schedule attainment and final customer satisfaction (Zhao et al. 2013).

2.2.4 Clients

Briscoe and Dainty (2005) found that clients in the construction industry seldom show trust to contractors and suppliers and at the same time often lack knowledge about the construction process. Furthermore, Crespín-Mazet and Ghauri (2007) argue that clients are more inclined and open to co-develop the project with the contractor when they do not have the knowledge and capacity to do it on their own (Briscoe & Dainty 2005; Kornelius & Wamelink, 1998; Pesämaa et al. 2009). Dubois and Gadde (2000) identify that clients in the construction industry encourage collaboration with their contractor and simultaneously collaborate with the sub-contractors among them. Research by Briscoe and Dainty (2005) found that clients interest in long-term relationship exist with main contractors, but show no, or very little incentives to do the same with suppliers. The results align with Love et al.'s (2004) findings, where the researchers found that clients, together with suppliers have established relationships and trust with main contractors and started encouraging a co-operative approach to problem solving. This is highlighted as the essence in order to succeed (Arshad et al. 2014).

2.2.5 Participants of the case study

The participants in the case study originate from existing theory where important stakeholders have been identified in order to be able to find answers that fulfil the purpose of the study. Participants from three entities in the construction industry will be studied. The first entity is called organisations, which consist of companies with great insight and knowledge of the Swedish construction industry. They are working to achieve better efficiency in the Swedish construction industry and therefore important for the purpose of the study (BEAst, 2016a). The second entity is main contractors. They are seen as imperative in the construction industry and recognised as the foremost accountable over construction projects (Briscoe & Dainty, 2005). Main contractors are defined to be responsible for the accountability over impact on the supply chain activities and performance (Vrijhoef & Koskela, 2000). Suppliers are the third stakeholder to participate. The motivation is that partnering with suppliers is an effective method to develop a lean CSC (Eriksson, 2010). Furthermore, according to the Department for Business, Innovation & Skills (2013) the relationship between main contractors and suppliers has frequently been an issue that can be linked to a number of different factors, determined by the nature of the case. Conclusively, suppliers are important to include since they are seen as an important link to main contractors (Department for Business, Innovation & Skills, 2013).

As a conclusion from the investigation of segmentation in the construction industry and its supply chain, three important stakeholders have been identified; (1) *Main Contractors*, (2)

Suppliers, (3) Clients. Theories state that trust and long-term relationships are CSFs in order to achieve better-integrated CSCs. Research on characteristics of these three participants proves insufficient performance in terms of the CSFs. Suppliers show reluctance to be involved earlier in the project planning and share the overview over the entire project. Rather they wish to focus on maximising their own utilisation level. Main contractors are identified as the most important member in the supply chain and because of their strategic position, the one accountable for increasing the vertical integration along the supply chain. Clients imply to be willing to collaborate more when they are lacking knowledge about the construction industry. However, they seem to be more open for long-term relationships with main contractors and show little or no interest in collaborative partnerships with suppliers. Due to clients' limited power and influence over supply chain operations, they will not be included in the case study. Instead, focus will be towards entities that either have an operational part in the supply chain, or have the power and influence to implement changes that will affect the outcome of how CSCs are operated. With the circumstances, organisations are a better fit and will thus be included in the empirical study.

2.3 SCI

SCI is hypothesised to mediate poor performance among actors in the construction industry. In order to understand the potential impacts of improved SCI in the rental segment, the following chapter will aim to emphasise a deeper learning of the characteristics of SCI as well as how it could be applied to the construction sector.

2.3.1 Definition

Researchers have identified SCM as a key operation with strategic relevance and suggest that it can be used in order to achieve increased firm performance (Chang et al. 2015). SCM is not exclusively a supporting activity with a sole purpose to transport necessary goods from point A to point B, it is rather a required activity that can be used as a strategic tool (Alfalla-Luque et al. 2015). The rationale behind the importance of SCI regarding SCM is that in order to achieve well-executed SCM and superior performance, SCI plays a crucial role (Wiengarten et al. 2016; Huo, 2012; Huo et al. 2015).

The scope of SCI aims to link entities in the supply chain, both internal and external, with the objective to facilitate flow of information and goods (Chang et al. 2015; Leuschner et al. 2013). Huo (2012, p.596) defines SCI as:

“The degree to which a firm can strategically collaborate with its supply chain partners and cooperatively manage intra- and inter-organisational processes to achieve effective and efficient flows of products, services, information, money, and decisions to provide the maximum value to the final customer with low costs and high speed”

Alfalla-Luque et al. (2015, p.242) uses a similar definition:

“The degree to which SC members achieve collaborative inter- and intra- organisational management on the strategic, tactical and operational levels of activities (and their corresponding physical and information flows) that, starting with raw materials suppliers, add value to the product to satisfy the needs of the final customer at the lowest cost and the greatest speed”

As SCI is a highlighted topic in recent literature, many researchers have used different definitions of the term (Chang et al. 2015; Weingartern et al. 2016; Liu et al. 2013; Leuschner et al. 2013), however the essence is what is emphasised in the two quotes. Indubitable is that SCI concerns cross-company collaboration of both tactical and operational activities that targets value maximisation by increasing efficiency and productivity. The outcome of SCI recognises the issues faced by the entire construction industry and motivates the importance of successfully implementing it.

2.3.2 Composition

In order to understand how SCI can be utilised in the construction industry, it needs to be broken down into components. SCI is a broad concept and in order to narrow it down, it can be divided into II (internal integration) and EI (external integration). Furthermore, EI can be classified as SI (supplier integration) and CI (customer integration) (Huo, 2012; Zhao et al. 2013). *Information sharing, communication, demand coordination and relationship building* are important aspects incorporated in the two definitions and constitute a wide description of SCI (Huo, 2012; Huo et al. 2015). II refers to the ability to structure strategies, practices and procedures in-house and reach collaborative and synchronised actions that aim to tend customer needs. Contradictory, EI aims to fulfil customers' requirements and achieve inter-organisational collaboration (Huo, 2012; Huo et al. 2015).

Although both II and EI are beneficial to firm performance, the respective effect is different as well as the degree of the effect. The same rule applies to differences between SI and CI. Studies have found that II has the greatest influence on overall firm performance, not only does it directly improve company performance, but also enhances both SI and CI (Huo, 2012; Zhao et al. 2013). EI has an indirect positive effect on firm performance, but does not influence II (Huo et al. 2015; Zhao et al. 2013). Thus, companies with a high degree of II are more likely to improve SI and CI. The separate effects of the three components are as follows: II has an impact on factors such as schedule attainment, competitive performance and customer satisfaction. Whereas SI and CI only influence schedule attainment and customer satisfaction, but does not have directly effect on competitive performance (Huo et al. 2015). Zhao et al. (2013) suggest that sharing information, communication and follow-up contribute to operational performance.

2.3.3 Requirements

The outcome of successfully implementing SCI is highly beneficial for companies, however there are obstacles to overcome in order to reap the benefits. One of the fundamental prerequisites is information exchange (Jacobs et al. 2016; Leuschner et al. 2013; Liu et al. 2013). Information exchange enables effective management of activities and sharing specific knowledge that enhance learning, flow of information and thus long-term improvement (Leuschner et al. 2013). In turn, communication in general and information exchange in particular is related to employee attitude and commitment (Jacobs et al. 2016). It is the employees involved in the value chain that execute all activities, which explains the importance of maximising the understanding they possess, both regarding on-the-job knowledge as well as real-time knowledge that affects the day-to-day decision-making. The human aspect in successful SCI execution is important to take into consideration, highly determinant of the outcome and explained by the reliability on human resources (Jacobs et al. 2016).

Dealing with people is a complex issue and in order to streamline operational value chain processes, focus towards trust, commitment and long-term goals needs to be emphasised (Chang et al. 2015). These objectives can be facilitated by close relationships, both intra-organisational and inter-organisational (Huo et al. 2015; Leuschner et al. 2013). Alfalla-Luque et al. (2015) further elaborate on the importance of employee commitment and find support to suggestions that employee commitment and operational performance is fully mediated by SCI. The findings also support theories that employee commitment improves II and thereby also performance. Alfalla-Luque et al. (2015) summarise the findings by suggesting that companies should strive towards employee commitment and II simultaneously as they mutually reinforce each other's. Huo et al. (2015) presents similar findings from investigating human resource management methods in relation to SCI. First, the study concludes that human resource management practices is related to SCI. Second, the results are obtained by including the employees in problem-solving activities, feedback loops and engaging them in the overall process. Including a human resource perspective can entail SCI and ease the implementation process (Jacobs et al. 2016; Huo et al. 2015)

In conclusion, SCI is a key operation in SCM and undoubtedly has a positive relationship with firm performance (Alfalla-Luque et al. 2015; Chang et al. 2015; Jacobs et al. 2016; Leuschner et al. 2013). Furthermore, Gimenez et al. (2012) suggests that the effect of SCI is higher in a complex environment, similar to the construction industry. Of the components that constitutes SCI, II is crucial and the key to improve EI and eventually also firm performance (Huo, 2012; Zhao et al. 2013; Huo et al. 2015). The alignment and streamlining of internal processes enable extensive collaboration with external partners, which results in high-performing supply chains that address efficiency issues. The obstacles to reach them concerns the human aspects and mainly address information exchange by commitment and communication (Alfalla-Luque et al. 2015; Huo et al. 2015).

2.4 BEAst

In this section theory and information about the construction industry's network organisation BEAst will be highlighted. BEAst was discussed in the background and identified as an important stakeholder within the Swedish construction industry. This part aims to identify what the organisation wishes to achieve and what type of actions that have to be taken.

2.4.1 Objective

Companies from different parts of the construction industry launched a joint venture and a business network with the objective to improve the industry's overall processes (BEAst, 2016a). BEAst's purpose is to become a meeting place for everything within the construction industry that relates to B2B, EDI and e-communication in order to facilitate and improve the entire sectors process efficiency and performance. BEAst and all members are working together with the objective to exploit new processes and increase the value and performance for multiple stakeholders in the construction industry. An important part is to support the construction industry and its suppliers of systems in effort to help achieve the possibilities (BEAst, 2016a). The support can ease implementation as well as share the usage of standardisation, which further help companies to create an infrastructure for e-business (BEAst, 2016a).

2.4.2 Actions and results

BEAst has taken several actions and initiatives where the organisation has created standardised processes in order to integrate the Swedish construction industry (BEAst, 2016a). Standards such as BEAst Trade/ Supply Material/ Invoice/ Label and Nordic e-Construction (NeC) have been established and provide basis for more standardised and efficient processes on an industry level (BEAst, 2016d). NeC is a standard aiming to simplify connection between actors and coordinate transportation of materials to the construction site (BEAst, 2016d). During 2012, NeC was implemented in the systems with projections to offer better planning, more efficient ordering, better follow-ups and extended capacity utilisation (BEAst, 2016e). Important is to start implementing the most value adding sub-processes, such as digital invoices and digital slips first and later continuously add sub-processes along the implementation phase. After the implementation several studies evaluated the outcomes of the standard. One analysis performed by Schnitzler and Österlund (2015), detected several improvements in the supply chain. Some of the improvements were; *increased transparency in the supply chain, integrated information sharing and improved delivery reliability*. This is described as some of the most significant problems in CS's and great obstacles towards achieving better SCP (Barlett et al. (2007); Childerhouse & Towill, 2011; Briscoe & Dainty, 2005; Bankvall et al. 2010).

2.4.3 NeR

NeR is a standard where the objective is a system that facilitates the entire process, from the company that rents the machine to a construction company, including the flow of all relevant information (BEAst, 2016c). NeR includes five sub-processes that aim to provide improvements for all actors involved: (1) *Standard Process* for simplified ordering and benchmarking of prices, (2) *Order Processing* through better forecasting, ordering and confirmation, (3) *Delivery and Reverse Management* to better notification and reception of goods, (4) *Invoice Processing* for easier invoicing and (5) *Communication* for contacting and handling of telephone communication between parties in the supply chain, subject to the last part of the process (BEAst, 2016c). Currently, the majority of machines and other rental gadgets are ordered the same day as they are required on site. The absence of coordination and communication is a barrier for suppliers to be proactive and to properly forecast future demand (BEAst, 2016c). Briscoe and Dainty (2005) identified the same problems in the UK construction industry. Another factor that differentiates rental and NeR from other segments is the reverse logistics, which include processes for picking up machines that have been rented rather than purchased (BEAst, 2016c). Furthermore, the mission for implementing NeR is to increase SCI and mitigate problems such as *lack of coordination and communication* (Bankvall et al. 2010), *product schedule slips and late involvement of parts and machines* (Aloini et al. 2012), *linking information and process integration* (Mellat-Parast & Spillan, 2014) and *collaboration systems to link parties in SC* (Cheng et al. 2011). The motives for implementing NeR is described by BEAst (2016c) as:

Sub-process (1): Standard Process

- The buyers systems will be frequently updated, resulting in an ordering process that will be simpler and faster.
- More detailed information about the suppliers offering, which also will be easier to evaluate and benchmark towards different suppliers.

Sub-process (2): Ordering Processing

- Easier for suppliers to plan deliveries and meet customer demand.
- Suppliers will have lower costs and a less volatile market.

Sub-process (3): Delivery and Reverse Management

- The order will automatically update the buyers system and give accurate information for delivery.
- The pick up will automatically update the renter's system and give accurate information for reverse processing.

