Linköping Studies in Science and Technology. Thesis No. 1753
Licentiate Thesis

# Exploring Third-Party Logistics and Partnering in Construction

## A Supply Chain Management Perspective

Andreas Ekeskär

LINKÖPING UNIVERSITY

**Exploring Third-Party Logistics and Partnering in Construction – A Supply Chain Management Perspective**

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This is a Swedish Licentiate Thesis. The Licentiate degree comprises 120 ECTS credits of postgraduate studies.

ISBN 978-91-7685-746-5
ISSN 0280-7971

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SE-601 74 Norrköping, Sweden

Printed by LiU-Tryck, Linköping, Sweden, 2016

# Abstract

The construction industry is associated with problems such as low productivity and high costs. This has been highlighted in several government-funded reports in both Sweden and in the UK during the course of over two decades. The construction industry is a large industry sector employing hundreds of thousands and a large contributor to a country's GDP. The problems therefore have a large impact on society. Some of the problems are rooted in the organizational structure of the construction industry. Compared to other manufacturing industries, the construction industry is organized in temporary organizations. The temporary organizations cause temporary supply chains, fragmentation among construction industry actors and adversarial relationships between those actors. Partnering has been but forward as a solution to overcome the temporariness and the adversarial relationships in the construction. Another solution to mitigate the problems suggested in the reports is supply chain management (SCM). Both concepts have been taken from the manufacturing industries and partnering has been more successful compared to SCM in the construction industry. In the construction industry the progress towards SCM has focused on logistics. In recent years dedicated third-party logistics (TPL) solutions have emerged in the Swedish construction industry, where a company is hired to manage the logistics in a construction project.

The purpose with the research presented in this licentiate thesis is to explore how client initiated TPL solutions and partnering can be facilitators for SCM in the construction industry. Being a new phenomenon in the construction industry TPL solutions provide a logistical competence not necessarily included in a traditional construction project. Therefore, TPL solutions are of particular interest when studying the realization of SCM in the construction industry. In the process of realizing SCM in the construction industry, the construction clients have been put forward as having a crucial and important role. The clients are the initiator and funder of construction projects and as such the client can influence the course of a construction project. Therefore, it is of interest to study how the client can take an active role in this process. Initiating a TPL solution in a construction project is one way for a client to take an active part in the realization of SCM in construction.

However, in order to study how clients can take an active role towards the realization of SCM in the construction industry, there have to be an understanding of how SCM is to be adopted to the construction industry context. SCM that derives from the manufacturing industry is designed to be used in long-term relationships with permanent organizational structures. The construction industry on the other hand is associated with short-term relationships and a temporary organizational structure. Partnering that is designed to mitigate the temporariness and establish long-term relationships have been quite successful in the construction industry, and could therefore be used as a facilitator for SCM in construction.

To study the use of client initiated TPL-solutions in construction and the realization of SCM in the construction industry the following research questions have been addressed:

RQ1: To what extent can a third-party logistics solution be a facilitator for client driven SCM in the construction industry?
RQ2: How will upstream and downstream tiers be affected when a third-party logistics provider is used in a construction project?
RQ3: How can partnering be used a mean to facilitate the realization of SCM in the construction industry?

To answer the research questions two main methodologies have been used; case study for the empirically grounded research and conceptual studies for the analysis of the case studies as well as for comparing the two concepts of partnering and SCM. All questions have been grounded in literature and previous research. The findings of this research is therefore grounded in both theory and in practice.

The main findings of this research is that TPL solutions are not a quick fix for realizing SCM in the construction industry. However, if used right a TPL solution can be an effective tool to address logistical issues in a construction project and to establish an interface between the supply chain and the construction site. By initiating a TPL solution the client addresses the importance of logistical competence in a construction project. A TPL solution does not have a purpose of its own; a TPL solution is a service function to the construction project, providing expertise on logistics management. There are also a number of driving forces and concerns that have been identified, if they are addressed prior to a TPL solution is implemented, the likelihood of its success will increase.

Furthermore, both partnering and SCM rely on high trust and share several key components and issues that have to be addressed. Partnering on strategic level with several suppliers included can even be hard to distinguish from SCM. Wherefore, partnering is considered a facilitator for the realization of SCM in construction. By addressing the necessary issues in both concepts a good foundation for SCM is established.

# Populärvetenskaplig sammanfattning

Byggbranschen lider av stora problem som höga kostnader och låg produktivitet. Då byggbranschen är en av de största industrisektorerna som har hundratusentals människor anställda och bidrar till en stor del av ett lands BNP, påverkar problemen i byggbranschen också det omkringliggande samhället. Byggbranschen är en komplicerad bransch där verksamheten bedrivs i projekt och en byggarbetsplats kan liknas vid en tillfällig fabrik. För att överkomma dessa problem är förbättrad logistik en lösning som har föreslagits i ett flertal rapporter och studier.

På senare år har ett nytt fenomen dykt upp i den svenska byggbranschen, så kallade tredjepartslogistikföretag, specialiserade mot byggbranschen. Vanligtvis sköts materialhantering i ett byggprojekt av byggarbetarna själva men det medför att mindre tid kan läggas på faktiskt värdeskapande arbete, det vill säga att bygga. Det bidrar till branschens låga produktivitet. Genom att använda en tredjepartslogistiker som sköter all materialhantering i ett byggprojekt frigörs arbetstid för byggarbetarna, tid som därmed kan läggas på byggproduktion och därmed öka produktiviteten i byggprojektet. Det kan också minska byggtiden och spara kostnader. Då det i Sverige råder stor brist på bostäder[1] är effektivare byggprojekt en nyckel i att öka byggtakten. I detta arbete har byggherrarna en viktig roll att fylla. I och med att det är byggherrar och beställare som initierar och investerar i nya byggprojekt kan de också påverka hur byggprojekten ska arbeta med logistik.

Min forskning syftar till att studera byggherre- och beställarinitierade tredjepartslogistiklösningar som ett sätt att förbättra logistiken i byggbranschen, samt aktivt involvera byggherrar och beställare i den processen. Forskningen har bedrivits bland annat genom att studera effekterna av logistiklösningen som används vid ombyggnationen av universitetssjukhuset i Linköping. Kritiskt i byggprojektet var att sjukhusets verksamhet inte fick störas, särskilt inte ambulanstrafiken.

Forskningsresultaten visar att tredjepartslogistik i sig inte är ett sätt att förbättra logistiken i byggbranschen som helhet, men att det däremot kan vara ett effektivt verktyg för att hantera logistikrelaterade problem och frågor i byggprojekt. Genom ett ökat fokus på logistik i byggprojektet ökade produktiviteten samtidigt som sjukhusets verksamhet inte störtes. Det är dock viktigt att poängtera att tredjepartslogistik i sig inte är ett självändamål, det är logistikkompetensen hos tredjepartslogistikern som efterfrågas. Vidare så visar resultaten att byggprojekt

[1] Enligt Boverket (2016) behöver det byggas 700 000 bostäder i Sverige på tio års sikt.

bygger på att alla inblandade parter samarbetar med varandra och för att bygglogistiken på effektivt sätt ska kunna överkomma de problem som byggbranschen associeras med måste alla inblandade aktörer i ett byggprojekt samverka för att överkomma de hinder som finns.

# Foreword

*"Even a fool who keeps silent is considered wise; when he closes his lips, he is deemed intelligent."* – Proverbs 17:28

Being a doctoral student and strive to get a PhD certainly means that you do not keep silent nor close your lips, as this thesis is a proof of. If this makes me a fool or not, I am not certain. However, I do know that it is a challenging, fun and exciting task and you question your sanity of having enrolled on this voyage. I also know that I would not have made it this far, and I would truly be a fool, if it was not for the support of important persons around me. The following lines are dedicated to those persons.

First of all, I want to thank my two supervisors, Martin Rudberg and Anders Vennström. Without your support this thesis would never have been done. Martin, I could not ask for a better supervisor and even if the feedback can be extensive and tough sometimes, I know that when it has passed through the Martin-filter it will come out in a better version. The time and devotion you have put in to support me during this journey is invaluable.

Secondly, I also want to thank my colleagues in the construction logistics group, Henric Jonsson, Micael Thunberg, Mats Janné and Anna Fredriksson, for valuable inputs, comments, laughs and discussions. You have contributed immensely to the quality of this thesis. You are not only my colleagues; you have also become dear friends.

Thirdly, I send my thanks to my colleagues at the Division of Communication and Transport Systems. Especially Vivvi, you are the solid rock the division rests upon. I also want to send a special thank you to Marcus Posada whom I shared office with and to Åsa Weinholt for being a strong member of Järngänget. It has been a true joy to work with and hang around with you two.

Finally, I want to send out a big portion of love to my family and friends. Thank you for your support and for believing in me. I want to thank my wife Camilla for all the love and support you have shown me. It is a miracle that you still want to listen and discuss my ideas and thoughts. I love you and Pumpan that grows in your belly so much!

Andreas Ekeskär

Stockholm, May 2016

# Acknowledgement

There are a number of persons that have contributed to this research that I also want to thank. I am very grateful to Peter Nilsson, Stefan Fredriksson, Johan Kristansson, Johan Larsson, Samuel Lindén and Christos Asimakidis. I am also very grateful for all the persons and companies that have contributed to this research by participating in interviews and observations. This research has been funded by Region Östergötland, Leijonfastigheter AB, Sankt Kors Fastighets AB, LiU Forskning & Framtid and The Lars Erik Lundberg Foundation for Research and Education.

# Thesis outline

This thesis is a compilation thesis (thesis by publication) including three articles; one is published in the journal *Construction Management and Economics*, the other two are working papers. The thesis is titled: *Exploring Third-Party Logistics and Partnering in Construction – A Supply Chain Management Perspective* and it consists of two parts. The first part introduces the background to the research, motivates why it is important, presents the purpose and the research questions, clarifies the theoretical frame of reference consisting of four main areas: the construction industry setting, partnering, supply chain management, and third-party logistics. Finally, part one answers the research questions, presents the conclusions and suggestions for further research. The second part consists of the three papers that the research builds upon, which are listed below.

**Paper 1**

Ekeskär, Andreas & Rudberg, Martin (2016a). "Third-party logistics in construction: The case of a large hospital project". Published in *Construction Management and Economics* (DOI 10.1080/01446193.2016.1186809). An earlier version was presented at presented at the 21st annual EurOMA conference in 2014.

**Paper 2**

Ekeskär, Andreas & Rudberg, Martin (2016b). "Third-party logistics in construction: Perspectives from suppliers and transport providers". *Working paper*. An earlier version was presented at the 22nd annual EurOMA conference in 2015.

**Paper 3**

Ekeskär, Andreas (2016). "Partnering as a mean towards the use of supply chain management in temporary construction organizations". *Working paper*.

*"Hjärnan behöver socker!"* – Peter Nilsson, livscoach

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# 1. Introduction

*This chapter describes the background to this research project. The underlying problems that motivate the research are described, the purpose with this research project as well as the research questions that have been in focus are presented.*

## 1.1 Background

The construction industry is a large and vital industry for society, providing buildings and infrastructure. The most recent report from the Swedish Construction Federation shows that the Swedish construction industry in 2014 directly employed over 300,000 people and the invested capital corresponded to 10 % of Sweden's GDP, the third highest in the European Union (Sveriges byggindustrier, 2015). However, when the Swedish construction industry is compared to the other Nordic countries (except Iceland) it is clear that in Sweden the number of multi-family houses built is considerably lower if each country's population is considered (Sveriges byggindustrier, 2015, p. 65). At the same time the production costs for multi-family houses in Sweden have risen during the last decade, which in turn have increased prices on houses (Sveriges byggindustrier, 2015, pp. 56-58; Statistics Sweden, 2015b). This might be an effect of the numerous problems such as low productivity (Abdel-Wahab and Vogl, 2011), high costs (Hwang *et al.*, 2009), waste (Josephson and Saukkoriipi, 2005), fragmentation (Segerstedt and Olofsson, 2010) and adversarial relationships (Bygballe *et al.*, 2010), that have for a long time been associated with the construction industry. The problems can result in an increase in cost for production and reduced productivity (Vrijhoef and Koskela, 2000). Since construction is such a vital and important industry for society, it is not only the construction industry that is affected by these problems, but also society itself. In order to suggest solutions to mitigate the problems, it is necessary to have an understanding of the construction industry, the construction industry context and the type of problems that the industry is facing.

The construction industry is a manufacturing industry whose products are generally physically large and immobile and therefore have to be produced on the site of use. This means that for every product produced (e.g. house, road, bridge, etc.) in a construction project, a new temporary factory, the construction site, is also built. This has led to that the general organizational form in the construction industry is the temporary organization, or project; in fact the construction industry is denoted as a typical industry working in temporary organizations (Lundin and Söderholm, 1995; Bakker, 2010). The temporary nature of the construction industry is something that cannot be overlooked. In order to understand the construction industry, the temporary organizational context has to be understood. The temporary organization also affects the supply chains; temporary factories leads to temporary supply chains, different for different construction projects (Vrijhoef and Koskela, 2000). This is important to understand when studying the

construction industry's problems and suggesting solutions to overcome and avoid them.

When Abdel-Wahab and Vogl (2011) compared the productivity in the construction industry with other types of manufacturing industries in the USA, Europe and Japan, the construction industry's productivity was lower in all regions. In some countries the productivity growth for the construction industry even was negative. The increase in production cost has been documented in several studies. In construction projects studied by Vrijhoef and Koskela (2000) an increase in the materials handling cost could be seen when materials were ordered with discounts. The low utilization of resources is also a factor that drives cost. When construction workers have been studied in different construction projects it is shown that a relative low proportion of their working day is spent on value adding tasks (Josephson and Chao, 2014; Josephson and Saukkoriipi, 2005; Strandberg and Josephson, 2005). This also true for construction equipment and machines that are used in construction projects. The effective time of use for different machines varies and as shown in Josephson and Saukkoriipi (2005) no machine is used more than 49 % of the time.

The problems in the construction industry have been a concern for authorities for decades and have therefore been addressed in several government funded reports, for example in the UK (see eg. Latham, 1994; Egan, 1998; Department for Business Innovation and Skills, 2013) and in Sweden (see eg. SOU2002:115; Statskontoret, 2009; von Platen, 2009). The UK reports have had a large impact on both the construction industry itself, but also on the research performed on improvements of the construction industry and ways to mitigate the problems. There are two general concepts that have been in focus in the research and the debate ever since: partnering and supply chain management (SCM) (Latham, 1994; Egan, 1998). Partnering is a governance form aiming at long-term cooperation between the different parties in a construction project (Eriksson, 2010). It was introduced in the construction industry to overcome the adversarial nature that characterize construction projects (Bresnen and Marshall, 2000a), due to the temporariness and fragmentation of the industry (Eriksson, 2010). One of the suggestions for improvements of the construction industry in Egan (1998) was partnering the supply chain, meaning that the different stakeholders in the construction industry need to work together towards common goals. In essence that is SCM, which has been implemented through various initiatives since the late 1980s. However, they were scattered and partial, and without a strategy behind them (Vrijhoef and Koskela, 2000). Managing supply chains is of importance, since every company is a part of one or many supply chains (Mentzer *et al.*, 2001). The construction companies are depending on well-managed supply chains for project success. Christopher (2011, p. 13) defines supply chains as "the network of organizations that are involved, through upstream and downstream linkages, in the different processes and activities that produce value in the form of products and services in the hands of the ultimate customer". The benefits with SCM are similar to those from partnering, shared risk and rewards between stakeholders and cost reductions to name a few.