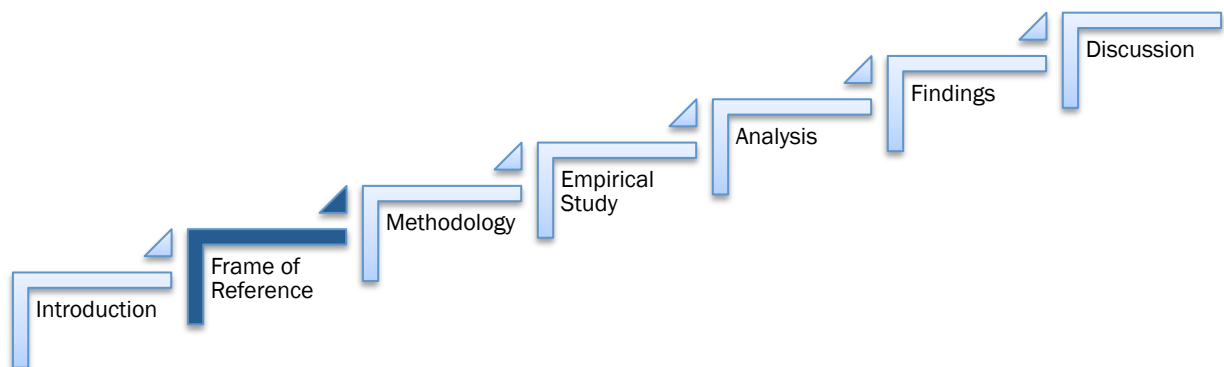
Sub-process (4): Invoice Processing

- When goods are delivered, an invoice will automatically be sent to customers that match the final renting period from delivery and pick up.

Sub-process (5): Communication

- To address efficiency, an electronic notification number will match the invoice and update the buyers system.

In summary, BEAst is an important stakeholder in the construction industry and facilitates the development of improving SCI. By working as a networking platform the objective is to improve the industry’s overall processes as well as support members with advice and foster innovation towards development. BEAst has launched several projects in order to increase the industry’s process performance. The outcomes have varied, but recent initiatives such as NeC, have been successful while NeR was launched without any breakthrough. Furthermore, NeR and the goal of the standardised process theory can be linked to the same problems that researchers have found studying the entire construction industry.



3. Research Methodology

This chapter will cover a number of important issues relating to methods used to conduct the study as well as further elaborate how the empirical data have been collected and analysed. First, research philosophy will be discussed, followed by a discussion on the theoretical assumptions that this study is based upon. The assumptions will affect the chosen research strategy and methods. Following, the rationale behind the assumptions as well as the processes will be explained in section. Furthermore, the data collection will be described in detail and include the analysing techniques that the thesis uses. Subsequently, a description of all the respondents of the empirical study will be presented. The chapter will be concluded with research quality, which will be discussed in regards to the areas of dependability, credibility, confirmability and transferability.

3.1 Methodology

Eriksson and Kovalainen (2008) define methodology as how knowledge about a given issue or problem can be produced. The method includes philosophical assumptions that the research is based upon as well as implications of these in terms of the method or methods used. This part of the chapter will focus towards defining these areas and emphasise a deeper understanding of the problems encountered.

3.1.1 Research philosophy

Research philosophy concerns the development of knowledge (Eriksson & Kovalainen, 2008). Bryman and Bell (2011) divide research philosophy into two different perspectives; *ontological* and *epistemological*. The study is based upon the ontological perspective, which means that it will assume that the reality is understood subjectively and that different actions are based on *different personalities, cognitive adopted attitudes or social constructed identities*. This means that it is based upon perceptions and experiences that may, and probably are different for each person and will change over time and depend on the context (Eriksson & Kovalainen, 2008).

There are several different philosophical positions that researchers can take (Bryman & Bell, 2011). The main philosophical position of this study is interpretivism, which comes from the positivist standing where the purpose is to generate hypotheses from existing theory, test these to reality and thereby allow explanations of the results (Bryman & Bell, 2011). The study is based on a review of existing theory with the objective to understand problems and ultimately formulate hypotheses that are either rejected or confirmed. Furthermore, the research philosophy is not only based on positivism that assumes the only legitimate knowledge can be found by experience (Eriksson & Kovalainen, 2008), but also believes that solely focusing on actions and understandings will limit the study's result. However, it is important to also understand that the interpretation of the actions is an essential part of any qualitative analysis (Bryman & Bell, 2011). According to Eriksson and Kovalainen (2008) and Bryman and Bell (2011) the interpretivism philosophical position will increase the subjectivism of the reality

examined and focus towards understanding the situation, which is important since this study's subject is yet unexplored and complex to comprehend.

3.1.2 Research Purpose

Understanding the nature of the research design and the study's purposes is crucial. The purpose differs between studies and can be classified in three categories; *exploratory*, *descriptive* and *explanatory* (Saunders et al. 2012). The nature of this research motivates an exploratory study. An exploratory study is of great use when the area of investigation is new or vague and forces the researchers to do an exploration in order to obtain a deeper learning regarding the problem at hand. A common scenario is that important variables may not be fully known and thus requires hypotheses about the potential outcome (Cooper & Schindler, 2011). According to Cooper and Schindler (2011) an exploratory study is most suitable when a research has characteristics similar to this one. The rationale behind choosing an exploratory study is that the construction industry in Sweden is one of the most developed in the world, but still cannot provide concrete examples where existing theory about implementation of SCI has been developed. Additionally, the research is facing a time restraint, which Cooper and Schindler (2011) also argue motivates an exploratory study. Lastly, the study aims to conduct interviews with experts to establish a greater understanding of the subject. Studies with similar characteristics usually use an explorative approach (Saunders et al. 2012).

Dul and Hak (2008) present two different purposes of empirical research; *theory-oriented research* and *practice-oriented research*. Theory-oriented research is research where the objective is to contribute to theory development. Ultimately, the theory may be useful for practice in general (Dul & Hak, 2008). This research strives to be aligned with Dul and Hak's (2008) exploration of theory-oriented research since the objective is to contribute with new knowledge to existing theory. In addition, the purpose is to provide insights in the construction industry and its supply chain, with the possibility to extract the findings and apply to analogous sectors.

3.1.3 Research Approach

There are three types of research approaches; *induction*, *deduction* and *abduction* (Bryman & Bell, 2011; Saunders et al. 2012; Eriksson & Kovailainen, 2008). Abduction is a mix of the other two (Eriksson & Kovailainen, 2008) and therefore it is important to understand the first two to be able to comprehend the third. Deduction is an approach where theory is the first source of knowledge. Research originates from theory, through hypothesis and ultimately leads to an empirical analysis. Contradictory to deduction, induction is research that proceeds from empirical research to theoretical results (Bryman & Bell, 2011; Eriksson & Kovailainen, 2008). Using both induction and deduction, but in different phases and move between these during the research process is the process of abduction (Eriksson & Kovailainen, 2008).

In order to serve the purpose of this study, an abductive research approach will be applied. The research process will start through a thorough review of existing theory that complies with the purpose of the research. Subsequently, the problem discussion and development of hypotheses emerge from the gaps identified in the introduction chapter. The mentioned sections are restricted to deductive approach. An inductive approach will be applied when empirical data and analysis have been conducted and then applied to new theory findings. An abductive approach has to be applied due to limitation of research regarding SCI and standardised processes within the Swedish construction industry. In order to get a comprehensive overview and understanding of the context, a mix of existing theory and recently collected data will be compared in the analysis chapter to be able to further develop new theory.

A deductive approach could have been adopted based on theory originating in UK or US since more research have been conducted in regards to those areas. The time limitations as well as the dissimilarities in construction industries in different countries are the reasons to reject the deductive approach. The reason that an inductive approach has been completely rejected is twofold. First, the method demands a large sample population, which is impossible to accomplish. Second, the time limit restricts a more extensive research (Saunders et. al 2012).

3.2 Research Strategy

In this section research strategy will be outlined and discussed in order for the reader to fully cope with and understand how the thesis is allowed to fulfil the research purpose as well as the process of data collection and data analysis.

3.2.1 Outline

The nature of the study demands a qualitative approach. The decision is based on the extensive construction industry knowledge that is required in order to highlight the specifics and be able to emphasise those in the findings. Primary this refers to a wider perspective, including how individuals interpret the social world according to the interpretivism philosophical position. With this in mind, a qualitative research design is to prefer prior to a quantitative and the results can be expected to better cope with the interpretation of the world (Bryman & Bell, 2011).

Research strategy focus on defining a plan of actions that will be taken in order to answer the research questions as well as the hypotheses and thus meet the objectives of the study (Bryman & Bell, 2011). Depending on the purpose, researchers have to determine the most suitable research strategy (Yin, 2014). Ultimately, this results in the adoption of a qualitative research strategy, where the study emphasise the way in which individuals interpret their social world and their view of social reality as a constantly shifting emergent property of individuals creation (Bryman & Bell, 2011). The subject in this study is complex and not clearly evident, which demands a deeper understanding and thereby motivates a qualitative rather than a quantitative approach.

3.2.2 Research Design

The chosen research strategy is referred to as *case study*, which Dun and Hak (2008) describe as an empirical inquiry that investigates a contemporary phenomena within its real-life context that are not clearly evident in existing subject of study. Additionally, Dun and Hak (2008) highlight another distinctive characteristic of the case study design. Case studies usually aim to reflect the object of study or its environment, and are not in anyway manipulated, which means it is a *real-life context*. Two important aspects that motivate a case study is when (1) *the topic is broad and complex*, (2) *the context is important* (Dun & Hak, 2008). The topic of this thesis covers both motivations since the subject relates to examination of SCI in the Swedish construction industry and the industry importance for Swedens social and economical development. Additionally these reasons motivate for choosing case study as a research design. The study will perform a type of case study that Dun and Hak (2008) refer to as *single case study*. This means that data will be collected from one instance, which is estimated to be enough in order to achieve the research objective. The investigated process of NeR is generally seen as one case within the construction industry and therefore single case study is the most relevant choice. In order for the researchers to get a comprehensive overview of characteristics in the rental segment, eleven respondents from different companies working with the rental segment, with insights in the NeR initiative and experience of these types of projects have been selected.

According to Eriksson and Kovailainen (2008) a case study that studies one chain of different actions should have a holistic view to be able to understand not only one action, but also how all these actions affect each other. Additionally, Vrijhoef and Koskela (2000) suggest a holistic view on case studies regarding CSCs since root causes to problems in the construction industry are very complex and are rarely found in the actual activity that encounters them, but rather in a prior activity, performed by another actor. Therefore this thesis will have a holistic view where one type of CSC will be investigated and examined. Furthermore, the research strategy is in accordance with the requirements of a holistic single case study. The case participants were selected due to their relevance in relation to the knowledge and insights that this thesis aims to exploit, investigate and contribute with.

3.3 Literature Collection

This section includes how the literature in the theoretical framework has been collected. The focus is towards describing the process of searching and collecting existing theory relevant to the study and its purpose.

In order to develop the theoretical framework substantial literature had to be collected. The searched and collected literature can be referred to already existing data and secondary data in this study (Collis & Hussey, 2014). Before starting the search for published journals, articles and books, the scope of the study had to be outlined. Collis and Hussey (2014) state that defining the scope of the study creates limitations of the research and will improve the search process for literature.

When the scope of the thesis was established, search after literature could start. Databases provided by the University of Gothenburg were used and GUNDA was the most frequently selected option. The keywords that were used to find relevant literature were: *supply chain integration, construction industry, productivity, efficiency, rental, Sweden, supply chain management*.

3.4 Data Collection

In this section the empirical data and how it will be collected will be discussed. The issues that will be addressed are both how the respondents have been chosen and also the manner in which they will be interviewed.

As previously stated, this study is a qualitative research where the research design carries out to a single case study. To achieve the objectives and present findings that supports or rejects the hypothesis, qualitative interviews will be conducted. According to Bryman and Bell (2011) qualitative interviewing gives insights to the elements that the interviewee finds relevant and important in terms of the research topic and thereby aligns with the applied methodology.

3.4.1 Interview design

The choice of using qualitative interviews is because the subject requires deep understanding in order to find evidence that supports or rejects the hypotheses. Qualitative interviews will provide flexibility, allow the respondents to answer freely and thereby provide the most relevant and detailed answers. However, qualitative interviews consist of different approaches that can be taken by the interviewer (Bryman & Bell, 2011). There are two major types; *unstructured* and *semi-structured* (Bryman & Bell, 2011). This study's interview approach is semi-structured interviews. This means that the researchers have a list of questions in reference to a specific topic, referred to as an *interview guide* (Bryman & Bell, 2011). Furthermore, semi-structured interviews are explained as an approach where questions may not always follow a strict schedule and follow-up questions that were not planned can be asked. The semi-structured interview approach will support the researchers to stick to the area of research and not risk to float away from the purpose. Contradictory, using an unstructured interview approach could increase the risk of similar scenario. By using semi-structured interviews, there is no risk of losing flexibility, but still follow a clear agenda that aim to serve the purpose of this study and address the hypothesis. In addition, an advantage with face-to-face interviews is the possibility to ask follow-up questions (Bryman & Bell, 2011). This is a critical choice for the study, since the area of interest requires deep knowledge within the topic and additionally can result in important and unexpected insights related to the research question. In order to find these insights, follow-up questions could be needed to fully understand and cope with the essence and context of the answers. Face-to-face interviews has a disadvantage; the respondents have limited time to attend the interview and therefore the answers can be stressed, not fully explained or well thought out. Still, a semi-structured interview approach and face-to-face interviews is the primary choice and best cope with the objectives and elements of the environment. If the respondents are unable to meet for a face-to-face interview, the interview will be held over the phone. According to Bryman and Bell

(2011) the potential downside is that misunderstandings or misinterpretation of the answers might occur during the interviews, which the researchers have to take into account. As a preventing measure, the researchers will try to summarise every answer during a telephone interview in order to confirm that the answers have been interpreted and understood correctly.