Both partnering and SCM have their origin in other manufacturing industries where they have been successfully used (Gadde and Dubois, 2012; Bygballe *et al.*, 2010; Vrijhoef and Koskela, 2000). To learn how other manufacturing industries

had solved the same type of problems was an intended strategy suggested by Egan (1998) in the work with the report "Rethinking construction". This challenges a common perceived notion among practitioners in the construction industry, namely that the construction industry is a unique industry and solutions from other industry sectors do not apply (Kadefors, 1995; Wegelius-Lehtonen and Pahkala, 1998; Josephson and Saukkoriipi, 2005). However, the same problems occur in the construction industry as in other industry sectors and Egan (1998) argues that the problems can be mitigated using the same management methods used in other types of industries. However, in general terms the construction industry is behind other industry sectors when it comes to the realization of SCM (Bankvall *et al.*, 2010). This has led to a shift in the debate among some researchers within the construction management research community during recent years. Instead of studying ways to realize SCM, they question the applicability of the concept in the construction industry (cf. Fernie and Tennant, 2013; Fearne and Fowler, 2006; Briscoe and Dainty, 2005). This is partly due to the lack of measurable effects and the relative few success stories that has been documented since the work towards the realization of SCM in construction begun. This might be an effect of not having considered the temporary nature of the construction industry. SCM derives from the manufacturing industry where long-term relationships and permanent organizations are standard (Mentzer *et al.*, 2001). In order for SCM to successfully be realized in the construction industry the temporariness has to be addressed (Vrijhoef and Koskela, 2000).

Besides partnering and SCM both Latham (1994) and Egan (1998; 2002) emphasize the importance of clients' involvement in addressing the construction industry's problems. It is the clients that invest in construction projects and wants better value for their invested money. This means that it is in the clients' interest to initiate the change process (Latham, 1994; Egan, 1998). Briscoe *et al.* (2004) conclude that the client is the most important factor if the work towards SCM will be successful. The clients must take lead and actively work with the integration of the supply chain; they have to change their traditional approach to procurement of construction projects and contractors. In their roles as initiators and responsible for choice of procurement strategy, the construction clients have the ability to put requirements on contractors, suppliers, authorities, engineers, architects and other stakeholders involved in order to realize SCM in the construction industry.

The successful realizations of SCM in the construction industry have tended to focus on managing logistics on the construction site (Agapiou *et al.*, 1998a; Hamzeh *et al.*, 2007). Logistical problems surface at the construction site and for the contractors it has been a logical first step to manage the logistics there. The supply of construction materials to a construction site is a difficult task and full of potential problems that can have a negative impact on the productivity and increase the production costs. However, with increased planning on how to receive and handle construction materials, it is possible to lower production costs and increase productivity. In a Danish construction project studied by Agapiou *et al.* (1998a) the total production cost was lowered with 5 % through the implementation of a logistics model. This was done through planning the site activities, as well as the deliveries by having daily communication with the suppliers. An important part of the success was the materials coordinator who was responsible for managing the logistics model during the construction process.

During recent years the use of third-party logistics (TPL) providers has emerged in construction projects in Sweden. TPL is defined by Marasco (2008, p. 128) as "an external organization that performs all or part of a company's logistics functions". This a new phenomenon in the construction industry where TPL providers have seen an opening and an opportunity in the market where the construction industry traditionally has poor performance; 25 % of a construction worker's time is spent on handling materials (Strandberg and Josephson, 2005; Josephson and Saukkoriipi, 2005). By outsourcing the materials handling to a TPL provider, the TPL provider take on a role similar to the materials coordinator in the Danish construction project described by Agapiou *et al.* (1998a). This also extricates the time the construction workers spend on materials handling; time that can be spent on value adding activities which will increase the construction project's productivity. When Lindén and Josephson (2013) compared construction projects that utilized TPL solutions to traditional construction projects, they showed that with a TPL solution a cost reduction could be seen. In the projects studied by Lindén and Josephson (2013) the TPL provider not only handled the materials, but also planned and coordinated the deliveries. Other forms of TPL solutions is much simpler and may only offer interim storage in close vicinity to the construction site (Gadde and Dubois, 2012). What form a TPL solution has depends on the complexity of the construction project, what the clients and contractors want and what the TPL provider is capable to offer. However, as a new phenomenon in the construction industry TPL solutions will continue to develop over time. TPL solutions is one way for the client in an early stage to address the importance of managing logistics in construction projects. TPL solutions is a good way to manage the interface between the supply chain and the construction site, the first of the four roles SCM can take described by Vrijhoef and Koskela (2000).

## 1.2 Scope and purpose

This research is part of a doctoral research project focusing on client perspectives on construction SCM. The purpose with the research presented in this licentiate thesis is to explore how client initiated TPL solutions and partnering can be facilitators for SCM in the construction industry. Being a new phenomenon in the Swedish construction industry, TPL solutions are of particular interest when studying the realization of SCM in the construction industry. Since TPL solutions focus on the construction site they affect the performance of the construction project at the construction site and therefore affect several contractors at once, and possibly also the suppliers. The importance of client involvement in order to improve efficiency and quality in the construction sector is emphasized by Latham (1994) in "Constructing the Team", Egan (1998) in "Rethinking Construction" and Egan (2002) in "Accelerating Change". Since the clients have a crucial and key role in the realization of SCM in the construction industry (Briscoe *et al.*, 2004), it is important to study how they can take an active role in this change process. Initiating a TPL solution in a construction project is one way for the client to take an active role in the realization process of SCM in the construction industry.

However, in order to study the how the client can take an active role in the realization of SCM in the construction industry, there has to be an understanding of how SCM can be adopted to the construction industry. SCM is developed for long-term relationships in manufacturing industries with permanent organizational structures, while the construction industry context is dominated by

short-term relationships and temporary organizations. In order to realize SCM in the construction industry the concept will have to be adapted to the characteristics of the construction industry (Vrijhoef and Koskela, 2000), but there have to be a method that bridges the temporariness without altering the essence of SCM. Partnering is already a concept designed and used to bridge the temporariness in the construction industry and with the aid of partnering there might be a method for realizing SCM in the construction industry.

In this thesis the focus is divided in two parts. The first part focus on the logistical part of SCM with an empirical study of the use of a client initiated TPL solution in a large construction project. Paper 1 and Paper 2 corresponds to this part. To develop the first part, the following research questions are addressed:

RQ1: To what extent can a third-party logistics solution be a facilitator for client driven SCM in the construction industry?

RQ2: How will upstream and downstream tiers be affected when a third-party logistics provider is used in a construction project?

The second part investigates how the realization of SCM can benefit from the use of partnering in the construction industry context of temporary organizations. Paper 3 corresponds to this part. To develop the second part, the following research question is addressed:

RQ3: How can partnering be used as a mean to facilitate the realization of SCM in the construction industry?

The scope of this research is SCM in the construction industry, and specifically the use of TPL solutions in construction projects. The research mainly focuses on housebuilding, even though the second part and RQ3 may also be applicable in civil engineering projects. Procurement and contract law are natural aspects of a client perspective, but the main focus in this research is to study the management part of construction SCM, therefore it will not study the different aspects of laws concerning procurement and contracts more than briefly.

The empirically grounded part of this research use case studies as the primary research method. The case studies are explorative single case studies conducted at, or in connection with, a large construction project in the Swedish city Linköping. All the companies participating in this research are firms that operate in Sweden. In the discussion the results from the case studies will be compared to “traditional” construction projects. In this thesis, a traditional construction project refers to a construction project that does not utilize a TPL solution.

## 1.3 Outline

The objective with this first chapter was to give a brief introduction about the problems that have been studied in this research project. It has also introduced the purpose with the research project along with the studied research questions. To derive, and to address, the purpose and answer the research questions put forward in this chapter a traditional literature review has been done. The literature review is presented as a frame of reference and is presented in chapter 2. The frame of reference gives a more in depth description of the literature and previous research

than what is done in this first chapter. The empirical work and the research that has been done to answer the research questions is presented in chapter 3, outlining the research design and the research process. The choice of methods that have been used are described and motivated. In chapter 4 each of the three papers that build up this thesis are summarized individually, as well as analyzed and discussed jointly. This discussion answers the thesis' research questions and leads to the contributions of this thesis. The contributions are presented in chapter 5 as newly formed theoretical constructs and identified gaps found in previous research. These gaps are briefly discussed and put forward as suggestions for further and future research to be done in line with this research project.

# 2. Frame of reference

*This chapter describes the theories that the research in this thesis build upon. The frame of reference is divided in to four major areas: the construction industry setting, partnering, supply chain management and logistics, and third-party logistics.*

## 2.1 The construction industry setting

The construction industry is a large industry that in Sweden, a country with a population of 9,9 million people, alone directly employs 300,000 people, if only the construction contractors are considered. It is also an industry that is a large contributor to society's economic growth. The total invested capital in the construction industry, i.e. new construction and refurbishment of real estates as well as civil engineering projects, amounted to 388 billion Swedish kronor in 2014. This constitutes 10 % of Sweden's GDP (Sveriges byggindustrier, 2015). If other industry sectors that are indirectly affected by the construction industry also are taken into concern, the societal impact is even greater. The construction industry creates work and business for other types of industry sectors such as transportation, consultants, material suppliers, financial services, etc. In Sweden this would mean that, carefully estimated, around 700,000 people are depending on the construction industry (Byggbranschen i samverkan, 2006).

The impact the construction industry has on other industry sectors and on society, means that problems in the construction industry will affect other industry sectors and society (Huang *et al.*, 2009). This is major reason why the construction industry has been investigated several times during the past decades by both authorities and organizations. In Sweden especially two government funded reports have been in focus, "Skärpning gubbar!" (English: "Sharp up men!") (SOU2002:115) and the follow up report "Sega gubbar?" (English: "Slow men?") (Statskontoret, 2009). Also in the UK the construction industry has been under investigation, especially in the reports "Constructing the team" (Latham, 1994) and "Rethinking construction" (Egan, 1998). Later the effects from these two reports have been dealt with in Egan (2002), Wolstenholme (2009) and Department for Business Innovation and Skills (2013).

### 2.1.1 Performance and productivity of the construction industry

The performance of the construction industry, as well as problems such as high costs and low productivity in the construction industry has been investigated for a long time (Eccles, 1981; Latham, 1994; Egan, 1998; Egan, 2002; SOU2002:115; Josephson and Saukkoriipi, 2005; Statskontoret, 2009; Department for Business Innovation and Skills, 2013). Productivity is a key driver in the economic growth of an industry and a country. An industry's productivity, the amount (or value) of output produced per unit input, measures the industry's efficiency (Huang *et al.*, 2009). As mentioned in chapter 1, Abdel-Wahab and Vogl (2011) compared the productivity in the construction industry to other manufacturing industries in

several OECD countries and found that the productivity was significantly lower in construction. Problems with productivity in construction has also been addressed in studies and reports by Fulford and Standing (2014), Josephson (2013) and Josephson and Chao (2014).

However, productivity has to be measured at different levels: industry, project or task level (Huang *et al.*, 2009). A high productivity for a certain project does not mean that the entire industry will benefit from it. Therefore, it is important to know what type of productivity that is measured. In a Nigerian construction project, Odesola (2015) studied labor productivity on the task of wall plastering and found that time and cost performance are positively influenced by the labor productivity. Similarly, there have been several studies on labor productivity in Sweden (cf. Josephson and Chao, 2014; Josephson and Saukkoriipi, 2005; Strandberg and Josephson, 2005). All of them find more or less the same thing, that a large portion of the construction workers workdays is used on non-value adding tasks such as material handling and waiting. In Figure 1 a typical working day for a construction worker is illustrated, based on the findings in Strandberg and Josephson (2005).

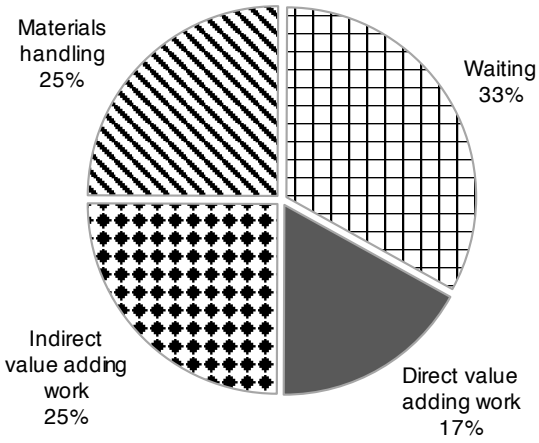


*Figure 1 - How a construction worker use the time on a typical workday (Strandberg and Josephson, 2005).*

Another indicator on the status of the productivity in the construction industry is to compare how the costs for construction have developed compared to how the overall costs have developed. In Figure 2 the building price index (BPI) for multi-dwelling houses and collectively built one- or two-dwelling houses are compared to the consumer price index. The graphs clearly show that the BPI is considerably higher than for the consumer price index (CPI) (Statistics Sweden, 2015b). This way of measuring an industry's productivity has been questioned. Lind and Song (2012) studied how the measurements for BPI are calculated and concluded that there are some errors in how the calculations are made, e.g. it is only some indicators for quality increase that is considered. This leads to a possible underestimation of the productivity in construction and Lind and Song (2012) conclude that nothing certain can be said about the productivity development.

However, the lack of adequate methods to measure productivity are known (Huang *et al.*, 2009). In a report on the productivity in the Swedish construction industry Josephson (2013) agrees with some of the critique. It is hard to measure productivity in the construction industry because of the different types of products being produced. The measurements are more suitable for stationary businesses with high repeatability and will have to be adapted to the temporary nature of the construction industry. But with the difficulties in mind, it is important to develop measurements for productivity in order to benchmark and stimulate improvements in the construction industry.