3.4.2 Interview Respondents

Lack of transparency is a great issue in many of today's qualitative studies (Bryman & Bell, 2011). The issue is often related to methods used in the collection of samples. Therefore it is important to specify the study's selection of samples process. This study's selection of respondents have been based on following criterias:

- *Do the respondents represent an organisation operating in the Swedish construction industry and the rental segment?*
- *Has the organisation been involved in working with standardised processes before, similar to NeR?*
- *Does the respondent hold a managerial position, or at least have a comprehensive overview of the supply chain processes?*

The first criteria was developed according to the scope of the thesis, which is in regards of the Swedish construction industry and the rental segment. This is important in order for all respondents to work with and have knowledge regarding the rental segment. The second criteria is based on the purpose of the research conducted and outcome of implementation of standardised measures in the construction industry. In order to enable collection of proper knowledge about the problem, respondents are required to have sufficient knowledge related to the subject of the study. With this in mind, respondents need to have some expertise within the field in order to properly answer the questions with a holistic view of both the construction industry and the value chain and adopt a managerial perspective. This leads into the third selection criteria. Providing a holistic view is imperative to the outcome of the study and the reason why a managerial point of view has been prioritised. These three criterias are based on the three hypothesis that aim to answer the research question and therefore vital for the process of collecting the samples. A list and description of all the eleven responding companies is provided below:

Actor	Definition
ORG.1	<i>An organisation that is working to improve the overall Swedish construction industry's SCI</i>
ORG.2	<i>A company that have deep knowledge in the Swedish construction industry</i>
ORG.3	<i>A company that provide SCI solutions for all parties in the CSC</i>
ORG.4	<i>An organisation that is working to improve the overall integration in the Swedish construction industry</i>
MC.1	<i>A well-established main contractor in the Swedish construction industry with a turnover of 50bn+ SEK.</i>
MC.2	<i>A well-established main contractor in the Swedish construction industry with a turnover of 5bn+ SEK.</i>
MC.3	<i>A well-established main contractor in the Swedish construction industry with a turnover of 10bn+ SEK.</i>
SUP.1	<i>A well-established supplier within the rental segment in the Swedish construction industry with several main contractors as customers and a turnover of 1,5bn+ SEK</i>
SUP.2	<i>A well-established supplier within the rental segment in the Swedish construction industry with several main contractors as customers and a turnover of 0,5bn+ SEK.</i>
SUP.3	<i>A well-established supplier within the rental segment in the Swedish construction industry with several main contractors as customers and a turnover of 2,5bn+ SEK.</i>
SUP.4	<i>A well-established supplier within the rental segment in the Swedish construction industry with several main contractors as customers and a turnover of 0,5bn+ SEK.</i>

Brief description of the companies that participated in the case study

The NeR standard was provided by BEAst in 2011, but experienced limited success. The respondents have been chosen from stakeholders identified in the frame of reference; *organisations, main contractors and suppliers*. Almost the same amount of respondents have been chosen from each group of stakeholders in order to mitigate biases.

Due to time limitations, the study will not include more than eleven interviews. It is important to highlight that conducting more interviews would have increased the credibility. However, eleven respondents is seen as a reasonable amount of interviews since the study applies an exploratory research design and is the first study within this field and thus can be seen as a pilot. The choice of the suppliers is based on companies' previous involvement in similar initiatives and their ability to influence the operational activities in CSCs. Industry organisations are chosen since BEAst is the foundation of the initiative and platform NeR, but also because these organisations have a holistic view and thereby withholds knowledge that is important to extract and use in order to increase the accuracy, relevancy and creditability of

the analysis as well as the findings. Another aspect to have in mind is the unbiased that organisations provide. Contrary to suppliers or main contractors, organisations have no operational part in the CSC, but only aims to improve the performance of operational stakeholders and contribute to construction industry development. The choice of main contractors is dependent of the fact that these companies are viewed as essential companies in the construction industry according to existing theory and essential in order for initiatives provided by BEAst can take place. Furthermore, suppliers are important stakeholders since they enable main contractors to perform construction activities by providing them with all necessary products and services and are identified as an important part of the CSC.

3.4.3 Interview Guide

An interview guide has been developed to comply with the choice of semi-structured interview design and cover the relevant subjects included in this study. In terms of the analysis, three categories have been developed; *knowledge about SCI*, *experience with NeR and other standardised processes* and *challenges and results from implementation of similar initiatives*. The dividing was made in order to collect relevant data to be able to fulfil the purpose of the thesis and test the hypotheses. The selection of these categories will be explained in detail in the data analysis section. As the idea of following the semi-structured interview design depends on the answers given the formal questionnaire, few or several follow up questions will be asked.

3.4.4 Interview Procedure

The interviews have been conducted both face-to-face and over telephone. For the purpose of credibility and to maximise the outcome of every interview, Bryman and Bell (2011) argue that face-to-face is the most suitable approach. However, some respondents are located far from Gothenburg, which limits their availability and force the interview to be conducted by telephone. This could limit the respondents' possibility to fully express their knowledge and insights. Another aspect to take into consideration is that only one interview was conducted in English. The reason is that it is usually easier to express thoughts in a native language and all other respondents were from Sweden. The interview guide was developed and sent to all respondents prior to the interview. All respondents were sent and asked the same standardised transcript questions. Also every respondent had the opportunity to change and/or approve the interview material afterwards and also give additional comments if they thought some discussion points were missing.

The interviews lasted between 30 to 60 minutes, where respondents had the opportunity to discuss and describe the different questions. As mentioned, the interview guide was followed in order to provide the structure an empirical study strives towards. Follow-up questions were allowed and constitutes the flexibility of the qualitative method. During the interviews one of the authors had more of a leading role for asking the questions and the other author had a noting role to make sure everything the respondents said was noted. If a respondent agreed to be recorded prior to the interview, the entire conversation was recorded. To ensure the quality the recordings were used afterwards to verify that no important empirical data was missed.

Still, the leading role took notes to the best of abilities in order to further increase the credibility of the collected data.

3.5 Data Analysis

Qualitative data is collected from interviews with the objective to allow the researchers to conduct a proper analysis (Bryman & Bell, 2011). In order to conduct the analysis, collected data need to be structured through a data analysis. This is a separate process in the empirical study (Eriksson & Kovalainen, 2008). Therefore, empirical data has to be structured through systematic coding and techniques, which the following section will outline and focus towards explaining.

When the empirical data has been collected it is important that the process for how the collected data will be analysed is clear. Following the research strategy, qualitative data analysis is used. Qualitative analysis implies a non-numerical data with answers from respondents to open-ended questions (Saunders et al. 2009). The research method is qualitative strategy using semi-structured interview design, which means that non-numerical data is collected. This approach was chosen since the Swedish construction industry is a complex concept of study and rather unexplored therefore the qualitative approach was chosen mentioned above to this exploratory study.

In this case study research pre-planned systematic coding has been used. Pre-planned systematic coding is a data analysis method often used when the research originates from existing theory and attempts to improve previous results (Eriksson & Kovalainen, 2008). Furthermore, Eriksson and Kovalainen (2008) suggest that pre-planned systematic coding is of great use when the research has pre-defined propositions. The hypotheses are developed from existing theory, which gives the thesis a great basis for a thematic coding scheme to be used when collecting and analysing the empirical data. The coding scheme follows the three categories described in the interview design; *knowledge about SCI, experience with NeR and other standardised processes* and last *challenges and outcomes when implementing similar initiatives*. According to Yin (2014) this is one of two main strategies where the analysis is based on pre-formulated theoretical hypotheses. Additionally, the study is based on the abductive approach, which means empirical findings have to be analysed and compared with existing theory. Therefore the analysis technique includes finding and matching patterns from empirical data and comparing them with the hypothesis developed on the basis of existing theory (Yin, 2014). Also, this type of technique is useful when a single case study is developed (Eriksson & Kovalainen, 2008).

3.6 Research Quality

The following section strives to explain the results and elaborate on the trustworthiness of them. In order to ensure the quality of the research, four elements will be discussed; dependability, credibility, confirmability and transferability will be discussed.

3.6.1 Dependability

A qualitative research can be difficult for other researchers to replicate and therefore it is important to describe all stages in the research process and be transparent regarding the data collection and the analysis techniques (Eriksson & Kovalainen, 2008). The data collection procedure has been explained and the interview guide can be found in the appendix. The procedure explains how the study was conducted and how it is presented as well as provides a detailed explanation of methods used in all stages during this study. According to Guba and Lincoln (1994) dependability concerns the possibility for a third part to understand and follow the research process that leads to the findings. The empirical data was collected from different types of actors along the CSC. The actors represented different companies and established a foundation for the study's empirical dependability.

Important to mention is that the authors have asked follow-up questions according to the semi-structured interview design, which makes the possibility to trace the progress and replicate the observations difficult. The difficulties arise when these questions were asked spontaneously and outside the regular interview guide. It is important to discuss the possibility for replication of this study, especially since this is a theory-oriented research where the research process includes a single case study including formulation and testing of hypotheses (Dul & Hak, 2008). Since single case studies test whether evidence confirms or rejects hypothesis, the degree of replication is important and might be case-specific. By using another context a research on the same subject can present findings with great deviations. There is a possibility for duplication if this study was to be conducted somewhere else and still concerning SCI and standardised processes in the construction industry. However, potential differences regarding the findings would occur because the construction industry is identified to be distinctive within different areas around the world.

3.6.2 Credibility

Credibility refers to whether the questions regarding how believable and convincing the findings of the study are (Bryman & Bell, 2011). The credibility was confirmed since the selection of respondents to the interviews has been provided in detail, where three criterias have been followed in order to ensure all collected empirical data was qualified for the study's purpose. Furthermore, during the data collection the interview design was followed throughout the interviews, with the objective to increase the credibility. Due to the semi-structured interview design, this means follow-up questions where asked to the respondents. This means different follow-up questions were asked to different respondents depending on their open-ended answers according to the semi-structured interview. This might decrease the credibility since respondents might have different opinions regarding the subjects asked. Thereby the answers might become confusing and decrease the credibility. The follow-up questions have not been noted since they deviate from the standard interview guide. This

results in a drawback on the level of credibility. Also, some interviews were held over telephone, which opens up for risk for misconceptions or misunderstandings regarding the respondents' intentions. To minimise the risk, the authors repeated the answers during the interviews and summarised them to ensure the interpretation was accurate. Also throughout all the interviews, the author that had the leading and the noting author was always the same in order for the data collection to be as systemised and standardised as possible.

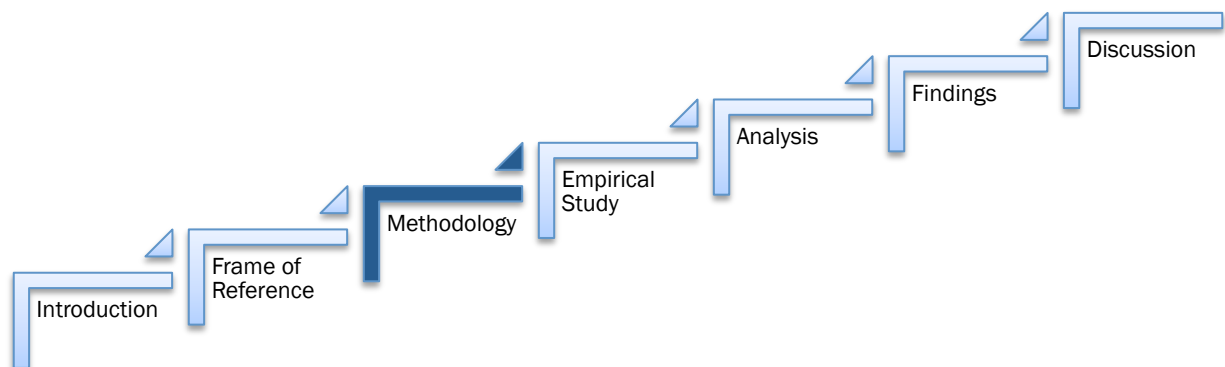
To further increase credibility of the thesis, a description of how the data has been analysed is clearly provided and thus simple for other researchers to follow as well as understand how the authors ended up to the findings. Furthermore, all respondents were asked to define what SCI means to them and discuss the subjects to ensure that all respondents had knowledge regarding the subject and were able to provide convincing and believable insights that serve the study's purpose. Regarding credibility Dul and Hak (2008) highlight the importance of understanding that one instance is not representative of the domain to which the proposition is assumed to be applicable. Therefore, when confirming or rejecting a hypothesis it will be important to connect both previous findings within this field, but also to connect this to the case study findings. Conclusively, it is imperative to understand that this is a first exploratory study and the stated findings have to be tested repeatedly in order to be classified with sufficient credibility.