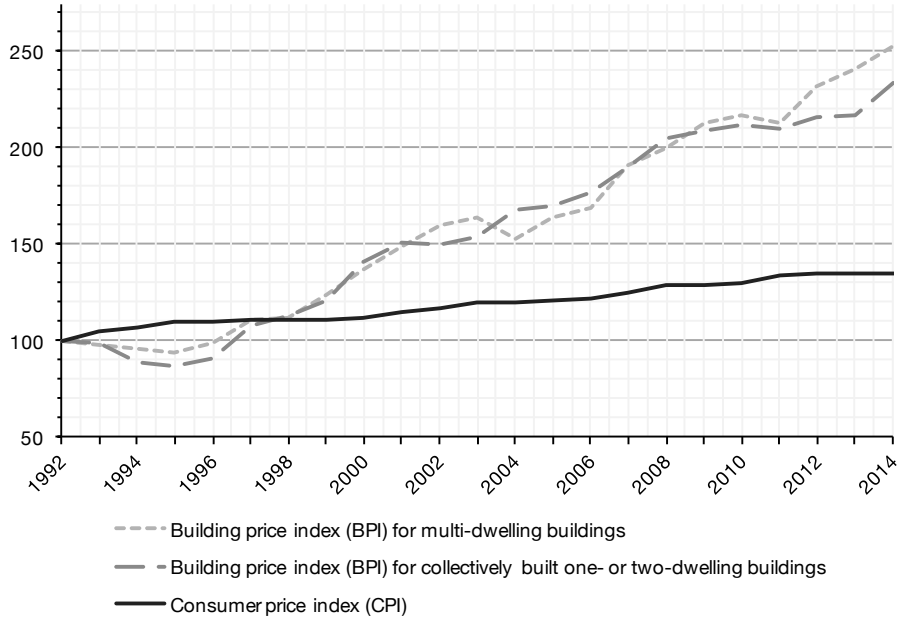


*Figure 2 - Development of BPI (with deduction of allowances) compared with CPI between 1992-2014 (Statistics Sweden, 2015b).*

### 2.1.2 Production cost and waste

The increase in BPI indicates an increase in production costs, the cost the client pays for a construction project. The production cost can be divided into four parts: client costs, tax such as VAT, land acquisition and municipal fees, and the construction costs. The construction cost is in turn divided into subcategories such as cost for wages, materials, transports, machines and overhead costs (Sveriges byggindustrier, 2015). Figure 3 illustrates how each cost category corresponds to the production cost.

Just above half, 53 %, of the production cost is the construction cost. The construction cost is also the part that is affected by an increase (or decrease) in productivity. However, the cost for land acquisition has risen with 345 % between 1998 and 2014, and if the land acquisition cost is omitted the construction cost is 80 % of the production cost (Sveriges byggindustrier, 2015). Two fifths of the construction cost are wages and comparing with how a construction worker spend

their time, as seen in Figure 2, it becomes clear that a large portion of the costs for wages are purely waste.

The use of machines is also a cost correlated to productivity. When the construction workers' productivity increases, the use of machines increase. When Josephson and Saukkoriipi (2005) studied how machines where used in construction projects they found that the four largest machines were on average used about 29 % of the time, and smaller machines 5 % of the time. This correlated to 2-5 % of the production cost.

The single largest construction cost is the cost for materials, also two fifths of the construction cost (see Figure 3). Materials are not directly affected by an increase of the productivity, however it is a large cost for a construction project and therefore it is important to reduce the costs for materials as much as possible. Some materials break and other materials are stolen, there is also the cost for excess materials. According to Josephson and Saukkoriipi (2005) around 1-3 % of the materials cost is purely waste.

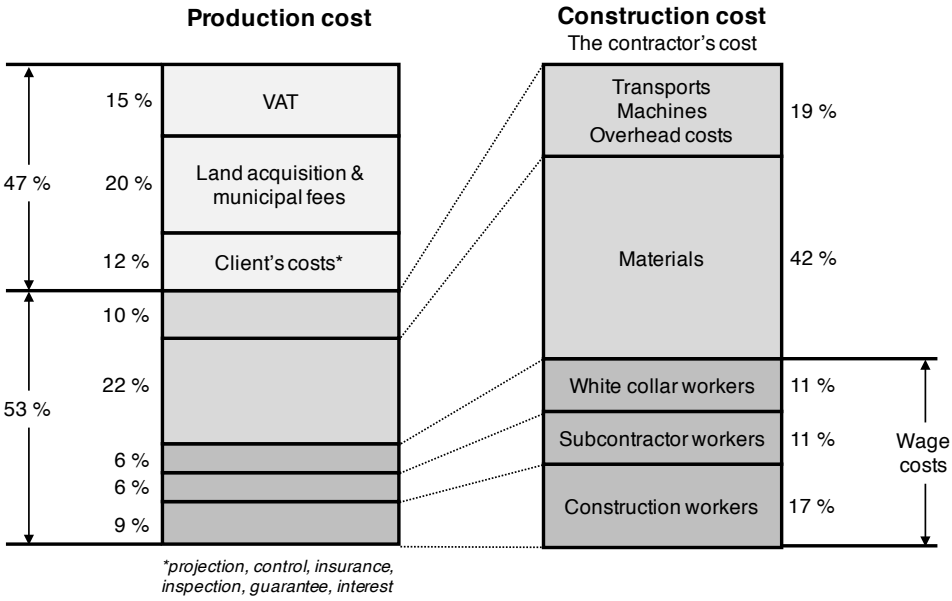


*Figure 3 - The difference between production cost and construction cost (Sveriges byggindustrier, 2015).*

However, it also necessary to look more in depth on the construction site itself and not only on how the construction workers spend their time. A construction site is often likened with a creative chaos in which it is always short of time and everyone is in a hurry (Karrbom Gustavsson, 2011). But this image of a construction site is only partly true, a majority of the time no work at all is conducted on a construction site. In Sweden a general workweek in construction is 40 hours, i.e. five days with one eight-hour shift, while total number of hours on a seven-day week is 168. This means that only 24 % of the week is utilized, with deduction for vacations and holidays even less time is used. Since machines, tools and other equipment stays

on the construction site when the construction workers leave for the day, the utilization rate of the four largest machines drops to 6.8 % of all the available time. For smaller machines the utilization rate drops to 1.2 % of all the available time (Josephson and Saukkoriipi, 2005; Josephson, 2011). Josephson (2011) argues that the contractors have to use more of the available time in order to increase the productivity. Certain activities can occur at other hours, e.g. activities that are not likely to disturb neighbors can be done after regular work hours. How work is to be done at construction sites is a question the construction contractors have to address in order to reform the construction industry.

### 2.1.3 The construction contractors

The construction contractors are the companies that perform the construction work in the production phase of construction projects. Contractors are divided into different categories depending on what type of work they perform: construction, installation (e.g. electricity, heating, ventilation and sanitation, etc.), demolition, companies working with finishing works (floors, painting, glass, etc.) and special contractors (diving contractors, roof works, etc.) (Sveriges byggindustrier, 2015; Eccles, 1981).

Contractors are divided between main contractors and subcontractors (Eccles, 1981; Dubois and Gadde, 2002; Miller *et al.*, 2002). Main contractors are procured by the client and responsible for the overall construction project and to coordinate construction activities in the construction project. Depending on type of contract the main contractor may also be responsible for the design of the construction (Eccles, 1981). Subcontractors are all other types of contractors involved in a construction project and can be procured by the client, the main contractor or other subcontractors. The subcontractors are the backbone of the organization in a construction project. Most of the construction works are outsourced to them and they perform a lot of different tasks and they all work in different pace, at different phase of the construction project (Miller *et al.*, 2002; Eccles, 1981).

The outsourcing of construction work to subcontractors has led to a large fragmentation in the construction industry and the industry is depending on many small firms (Segerstedt and Olofsson, 2010; Miller *et al.*, 2002; Dubois and Gadde, 2002; Dainty *et al.*, 2001a; Dainty *et al.*, 2001b; Dubois and Gadde, 2000). Most of the construction work is done by small and medium sized companies. Figure 4 below indicates that 99 % construction contractors (house building only) in Sweden 2013 had a maximum of 49 employees. Most of the construction workers, 55 %, was also employed by those small firms. However, despite that there were only six companies with 500 employees or more, these six companies employed 27 % of the construction workers (Statistics Sweden, 2015a). Among the ten largest construction contractors, had the three largest companies (based on turnover) around five times as many employees as the companies placed number four to seven on the list (Sveriges byggindustrier, 2015).

This fragmentation of the construction industry has several implications. Egan (1998) addresses the fragmentation and states that it inhibits performance improvements in the construction industry. However, Egan (1998) consider the fragmentation to be both a strength as well as a weakness. The positive side is that it has enabled flexibility in the construction industry to deal with highly variable workloads and shifts in the economic cycles. This type of interdependence between

entities is also mentioned by Eccles (1981) and Dubois and Gadde (2002). The negative side is that contractual agreements has become more important and hindered long-term development (Egan, 1998; Dubois and Gadde, 2002). The fragmentation with many small companies in a construction project can cause uncertainty (Fearne and Fowler, 2006) and problems with coordinating activities (Dubois and Gadde, 2002). Problems with coordination is not limited to the specific construction project, but also extends to the supply chain and between companies in other projects (Dubois and Gadde, 2002; Dubois and Gadde, 2000).

Since the fragmentation of the construction industry has its roots in procurement strategies, the construction clients also have a responsibility. The client is the initiator of a construction project and also procures the consultants, and the contractors that are responsible for the design and the production of the building being built. Clients tend to rely on tried and tested methods of procurement and of how a construction project should be performed, rather than what suits the particular project best (Bresnen and Haslam, 1991).

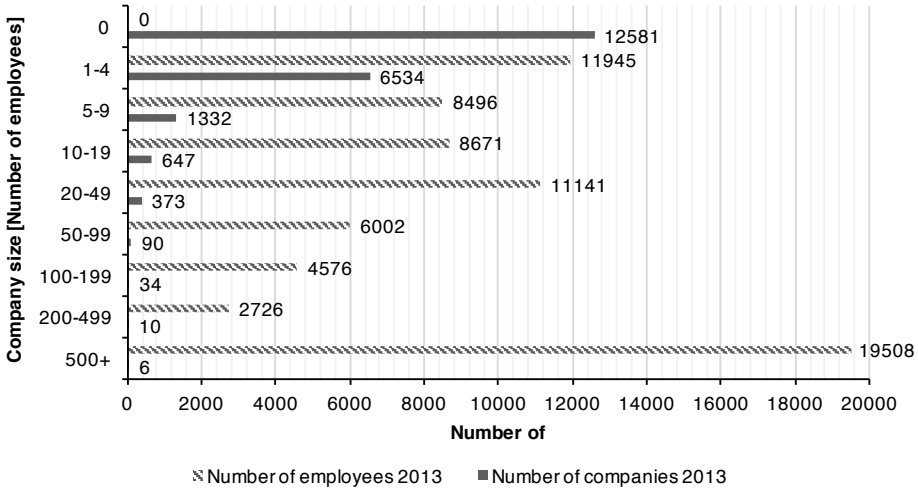


*Figure 4 - Number of construction contractors and employees based on company size (Statistics Sweden, 2015a).*

### 2.1.4 The construction industry suppliers

Materials make up a large part of the construction cost and a construction project is depending on suppliers and transport providers to deliver materials to them (Vidalakis and Sommerville, 2013). Materials suppliers can roughly be divided into two parts: manufacturers and wholesalers or building merchants. Manufacturers are suppliers that manufacture materials or components necessary for the construction work such as kitchen cabinets, concrete elements, ventilation equipment, windows and doors. Wholesalers are suppliers that sell a large variety of materials from different manufacturers. Building merchants are a type of wholesalers that sell typical construction materials such as plasterboards, wood, nails, etc. (Agapiou *et al.*, 1998b).

Construction materials can be divided into several categories such as heavy and light materials. Heavy materials are typically concrete, sand, gravel, bricks, timber, etc., while light materials are material for structure completion and decorating materials (Agapiou *et al.*, 1998b). Furthermore can construction materials also be divided between standard materials and project specific materials (Dubois and Gadde, 2000; Wegelius-Lehtonen and Pahkala, 1998). Examples of standard materials or components are plasterboards or kitchen cabinets and is typically bought from a manufacturer or a wholesaler. Project specific materials are materials that are specially designed for the construction project and is bought directly from the manufacturer. Examples of project specific materials are prefabricated concrete elements and ventilation installations. The number of materials and components used in a construction project has been growing and with the increased amount of materials, the number of materials suppliers have increased as well (Agapiou *et al.*, 1998b). This means there are several material suppliers involved in a construction project since the different contractors have different suppliers. Their deliveries will have to be coordinated throughout the construction project (Dubois and Gadde, 2002; Dubois and Gadde, 2000).

### 2.1.5 The construction clients

According to the Swedish Planning and Build Act (SFS 2010:900) a construction client is:

> *"The one who for its own account performs or assigns others to perform design, construction, demolition or ground works."*

This means that the construction client is a legal entity and as such also has responsibilities to perform different tasks as stated in the act (Vennström, 2008). However, construction clients cannot be seen as unitary and must be seen in plural; they are several heterogeneous stakeholders with different needs and priorities (Boyd and Chinyio, 2006; Cherns and Bryant, 1984). According to the definition from the Planning and Building Act anyone or any organization that builds a building is a construction client. This means that organizations that do not see themselves as working with construction are in fact important participators and stakeholders of the construction industry, and as such they are affecting the performance of the industry. An example of this is that the department store chains ASDA and Tesco were ranked numbers 8 and 16 respectively, when the top 50 construction clients in the UK between May 2004 and April 2005 were listed by expenditure (Boyd and Chinyio, 2006, p. 9).

Department store chains are not what comes in mind when thinking about construction clients, they are rather associated with retailing of food and household items. It is even possible that the construction project as such is not particular important to the department store chains, or any other type of construction client. The construction of a building is for those types of clients a necessity in order for them to focus on their main business; new department stores in order to expand, new mobile towers to increase cellular phone reception, new factories in order to increase production and so on. These types of clients probably have a division that work with property development and for this division construction is important. However, the property development division is not representative of the client. This might be troublesome since the client and the contractor sees the construction project differently (Boyd and Chinyio, 2006). The client's view of the construction

project is in terms of its business. The contractors and the consultants are interested in the technical aspects of the construction projects and for them the client's business is not relevant. Boyd and Chinyio (2006) calls this the perceptual gap and it might lead to miscommunications, errors in design, reworks and conflicts in the construction projects. Sometimes it is because the client does not know what it is they really want in terms of the construction project (Cherns and Bryant, 1984). Therefore, it is important to understand what type of client that is involved in a construction project.

Cherns and Bryant (1984) argues that in order to be able to understand the client it is not enough to look at technical and economic factors, but also political and social factors within the client's organization. Each client is a complex system (Bertelsen and Emmitt, 2005; Cherns and Bryant, 1984), and can be described out of several different aspects that will affect how they act in a construction project. First of all, construction clients can be divided into three different categories: *uninformed (or naïve) clients* who procure projects very infrequently; *partially informed clients* who have procured some projects and procures projects from time to time; and *well-informed (or sophisticated) clients* who procure construction projects on a regular basis or are from the construction industry (Boyd and Chinyio, 2006). The clients can also be described by their main purpose with construction projects. The *using* client builds to accommodate its own organization; the *maintaining* client builds to own and to rent out and is also responsible for maintenance; and the *selling* client builds to sell with maximized profit (Frödell *et al.*, 2008). Furthermore, construction clients can also be divided into public or private clients.

In "Rethinking construction" Egan (1998) built on the work by Latham (1994) and argued that the work with changing and improving the construction industry begins with the clients. Major clients must be committed to the change needed in order to improve performance and quality. However, Egan (1998) recognize the difference between different types of clients. It cannot be demanded that a uniformed client with little or no experience of construction takes lead in the reformation to improve the construction industry. It is the client with knowledge about the construction industry that will have to take lead. Especially the public clients who are the largest clients. The government and other authorities should use them as best practice clients and govern them to be in the forefront of the change initiatives. In Egan (2002) the progress since the "Rethinking construction" was evaluated and concluded that the actions taken increased the clients' satisfaction. That there was a mood for change in the construction industry. However, the measures taken were not sufficient and the change process need to accelerate. Other authors such as Briscoe *et al.* (2004), Boyd and Chinyio (2006), Vennström (2008), and Vennström and Eriksson (2010) have also studied how clients can be facilitators for change of improvement in the construction industry.