3.6.3 Confirmability

Confirmability concerns whether the authors are biased and how that might affect the findings (Bryman & Bell, 2011). Also, it refers to how the authors choose processes to increase the objectiveness (Bryman & Bell, 2011). In this study the interview questions were designed and constructed clearly in order to understand and gain accurate data for the research purpose. All respondents were chosen according to the three criterias, with no exception. Furthermore, during the data collection, the interview guide was followed throughout the interviews to ensure the objectiveness by the authors. However, the semi-structured interview design results in follow-up questions, which were asked spontaneously and therefore different from each interview. This might affect the results. Additionally, the empirical data was based on several different individuals, from different organisations and entities along the CSC, which limited the possibility of basing empirical findings on input from only a few individuals. Using secondary data would further increase this study's confirmability (Guba, 1981), but since this is an exploratory study the authors suggest that this would not gain the purpose. The rationale is that the study does not test existing theory through a deductive approach, but rather aims to focus towards unexplored academic areas. Also the study follows the abductive approach, which is not the strictest method. This approach is based on using the traditional deductive and inductive approaches in different stages, which is less strictly and risk lacking objectiveness.

3.6.4 Transferability

Bryman and Bell (2011) also highlight transferability as something important for researchers to take into account. Transferability refers to the degree of which findings in the research can be generalised beyond the specific research context. This can be a problem since the data collected is strictly focused to the Swedish construction industry and findings might differ compared to a study with the same research process conducted somewhere else in the world. However, this can also act as guidance to other industries with similar traits and become a reference point. Nevertheless, the study concerns theory development and therefore does not make any claims about theory justification. The importance of theory development within case studies is about providing findings that can increase the understanding of the existing theory and thereby become useful for others. General SCI and implementation theory is studied and therefore the results regarding these areas are transferable. Also the thesis transferability can be a problem when the empirical study only has one single case study (Bryman & Bell, 2011), although this is an exploratory study that aims to find new insights in an unexplored area. The scenario limits the possibilities to generalise findings and requires thorough investigations in order to present some results that are possible to generalise. Additionally, the finalised conceptual model in the study provides insights to why the construction industry is lacking regarding SCI. The insights were developed through analytical reasoning that empower analytical generalisability to the extent that the findings could be transferred to other studies of construction industry development (Bryman & Bell, 2011).



4. Empirical Study

The empirical study differs from the previous chapters in terms of sources of information. Rather than studying academic research, this chapter focuses towards initiatives, experiences and opinions from professionals in the construction industry. The subjects have been divided into three categories (1) Organisations, (2) Main Contractors, and (3) Suppliers, and categorised based on their role in the value chain. Each category will be structured in three sub-chapters that aim to separately address one hypothesis. The objective is to present material that will constitute the foundation of the following chapters. The material will be compared towards the frame of reference in order to analyse and discuss the results, present findings and provide suggestions for future research.

4.1 Organisations

Organisations are defined as actors that do not have an operational part in CSCs. However, their work aims to improve the overall performance in the sector. In order to achieve their objectives, organisations provide tools and/or platforms that support the integration of supply chain actors. Rather than actors in the construction industry, they can be described as interest organisations that care about the results among operational actors in the industry. Four organisations have been subjects to the empirical research and will be referred to as ORG.1, ORG.2, ORG.3 and ORG.4.

4.1.1 SCI

Organisations have a unison opinion regarding the meaning of SCI. Although the formulations might differ, the general purpose refers to integration among partners in the value chain and to the most extent share and exchange information. In order to achieve integration ORG.1 highlights the importance of creating and presenting standards. Also, ORG.1 will adopt an active role that supports suppliers and main contractors to successfully implement the standards. ORG.3 and ORG.4 aim to improve a collaborative relationship between actors by enhancing the information flow. The information flow is accomplished by increasing the visibility of forecasts, orders, deviations, traceability, invoicing and follow-ups.

The organisations have identified a number of obstacles that prevent optimisation of integration and process development. ORG.1 suggests that the greatest implication refers to internal decision-making and determination to follow-through with commitments. Similarly, ORG.2 and ORG.3 emphasise the difficulties of reaching a collaborative environment where a holistic view is adopted. Sub-optimisation is found to be counter-productive and an approach aimed to enhance the entire value chain is preferred. On the other hand, ORG.4 believes that the greatest obstacles are to visualise the potential results as well as liberate time and fund resources. By overcoming these obstacles ORG.2 and ORG.3 believe that *real-demand* will determine the flow in value chains, which results in accurate and correct ordering as well as in mitigation of the bull whip-effect.

ORG.1 identifies the greatest benefits of improved integration as time saving, reduced lead times and fewer mistakes, while ORG.4 wishes to convert the decision-making from a short-term mind-set to a long-term approach.

SCI's positive effect on operational performance is indubitable among the organisations. However, NeR only addresses the rental segment, which is a small part of the entire construction industry. Therefore the potential effect on the overall operational performance could be limited. On the other hand, the initiative can acknowledge the possibilities that might be realised by increased integration and also work as a reference point for other segments and give valuable experience regarding the implementation process.

4.1.2 NeR

Organisations do not have an operational role in CSCs and are not a subject of the implementation of NeR or similar initiatives. Rather they aim to facilitate the process and provide support to suppliers and main contractors in order for them to successfully cope NeR with their day-to-day business. All organisations have a positive attitude towards initiatives that address issues of integration in general and NeR in particular. They all focus towards different activities:

- *ORG.1 strives to adopt a more active role in order to further support the implementation of NeR. In addition, they engage increasingly in the development the concept and focus towards easing the implementation process.*
- *ORG.2 works closely with both suppliers and main contractors with the objective to convey the positive aspects of NeR as well as mediate communication between them.*
- *ORG.3 engages in development and improvement of activates and argues that the initiative will demand change management through the value chain and affect the entire organisation.*
- *ORG.4 highlights the long-term view. Today, many companies apply their own tools, but in the long run standardisation will increase the transparency and thereby enable better forecasting. By educating employees and illustrating the benefits, ORG.4 encourages actors to adopt new initiatives that favour a long-term approach.*

Organisations play an important role with an unbiased point of view and knowledge about the potential benefits of increasing integration as well as the know-how of how to develop and improve the concepts.

4.1.3 Attitude

The organisations see NeR as a potential element that can increase the relationships between actors in the value chain. ORG.2 and ORG.4 highlights the standardised processes as a factor that increases the collaboration between suppliers and main contractors and can become important for suppliers to offer their clients. Implementing NeR can result in affections in supply chain operations. Both ORG.1 and ORG.3 acknowledge the potential automation of communicative processes. The execution of communication activities, such as calling and e-mailing, can be automatised and only require follow-ups in scenarios regarding insufficient invoicing. The outcomes are more efficient communication channels and less routine work. ORG.1 believes that less manual work and the removing of communication activities will increase the performance among all involved actors. Eventually this can be a cornerstone for future development and continuous improvement. A successful scenario can be used to illustrate an example and encourage other segments to engage in similar initiatives.

In addition to the operational barriers there are a few non-business related obstacles. ORG.3 highlights the complex situation concerning the amount of articles in the rental segment. What can be seen as only one article (e.g. a vacuum cleaner) could in fact consists of ten articles. The hose is one, the bag another, the lead a third and so on. This results in an immense number of different articles to categorise and also for the main contractors and suppliers to keep track of. To address the issue ORG.3 suggest increased communication by sharing plans and details of a project in advance, which allows both parties to act proactively. Additionally, in a scenario where the complexity is high it is important to know what you have rented and for how long. With the number of articles the difficulty increases and the demand for knowledge about specific products and when they are required needs to be further emphasised. This becomes an issue in the invoicing as well. A complex invoicing structure withholds the buyer from actually reading the content and results in increased errors in invoicing. As a solution ORG.3 suggest that customised *kit* should be offered. A *kit* would include everything that is needed for a specific activity and would only require ordering of a single article.

The organisations focus towards facilitating the process of implementation, which have lead them to encounter internal issues among suppliers and main contractors. ORG.2 suggest that the most critical aspect is the people behind every organisation. Ultimately it is the employees that will push the initiative though and the outcome is heavily dependent on their support. Additionally, ORG.2 believes that the most difficult part is to deal with people. Everyone has their own interpretation of how operations should be executed and which areas of improvement that should be prioritised. With that in mind, both inter-organisational and intra-organisational alignment is a must in order to achieve a successful outcome. ORG.3 believes that the attitude-related issues originate from the lack of focus towards improvement. Main contractors lack awareness and only wish the rental part to work seamlessly. Suppliers are under pressure from main contractors and are expected to reap the greatest benefits of initiatives like NeR.

Furthermore, ORG.4 suggests that efficient communication and enhanced coordination can result in timesaving by identifying mistakes earlier in the process. However, the potential cannot be reaped instantly, but rather a few years in the future. The situation is further implicated by the resources and time demanded to implement similar initiatives.

There are limited differences between the NeR standard this time compared to the last it was launched. ORG.3 believes that the most distinguishing aspect is the maturity of the end-users. The digitalisation has taken major leaps and the utility of digital tools are much more scattered, which could contribute to the attitude that employees adopt. Although many obstacles have been identified, ORG.1 highlights that similar attempts have been done in other segments with successful results. NeR has the same opportunities to success.

4.2 Main Contractors

Main contractors are characterised as the last entity of CSCs and perform the most value creating activity that finalise the end product. In order to accomplish that, they are dependent on suppliers that provide them with the proper tools for their operations. However, their magnitude distinguishes them from other actors and the importance of their assignments gives them power that they can exercise to push requests through. Three main contractors have been selected to this study. They will be referred to as MC.1, MC.2 and MC.3.

4.2.1 SCI

The main contractors perception of SCI is aligned with academic definitions and linked together. MC.1 thinks of SCI as processes and business systems that can easily be transferred from one actor in the value chain to another. MC.2 have a similar definition and believes that SCI is about building long-term relationships in order to sustain profitable contracts. This is achieved by transparency, supporting each other early in the process and focus on the overall process rather than price reduction. Accordingly, MC.3 emphasise transparency and improvement of information flow. Technical integration is seen as the crucial aspect. In summary, the general interpretation of SCI is building relationships and operating with transparency.

MC.1 highlights the importance of receiving information instantly. Before every project, they schedule a meeting in order to determine the responsibilities and ask for invoices. If this is executed successfully both parties have obtained valuable information already before the project starts, which enables better planning and allocation of resources. MC.2 and MC.3 discuss the benefits of automation. MC.2 has established an interface towards their suppliers, through a purchasing portal. Rather than placing orders over the telephone or by fax, it can be done in a standardised manner by using the portal. Similarly, MC.3 strives to establish standards in order to enable electronic invoicing and call-offs. By implementing electronic solution their systems are subjects to internal efficiency improvements as well as minimisation of manual changes and searches. However, the construction industry is based upon decentralised decision, which results in a few implications with this process. When the human contact is removed and everything is based on article number, the supplier has no knowledge about the context in which the customer plans to use the products. Without

knowledge about the context, suppliers are unable to correct mistakes or add necessary tools. The complexity of the situation is further aggravated by the shifts in the working environment and the immaturity of the construction industry. In general, no standards suit because the sector is too immature to use them (MC.3). The immaturity of the construction industry is a repeated subject regarding challenges. MC.2 does not see any issues regarding the IT infrastructure. The technical solution is already available, the problem is related to the implementation. By suggesting new IT solutions, a new way to perform business is proposed. The implications come with the attitude and adaptability towards the new working methods rather than providing the right systems. MC.2 sees main contractors as the leader of initiatives that address technical solutions, but also suggests that suppliers are more driven to reach a successful integration. Accordingly, MC.1 encounters no issues regarding SCI towards suppliers, but finds the internal challenges, such as to freeing resources and allocate them properly in order to support changes.

The greatest benefits from overcoming the obstacles are cost reductions. Cost reductions are suggested to arise from different sources. MC.3 highlights the minimisation of duplication, while MC.1 believes that transparency will enable comparison, which eventually lower prices. MC.2 elaborates further and accentuate higher efficiency as the reason to cost reductions. By standardising procurement methods and closer collaboration with suppliers, the performance can be improved and result in decreased costs.

The subjects highlight the complexity in the rental segment. Compared to other segments, it is more difficult to standardise methods in the rental segment. There is limited knowledge about the specifics regarding each article. The limited knowledge aggravates possibilities to work proactively and customise orders. Instead, ad hoc tasks increases. MC.2 mentions that there are not any similar initiatives to BEAst and NeR. Both MC.1 and MC.2 have some internal projects that use a higher level of technology. MC.1 have their procurement portal and MC.2 have a GPS-system that aims to track the usage of rental products and thereby increase the product knowledge (e.g. time a product have been rented). However, those examples are internal and not an initiatives that can be standardised and generalised across the entire construction industry. MC.3 further highlights the lack of competitive solutions to BEAst and NeR as an issue.

4.2.2 NeR

Main contractors have a positive attitude towards NeR and both MC.1 and MC.2 sees NeR as an important step and natural part of developing the business. However, MC.2 mentions that that NeR has not been paid full attention due to the limited time and resources. MC.3 has focused on their internal system, and NeR does not support that, which limits their possibilities to cope with the initiative. The engagement in the internal solution explains why they did not engage in NeR the first time. This time it is different, MC.3 is planning on engaging fully in NeR when it is launched again. MC.1 is focusing on facilities and transportation, which might limit their engagement in NeR, since they wish to completely finish those first. MC.2 considers the potential outcomes of NeR to be good, uppermost in

invoicing and administration, which motivates them to engage in the re-launch. In summary, the attitude and expected involvement from main contractors is positive and high.

In addition to the operational challenges, some organisational barriers have been identified. The employees involved in the project play a significant role and are critical to take into consideration. The construction industry is conservative, which further implicates the implementation process (MC.2). A measure to mitigate the human aspects is to illustrate the potential benefits of easier day-to-day work and less administrative work. If the involved employees can see the actual improvements, they will be more eager to adopt unconventional methods. MC.1 believes that suppliers have to take more responsibilities and push projects through as well as showing interest to try previously non-established means. On the other hand, MC.3 cannot see any great organisational obstacles. Some minor education regarding the systems will probably suffice as preparatory measures.

4.2.3 Attitude

All subjects agree that NeR would enhance their relationship with suppliers. MC.2 suggests that suppliers that engage in the NeR initiative will gain a competitive advantage towards their peers. The investment will pay off because main contractors will be dependent on the services that only the NeR-suppliers can provide. However, the advantage cannot sustain over time, eventually all suppliers can offer the same services when the method is a standard. Accordingly, MC.3 believes that NeR will have a positive impact on relationships and bring actors closer together. A similar scenario is expected to occur where digital solutions are standard. In that scenario, the environment will rather support shifts of suppliers, since everyone has the same standard and a change would not impact their operations or processes. MC.1 can visualise a scenario where NeR create a locked situation and main contractors are dependent on the suppliers that provide digitally standardised solutions. Main contractors and suppliers can establish close collaborations, an understanding of each other's and thereby be favoured in procurements and choices of supplier.

Another aspect to consider is the affection that NeR would have on main contractors operations. All subjects have a unison opinion that NeR would have an impact on the day-to-day business as well as that the outcome would be positive. MC.1 mentions the time saving factor and that standardisation liberates time to focus on other tasks, mainly by reducing work with invoices. MC.2 highlights the maturity regarding work processes. By using automation the level of maturity among actors in the construction industry will rise. Additionally, MC.3 believes that NeR would increase the handling of simpler tasks. Electronic processes make it easier and employees will have more knowledge regarding the rented objects. Conclusively, issues in terms of productivity and efficiency are addressed and treated by the implementation of NeR. The process of conducting business becomes more structured and streamlined.

When adopting digital initiatives, suppliers should not be seen as an e-business, but rather a total service provider. The trend today is towards taking on more responsibilities from the main contractor and manage rental of all necessary object and related services (MC.1). A suggestion to mitigate the problems is to use two different channels; one for ordering and one

for services. Usually, services are the complex issue that requires extended contact. Ordering is simpler and rarely results in a scenario that involves contact by telephone or other means. MC.3 agrees and mention that they seldom encounter any issues in terms of getting the product they need. However, they do require additional services in order to complete a successful order, usually by contacting the supplier and explaining the situation. The implications of ordering online increase when they have limited product knowledge and might need support from a more experienced supplier. MC.3 agrees with MC.1's suggestion of providing two different channels and elaborate further by suggesting that the more information a customer has regarding the products, the less incentives exists for human contact. MC.2 have a similar opinion regarding the complexity of the situation. Due to the engagement in internal initiatives the resources to allocate to external initiatives are limited. The results might be that actors do not commit to the implementation and do not put full effort into succeeding. MC.3 points to another aspect that implicates the situation. Main contractors have a mind-set that focus towards purchasing and if the systems do not cope with the buying process the risk of failure increases.

4.3 Suppliers

Suppliers are defined as actors that support main contractors with necessary products and services. There are different tiers of suppliers depending on their offerings and involvement with clients. The focus has been towards tier-1 suppliers, which are highly involved with main contractors and critical for them in order to execute their operations. However, one distinctive difference is suppliers' non-mutual dependence on main contractors. There is a restricted amount of main contractors, which limits the potential client base and results in a significant importance of every relationship. Four suppliers have been subjects to the study and will be referred to as SUP.1, SUP.2, SUP.3 and SUP.4.

4.3.1 SCI

The definition and concept of SCI is generally seen as the level of integration and inter-linkage between all entities in the value chain. The differences concern the nature of relationships between actors, and to what extent that relationship can be influenced. SUP.1 describes SCI as a concept to connect data between different partners, while SUP.2 focus more on the intangible connections between suppliers and customers. On the other hand SUP.3 suggests that SCI is a tool used to analyse and identify either synergies that can be realised or risks that might occur in the value chain. Additionally, SUP.4 believes that SCI will decrease the accumulated time a product exists in the value chain.

In practice there are two ways to integrate partners in the supply chain and thereby increase SCI. First, by using a digitally standardised platform in both purchasing from suppliers and in receiving orders from customers. All suppliers have implemented this method. Second, by focusing more on the relationship with partners in the value chain. SUP.3 illustrates this suggestion by sharing more information with partners the value chain, while SUP.2 is focusing on supporting the customers by complying with more responsibility in mutual projects. Both initiatives aim to better understanding the customer and support them to achieve efficient processes by decreasing time spent on non-value adding activities and also

enable suppliers to get a holistic view over the entire supply chain. The greatest challenge identified by SUP.1 is that all main contractors work differently compared to each other. This leads to difficulties for suppliers to keep track of what information that is required by the contractors. As a consequence, telecommunication is seen as the best method to correct mistakes and mitigate the risks of making another one. Furthermore, both SUP.2 and SUP.3 argue that the two main barriers to achieve a higher level of integrations are: *misinterpretation of the SCI concept* and *top-managements acknowledgement of the great improvements that can be realised from well-executed SCI initiative*. SUP.3 suggested that top-managements attitude have emerged from non-existing education and limited knowledge regarding SCI, in combination with a general conservatism in the construction industry. Furthermore, SUP.4 argues that the willpower for change among all parties involved is an important factor, otherwise initiatives for integration along the supply chain will fail. Additionally, SUP.3 highlights deficient information flow through the value chain as another area of improvement. Increased information flow is related to SUP.2's solution to a similar problem, where the supplier minimises shortage of information and thereby increases their involvement in customer-lead projects. The outcome is that SUP.2 can understand their customer's reality, while simultaneously is able to increase proactive planning and mitigate risk of delays and unnecessary costs.

All suppliers identify the benefits from SCI initiatives as increasing efficiency and lower overall costs in the supply chain. SUP.2 highlights the possibility to avoid both ad hoc ordering and the outcome where the quality of the end customer product decreases. SUP.3 argues that the internal efficiency is the most important outcome of improved SCI and originates from less time spent on duplication and routine businesses and SUP.4 further argues internal efficiency such as better warehousing and shorter lead times will be improved.

Increasing integration between supply chain partners is seen as a significant aspect for all suppliers. SUP.1 argues that increased integration will not affect the overall operational performance significantly, nor will it improve the financial results since new issues will occur. Another important aspect to have in mind when considering digitalised ordering is that ad hoc ordering might increase. The reason is that the complexity increases when some parts from the ordering process have been missed in the first stage and only noted when the projects starts. Similar scenarios would never occur if the supplier had been involved in the ordering process. Additionally, SUP.1 suggests that in order for the operational performance to be increased, the information flow and process of shared planning needs to be developed. The expected outcome is decreased ad hoc ordering. This is in accordance with SUP.3 arguments regarding the elements that have to be increased in order to improve the overall operational performance. Today, suppliers do not receive 100% of the planned activities, which limits their possibilities to perform better operationally. A scenario where suppliers possess the plans enable proactive work and mitigation of misunderstandings. SUP.4 identifies the same scenario and further describes the potential increased usage of all capacity available.

To summarise, all suppliers have the same interpretation of SCI and what it aims to improve, although through different means. In order to integrate supply chain partners, two means were identified; (1) using a digitally standardised platform in both purchasing from suppliers and in receiving orders from customers or (2) focusing more on the relationship with partners in the value chain. Furthermore, the two main barriers to achieve a higher level of integrations were identified as: misinterpretation of the SCI concept and top-management's acknowledgement of the great improvements that can be realised from well-executed SCI initiative. The information flow is seen as the major key for success in working with SCI initiatives and for the supply chain actors to be able to perform better by sharing of information along the chain.

4.3.2 NeR

Mistakes in the ordering process are a common problem that leads to duplication (SUP.2; SUP.3). All suppliers agree that those mistakes are often related to limited information and knowledge about the usage of goods or machines linked to different projects. According to SUP.2 the complex situation leads to necessary communication over phone in order to ensure all details and complementary products and thereby prohibit ad hoc ordering. This is a service that is difficult to provide over a standardised interface and one of the concerns that suppliers have regarding standardised ordering processes with limited supplier-customer interface. If ad hoc ordering cannot be avoided and equivalent information about customer needs cannot be obtained, integration initiatives might result in a worse situation than before.

All suppliers have made attempts to implement tools or processes in order to address the issues of insufficient SCI. SUP.4 does not see any organisational challenges, but SUP.3 highlights the importance of the awareness from top-management and their acknowledgement of the possible improvements that can be realised. Communication with top-management is seen as a step-by-step process where it is crucial to communicate success stories that illustrate the potential benefits. Therefore it is important to first implement the most value adding sub-processes, and when they have been implemented right continue with the remaining sub-processes (SUP.3). All suppliers have implemented, or have plans to implement, an internal standardised digital web-based platform where customers can create their orders over the Internet. Furthermore, SUP.3 relates to the issues of complex ordering and constitutes that the initiative would not work completely because of demand for direct human contact over phone or e-mail. Another aspect is the IT perspective of the problem, where it will be difficult to develop a function that includes all choices of gadgets to the machines. Additional communication is often needed in order to complement the original order. Otherwise, mistakes will occur due to limited knowledge and experience about the machines and gadgets that are needed for a specific project or task. SUP.2 explains the outcome by main contractors deficient insights regarding their complete needs.

When answering the question if NeR would improve productivity and efficiency in the CSC, three of four suppliers agreed, but with different ideas of the method. In terms of implementation of NeR, SUP.2 believes that it would be helpful to create underlays or basics for the operations day-to-day business. The potential effect could be increased efficiency through faster processes and less duplication in the contact with customers. However, SUP.3 does not believe NeR would have any direct impact on the supply chain operations or change any steps from today's supply chain. Rather it would change indirectly by providing digital solutions and decrease time spent on non-value adding processes. SUP.1 believe NeR would ease the integration of actors and get an enhanced understanding compared to today. SUP.4 identified the purchasing departments at MC as the only ones with potential improvements and could change in the way to do business.

When discussing NeR as a way to decrease the complexity in SCI and increase the integration between CSC partners SUP.1, SUP.2 and SUP.3 were positive to the NeR initiative. SUP.4 had concerns that it is too theoretical and will not work in practice. SUP.4 does not plan to implement NeR due to lack of time and resources, especially when the outcomes are unknown. The obstacle mentioned in regards to NeR was the degree to which standardised integration processes would replace inefficient communication over the phone. The suppliers identified different solutions to the issue:

- *Using it as an underlay and/or take over more of the responsibility over entire projects (SUP.2)*
- *Share more information of the process and not only complete the ordering, but rather share the plans of the entire project from the beginning, which would decrease the complexity for the supplier and support their performance (SUP.1, SUP.3).*

SUP.3 agrees that NeR will make it easier to work with all the customers since the idea is to work in a standardised manner. Furthermore, SUP.1 argues that NeR may encounter problems to succeed on this subject since every main contractor tends to add different applications to the regular standard and thereby customise every standard and disregard the initial objective. This is something that SUP.1 argues can increase the complexity in comparison to the *ideal standard* that NeR is aiming to implement. An idea is to complement and use RFID for the machines that main contractors are hiring, along with NeR. This would make it easier to share data regarding renting. The renting information is something both SUP.1 and SUP.2 identifies as a problematic issue in the invoice process and might lead to a scenario where the parties have different information regarding the amount of machines that were rented as well as the time they were on the project site. In line with this, SUP.4 believe it is important to view standardisation as a tool to decrease the complexity in the construction industry. SUP.4 claims the reality is different and planning machine logistics beforehand is nearly impossible since circumstances change and often you do not know what you need the next day. SUP.4 presents an analogy from the automotive industry:

“Compare to automotive, if you build a car and half way through the customer change model from wanting a sedan to a kombi or if you painting a car and it starts to rain in the middle of the process it would be difficult”.

The effect on relationships is seen differently among the suppliers. SUP.1 argues that it would neither affect the relationships positively nor negatively. According to SUP.1 NeR would lower the construction industry’s complexity through establishing a requirement for the industry’s participants and erase none serious actors. Companies that initiate the standardisation will have a competitive advantage and outperform outside competitors. SUP.2 argues that it would have a negative impact on building relationships and overcome complexity, since there will be less direct contact with the supply chain partners the outcome would risk a decrease in the service level provided. SUP.3 and SUP.4 believe that the effect, if NeR works as expected, would be positive in terms of decreasing the complexity of the construction industry. This rationale is that NeR will support the development of better partnerships with customers and thereby establish better contacts, while simultaneously decreases the complexity of the construction industry. To conclude, the construction industry is seen as a complex sector where unnecessary communication and the need of ad hoc ordering are common problems. All suppliers have worked internally to address complexity issues and insufficient SCI. To address these issues and implement initiatives to increase SCI, continuous communication with top-management and the day-to-day users are important. Also, providing well-functioning IT systems that are accessible for the user is imperative. All suppliers have implemented, or plan to address the problem by a web-based portal for customers. NeR is generally seen as a measure to address these problems, although there is a risk identified. Since all parties included tend to change something in the standard, it might differ among actors and thus not be a standard anymore. In the end NeR is identified as a great initiative that will enhance the relationships between actors in the construction industry.