Briscoe *et al.* (2004) studied three different clients and agree with the suggestions put forward in Egan (2002). For a successful construction project, the client has to have a clear understanding of their business needs. Furthermore, it is essential that the client takes lead and actively works to integrate the construction project participants, including suppliers, in a construction project (Briscoe *et al.*, 2004). Vennström (2008) concludes that construction clients are in a position to initiate and facilitate change in the construction industry. However, the clients need to

shift their mindsets from "seeing the construction process as a straightforward process of problem solving that ends with a product, [their] view must be changed to be more process-oriented" (Vennström, 2008, p. 82). The client can accelerate the change process by taking the role of, or by engaging, a change agent (Vennström, 2008). In a survey among Swedish construction clients Vennström and Eriksson (2010) studied client barriers to change. Generally speaking there are three categories of barriers: industrial (short-term focus, adversarial attitudes, project focus instead of process focus, etc.), attitudinal (conservative industry culture, traditional organization of the construction process, traditional production processes, industry structure, etc.) and institutional barriers (standardized contracts, laws and traditional procurement principles). The industrial and attitudinal barriers were found to be critical barriers on the clients influence on the construction process. Furthermore, the study showed that how the clients handled project management influenced their ability to change the construction process. Clients that relied on external project management had a harder time to influence other actors in a construction project, compared to clients that managed projects internally (Vennström and Eriksson, 2010). This illustrates how a client's actions affect the temporary organization that is the construction project as indicated by Cherns and Bryant (1984).

### 2.1.6 The temporary organization of the construction industry

The construction industry is a typical industry that works in temporary organizations, i.e. projects, and has done so for a long time (Bakker, 2010; Lundin and Söderholm, 1995; Eccles, 1981). The reason behind the use of the temporary organizational form in the construction industry is twofold. First of all, the uncertainties in the market and economic cycles causing the fragmentation in the construction industry, as well as the diversities among the construction clients, makes it hard to perform construction works in other organizational forms than in projects. The large amount of different types of specialist contractors that is needed at different times to successfully construct a building induce that a temporary organization is the most suitable organizational form (Cherns and Bryant, 1984; Eccles, 1981). Secondly, since the products (i.e. buildings, bridges, tunnels, etc.) in the construction industry are large, heavy and not mobile, they have to be built on the site of use. The construction site is also built and adapted alongside with the the construction being built. In this regard, the construction site can be viewed as a temporary factory (Bygballe and Ingemansson, 2014). However, in the construction industry there are different initiatives towards construction in off-site production facilities in varying degrees. Jonsson and Rudberg (2013) classified industrialized building in a matrix ranging from prefabrication and subassembly of certain components off-site, to modular building when everything is done off-site and only preparatory ground works and finishing works have to be done on the construction site.

Bakker (2010) defines temporary organizations as "a set of organizational actors working together on a complex task over a limited period of time". In their conceptual study "A theory of the temporary organization" Lundin and Söderholm (1995) put forward that a temporary organization is constituted by four basic concepts: time, team, task and transition. *Time* is a natural concept since the organization is temporary and only exist for a finite period of time. *Team* is the temporary organizations resources, the project members working in the temporary organization. The team is often temporary as well, i.e. the members belong to other

mother organizations, and may change throughout a temporary organization's lifetime. *Task* is what the temporary organization is working with, and the reason why the temporary organization exists, and is either a unique or a repetitive task. If the task is unique the temporary organization is formed to solve a specific task that will not occur again, while if it is a repetitive task a temporary organization will repeat it in the future. *Transition* is the change a temporary organization undergoes when the work progress. It can be a change of the task, in the team or the change of phases in the project (Lundin and Söderholm, 1995). In Bakker's (2010) literature review on temporary organizations little support was found on transition as one of the basic concepts constituting temporary organization. Instead Bakker puts forward *context* as a basic concept. The context can be an industry context, e.g. construction, or an organizational context. Engwall (2003) declared that "no project is an island" meaning that no project is unaffected by its parent organization. As mentioned earlier, a construction project exists because of the client's need. Regardless if the client's aim is to sell or own, the project will be affected by this need. Boyd and Chinyio (2006) also address that the client's permanent organization itself will change because of the construction project. This point of view includes both the concepts of context and transition.

The characteristics of the temporary organization naturally also affects a construction project. In construction, time is of the essence and work is often done towards a deadline (which also can be interpreted as a goal), e.g. the residents of a building will move in. The deadline is set long before the actual construction works begin and the residents buy their apartment together with information about when they will be able to move in. This makes effective planning an important and crucial skill to master in construction projects. The architects and engineers will need to have the blueprints ready when the construction project begins. However, the construction industry is characterized by high uncertainty due to the lack of information. The closer to the construction phase a construction project comes, the more information is available to base planning and design decisions on. But at the same time it becomes harder and more expensive to make any alterations in the blueprints (Winch, 2001). The construction industry is also characterized by being a complex industry that is becoming even more complex (Fellows and Liu, 2012; Kemmer and Koskela, 2012; Segerstedt and Olofsson, 2010; Winch, 1998; Baccarini, 1996). The vast amount of project participants that work in different stages of the construction project, some depending on others work being finished, complicates forming of the project team. This requires a skilled and experienced project management in order to coordinate activities and different project participants. A subcontractor is a team member in the construction project, but for the subcontractor the work it performs can be seen as a subproject. However, the individual contractor might not have the large construction project in focus, but rather sees the subproject as a project of its own. The construction temporary organization is therefore seen a temporary multi-organization (Dubois and Gadde, 2000; Baccarini, 1996; Cherns and Bryant, 1984). The task in a construction project coincides with the definition of a construction client; it is everything that is done in a construction project in order to construct a building. It is very seldom a unique task; construction projects are typically of a repetitive nature (Lundin and Söderholm, 1995).

Even though Bakker (2010) did not find support for transition as a basic concept constituting temporary organizations, does a construction project go through

several transitions. The shift of different phases from design, to construction and finally handing the finished building over to the client, are examples of transitions that will affect the construction project. The number of contractors involved in the construction project will change throughout the construction project. Some of the transitions a construction project undergoes have been historically important. One example is finishing of the climate screen which still today often is celebrated with a roofing ceremony. Also the construction site will change along with the project, affecting the construction that is to be performed. It will change how machines can be used, how and when deliveries can enter, where to unload and store materials and so on.

The construction industry context will affect the performance and planning of construction project, and has to be considered. Much of the construction works is carried out outdoors, which means that construction works will be affected by weather conditions. Rain and snow might damage some kinds of materials if they are not stored properly. Snow will also make materials hard to find if they are not sheltered. Weather and temperature will also affect the productivity of the construction workers. The geography of the construction site affects planning and execution of a construction project. Ground conditions will change and differ in construction projects. In some places extensive ground works has to be done before construction can begin. For heavily industrialized construction projects the ground conditions may be one of the few, but very important factors that affect the construction work performed on the construction site (Jonsson and Rudberg, 2013). The layout of the construction site, disposition plans, placements of cranes, how materials will be delivered are examples of how the geographical location affect construction works (Lindén and Josephson, 2013; Larsson *et al.*, 2008; Agapiou *et al.*, 1998a). Since construction is performed in temporary factories and since construction work is performed on several different locations with many participants also the supply chains are temporary (Behera *et al.*, 2015).

## 2.2 Partnering in construction

To address the problems with low productivity, high costs and fragmentation in the construction industry, improved collaboration and cooperation have been put forward as solutions to the problems. After Latham (1994) and Egan (1998) advocated for partnering as a form to increase cooperation between the different stakeholders in the construction industry, has partnering increased in popularity (Saad *et al.*, 2002). Now is partnering the dominant cooperative governance form in the construction industry (Jacobsson and Roth, 2014). The concept of partnering is old and derives from the manufacturing industry where it has been used for a long period of time (Gadde and Dubois, 2012). In the construction industry it has been used for a number of decades and was introduced by the United States of America's armed forces in the 1980's to increase efficiency in construction (Kadefors, 2011). Since then partnering and other collaborative practices has been used in the construction industry (Saad *et al.*, 2002; Li *et al.*, 2000). The introduction of and increased work with partnering represents a major shift from the adversarial nature that characterize traditional construction projects (Bygballe *et al.*, 2010; Bresnen and Marshall, 2000a).

The introduction of partnering has been described as "the most significant development to date as a means of improving project performance" in the construction industry (Wood and Ellis, 2005, p. 317), and partnering is often

associated with and said to generate several advantageous benefits, such as reduced costs, improved quality, reduced lead times, increased productivity, increased sustainability, increased number of innovations, etc. (cf. Crespin-Mazet *et al.*, 2015; Eriksson, 2010; Manchester Business School, 2009; Bresnen and Marshall, 2000a; Egan, 1998). However, the benefits will not be automatically obtained if a partnering agreement is met between the construction project stakeholders (Bresnen and Marshall, 2000a). Not all construction projects are suitable for partnering; small and less complex projects in which the setup-costs of the partnering agreements outweigh the benefits, are not suitable for partnering (Eriksson, 2010). To estimate if a construction project is suitable for partnering the project can be placed on a continuum ranging from competition to cooperation. The balance point on the continuum is a state Eriksson (2010; 2008) labels coopetition, see Figure 5. Coopetition can be described as the balance between competition and cooperation in a buyer-supplier relationship. When the complexity, levels of customization, duration, time pressure and uncertainty increases, the more should a project focus on cooperation, and partnering becomes suitable (see Figure 5) (Eriksson, 2010).

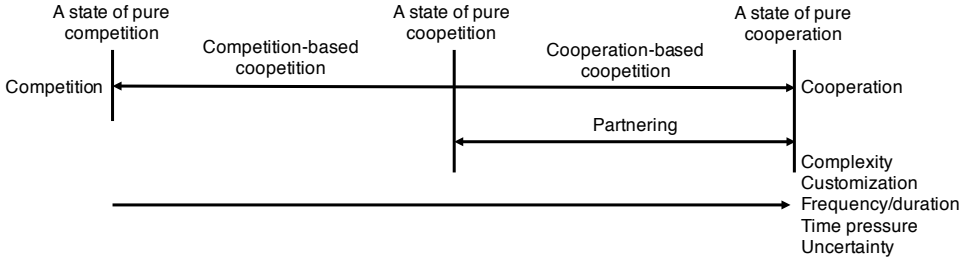


*Figure 5 - The coopetition continuum (Eriksson, 2010).*

### 2.2.1 Defining partnering

However, there is a lack of a unanimous definition of partnering in the construction industry (Eriksson, 2010; Nyström, 2005) and to describe it as a governance form on the coopetition continuum is not enough. Many researchers tend to lean on a definition provided by the Construction Industry Institute (CII) in 1991 (Bygballe *et al.*, 2010; Kadefors, 2011; Manchester Business School, 2009):

> *"A long-term commitment by two or more organizations for the purpose of achieving specific business objectives by maximizing the effectiveness of each participant's resources. This requires changing traditional relationships to a shared culture without regard to organization boundaries. The relationship is based upon trust, dedication to common goals, and an understanding of each other's individual expectations and values. Expected benefits include improved efficiency and cost-effectiveness, increased opportunity for innovation, and the continuous improvement of quality products and services." (CII, 1991, p. iv)*

This definition is now old, and the CII has revised their definition of partnering into:

> *A long-term commitment between two or more organizations as in an alliance or it may be applied to a shorter period of time such as the duration of a project. The purpose of partnering is to achieve specific business objectives by maximizing the effectiveness of each participant's resources. (CII, 2015)*

The general prerequisites for partnering are said to be top management support and adequate resources. However, these factors are not unique for partnering and do not say anything further about the concept (Nyström, 2005; Yeung *et al.*, 2007). In a conceptual study, Nyström (2005) defines partnering out of nine components illustrated as a flower, see Figure 6. In the center of the partnering flower the two components *trust* and *mutual understanding* can be found. The additional seven components: *economic incentive contracts, relationship building activities, continuous and structured meetings, a facilitator, choosing working partners, predetermined dispute resolution method* and *openness,* are petals surrounding the center of the partnering flower.

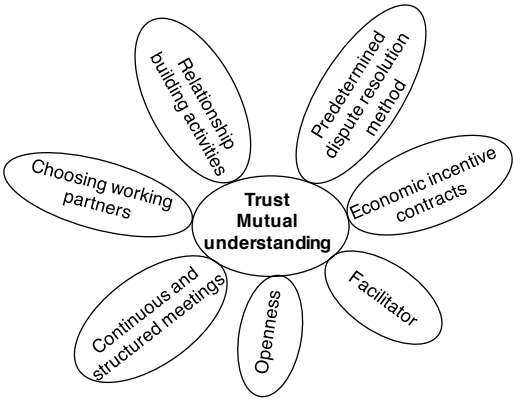


*Figure 6 - Illustration of the partnering flower, based on Nyström (2005)*

By this illustration Nyström (2005) illustrates that trust and mutual understanding are necessary and common components, and are central to all partnering projects. However, the project must also contain some of the petal components in order to be a partnering project. The type of partnering project will differ depending on how many and which of the components that are included. Yeung *et al.* (2007) has elaborated further on how the components can be interpreted and distinguish between "hard" and "soft" components. The "hard" components are the contractual based components while the "soft" components are relationship based. However, Karrbom Gustavsson and Hallin (2014) problematize the dichotomization of project management theories into "hard" and "soft". It indicates that components are opposite to each other. The "hard" components can also be interpreted as being more important compared to the "soft" ones. But projects are not binary and it is hard to say that certain actions are more important than others. The complexity of projects risk getting lost by this over simplification of project management (Karrbom Gustavsson and Hallin, 2014).

### 2.2.2 Working with partnering

Formal contracts are still common when partnering is implemented and used in construction projects (Manchester Business School, 2009). But partnering has become associated with relationship building activities and joint workshops with key project stakeholders, in the beginning of the project and continuing through out the project (Kadefors, 2011; Bresnen and Marshall, 2000b). These include:

- teambuilding activities
- formulation and documentation of common goals
- jointly working out a structure for communication and work models (design, risk analysis, procurement, controls, etc.)
- reflect on the cooperation
- evaluate achievements
- risk management

However, it is important to note that relationship building activities alone are no guarantee of successful partnering (Bresnen and Marshall, 2000b). As joint workshops have become more important in construction, has partnering managers also become more common. They are often hired from an external management firm (Kadefors, 2011; Bresnen and Marshall, 2000b). The partnering manager is in charge of maintaining the relationship and developing the team spirit in the partnering project. This is done by organizing and leading workshops to continuously follow up the cooperation. It is emphasized that the partnering manager should be separated from the project manager and not having any operational role in the project. The advantages of keeping these two roles apart is that a neutral part can better follow up the partnering agreement and initiate discussions. The project managers can then focus on the operational work of planning, leading and controlling the project. However, the risk is that two parallel systems are initiated and that the work is sub-optimized; project managers do not always see the operational project work from a relationship perspective (Kadefors, 2011).

The success of partnering differs between countries and barriers to change (Eriksson, 2010). Differences in organizational cultures (Bresnen and Marshall, 2000a) as well as the culture of different countries (Jacobsson and Roth, 2014) have been attributed as the reasons behind the varying success of partnering. An example of cultural differences can be seen in the balance of power between clients and the main contractors. In the UK clients are powerful and partnering has been criticized as being a method for the clients to put even more pressure on the contractors. In Sweden the balance of power is the other way around and the contractors are generally more powerful and therefore has partnering been seen as a contractor initiative (Kadefors, 2011). Partnering has been very successful in the UK and south-east Asia and has only in recent years been increasing in the Nordic countries (Bygballe *et al.*, 2010; Kadefors, 2011; Manchester Business School, 2009). However, among the Nordic countries Denmark has been in the forefront of partnering in construction projects. In construction projects with 50 % or more of public financing the clients have to work with partnering, or present substantial reasons to not work with partnering (Kadefors, 2011; Manchester Business School, 2009). In Sweden it was the large contractor NCC (the third largest in Sweden in 2014 (Sveriges byggindustrier, 2015)) that introduced partnering after having

worked with the concept in Denmark through their Danish subsidiary company. In Sweden most large construction companies work with partnering today. As an example came more than 30 % of the large construction contractor NCC's turnover between 2009 and 2010 from partnering projects (Kadefors, 2011).

Even though the implementation of partnering in the construction industry has been attributed a great importance in the improvement of performance in the construction industry (Wood and Ellis, 2005), the implementation process still needs to be improved. Today most partnering agreements are dyadic, typically only between the client and the main contractor (Bygballe *et al.*, 2010; Dainty *et al.*, 2001a; Bresnen and Marshall, 2000a; Li *et al.*, 2000). Often the consultants also are included (Bygballe *et al.*, 2010; Manchester Business School, 2009), but since they are representatives of the client in the design process the relationship is still considered to be dyadic (Bygballe *et al.*, 2010). From the large main contractors' perspective, it has been more important to secure contracts from their customers, i.e. the clients, than focusing on the extended supply chain (Meng, 2013). A consequence is that it has been hard for subcontractors and suppliers to be included in the partnering agreements. The contracts between main contractors and subcontractors have been more like traditional adversarial agreements. Because of the fragmentation in the construction industry, with competition between many small construction contractors, the subcontractors have been afraid to state demands with the risk of losing contracts (Meng, 2013; Dainty *et al.*, 2001a; Dainty *et al.*, 2001b). Although some suppliers have initiated partnering agreements of their own (Wolstenholme, 2009), many suppliers are skeptical about partnering, viewing it as a way to push costs upstream in the supply chain (Bygballe *et al.*, 2010; Akintoye *et al.*, 2000). In the review of the UK construction industry since the Egan (1998) report, Wolstenholme (2009) confirms the suppliers' fears. Contractors push risk down the supply chain, a consequence of procurement principles still focusing on lowest price instead of lowest cost.

The barriers to change identified by Vennström and Eriksson (2010) still remains in many cases. Wolstenholme's (2009) review of the progress in the construction industry also found that many clients and suppliers had abandoned the partnering principles, as a result of the economic downturn between 2007 and 2009. However, Swedish investigations of partnering indicate that those who have participated in a partnering project see great advantages with the concept. The number of partnering projects also seems to increase despite economic recession. Many clients choose partnering in order to retain flexibility in the later stages of construction projects. This makes it easier to manage expensive alterations late in the construction project and better information about possible cost effective solutions (Kadefors, 2011). Public clients in Sweden have also been reluctant to engage in partnering projects due to the laws and regulations hindering public clients to engage in long-term agreements. However, in the UK and in Denmark public clients do not see the limitations in the laws and regulations on public procurement as Swedish public clients do, and the Swedish public clients may very well learn from other countries (Kadefors, 2011; Manchester Business School, 2009).

### 2.2.3 Different levels of partnering

Partnering can be divided into different levels depending on how far the partnering agreement goes. The two most common forms are *project partnering* and *strategic*

*partnering*, but also *pseudo-partnering* exists (Jacobsson and Roth, 2014; Gadde and Dubois, 2012; Kadefors, 2011; Bygballe *et al.*, 2010; Li *et al.*, 2000). To distinguish between them they can be put on a continuum where pseudo-partnering indicates low level of cooperation, project partnering indicates more increased cooperation and strategic is full cooperation (Jacobsson and Roth, 2014). Pseudo-partnering is still based on the adversarial contractual agreements of traditional construction projects. These types of construction project are not true partnering projects and the involved parties do not share common goals or risk during the project. However, they include some form of collaboration between parties even though the collaboration do not go particular far, and are typical arm's length collaborations (Li *et al.*, 2000). A construction project with pseudo-partnering would most likely be placed on the left side on the coopetition continuum (see Figure 5) presented by Eriksson (2010; 2008). An example might be the "expanded cooperation"-contracts in Sweden.

Project partnering is the most common and popular form of partnering. It suits most kind of projects, and since it is a partnering form that only stretches across one project it is often used in publicly funded construction projects where public procurement acts hinder long term agreements (Kadefors, 2011; Bygballe *et al.*, 2010; Li *et al.*, 2000). In project partnering agreements trust has been established between the parties and there is also an expected increase in communication and mutual understanding. The parties also share common, project specific goals. This is a real form of partnering placed on the right side on the coopetition continuum, see Figure 5. The cooperation goes beyond the contract, and risks and rewards are shared (Manchester Business School, 2009; Li *et al.*, 2000). Bygballe *et al.* (2010) identifies project partnering to be on short-term basis because it only includes one project, and therefore the benefits are limited. Project partnering can however be a prelude to strategic partnering (Cheng and Li, 2002).

Strategic partnering is a more mature, long-term relationship between the parties that stretch over several projects (Kadefors, 2011; Manchester Business School, 2009; Bygballe *et al.*, 2010). Strategic partnering involves high trust between the parties and the relationship evolves further to include development of products, services, procedures, etc. The parties shall engage in the partnership on equal terms and share both risks and rewards throughout the collaboration. There is a specific intention to work together with all firms included in the agreement (Manchester Business School, 2009; Li *et al.*, 2000). In the UK and Sweden there are examples of successful strategic partnering in both private and public projects (Manchester Business School, 2009). However, in general terms they seem to be rare and there is little research on them (Bygballe *et al.*, 2010).

Gadde and Dubois (2010) argues that the industry has gone towards strategic partnering to rapidly and therefore the success, or the expectations, of partnering has been limited. They suggest that the focus should be on a differentiated approach on project partnering instead, with extensions in the local, regional and central level. Gadde and Dubois (2012) develops this further and labels it *focused partnering* which is founded in project partnering. On local level it is partnering within the boundaries of the specific project. If suppliers and subcontractors are involved early on, from the design and planning stages of a construction project, many of the problems that occur in the production stage could be mitigated. The next level is to have interaction between projects. Subcontractors could be grouped

into more or less stable constellations, eliminating procurement for every projects. With the same subcontractors (and suppliers) involved over several projects, knowledge will more easily be transferred from a project to another. The final level resembles strategic partnering and is increased interaction in the permanent network, i.e. the mother organization. On this level, standardization can be developed and common interests and resources will be used more efficiently. Research on other industry sectors has shown that improved client-customer relationships on the permanent level increase innovation and efficiency (Gadde and Dubois, 2012).

## 2.3 Supply chain management and logistics

SCM was together with partnering one of the main suggestions Egan (1998) had to reform the construction industry. The concept of SCM is not a new one, it was put forward by consultants in the 1980's (Harland, 1996; Lambert and Cooper, 2000). However, elements of the concept can be traced back to Forrester (1958) when he presented a theory of distribution management that recognized the integrated nature of relationships between organizations (Mentzer *et al.*, 2001). SCM increased in popularity both in academia and in practice during the late 1990s, and the interest and development of SCM has increased ever since. However, there have been many different perceptions of what SCM really is. Just as in the case of partnering, there has not been a uniform definition of SCM. The concept has been defined as a management philosophy, as a set of activities to implement a management philosophy and a set of management processes (Mentzer *et al.*, 2001). The Council of Supply Chain Management Professionals (CSCMP) define SCM as the following:

> *"Supply Chain Management encompasses the planning and management of all activities involved in sourcing and procurement, conversion, and all logistics management activities. Importantly, it also includes coordination and collaboration with channel partners, which can be suppliers, intermediaries, third-party service providers, and customers. In essence, supply chain management integrates supply and demand management within and across companies. Supply Chain Management is an integrating function with primary responsibility for linking major business functions and business processes within and across companies into a cohesive and high-performing business model. It includes all of the logistics management activities noted above, as well as manufacturing operations, and it drives coordination of processes and activities with and across marketing, sales, product design, finance and information technology." (CSCMP, 2013)*

This definition clearly states that SCM includes management of physical items, i.e. logistics, as well as information and relationships. However, despite this definition many have a hard time separating between SCM and logistics. Larson and Halldorsson (2004) have distinguished four different views, or interpretations of the terms logistics and SCM, see Figure 7. The definition says that logistics management is a part of SCM, a view Larson and Halldorsson (2004) labels as the *unionist* perspective. The opposite perspective, when SCM is a part of logistics is labeled *traditionalist*. Another perspective is *relabeling*, meaning that what earlier was known as logistics is now labeled SCM. The last perspective is labeled the

*intersectionist* perspective, when SCM and logistics are two separate concepts with some overlap (Larson and Halldorsson, 2004). In this thesis a unionist perspective following the definition by the CSCMP is used.

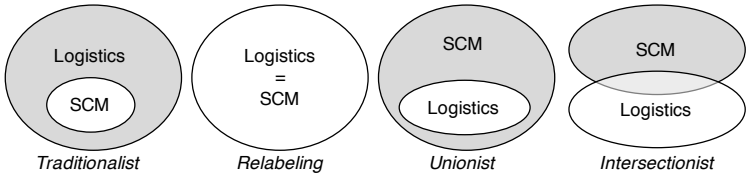


*Figure 7 - The four different perspectives of SCM and logistics as distinguished by Larson and Halldorsson (2004).*

Furthermore, it also necessary to define what is meant by a supply chain in order to understand how it will be managed. Even though it is called supply chain, indicating that it is a line of connected organizations and business relations, this description is not accurate. A better description is a supply network with several connected organizations as described by Christopher (2011) and Lambert and Cooper (2000). Christopher (2011) also provides a definition of a supply chain as:

> *"[…] the network of organizations that are involved, through upstream and downstream linkages, in the different processes and activities that produce value in the form of products and services in the hands of the ultimate consumer." Christopher (2011, p. 13)*

It is important to realize that supply chains exists whether they are managed or not. A distinction can be made between supply chains as a phenomenon and the management of the supply chains (Mentzer *et al.*, 2001). An organization may also be part of several supply chains and are also included in other organizations' supply chains (Christopher, 2011; Lambert and Cooper, 2000). The connections in a supply chain symbolize both material flow, information, transactions and business relationships (Christopher, 2011; Mentzer *et al.*, 2001; Lambert and Cooper, 2000). In Figure 8 an example of a supply chain is illustrated. The black box indicates the focal company, the white boxes indicates companies that are members of the focal company's supply chain, the grey boxes indicate companies that are not member of the focal company's supply chain.

Mentzer *et al.* (2001) argues that in order for SCM to be fully realized in the supply chain, must all participating companies have a supply chain orientation (SCO). SCO is defined as *"the recognition by an organization of the systemic, strategic implications of the tactical activities involved in managing the various flows in a supply chain"*. In order to have a SCO a participating company must willingly address: eight antecedents, *trust, commitment, interdependence, organizational compatibility, vision, key processes, leader* and *top management support*, in both a strategic and a systematic way. Since a supply chain is made up of at least three or more companies, all the participating companies must have a SCO in order to realize SCM across the supply chain (Mentzer *et al.*, 2001). SCO is a prerequisite and individual members of the supply chain must first coordinate activities within the company (Lambert and Cooper, 2000), but disjointed supply chain tactics (such as Lean, just-in-time, etc.) is not SCM unless they are coordinated over the

supply chain (Mentzer *et al.*, 2001). When all participating companies in the supply chain have SCO they must first realize SCM activities before any potential benefits can be obtained. These activities are cooperation, sharing of information, sharing risks and rewards, integrate key processes, establish long-term relationships and coordinate business functions. The potential benefits with SCM are lower costs, improved customer value and competitive advantage (Mentzer *et al.*, 2001).

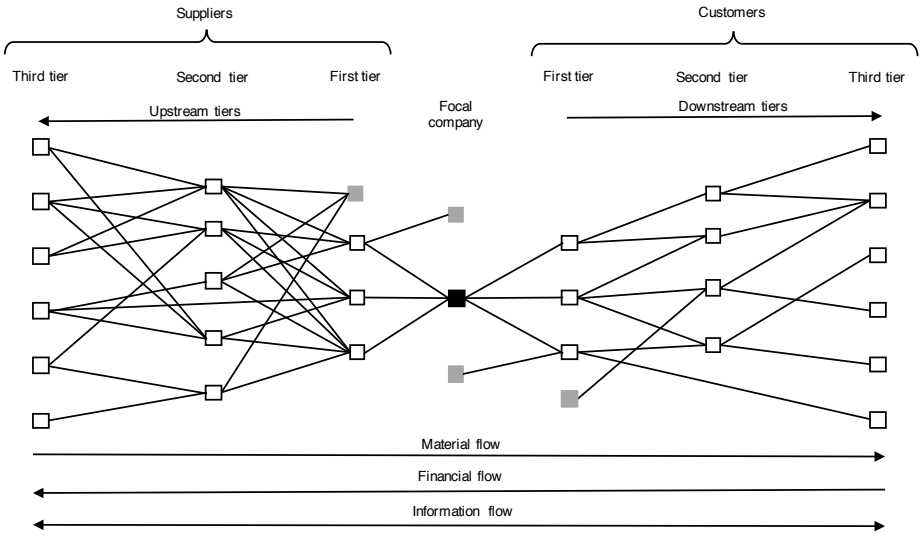


*Figure 8 - Illustration of a supply chain based on Lambert and Cooper (2000).*

Lambert and Cooper (2000) have developed a conceptual framework for managing supply chains when SCM is realized throughout the supply chain. The framework consists of three closely interrelated elements: the supply chain network structure (member firms and the links between these firms), the supply chain business process (activities that produce a specific output of value to the customer) and the supply chain management components (managerial variables that are integrated and managed across the supply chain).

Since all companies are members of a *supply chain network*, from the raw material supplier to the end customer (Mentzer *et al.*, 2001; Lambert and Cooper, 2000), it is pertinent to know where in that supply chain a company is situated. A company close to the raw material will have more tiers of customers compared to a company closer to the end customer and vice versa. The position in the supply chain needs to be assessed from both a vertical and a horizontal perspective. The horizontal perspective tells if it is a short or long supply chain, i.e. how many tiers are included. The vertical perspective will tell how many companies are included in a tier. All this information will affect how the supply chain will be managed (Lambert and Cooper, 2000).