4.3.3 Attitude

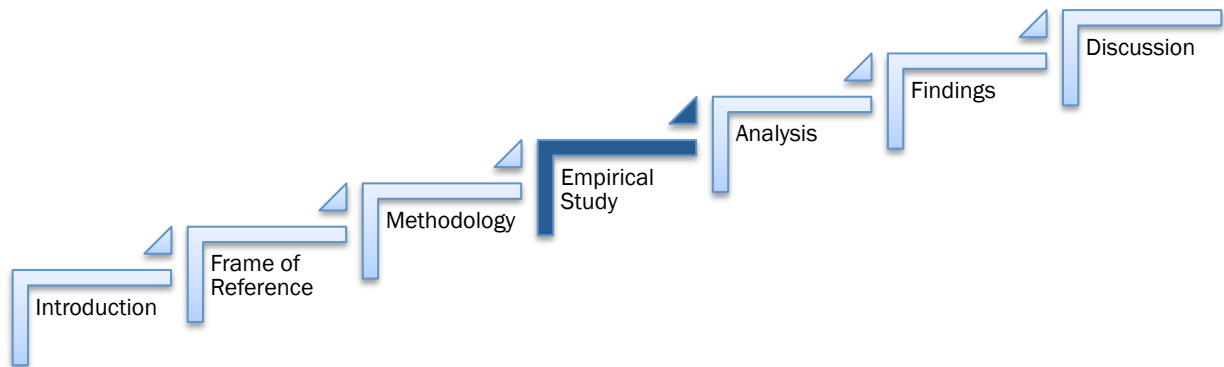
All suppliers mentioned that the construction industry is a conservative industry where attempts have been made to change existing processes, but with little or no success. SUP.3 elaborates on the importance of continuous internal information sharing of successful integration projects, both to top-management and downstream in the organisation. Changing the daily operations is not seen as a problem as long as the person doing the work can see the improvements. Furthermore, SUP.1 discusses important aspects to consider when implementing new integration processes and highlights the impact of prioritising within the organisation, reservation of time for the project and that the rest of the company present a will for change. These aspects are often created by early wins. SUP.2 mention conservatism as a major obstacle for change. A key success factor is to provide good support for the staff and rather include than overrun them. *“Be flexible for change and open for suggestions”* are the lead words for change according to SUP.2. This aligns with SUP.3’s mentions regarding the importance of top-management’s involvement and that the change management team are able to illustrate concrete examples of improvement. Further SUP.2 discuss the importance of the NeR initiative and that it is a win-win for the construction industry since it gives more power to the entire industry and allows all actors to follow and accept changes. SUP.3 mentions that

if BEAst and the NeR initiative were not planned, they would start working on a solution and start implementing standards towards their biggest customers internally.

SUP.1 and SUP.3's main explanations to why no real implementation occurred after the initial launch concerns limited interest internally in combination with lack of interest among external stakeholders. SUP. 2 had limited knowledge regarding the NeR initiative since there was no interest in changing the organisation at the time. There were several other reasons to why this initiative did not take place. SUP.1 also argues that it was because their customers were not implementing NeR and the supplier complies with customer demands. SUP.2 was not ready organisationally and did not see the positive outcomes, while SUP.3 discussed the initiative, but at the time the company engaged in several other projects that were prioritised. Furthermore, SUP.1 discuss the importance of *early wins*, which is communicated to all included partners and illustrate the potential benefits that can be realised. SUP.3 also mentioned another key success factor, which relates to a longer implementation period where changes can be done to the standard in order to achieve the full potential and find *the best practice*. Contradictory, SUP.1 argues that it is not an issue, as long as the IT works, possibly with the support of IT consultants. SUP.2 discuss the importance for everyone to adopt a comprehensive view, because if not, the synergies will not be realised. The scenario is further discussed by SUP.3, whom suggests that engaging employees and make everyone feel involved in the process of developing the best practice. From the IT perspective the main challenge, according to SUP.1 and SUP.3, is to create a platform that is usable for all parties and includes all necessary applications. SUP.1 mention the use of skilled IT consultants to support the organisations development. From the business side SUP.2 discussed the importance of transparency and understanding between the parties in the supply chain.

SUP.3 mentions that the organisation is more ready for projects with characteristics similar to NeR, and that the timing is better when it comes to technical and digital solutions. SUP.2 is not sure how much attention NeR will have internally since other projects are going on right now. Compared to the last time NeR was launched, SUP.3 can see the real improvements that can be realised, which is also what SUP.1 believes distinguish this attempt from the previous. Still, the risk of different standards can become a problem for change. That would lead to different types of flows of information needed and it will be hard to keep track (SUP.1). Another difference today, according to SUP.2, is that the main contractors have shown more interest, especially the organisations with younger employees have expressed interest in increasing the usage of telephone or computer. However, SUP.2 argues that in the end it is crucial to understand that it is still employees behind the screens, which is easy to forget. Ultimately it is they that will create the value, IT and is only a tool to help the employees create value.

To summarise the attitude among the suppliers, the important aspects to consider when implementing new integration processes is *the impact of prioritising within the organisation, reservation of time for the project and that the rest of the company present a will for change*. All suppliers mention that the conservatism is a major obstacle for change. Today, almost all suppliers agree that the organisation is more ready for projects with characteristics similar to NeR, and that the timing is better when it comes to technical and digital solutions. Although the timing is better for the IT solutions, in the end it is crucial to understand that it is still employees that performs the activities and they that create the value.



5. Analysis

The frame of reference constitutes the fundamental insights in the construction industry, where issues are highlighted and findings from previous researchers are presented. The analysis strives to compare the empirical study towards the frame of reference with the objective to test the hypothesis and answer the research question. Since the analysis becomes the foundation for the findings and discussion of them, this step of the thesis is critical. The analysis is structured to test each hypothesis separately in different chapters. Hence, each chapter will treat one hypothesis and be categorised in terms of each entity in the supply chain.

5.1 SCI

The following section aims to treat the analysis in regards of the first part of the interview guide. Each entity will be addressed accordingly and analyse the empirical study compared to the frame of reference. The objective is to find results that can be used in the findings in order to answer the research question and be able to either confirm or reject H_1 .

5.1.1 Organisations

Although organisations do not have any operational tasks in CSCs, they play an important role with their influence and knowledge. Researchers suggest that an essential measure towards improved SCI is sharing and application of information (Prencipe & Tell, 2001; Ayas & Zeniuk, 2001; Bröchner, 2005; Chang et al. 2015; Leuschner et al. 2013). Accordingly, organisations believe that an increased flow of information would enhance collaborative relationships, which consequently would impact SCI positively. Better information flow is achieved by increasing visibility of *forecasts, orders, deviations, traceability, invoicing and follow-up*. By allowing subsequent actors to take part of information they are able to minimise procurement and delivery errors as well as decrease administrative tasks and transaction costs. (Barlett et al. 2007). The reason why CSC actors cannot share information is hypothesised to be the project-based environment. A common issue in project-based environment is that there is no coherent strategy and that the focus is restricted towards short-term acquisitions without a holistic view or long-term approach (Cox et al. 2004). Additionally the situation implicates coordination and communication, which increase the difficulty of reaching better information flow (Chan et al. 2004). The organisations confirm that CSC actors work with sub-optimisation where a holistic view and long-term approach is neglected. They believe that this mind-set can be one of the factors that prevent actors from achieving top-level integration. Contradictory to the theory, organisations also highlight another factor that influence the situation. They have identified a problem where actors do not follow through on their commitments. The rationale behind the behaviour is that actors do not have the ability to visualise the potential benefits of changing their operations and that there is neither time nor resources to spend on change initiatives. There are two outcomes that prevent actors from engaging in change initiatives. Either there is not enough incentives to even start, or they launch an initiative but do not fully commit due to limited resources and eventually fails.

5.1.2 Main Contractors

Main Contractors general interpretation of SCI is aligned with the academic definitions and confirms that the subjects possess a deep knowledge regarding the topic and can provide valuable insights as well as have an idea of how SCI should be achieved and improved. The actors have identified three measures as key factors to achieve a better-integrated supply chain; *technical solutions, an established interface and proactive working methods*.

These measures are related to researchers findings that focus on the importance of information sharing and transfer of know-how in order to increase SCI (Prencipe & Tell, 2001; Ayas & Zeniuk, 2001; Huo, 2012; Sahlin-Andersson, 2002; Huo et al. 2015). Additionally, suppliers are encouraged to be involved earlier in the process in order to obtain a better understanding of the entire process (Cox & Ireland 2002; Bankvall et al. 2010; Cheng et al. 2011; Adams et al. 2014; Mellat-Parast & Spillan 2014; Segerstedt & Olofsson 2010). The issues arise in terms of execution of the measures. Main contractors wish to receive as much information as possible before a project starts in order to work proactively during the entire project and enable more effective management of activities (Leuschner et al. 2013). It is hypothesised that the project-based environment prohibits the execution, however the empirical study highlights the complexity of CSCs as the main influencer. The reason why information cannot be shared in advance is not dependent on the fact that CSCs are temporary systems (Sydow et al. 2004; Aloini et al. 2012) or that the characteristics differ from a static and more predictable supply chain (Scarborough et al. 2004). Rather the complexity of CSCs in general and the rental segment in particular is seen as the main causes.

Procurement of rental products is difficult due to the number of articles and their relation to each other. The results are limited knowledge regarding the products and their functionality. Hence, the process demands increased human contact in the ordering and service processes. Dealing with people is a complex issue (Jacobs et al. 2016; Chang et al. 2015) that aggravates the execution of information sharing in advance as well as establishing interfaces and technical solutions. Additionally CSCs are managed in a decentralised manner, which limits the possibilities to effectively control and manage processes. These two aspects are considered as critical in order to operate a complex supply chain (Barker et al. 2000) and also prohibit suppliers from engage earlier in the value chain.

5.1.3 Suppliers

When discussing SCI, all suppliers describe it as the level of integration and inter-linkage between all entities in the supply chain. The description is linked to theory where SCI is defined as close relationships between actors in the supply chain, both intra-organisational and inter-organisational (Huo et al. 2015; Leuschner et al. 2013). In theory barriers to achieve SCI have been identified as *lack of knowledge sharing within the organisation* (Prencipe & Tell, 2011; Ayas & Zeniuk, 2001), *the complexity of project-based nature* (Cox & Ireland, 2002; Dubois & Gadde, 2002) and *issues in project-based environment due to the absence of coherent strategy with an holistic view and long-term approach* (Cox et al. 2004). Barriers identified in the empirical study are a *misinterpretation of the SCI concept* and *lack of top management's acknowledgement of the great improvements that can be realised from well-*

executed SCI initiatives. These barriers were identified as outcomes from limited knowledge and a general conservatism in the construction industry. Suppliers believe that increasing SCI is an important subject where different initiatives have been launched, in which suppliers expect increased information flow and shared planning in order to address common issues in CSCs. Increased, SCI is identified to improve coordination and integration, which would result in information sharing (Bröschner, 2005; Huo, 2012; Huo et al. 2015) and longer length of relationships where trust is an important factor (Davis, 2008). Common issues in project-based environments are that there is no coherent strategy and short-term acquisitions without a holistic view (Cox et al. 2004). Also, a general problem is lack of involvement from the suppliers (Fearne & Fowler, 2006). Additionally, increased involvement of suppliers in CSCs, where suppliers start to involve themselves in the project at an earlier stage would enable them to learn about the end customer's requirements (Cox & Ireland 2002; Bankvall et al. 2010). Suppliers do not receive 100% of the planned activities and information regarding them, which limits their possibilities to perform better operationally and rather end up focusing on sub-optimising their acquisitions. Suppliers argue that it is imperative for them to get a holistic view over the entire CSC in order to enhance their performance in terms of involvement in customer-lead projects. However, it is difficult since the interest is not fully coped among main contractors, which results in limited time and resources that impedes them from succeeding in this matter.

Initiatives that have been taken to increase the SCI by the suppliers are identified as increasing II. This is the most important factor among suppliers since it has the greatest influence on overall firm performance (Huo, 2012; Zhao et al. 2013), while EI only has an indirect positive effect on company performance (Huo et al. 2015). Companies with high degree of II are more likely to improve customer integration and influence schedule attainment as well as customer satisfaction. Suppliers argue that II is the most essential factor and leads to better coordination and collaboration in-house. In addition, lead-times are also expected to decrease. All suppliers have implemented or plan to implement a standardised digital platform that handles all purchasing processes for their customers. This is a procurement-related factor and one of the CSF's for increasing SCI in construction projects that will make the suppliers work in their business processes more efficient (Chen et al. 2004).

5.2 NeR

Similar to the previous section, this part aims to analyse the results from the second part of the interview guide and compare the results towards the frame of reference in order to find and answer to the research question and either confirm or reject H₂.