There are several *business processes* occurring throughout the supply chain that will affect each other. Marketing will affect sales, that in turn will affect production, that will affect the suppliers. In order to deliver to its customer a company is depending on that its suppliers can deliver and what uncertainties there are. The

key business processes are: customer relationship management, customer service management, demand management, order fulfillment, manufacturing flow management, procurement, product development and commercialization, and returns (Lambert and Cooper, 2000). However, some processes are more important than others, as well as that some relationships with suppliers and customers are more important. Some suppliers and customers are managed throughout the entire supply chain, and some only one step. Other relationships are only monitored and some are neither managed nor monitored (Lambert and Cooper, 2000).

The third element of the framework is *the management components* that determines the level of integration and management of the business processes. The more components, the higher integration of a business process. The components can be divided into two groups. The first group are the physical and technical components, and includes the components that are most visible, tangible, measurable and easy to change. However, if only this first group of components are considered and the results will be disappointing and therefore the second group of components has to be considered as well. The second group are the managerial and behavioral components, they are less visible and tangible and harder to measure and change. The second group of components influence how the first group of components can be implemented and define the organizational behavior (Lambert and Cooper, 2000).

### 2.3.1 SCM in construction

Inspired by other industry sectors Egan (1998) suggested SCM as a solution to the problems in the construction industry. A view that has later been confirmed in studies by others (cf. Department for Business Innovation and Skills, 2013; Vrijhoef and Koskela, 2000). The complexity and fragmentation of the construction industry set special requirements on SCM. Temporary factories induce temporary supply chains that differ between projects (Behera *et al.*, 2015; Vrijhoef and Koskela, 2000). The construction supply chains are considered to be complex (Fellows and Liu, 2012) with many interactions between multiple actors (Winch, 2001). A temporary organization also leads to that, besides materials, also other resources such as machines (cranes, wheel loaders, etc.), labor (contractor, subcontractors, etc.) and equipment (tools, scaffolding, construction elevators, etc.) have to be allocated to the construction site (Cox and Ireland, 2002). The procurement of materials, services and other resources constitutes 60-80 % of the gross work done in construction. The gross work tend to be higher in the construction of new-build projects compared to refurbishment projects since they include more subcontractors (Scholman, 1997; Dainty *et al.*, 2001a). The construction supply chains therefore have a large impact and influence on the success of a construction project (Dubois and Gadde, 2002; Miller *et al.*, 2002).

The temporariness in the construction industry implicates that the supply chain processes and the construction processes needs to be well planned and adapted specifically to every construction project (Olsson, 2000; Larsson *et al.*, 2008; Lindén and Josephson, 2013). The project and the supply chain can be seen as two processes that meet at the construction site, see Figure 9. However, it is crucial that information is shared between the supply chain companies and the construction project to optimize supply chain activities, as well as securing the project outcome. This is seldom the case in the construction industry. Contractors do not always

know what they need and the designers seldom inform the suppliers in advance (Olsson, 2000). Agapiou *et al.* (1998a) showed that with regular contact between the contractors and the suppliers, the logistics are improved and significant costs can be saved. Involvement of suppliers early on in the design phase has also shown to generate considerable gains in productivity. Decrease in production times by 10 % and large reductions of reported errors (Agapiou *et al.*, 1998b).

Procurement procedures in the construction industry are often disconnected with how the project is executed on site. Procurements often occur twice, first on regional level or above, and then on the operational level in the projects (Frödell, 2014). Suppliers are typically procured based on lowest price with large discounts, instead of lowest cost (Wolstenholme, 2009). Even when the main contractor have knowledge of pricing errors or subcontractors with significant added value, the procurement is based on lowest price (Dainty *et al.*, 2001a). Vrijhoef and Koskela (2000) showed that when materials were bought with discounts the costs for site logistics increased, in the worst case with 250 % of the materials purchase price.

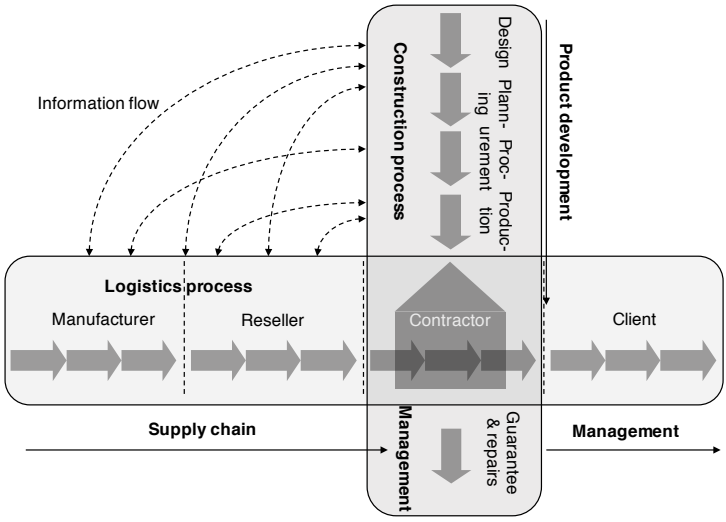


*Figure 9 - The interaction between the supply chain and the construction project activities. Figure based on Olsson (2000).*

Materials suppliers often have to be flexible and cope with orders placed in the last minute due to lack of inventory control and poor storage capacity on the construction sites. This is a service appreciated by the contractors, but have negative effects on the suppliers' ability to plan their work. It can also be seen as an indicator on the contractors' poor planning (Frödell, 2014; Vidalakis and Sommerville, 2013). This is reflected in the poor delivery service in the construction industry. Only 38 % of the deliveries are delivered in full (damage free and in the right amount, to the right location, with the right documentation and in time) (Thunberg and Persson, 2013). The suppliers have to balance customer responsiveness and loading efficiency by consolidating deliveries to reduce transportation costs. Transportation costs are significant for the suppliers,

therefore addressing transportation efficiency can result in decreased costs for the suppliers and reduced total acquisition costs of materials (Vidalakis and Sommerville, 2013).

Despite that the suppliers, manufacturers and transport providers ability to perform in the desired way are affected by decisions made on the construction site (Bankvall *et al.*, 2010), they seem to have come a long way in their work towards the realization of SCM. However, the suppliers' problems often begin at the construction sites. This affects the suppliers and transport providers no matter how far they have come in their efforts of becoming SCO (Bankvall *et al.*, 2010). Problems also tend to spread along every interface in the construction supply chain and the construction process (Vrijhoef and Koskela, 2000). To improve supply chain performance, SCM principles have to be included in the procurement process (Vidalakis and Sommerville, 2013) and improved relationships between suppliers, transport providers, manufacturers and contractors have to be established (Vidalakis and Sommerville, 2013; Frödell, 2011; Akintoye *et al.*, 2000; Olsson, 2000). To summarize, the performance of construction supply chains can be said to be troubled in three areas: a cost driven supply chain, an unclear interface between the supply chain and the construction site, and inferior construction site logistics, see Figure 10.

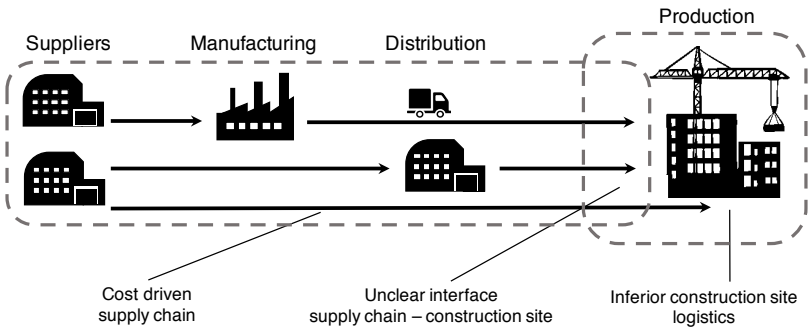


*Figure 10 - The construction supply chain with three areas that affect its performance are indicated.*

### 2.3.2 The four roles of SCM in construction

Vrijhoef and Koskela (2000) describe four roles SCM can have in construction that are illustrated in Figure 11. The first role is to clarify the interface between the supply chain and the construction site. The supply chain's companies do not generally work in temporary organizations, i.e. it is process driven and not project driven. Sharing information between the supply chain companies and the construction project is essential in order for all the parties to be able to plan their work. The second role is to streamline the supply chain so it supports the construction project in the best possible way. Examples are to specify how materials are packed on pallets, and size of pallets so they can be handled on the construction site. The third role is to move activities from the construction site to the supply chain. An example of this is prefabrication of construction materials. The fourth role is when the supply chain and the construction site is fully integrated and it can be interpreted to be the sum of all the other three roles. The fourth role

is the only role that can truly be interpreted as SCM, since all the other roles are different examples of logistics management (Vrijhoef and Koskela, 2000).

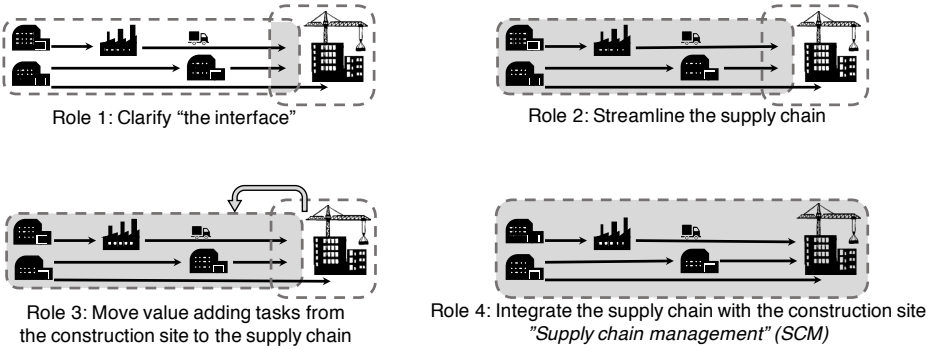


*Figure 11 - The four roles of SCM in construction (Vrijhoef and Koskela, 2000).*

SCM in the construction industry has been debated ever since Egan (1998) advocated for it to be a solution to the problems the construction industry is associated with (Behera *et al.*, 2015). However, initiatives and solutions towards the realization of SCM in construction have been done before that (Vrijhoef and Koskela, 2000; Agapiou *et al.*, 1998a). In some cases it has been mixed up with partnering, especially in partnering agreements including subcontractors and suppliers (Bresnen and Marshall, 2000b). Fernie and Tennant (2013) claim that the success of SCM in construction is small, if any at all, compared to partnering. Furthermore, their argument is that SCM is not applicable in the complex construction industry due to its unique characteristics. However, as Lundin and Söderholm (1995) states, construction is a repetitive business and not unique, and other complex industries with long project cycles have managed radical changes (Wolstenholme, 2009). However, SCM is only a partial success in the construction industry (Bankvall *et al.*, 2010) and this may be due to the temporary organizational structure of the construction industry. SCM is developed for other industry sectors, such as the automotive industry, with long-term relationships and permanent organizational structures. The construction industry stakeholders are becoming aware of the potential benefits with SCM. An indicator of this is the emergence of dedicated logistics and SCM solutions in the construction industry, e.g. TPL solutions (Lindén and Josephson, 2013; PEAB, 2014).

## 2.4 Third-party logistics

The definition of SCM provided by CSCMP was clear that SCM includes logistics. That part of SCM is often labeled logistics management and is defined as:

> *"That part of supply chain management that plans, implements, and controls the efficient, effective forward and reverse flow and storage of goods, services and related information between the point of origin and the point of consumption in order to meet customers' requirements." (CSCMP, 2013)*

One area of logistics management that has been increasing in interest is third-party logistics (TPL), also known as logistics alliances, logistics partnerships and logistics service providers (Skjoett-Larsen, 2000). The interest is not only seen in academia (Selviaridis and Spring, 2007), but also in practice when companies outsource all or parts of their logistics operations to TPL providers (Marasco, 2008). An indication of the increased interest is that TPL service providers are included in the definition of SCM provided by CSCMP (2013). Marasco (2008, p. 128) defines TPL as "an external organization that performs all or part of a company's logistics function", furthermore is TPL offered as a bundle of services rather than just isolated transports or warehousing (Selviaridis and Spring, 2007). Examples of such services are transport, warehousing, inventory management (e.g. materials handling, repackaging), value-adding activities (e.g. secondary assembly, installation of products), information related activities (e.g. tracking and tracing, distribution planning), as well as design and reengineering of the supply chain (Hertz and Alfredsson, 2003; van Laarhoven *et al.*, 2000). In recent years a more advanced relationship termed fourth-party logistics (4PL) has emerged (Selviaridis and Spring, 2007). While TPL focus on logistics management, 4PL is much closer to SCM focusing on managerial, planning and strategic aspects of logistics.

Since logistics management is a part of SCM the goals coincide as well as the potential benefits of lowered costs, improved satisfaction and customer value, and competitive advantage (Mentzer *et al.*, 2001). There are both risks as well as benefits with outsourcing logistics operations to a third party. Aguezzoul (2014) notice that cost and service related issues are the most common drivers for companies to implement a TPL solution, while relationship issues are the most common concerns. However, just like SCM, TPL are long-term partnerships; the concerns tend to decline over time as the TPL is setup and the relationship develops (van Laarhoven *et al.*, 2000).

### 2.4.1 Third-party logistics in construction

Dedicated TPL providers working towards the construction industry is a new phenomenon in the recent years (Langley, 2015). Clients and contractors have focused on securing contracts with each other and not focused on improving the relationships with suppliers and subcontractors (Meng, 2013; Bygballe *et al.*, 2010). This combined with little knowledge of SCM and logistics among contractors and clients (Cox, 2008; Thunberg, 2013), has opened up a market for TPL providers specialized towards construction (Lindén and Josephson, 2013).

TPL solutions in the construction industry have various configurations depending on the TPL provider, the construction project (i.e. context), the client, the contractors, the suppliers and the transport providers. Common is that the TPL provider offers a service of coordinating and handling of materials at construction sites (Lindén and Josephson, 2013; Gadde and Dubois, 2012). Some solutions use decentralized warehouses were materials can be stored in a secure environment and be delivered regularly to the construction site (Gadde and Dubois, 2012). Other solutions are present at the construction site and deliveries are routed to a checkpoint or a specified unloading area on the construction site (Lindén and Josephson, 2013). One argument for TPL solutions is that the time the construction workers spend on materials handling (see Figure 1) is set free so that the construction workers can focus on value adding activities. If this is not the case, the time set free is pure waste.

There are positive examples of use of TPL solutions in construction projects, however there are only a few studies made on them. Sobotka and Czarnigowska (2005) showed that when contractors outsource logistics management tasks, such as handling materials, to logistics professionals a reduction in costs could be seen. The cost reductions were mainly seen in less storage of materials and reduction in transports. Lindén and Josephson (2013) compared traditional construction projects with construction projects to construction projects that utilized a TPL provider dedicated towards the construction industry. The TPL provider acted as a consultant and was responsible for the planning of the logistics as well as managing the handling of the delivered materials. The comparison showed that the TPL provider's efforts made the logistics process more effective. The the total cost was lower for the construction projects that utilized the services of the TPL provider. As an example was the handling of plasterboards approximately 20 % lower when the materials handling was outsourced.

Dedicated TPL solutions are a new phenomenon in the construction industry, and as such the development of them has just begun. It can also be questioned if the contractors will outsource the materials handling to TPL providers, or develop the ability and competence in-house. One aspect that speaks in favor for this is the fact that most other types of construction works already are outsourced (Miller *et al.*, 2002; Eccles, 1981). However, the contractors might also experience that they lose a possible source of income and control in the construction project and therefore develop solutions of their own. In either case, it is important to analyze the benefits as well as the drawbacks with the chosen solution. Both scenarios can be seen in the construction industry today (cf. Lindén and Josephson, 2013; Gadde and Dubois, 2012; PEAB, 2014). For a client working actively with the issues of logistics and SCM, the procurement of a TPL solution might be a rather easy way to address logistical issues in a construction project.

# 3. Research design

*This chapter describes the epistemological orientation of the thesis and the research process used in this thesis. The research design and the methods used are all described and motivated. The chapter also includes a final reflection on research quality.*

## 3.1 The thesis epistemology

A researcher's epistemological orientation will affect how the research is performed, analyzed and interpreted. Since the epistemological orientation varies between researchers, the results may be interpreted differently between the researcher who has conducted the research and other researchers. Therefore, it is important to clarify in which epistemological orientation the research is conducted.

This thesis is written at a department where a *positivist* view is predominant. A positivist stance is the "belief in objective reality" (Croom, 2009, p. 63). For the positivist, reality exist in truth and can be found by observing facts that are measurable. The findings can be tested and therefore the research is replicable. The opposite stance to positivism is *constructivism* (or *interpretivism*) where the research considers all observation and analysis to be depending on the context, i.e. the researcher as well as what is researched. While the positivist is concerned with finding out the facts, the constructivist is more concerned with the interpretation of the phenomenon studied. These two views are the extremes on a spectrum of research paradigms and naturally there are views between them; *postpositivism* is such an example. The postpositivist stance is still that truth exist in reality, however only some of it can be obtained (Croom, 2009).

A researcher's epistemological orientation does not have to coincide with the predominant view in the environment the research is conducted. Different epistemologies exist within a research discipline and construction is such an example (Schweber, 2016). This is especially true when the field of research is interdisciplinary.

The author's epistemological orientation in this thesis is closer to a constructivist stance than a positivist stance, and the research in this thesis builds upon that epistemology. However, to define one's own philosophical position on the continuum between positivism and constructivism is a process that causes confusion for all doctoral students (Croom, 2009). The research group the author belongs to can be said to have a postpositivist view on knowledge and the thesis author has most certainly been affected by it. The research has been discussed within the group and valuable input has been gained from those discussions. Furthermore, two of the papers in the thesis have been co-authored by two authors and reflect both researchers' epistemological orientation. Academic research has much to gain from more multi-research agendas, combining the strengths of different epistemologies (Schweber, 2016).

## 3.2 The research process

The research process of this research project consists of three studies, i.e. papers, that have been conducted on the course of about three years. Each of these papers correspond to one of the research questions presented in the first chapter. Two of the papers are explorative single case studies and one is a conceptual literature review. The research process is illustrated in Figure 12.

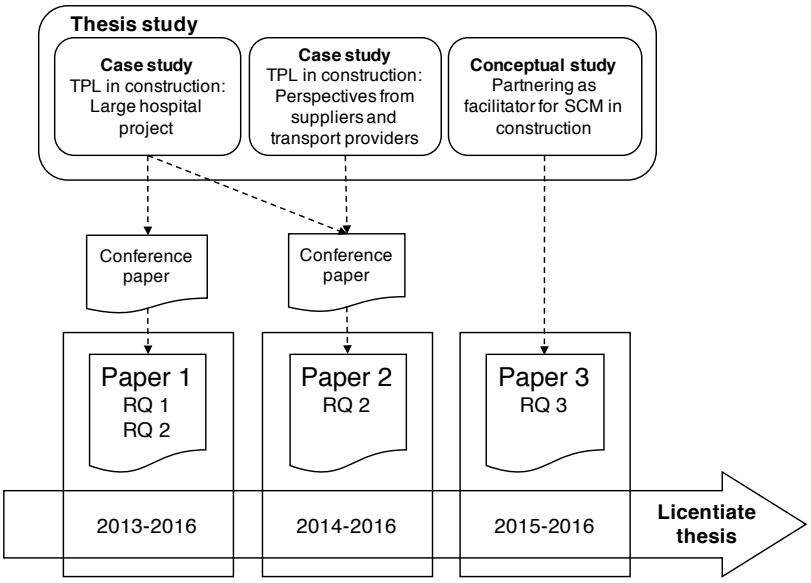


*Figure 12 - The research process.*

### 3.2.1 The three studies

The two case studies on TPL in construction that constitutes Paper 1 and Paper 2 were performed with the same construction project as basis for the case studies. However, the two papers have studied the TPL solution used in the construction project from different perspectives as illustrated in Figure 13. The first case study, that is presented in Paper 1, studied the effects of a client initiated TPL solution and focused on the participating companies working on the construction site. Besides the case study, Paper 1 also consist of a literature review identifying driving forces for and concerns with implementing TPL solutions. Through a conceptual analysis combining the findings from the case study and the literature review, Paper 1 answers RQ1 and partly answers RQ2.

The case study presented in Paper 1 focused only on the downstream tiers in the construction project's supply chain. Some of the findings also indicated that it would be interesting to study how the upstream tiers were affected by the use of the TPL solution. This resulted in the second case study presented in Paper 2, which can be seen as a follow up paper to Paper 1. In this case study the TPL solution's effect on upstream tiers (i.e. manufacturers, wholesalers, building merchants and transport providers) to the construction project were studied, answering RQ2.

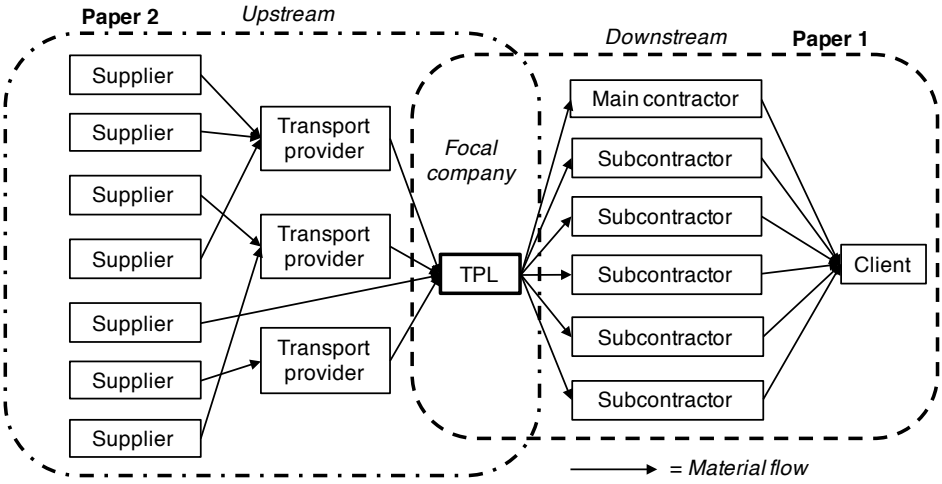


*Figure 13 - The two perspectives of Paper 1 and Paper 2.*

Paper 3 consists of a conceptual literature review investigating if and how partnering can be a facilitator towards the realization of SCM in construction and answers RQ3. The temporary organization of the construction industry is used as the contextual background in this study.

### 3.2.2 Description of the TPL solution in the case studies

The two case studies investigated effects from the use of a client initiated TPL solution in a large construction project of the university hospital in Linköping, Sweden. The construction project was divided into three phases and the case studies were performed during the first phase of the construction project. During the first phase there was an estimated number of deliveries of approximately 60,000, or 40-45 per day. The hospital was fully operative during the entire construction project and in order to minimize disturbances on the hospital, the client decided to use a TPL solution. Of particular importance was that no ambulances were to be delayed.

The TPL provider was a company dedicated to providing TPL solutions in the construction industry. The focus of the TPL solution was on the construction site and the TPL provider had no communication upstream in the supply chain; that was left to the contractors. However, the TPL solution affected the upstream tiers by having regulations on when deliveries could be made, how materials were to be packed on pallets, and maximum size and weights of pallets. Furthermore, no materials other than what was needed for immediate production were allowed to be stored on the construction site and the TPL provider did not offer any warehouse for interim storage of materials. All deliveries were destined to a checkpoint south of the construction site. There the TPL provider accepted the deliveries and directed them to specific unloading areas. All materials that were used for structure completion had to arrive during after regular working hours for the construction workers and were handled by the staff of the TPL provider.

### 3.2.3 Publication process

Both Paper 1 and Paper 2 have evolved from earlier conference versions. The conference version of Paper 1 was presented at the 21st Annual EurOMA Conference in Palermo, Italy the 20th of June to the 25th of June 2014 (Ekeskär *et al.*, 2014), and the conference version of Paper 2 was presented at the 22nd Annual EurOMA Conference in Neuchâtel, Switzerland the 26th of June to the 1st of July 2015 (Ekeskär and Rudberg, 2015).

Paper 1 has been improved and extended, and is published in the journal *Construction Management and Economics*. Paper 2 has also been improved and elaborated further, but is still a working paper planning to be sent to a journal.

Paper 3 originated as an examination paper of a doctoral course in temporary organizations provided by the Nordic Academy of Management during the fall of 2015. Since then it has been elaborated and extended, but has not been sent to a conference and/or journal.

### 3.2.4 Author's statement

The two case study papers, Paper 1 and Paper 2, are authored by the thesis author and the author's main supervisor.

In Ekeskär and Rudberg (2016a), in this thesis referred to as Paper 1, both authors contributed equally to the study. However, the author of this thesis had main responsibility of collecting empirical data, i.e. performing interviews and observations, as well as the analysis. The main supervisor contributed more on the literature review and the structure of the paper, as well as with a majority of the writing in the development of the paper into the journal version. In the initial conference version (Ekeskär *et al.*, 2014) the co-supervisor also contributed to the paper in various parts and is also listed as co-author, however when the paper was improved and developed to Paper 1 he did not participate.

In Ekeskär and Rudberg (2016b), in this thesis referred to as Paper 2, both authors contributed equally to the study. However, the main supervisor provided more of the foundations and structure for the paper, while most of the writing was conducted by the thesis author.

Ekeskär (2016), in this thesis referred to as Paper 3, is authored by the thesis author alone. However, the main supervisor has been supporting with ideas and feedback in his role as supervisor.

## 3.3 Choice of methods

The initial research approach for this research has been a deductive approach, i.e. prior to the empirical data were gathered, theory was studied and literature reviews were conducted. However, when the studies progressed it became clear that more literature and theory were needed. The extended literature reviews were performed both parallel to the empirical data gathering as well as after the empirical data were collected. This can be described as an abductive approach, i.e. an iterative approach between theory and empirical data. The abductive approach were particularly used when Paper 1 and Paper 2 were developed from their respective conference versions since no new empirical data were collected.

### 3.3.1 Theory-building research

The research presented in this thesis is close to the industry and is intended for use in its real world context. According to Wacker (1998) theory building research is good since it provides new insights to real world problems, that then can be analyzed and applied in its real world context. When studying new phenomena, such as dedicated TPL solutions, or concepts within a new context the insights will increase in value if they are applicable. Meredith (2001) suggest that theory building is an iterative process of three phases: description, explanation and theory testing. The iterative process in this research reaches only the first two phases, hence the normative theory of this research will therefore not be tested. Wacker (1998) argues that theory building research is made up of both analytical and empirical methodologies. These methodologies can in turn be divided further into subcategories (Wacker, 1998), see Figure 14.

For the empirically grounded part of this research, i.e. Paper 1 and Paper 2, case studies were chosen as the main research methods, as highlighted in Figure 14. The case studies are of explorative nature; investigating the phenomenon of dedicated TPL solutions in a construction project. Exploratory case studies is considered a good method when studying new phenomena (Voss, 2009) and motivates the choices of methods. The case studies have then been conceptually analyzed since neither mathematical nor statistical material was available, as highlighted in Figure 14. The combination of analytical conceptual research and case studies is commonly used together. The analysis has been based on logical reasoning in accordance with Wacker (1998).

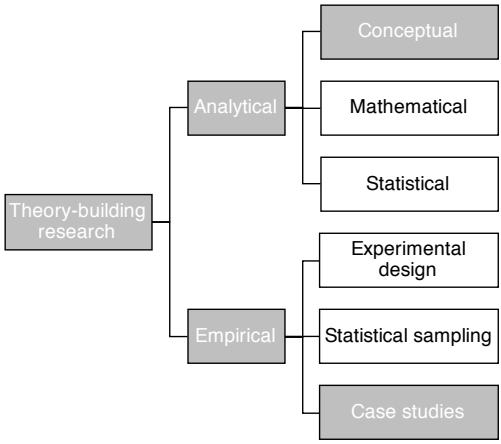


*Figure 14 - Theory building types of research (Wacker, 1998, p. 378).*

Paper 3 is not empirically grounded and investigates the relationship between two concepts that are neither mathematical nor statistical and is therefore a purely conceptual paper. The analysis in Paper 3 uses also logical reasoning in accordance with Wacker (1998), and the concepts have been studied within a specific context and from that new insights have been made.

Table 1 lists the different methods and sources of data that were used in the three papers to answer the three research questions listed in chapter 1.

*Table 1 - The connection between research questions, methods and sources of data.*

| Paper | Research question | Research method | Sources of data |
|---|---|---|---|
| Paper 1 | RQ1: To what extent can a third-party logistics solution be a facilitator for client driven SCM in the construction industry? | Case study | Literature review, interviews, participatory observations, review of project documentation |
| Paper 2 | RQ2: How will upstream tiers be affected when a third-party logistics provider is used in a construction project? | Case study | Literature review, interviews, observations |
| Paper 3 | RQ3: How can partnering be used as a mean to facilitate the realization of SCM in the construction industry | Conceptual study | Literature review |

### 3.3.2 Case study

Since TPL solutions are a new phenomenon in the construction industry, there are not that many construction projects to study that utilizes them. Therefore are both case studies single case studies and the two perspectives depicted in Figure 13 can also be seen as two units of analysis in one single case study reported in two papers, i.e. Paper 1 and Paper 2. This can be motivated by that the project is considered revelatory and is studied over a long period of time, i.e. as longitudinal case studies (Yin, 2014; Voss, 2009). A critical aspect when conducting case studies is to have access in order to be able to perform the case study. (Yin, 2014). The aspect of access becomes even more critical when the phenomenon being studied is rare or new. For the case studies in this research, access was never a problem and since it was a very large construction project there were many sources of data available.

In both case studies interviews have been conducted. The interviews were semi-structured with managers representing the different companies that participated in the study. Prior to the interviews the companies' web pages were reviewed in order to gain knowledge about the companies. In Paper 1 a total of seven interviews were performed and in Paper 2 a total of eleven interviews were performed. The interviews generally took place at the offices of the respondents, even though some interviews were conducted on telephone. An interview protocol with predetermined questions was used with questions divided into four categories:

- Background and general information about the companies and the respondents
- The TPL solution
- Effects from the TPL solution
- Operational procedures of the companies

The first bullet aims to give understanding about the company and the manager, the manager's role in, and experience of, the construction industry. The second bullet provide information about how the companies had experienced and perceived the TPL solution. The third bullet provide information about what perceived effects the companies had experienced as a result from the TPL solution. This was contrasted to a traditional construction project without a dedicated TPL solution. The fourth bullet give information on how the companies work in relation

to the studied construction project. After the interview the respondents were sent the transcribed versions of the interviews to ensure reliability and in some cases additional questions were asked over telephone or e-mail.