5.2.1 Organisations

The effect of change initiatives in general and NeR in particular is positive in terms of operational performance. Organisations expect the outcome to be *time saving, reduced lead times and fewer mistakes* as well as convert the *decision-making from a short-term mind-set to a long-term approach*. However, main contractors and suppliers have not successfully executed the initiatives and kept operating inefficiently and unproductively. The hypothesised reason is the complex environment of CSCs (Cox & Ireland, 2002; Dubois & Gadde, 2002), where know-how of operational excellence and project execution is tacit and therefore difficult to transfer (Sahlin-Andersson, 2002). In addition, control and management of key processes are two critical factors in order to operate a CSC effectively (Barker et al. 2000) and further aggravated in a complex environment. The organisations have highlighted difficulties with *change management and education of employees* during the implementation process with main contractors and suppliers. These factors have significant influence over execution of key processes and transfer of knowledge. If they are not performed properly, achieving a high level of integration, both internally and externally, is problematic. The issue has not been a lack of focus towards mentioned factors, rather the unsatisfactory results originate from implications with the execution. As organisations strive towards facilitating and mediating the implementation process, the outcome explains why organisations have decided to *take a more active role, work to convey the message with change initiatives and educate the employees*. By giving support to the actors, organisations hope to address the issue of supply chain complexity in order to overcome the obstacles and allow them to implement NeR and other unconventional initiatives.

5.2.2 Main Contractors

The consensus of NeR is genuinely positive among main contractors and considered as an important step toward developing the construction industry. *Technical solutions and an established interface* are two factors that are believed to facilitate the implementation and thereby enhance SCI among actors in the construction industry. In theory NeR fulfils both objectives, although some implications exists in practice.

A repeatedly discussed subject is the available resources, mostly in terms of time. Due to time limitations the situation has resulted in a trade-off regarding which activities to engage in. The decision has regarded whether to invest in II or EI, where the outcome often has been II. II is structuring of strategies, practices and procedures in-house and reach collaborative and synchronised actions (Huo, 2012; Huo et al. 2015; Zhao et al. 2013), characteristics similar to an internal procurement portal or tracking system. Contradictory, NeR is characterised as EI, where focus is towards outside partnerships and the capability to collaborative with them and together execute processes (Huo, 2012; Huo et al. 2015; Zhao et al. 2013). The decision is rational in a theoretic point of view, where II is found to have a direct impact on SCI, whereas

EI only have an indirect impact by enhancing II and thereby affecting SCI (Zhao et al. 2013; Huo et al. 2015). More importantly, there are environmental aspects that influence the decision-making.

In terms of technical adaptability, the construction industry and rental segment is immature and behind. Since change management is accomplished by people, their involvement and determination is imperative to the outcome. EI demands involvement of multiple entities and thereby an immensely increased amount of relevant employees. II on the other hand, only refers to internal systems and processes, which decreases the complexity and thereby becomes a more attractive investment opportunity. Furthermore, a strategy that targets II and employee commitment simultaneously is to favour since they mutually reinforces each other's and improves the integration (Alfalla-Luque et al. 2015).

5.2.3 Suppliers

CSCs are highly complex due to the compound of products needed and systems used. Compared to other value chains, the complications of executing proper supply chain improvement and alignment of processes is greater in the construction industry (Sydow et al. 2004). In the empirical study the suppliers argue that mistakes in the ordering process is a common problem that derives from the complexity and leads to duplication. This problem is an outcome of limited knowledge and experience regarding the different articles that a projects needs from the main contractors. Therefore, the demand of direct human contact over the phone increases. As the demand for human-related services increases, so does the inefficiency.

The suppliers argue that limited possibilities for information and knowledge sharing lead to these issues. Issues that arise from the complexity are capturing knowledge and share that both within and outside the organisation, as well as apply it to similar projects (Principe & Tell, 2001; Ayas & Zeniuk, 2001). This also leads to decreased information flow between actors, where exclusion of information and trust is the most problematic issues (Davis, 2008). NeR is presented to address this problem by describing the process and enables visible information sharing to subsequent actors that can use the information to improve their operational performance and SCI (Fredholm, 2009). When discussing NeR, the majority of the suppliers think it will improve efficiency in CSCs and increase the information and knowledge sharing. This results in *more efficient processes, less duplication and decreased time spent on non-value adding processes*. The limitations or risks with SCI initiatives such as NeR is to which degree NeR can take over inefficient communication channels without causing new problems (e.g. missed orders).

The construction industry is identified as fragmented and adversarial with increasing difficulties to improve efficiency and productivity (Chan et al. 2004). A risk identified in the empirical study is that main contractors will have different applications added to the regular standard. The outcome could be contradictory to the objectives and rather increase complexity of information flow since the standard will not be *industry standard* anymore. To mitigate the risk of this scenario, the suppliers suggest that a platform usable for all parties should be

implemented by all entities in CSCs. In order to increase SCI, supplier driven integration strategies (Vrijhoef & de Ridder, 2005) and partnering in CSCs (Segerstedt & Olofsson, 2010; Briscoe & Dainty, 2005) are keys to success. The rationale is that NeR will support the development of better partnerships with customers and thereby establish better contacts, while simultaneously decreases the complexity in the construction industry.

5.3 Attitude

The chapter is concluded by an analysis regarding the third part of the interview guide. In accordance with the structure of the entire chapter, the empirical study will be compared to the frame of reference with the objective to answer the research question as well as test H_3 in order to either confirm or reject it.

5.3.1 Organisations

Information exchange is a prerequisite for SCI and enables effective management of activities (Jacobs et al. 2016; Leuschner et al. 2013; Liu et al. 2013; Chan et al. 2004). Absence of coordination and communication is a barrier to information sharing and thereby proper forecast of future demand (Arshad et al. 2014; BEAst, 2016c). Accordingly, organisations believe that NeR is an element that improves relationships between actors. In turn, the increased relationships would result in better integration among entities in the value chain. The communication process would also be more efficient and rental activities could be automatised and removed. This outcome would address the issues regarding CSCs compound and complexity (Scarbrough et al. 2004) as well as minimise the amount of situation where actors detect a problem that they did not cause and therefore do not know how to solve (Vrijhoef et al. 2001; Vrijhoef & Koskela, 1999). Redundant activities would be removed, which reduces the complexity and possible management errors. However there are a few aspects that impede CSC actors from implementing NeR.

An aspect restricted to the rental segment is the number of articles and article numbers. Not only are CSCs complex in nature, but also further provoked by this condition. As the complexity increases, so does the demand for human contact and requirement for assistance. Theory states that streamlining employee management is imperative to achieve a collaborative environment (Huo et al. 2015; Leuschner et al. 2013; Chang et al. 2015). Additionally, organisations define *employee management* and *attitude* as the most critical aspects in the implementation processes. Organisations believe that there is a lack of both factors among main contractors and suppliers. Main contractors are not aware of the need of change and only wish the supply chain to work seamlessly. The employees cannot visualise the outcome or benefits and therefore do not acknowledge a need. Since main contractors often are the only entity with accountability over quality control (Dainty et al. 2001; Aloini et al. 2012; Vrijhoef & Koskela, 2000) their acknowledgement is crucial in order for the implementation to succeed. Ultimately, gaining attention from all involved actors, enlighten them to the potential benefits and engage them in the process should be seen as the key activities in almost any change process. If not, the process is most likely to be failed, whatever the initiative concern.

5.3.2 Main Contractors

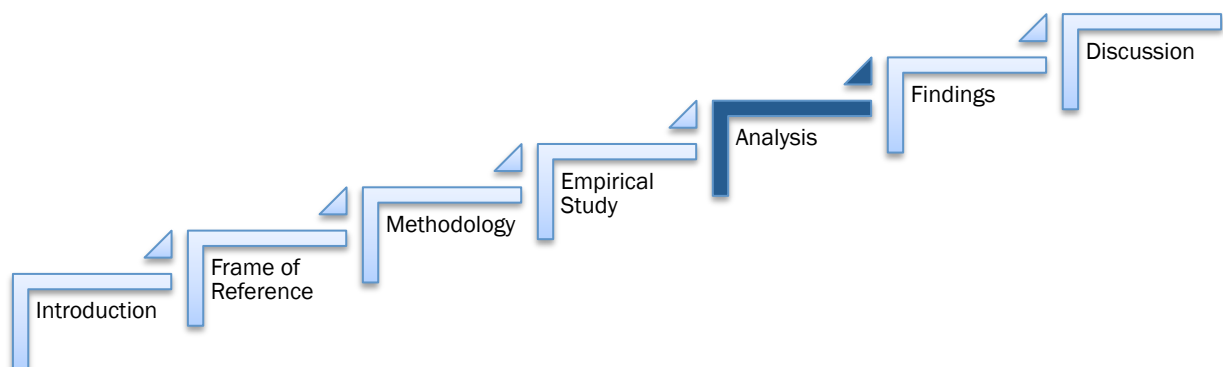
All subjects agree that a successful implementation of NeR would enhance their relationships with suppliers and that early adopters will gain an initial competitive advantage. Additionally the potential impact on operations is seen as positive, which would result in higher levels of efficiency and productivity. Close, collaborative and long-term relationships between actors in CSCs are important in order to achieve increased SCI (Briscoe & Dainty, 2005; Segersted & Olofsson, 2010; Eriksson, 2010). Accordingly, NeR should be highly interesting for main contractors and an excellent tool to increase the level of commitment with their suppliers. On the other hand, a contradicting scenario where everyone uses the same standards and a shift of supplier would not have any impact on the operations is presented. That scenario is in a long-term perspective and not considered as relevant today. The obstacles are related to the implementation process and actual usage of the standard.

Two aspects are highlighted in terms of implementation and usage; *supplier involvement* (Vrijhoef & Koskela, 2000) and *employee commitment* (Huo, 2012). Supplier involvement focuses towards committing them to take greater responsibility and engage earlier in the process (Cox & Ireland, 2002; Bankvall et al. 2010; Cheng et al. 2011; Adams et al. 2014; Mellat-Parast & Spillan, 2014), while employee commitment concerns their attitude towards an assignment (Alfalla-Luque et al. 2015). In order to reap the potential benefits from NeR and thereby enhanced SCI, execution of mentioned aspects is critical. However, the attainment of such is not sufficient. The construction industry and rental segment are seen as too immature to adapt to unconventional measures instantly and explains why employees are reluctant to usage of unproven methods. Involving suppliers earlier in the process further increase the complexity of the value chain and flow of goods and information by adding a service-activity. Committing, and successfully conducting, the additional activities simultaneously as the original are a challenging task that not many suppliers can achieve. The outcome is limited commitment and involvement from both suppliers and employees, which impede actors from obtaining higher levels of integration.

5.3.3 Suppliers

The construction industry is identified as having a lack of will to implement innovative solutions in order to obtain integration (Briscoe & Dainty 2005; Bankvall et al. 2010). Suppliers state that the construction industry is conservative, where attempts have been made to change existing processes, but with little or no success. The failure is dependent on limited internal interest, but foremost due to the lack of interest among main contractors. The suppliers state that it is important for main contractors to be involved and initiate changes. In theory main contractors are recognised as the foremost accountable over construction projects and CSCs (Briscoe & Dainty, 2005). The Department for Business, Innovation & Skills (2013) illustrates the importance of some vertical integration, where main contractors should take the overall responsibility and act as an integrator.

To successfully increase SCI in CSCs, internal information sharing is important for further successful integration outside the organisation. To be able to do this, awareness from top management is essential according to the suppliers. The reason is that they manage and control the organisation and without good change management, transformation is difficult to achieve. Further discussing change, suppliers state that it is important for employees to see the benefits for both the organisation and their personal day-to-day work. It is important to understand that it is employees that are adding the value to the processes and not the IT systems. Therefore, it is imperative to help them succeed in changing their work and engage employees to contribute with suggestions for improvements, integrate them in the process and make them feel involved in the implementation. In theory, it is stated that it is the people involved in the value chain that executes all activities and that the human aspects is important for successful SCI execution. Dealing with people is a complex issue where commitment and involvement is important in order to achieve long-term goals (Chang et al. 2015). The suppliers conclude that for SCI to work in CSCs it is important that the willpower for change exists within all entities. The difference today apart from earlier is that it is better timing with technical and digital solutions. There are two important initiatives integrating partners that the suppliers have issued: (1) providing a digital standardised purchasing platform for their customers and (2) working more on the relationships between actors by taking more responsibility. Most of the suppliers are in the forefront in CSCs working in regards of the actions, but face little support from main contractors. Suppliers increased involvement in the decision-making process gives them the holistic view that results in more effective CSCs facilitated by close relationships, both intra-organisational and inter-organisational (Arshad et al. 2014; Zhao et al. 2015; Leuschner et al. 2013). Furthermore, one of NeR's goals is to provide a business description to enforce a standardised method of exchanging information between suppliers and main contractors, which should enhance and support collaboration.



6. Findings

The following chapter is based on the results from the analysis and structured to first address each hypothesis and determine if it should be confirmed or rejected. Subsequently, the objective is to use the outcome of the hypothesis in order to present conclusions regarding the research question. The results will then be used as material for a discussion regarding theoretical contributions, managerial implications, limitations and future research.

H₁ Insufficient SCI in the construction industry is a result of its project-based nature

The project-based nature is expected to impact the comprehensive mind-set of CSC actors and result in counter-productive actions in terms of efficiency and productivity. Additionally, the project-based structure is anticipated to prohibit CSC actors from reaching a higher level of information sharing and collaborative relationships, which are essential factors in order to achieve a better-integrated supply chain. The results confirms that the project-based nature leads to a focus towards sub-optimising processes as well as neglecting a holistic view and long-term approach. However, these reasons only partially explain the deficient SCI. The greatest implications arise during the execution of activities and are related to *CSC complexity* and *employee commitment*. An employee that cannot visualise the potential benefits from a change is more reluctant to commit to the process. In addition, procurement of rental products is a complicated task that requires deep knowledge regarding the product elements. The conclusion is that the combination of these two aspects is a significant explanatory factor to inefficiency and unproductivity that leads to insufficient SCI in the construction industry. Hence, *H₁ is rejected*.

H₂ Insufficient SCI in the construction industry is a result of the supply chain complexity

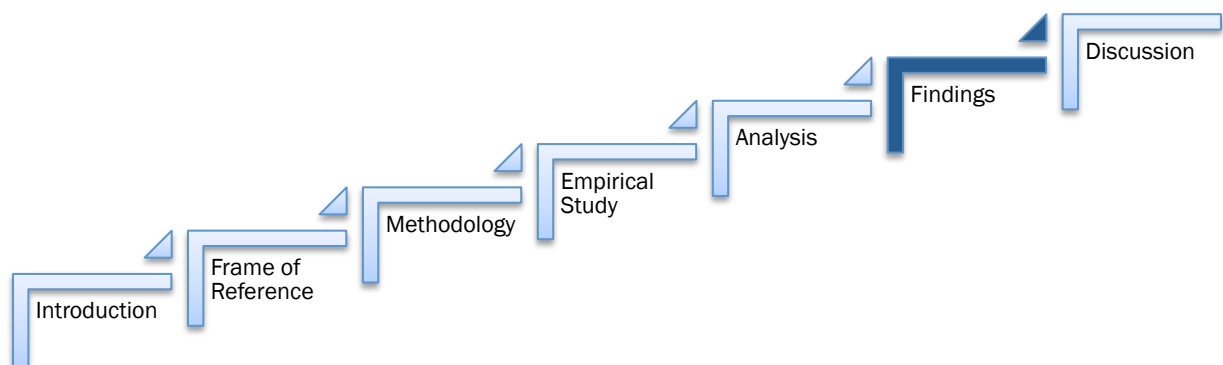
The elements of CSCs are seen as more complex than their peer industries and hypothesised to be an explanation to the unsatisfactory integration between entities. In order to reach a high level of integration, execution of key processes and transfer of knowledge is critical. Two factors that have significant influence over these activities is *change management* and *employee education*. The conclusion is that performance of both factors is impeded by CSC complexity. The rationale is that the construction industry and rental segment is immature and behind in terms of development and implementation of new methods. Both factors are dependent on human aspects and thereby employee involvement and engagement becomes imperative to the outcome. CSC complexity results in an increased demand of human contact during execution of procurement activities, which leads to implications with implementation processes. Procurement activities in the rental segment become highly complex due to the immense number of articles existing and their relation to each other. Without product specific knowledge and information regarding the use, errors occur more frequently. Therefore, the human contact in the ordering process is essential. Changing the standardised working methods as well as learning about the products is difficult and limits the potential of implementing unconventional initiatives. Hence, *H₂ is confirmed*.

H₃ Insufficient SCI in the construction industry is a result of the unwillingness to acknowledge the need of change

Reaching a higher level of SCI demands change and change is driven by people, which motivate a hypothesis that address the attitude towards transformation. Absence of coordination and communication is a barrier to information sharing as well as forecasting future demand and thereby also a barrier to enhanced SCI. Both coordination and communication is mediated by the *attitude among employees* and *management of employees*. In order to improve SCI, acknowledgement from all entities is critical. Acknowledgement is not limited to the operational workforce, but awareness from top-management is also essential. In terms of external factors, involving suppliers earlier in the process is expected to result in a better-integrated supply chain. However, the results define the performance in all mentioned aspects as unsatisfactory. Suppliers are unable to perform their original tasks simultaneously as new commitment, top-management pays little attention to change initiatives and overall the construction industry is identified as too immature and incapable of adapting to new conditions. Hence, employees become reluctant to accept changes and present an unwillingness to transform. In addition, the construction industry is highly conservative, which further aggravate the difficulties of implementing unconventional methods or initiatives and increase the unwillingness to change. Thus *H₃ is confirmed*.

Is poor performance in the construction industry related to absence of sufficient SCI among actors across the value chain?

The construction industry is indubitably suffering from poor performance and the level of SCI among actors has been investigated as an explanatory factor. With the results from this study, two out of three hypothesis regarding the aspects that influences SCI have been confirmed; *CSC complexity* and *unwillingness to acknowledge change*. By confirming at least one hypothesis the ultimate conclusion must be that poor performance in the construction industry is related to absence of sufficient SCI among the actors across the value chain.



7. Discussion

The discussion is the concluding chapter of the thesis and will aim to further elaborate on the findings in order to suggest how the results should be interpreted and used. Four different aspects will be addressed with the objective to contribute to both the academia and the construction industry. The academic point of view concerns the contributions that the findings provide and suggest the most suitable approach to use them as a foundation for future studies. The limitations of the results will be discussed in terms of generalisation across segments as well as entire industries. In addition, the potential use for the construction industry will be highlighted.

7.1 Theoretical contributions

By testing a number of hypotheses, the main academic objective with the study is to determine if poor performance in the construction industry is a product of insufficient supply chain integration. Second, the outcome of the hypothesis is used in order to exclude theories that lead to deficient supply chain integration. Two out of three hypotheses have been confirmed, which ultimately means that the research question is affirmative. If at least one hypothesis could be confirmed, that would result in an affirmative conclusion. The reason is that at least one factor related to supply chain integration would have significant impact on the outcome of supply chain performance and thereby partially explain the insufficient results. By concluding that absence of supply chain integration is related to deficient performance in the construction industry, a problem with great socio-economic influence and monetary value is highlighted and encouraged to be treated further in order to develop the construction industry and eventually improve the results. The outcome of the hypothesis allow future researcher to narrow their focus in coming studies. Previously, the project-based environment has been paid wide attention as it has been seen as one of the main causes to unsatisfactory supply chain integration. With the rejection of H_1 researchers can limit their focus towards the project-based environment and thereby enable more efficient allocation of resources to areas with higher relevance and support development of the construction industry. Still, two hypotheses have not been rejected yet and demand an extended focus to either find results that support a rejection, or present findings that mitigate the problem.

7.2 Managerial Implications

The greatest managerial implications refer to the trade-off between internal integration and external integration. Due to limited resources for construction supply chain actors lead them to not been able to focus on internal integration and external integration simultaneously, which have resulted in a favour towards internal integration. The decision is rational in both a theoretical and operational point of view since internal integration has higher impact on the performance as well as less implications regarding implementation. However, the development of maturity in the construction industry has resulted in a trend with shifting focus from internal integration to external integration. Many actors have acknowledged the potential benefits of complementing internal integration with external integration and thus given more attention to activities that involve external actors. The scenario explains the limited engagement in Nordic e-Rental during the first launch and implies that a second

attempt would have higher probability of succeeding. One of the most motivating factors for implementing Nordic e-Rental would be the elimination of redundant activities, which allows focus on key operations and minimise human errors. A barrier towards achieving the benefits is the procurement complexity. The main concern regards the complicated structure of products. One suggestion to mitigate the complexity is to offer a complete *kit*, i.e. rather than offering ten different articles that compound a single product, they should be offered as a *kit* that includes all the needed articles. This measure would decrease the number of ordering errors and thereby minimise the need of human contact, which eventually would result in streamlining of operations and improvement of both efficiency and productivity. In an environment where implementation of unconventional initiatives is complicated and further aggravated by undertaking multiple commitments simultaneously, focus should be towards finishing the most value adding activity first and then continuing with the second most value adding. By systematically processing one initiative after another, construction supply chains can achieve better result instantly as well as increasing the possibility of implementing several initiatives by creating an less complex environment.

7.3 Limitations

The results have a number of limitations regarding the academic findings as well as construction industry effects. First, the case study is focused on the rental segment within the construction industry. The rental segment is different compared to other areas in the construction industry and concerns hiring of objects rather than typical buy and sell transactions. The implications might occur in terms of generalising the findings to construction theory and industry practices due to the distinctions between business processes in rental and other segments. There might be more long-term incentives within rental since the entities work together during the rental period rather than solely focus on single buy and sell activities. Ultimately, the potential limitations across the construction industry are restricted to the segment related differences.

Second, the hypotheses refer to specific business characteristics and can only be applied to industries with similar elements. The findings conclude that insufficient supply chain integration is not dependent on the project-based environment, but rather affected by the complexity and unwillingness to change. In turn, industries that posses these characteristics have to assess how similar they are to the Swedish construction industry in order to use the results as a determining or guiding reference point. An example of that could be the medical and hospital purchasing industry, where buying or renting complex machines with gadgets is a difficult process that can have serious consequences if it is not performed properly (McCrum et al. 2014).

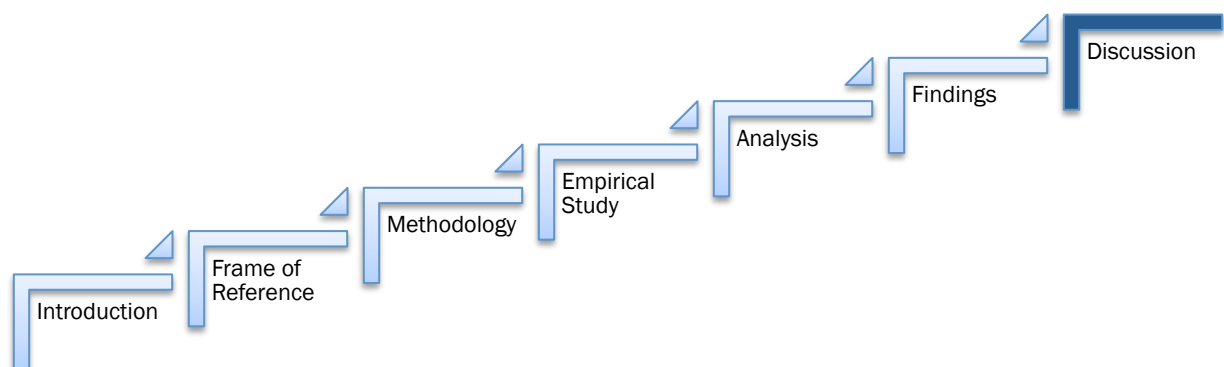
Third, the level of significance regarding acknowledging employees commitment and willingness to change might differ depending on the complexity of the industry. The finding can be generalised, but only to other highly complex industries. In a less complex environment the trade-off between internal and external initiatives might not be as distinctive. Furthermore, the empirical study only includes large companies, and did not address smaller or local companies, which limits the findings to only be generalisable to smaller organisations

within the construction industry. Also as identified in existing theory, the construction industry is widely different between countries and regions and therefore these findings can be limited to the Swedish context.

7.4 Future Research

Rejecting H_1 and conclude that the project-based environment is not the reason for insufficient supply chain integration in the rental segment makes it interesting to test other project-based industries and investigate whether the finding is restricted to the construction industry or can be applied to all segments with similar characteristics. A suggestion is to study a temporary outsourced manufacturing strategy in the pharmaceutical healthcare research sector, which has similar elements in terms of the project-based structure (Strategy+Business, 2015). H_2 and H_3 could not be rejected based on the findings in this research. However, this does not mean that the findings are completely exhaustive. Rather the results motivate further studies that test the hypothesis. By addressing the same hypothesis repeatedly the credibility increases and might lead to further insights that provides solutions to the problems. Both the frame of reference and empirical study highlights the complexity of reaching a high level of supply chain integration. The results imply that information sharing is a paramount factor to successfully achieve supply chain integration. A suggestion to address this issue is to explore the possibilities to improve the situation by using new technology, such as RFID. Further research regarding the subject would be an area of interest for future studies. The potential outcome would not only help the construction industry to develop set ups for jointly accurate data processes for all parties involved in the renting process, but also support other industries in how to set up sufficient information sharing processes throughout the supply chain.

Conclusively, another finding that is not related to the research question has been encountered. Previous research highlights three main stakeholders in the construction industry, however this study implies that another actor should be added. Interest organisations do not have an operational role in construction supply chains, but still influence the development of processes and working methods. By identifying organisations significance, a previously untapped source of influence has been discovered. The finding motivates further investigation in order to determine the potential use of organisations in order to address the issues of inefficiency and unproductivity.



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Appendix

Interview questions

The questionnaire includes 16 questions with some additional follow-ups. The questions may be rephrased depending on previous answers. There are three categories that divide the questions based on the relation to the research question and hypothesis. All answers will be anonymous in the paper, both regarding the company and the respondent.

SCI

- What do you define as Supply Chain Integration?
- How do you operate in order to integrate your Supply Chain partners?
- Which are the greatest challenges to successfully integrate your Supply Chain partners?
- What do you see as the greatest benefits of improved integration?
- Do you believe that your overall operational performance could be significantly improved by increasing the integration with your Supply Chain partners?
- Have you engaged in any initiatives that aim to address the issue of Supply Chain Integration?

NeR

- What do your company think about the concept of Nordic e-Rental?
- Did you engage in implementing NeR when the initiative was launched?
 - Do you plan on engaging when the initiative is re-launched?
- Were there any organisational challenges when implementing NeR?
 - Do you see any organisational challenges when implementing NeR?
- From your perspective, are there any issues in terms of standardisation when implementing NeR?

Other

- How have your relations with other Supply Chain actors been affected by NeR?
 - Could NeR improve the relationships?
- How would your supply chain operations be affected by implementing NeR?
- How has the amount of time spent on routine business been affected?
- Do you think NeR could improve the productivity and efficiency in Construction Supply Chains?
- Have you encountered any other non-business-related challenges during the integration process?
 - Do you recognise any potential non-business-related barriers to the integration process?
- Have you received any feedback on the NeR initiative?
 - What do you think would be the feedback?