In both case studies observations were used to collect data. Direct observations included inspection of the construction site and facilities of some of the participating suppliers in Paper 2. In Paper 1 there were also participatory observations during meetings between contractors and the TPL provider. During the meetings the researcher attended and took notes on what was discussed, how the meeting participants acted (i.e. active or passive), which companies that participated, how long the meetings lasted, etc.

The first case study also included review of project documentation. The documentation included an external review report on the TPL solution conducted by a large audit bureau, statistics on deliveries, information leaflets and official presentation material of the construction project.

### 3.3.3 Conceptual study

Meredith (1993) list seven research methodologies used in conceptual research. In Figure 15 they are ranked based on their explanatory power. The first three, i.e. conceptual description, taxonomies and typologies, and philosophical conceptualization, are basic conceptual models. The second three, i.e. conceptual induction, conceptual deduction and conceptual systems, are different types of interrelated conceptual frameworks that try to explain and provide understanding. The last one, i.e. meta-framework, is the theory testing of the conceptual research.

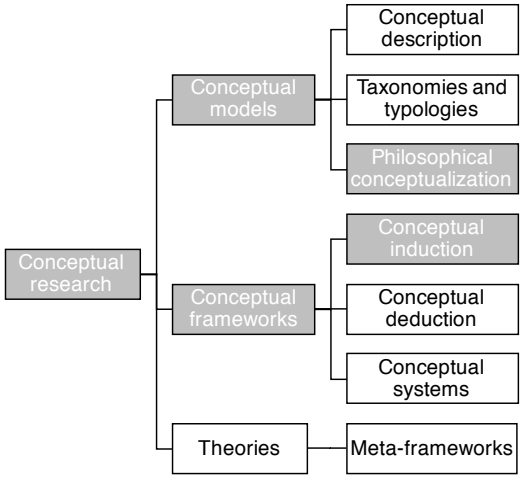


*Figure 15 - Conceptual research methodologies (Meredith, 1993, p. 7).*

A conceptual literature review is a version of a traditional literature review that "aims to synthesize areas of conceptual knowledge that contribute to a better understanding of the issues" (Jesson *et al.*, 2011, p. 15). An example can be a discussion about two concepts with unclear definitions in a certain context. Through the conceptual review the researcher can compare the meanings of the different concepts and how they have been used in other studies or contexts

(Jesson *et al.*, 2011). A conceptual review can therefore be used when concepts needs to be clarified before any empirical research can be done (Cronin *et al.*, 2008).

Just as any type of traditional review the conceptual review does not have to rely on a systematic selection of material, rather it is often the author's own personal selection that guides the selection process. This may especially be the case in a conceptual review since the author often takes a stance and therefore chooses literature that will support the author's stance (Jesson *et al.*, 2011; Cronin *et al.*, 2008). It is an approach that offers the author to have a reflective scope, but the conceptual review will also risk of forwarding biased arguments. To avoid bias and preconception there are some measures that can be taken. First of all, even though a conceptual review does not have to provide a description of how the material was selected, it can be helpful for the reader to describe the selection process. Secondly, to involve material that brings forward other or opposite standpoints than the author's will improve the validity and reliability of the conceptual review (Jesson *et al.*, 2011). In Paper 3 examples of search terms and databases are provided to strengthen up the method, however a lot of the material was found through a snowballing procedure (cf. Bakker, 2010).

## 3.4 Research quality

In all types of research, but especially in case study research (Voss, 2009), it is important that the results from the research can be trusted to be valid and reliable. Therefore, must the researcher be transparent and show how the research was conducted, as well as how the issues of validity and reliability have been addressed. Yin (2014) describe four "tests" to assess the three dimensions of validity (i.e. construct validity, internal validity and external validity) and reliability. In Table 2 the means to ensure validity and reliability are described.

*Table 2 - Means to ensure validity and reliability (Yin, 2014, p. 45).*

| Test | Case study tactic | Phase of research in which tactic occurs |
|---|---|---|
| Construct validity | • Use of multiple sources of evidence | Data collection |
| | • Establish chain of evidence | Data collection |
| | • Have key informants review draft case study report | Composition |
| Internal validity | • Do pattern matching | Data analysis |
| | • Do explanation building | Data analysis |
| | • Address rival explanations | Data analysis |
| | • Use logic models | Data analysis |
| External validity | • Use theory in single case studies | Research design |
| | • Use replication logic in multiple-case studies | Research design |
| Reliability | • Use case study protocol | Data collection |
| | • Develop case study database | Data collection |

In the following each dimension of validity and reliability are assessed related to the described research process.

Construct validity is defined as having the right measures for a studied object (Yin, 2014). To ensure construct validity in this research the following measures have been taken:

- Data has been collected from multiple sources: interviews, observations, project documentation, audit reports, statistics and company web sites.
- The iterative process going through literature to empirical data and back to literature should strengthen the construct validity. In this process support from findings in the literature can be observed in the empirical data. The empirical data can also reveal the need of more an in-depth review of literature.
- After the interviews a draft of the interview protocol was sent to the respondents for review.
- The review of project documentation has been discussed with project officials in order to validate the understanding of the documentation.
- The case study reported has been sent to key informants for review.

Internal validity is the assurance that the relationship between cause and effects are true. However, internal validity is mostly a concern for explanatory research and is not applicable in exploratory research (Yin, 2014). Since the research in thesis is of exploratory nature internal validity would not be of a concern. However, the following measures could be said to strengthen the internal validity of this research:

- This thesis is a compilation of papers in which two of the papers have been written by two authors. In order to strengthen internal validity, the authors have had extensive discussions and information sharing throughout the different phases of the research process.
- Data have been collected from different sources and through different methods, that have enabled triangulation of results.
- In Paper 3 the main supervisor has fulfilled the role of discussion partner even though the thesis author is the sole author of Paper 3.

External validity is defined as a how generalizable the findings of a study are (Yin, 2014). To ensure external validity the following measures have been taken:

- Since the two case studies are single case studies the findings are less generalizable. However, by extensive literature reviews some of the findings have been found to exist in other contextual settings and the likelihood of them to be accurate therefore increase.
- Data have been collected from different sources and through different methods, that have enabled triangulation of results.
- The companies that participated in Paper 1 and Paper 2 were deliberately chosen based on differences in types of contractors (Paper 1) or suppliers (Paper 2) and company size.

Reliability means that the research process can be repeated with the same results (Yin, 2014). The reliability of this research has been ensured by:

- Using a well prepared and structured research protocol when collecting data.
- Storing drafts from interviews digitally in a database, so that they can be reviewed and controlled.

- Storing notes from observations both as hardcopy and digitally in a database.
- Storing documentation digitally in a database.
- Important when assessing reliability of the research is that data is collected and analyzed by specific persons. To know if the results would be exactly the same if the research had been done by other individuals is more or less impossible. However, the main findings should be the same independent of who is doing the research.

### 3.4.1 Research objectivity

A researcher should always try to interpret the collected data in an objective manner and not disregard data or results that contradicts other data or results. As human beings we all have preconceived notions of how certain things should be or what way is the right way. When conducting research it is important that the researcher are aware of these preconceived notions and take the right precautions to avoid making biased conclusions (Yin, 2014; Voss, 2009). The research reported in this thesis has been done with the preconceived notion that the construction industry can be improved by realizing SCM. However, this preconceived notion can be likened with a general hypothesis of the research project, and can be seen in the thesis' three research questions.

However, as mentioned above, this research has been influenced by a constructivist view on knowledge. This means that the research has to be interpreted consciously within the context it has been done, and also by whom it has been done. The researcher will affect the results of the data in several ways, e.g. what questions are asked or not asked, what literature that is used to support the research, etc. From a constructivist stance, answers to questions will be interpreted differently by different researchers and will therefore affect the research results.

To avoid bias when data has been gathered in this research some measures have been taken. During interviews the answers have not been recorded, however they have been written down simultaneously and as soon as possible after the interviews the interviews have been transcribed. Most interviews have been conducted by two researchers that both have been taking notes and after the interviews the transcripts have been compared. After the interviews the respondents have also been sent the draft from the interview and been able to comment them. This has ensured that the respondents answers were collected in a proper and accurate way. The interview questions have been open questions without guidance to how the respondents should answer, ensuring that it is the respondents own opinions that have been collected. A similar method has been used during participatory observations of meetings. Two researchers have been observing and afterwards their notes have been compared.

# 4. Summary of papers

*This chapter briefly summarize the three papers that constitute this thesis. The content and the contributions from each paper is presented. In the end the three papers are analyzed and discussed, answering the thesis' research questions.*

## 4.1 Summary of paper 1

The purpose is to investigate the use of a TPL provider in a large construction project, and to analyze the resulting effects on performance for the project and for the construction supply chain. Dedicated TPL solutions is a new phenomenon in the construction industry and little research has previously been done on them. What are the main drivers and barriers with implementing TPL? How do they affect the actors in the construction supply chain? The study is done through a single case study together with a literature review on TPL, but also taking SCM and the construction industry into account. The single case study is of a large refurbishment project of a hospital which utilized a dedicated TPL solution initiated by the client.

The literature review on TPL identified main driving forces for and concerns with implementing TPL. The driving forces and concerns are summarized in Table 3 using Selviaridis' and Spring's (2007) division between strategy-, finance- and operations-related issues as a mean for categorizing the issues. However, the literature review was based on experiences from other industry sectors than construction, the factors must therefore be investigated further in order to be validated to also exist in construction.

By following a large construction project that utilized a TPL solution it was possible to map realized and potential effects with a dedicated TPL solution as a new phenomenon in construction. The effects were analyzed following Selviaridis' and Spring's (2007) division between strategy-, finance- and operations-related issues as a mean for categorizing the issues. Some of the identified driving forces and concerns with TPL identified in the literature review were found to also exist in a large construction project, while others could not be verified. However, this does not mean that they do not exist in a construction industry context, further research is needed to verify this. Some of the effects were new compared to what was found in the literature review, indicating that the construction industry involves new driving forces and concerns compared to other industries. The potential and realized effects from using a TPL solution in the studied construction project are listed in Table 4.

*Table 3 - Identified driving forces for and concerns with implementing TPL.*

| | Driving forces | Concerns |
|---|---|---|
| Strategic issues | • Possibility to focus on core competencies[2, 4]<br>• Possibility to exploit external logistical competence[4]<br>• Enhanced flexibility to changes in product, requirement and demand[1, 2, 4, 5]<br>• Improved customer satisfaction[1, 4, 5, 6]<br>• Possibility to implement change and restructure the supply chain[3, 4, 5, 6]<br>• Increased and faster learning[3] | • Loss of control[2, 4]<br>• Loss of in-house capability[4, 6]<br>• Loss of customer contact and lack of responsiveness to customer needs and demands[4]<br>• Risk of limited acceptance by employees[2] |
| Financial issues | • Lower costs (including labour and equipment maintenance)[1, 2, 3, 4, 5, 6, 7]<br>• Reduced capital tied-up in assets[1, 2, 4, 5, 6]<br>• Exploiting economies of scale and scope[3, 4] | • Fear of unrealistic fee structure[4]<br>• Lack of knowledge of own internal logistics costs[4] |
| Operational issues | • Reduced inventory levels[2, 4]<br>• Better lead-time performance[2, 4, 6, 7]<br>• Reduced order cycle times[2, 4]<br>• Improved delivery service[1, 2, 4, 5, 6, 7]<br>• More efficient operations[3] | • Fear of inadequate TPL provider expertise and inadequate employee quality[2, 4, 7]<br>• Inability of TPL provider to deal with special needs and products[4, 7]<br>• Inability of TPL provider to deal with emergency circumstances[4]<br>• Risk of poor service performance and disruptions in inbound flows[2, 4]<br>• Performance of TPL providers IT system[2, 4, 6, 7] |

1: Skjoett-Larsen (2000)
2: van Laarhoven *et al.* (2000)
3: Hertz and Alfredsson (2003)
4: Selviaridis and Spring (2007)
5: Marasco (2008)
6: Liu and Lyons (2011)
7: Aguezzoul (2014)

Furthermore, the findings indicate that a TPL solution will effectively establish an interface between construction site and supply chain (the first role of SCM in construction (Vrijhoef and Koskela, 2000)). The TPL solution was also found to establish a new role of SCM in construction, focus on the construction site, not previously identified by Vrijhoef and Koskela (2000). With the new role the other four roles of SCM in construction identified have to be reinterpreted. In Figure 16 the new role is illustrated as role 3. The previous role 3 and role 4 are now relabeled as role 4 and role 5 respectively. Role 5, the role that truly illustrates SCM, is now the sum of the other four roles.

*Table 4 - Potential and realized effects from using a TPL solution in the studied construction project, based on the findings presented in Table 3.*

| | | Driving forces | Concerns/Barriers |
|---|---|---|---|
| Strategic issues | Verified | • Possibility to focus on core competencies (including more focus on activities at the construction site) [2, 4]<br>• Possibility to exploit external logistical competence[4]<br>• Improved customer satisfaction[1, 4, 5, 6] | • Risk of limited acceptance by employees[2] |
| | New | • Not interfering with third-party (i.e. the hospital in this case study)<br>• Establishing interface between construction site and supply chain<br>• Necessity in large projects | • The TPL solution has to be considered in early planning<br>• Lack of experience with TPL solutions<br>• The TPL providers position in the organization<br>• Risk of not focusing on the upstream tiers |
| | Not verified | • Enhanced flexibility to changes in product, requirement and demand[1, 2, 4, 5]<br>• Possibility to implement change and restructure the supply chain[3, 4, 5, 6] | • Loss of control[2, 4]<br>• Loss of in-house capability[4, 6]<br>• Loss of customer contact and lack of responsiveness to customer needs and demands[4] |
| Financial issues | Verified | • Lower costs (including labour and reduced and better utilized equipment)[1, 2, 3, 4, 5, 6, 7]<br>• Reduced capital tied-up in assets[1, 2, 4, 5, 6] | • Fear of unrealistic fee structure[4]<br>• Lack of knowledge of own internal logistics costs[4] |
| | New | *None identified* | *None identified* |
| | Not verified | • Exploiting economies of scale and scope[3, 4] | *None identified* |
| Operational issues | Verified | • Reduced inventory levels[4]<br>• Better lead-time performance[2, 4, 6, 7]<br>• Improved delivery service[1, 2, 4, 5, 6, 7]<br>• More efficient operations[3] | • Fear of inadequate TPL provider expertise and inadequate employee quality[2, 4, 7]<br>• Inability of TPL provider to deal with special needs and products[4, 7]<br>• Inability of TPL provider to deal with emergency circumstances[4]<br>• Risk of poor service performance and disruptions in inbound flows[2, 4] |
| | New | • Performance of TPL provider's IT system<br>• Better working environment | • Monotone work<br>• TPL provider pinioned by contractors not following regulations |
| | Not verified | • Reduced order cycle times[2, 4] | • Performance of TPL providers IT system[2, 4, 6, 7] |

1: Skjoett-Larsen (2000)
2: van Laarhoven *et al.* (2000)
3: Hertz and Alfredsson (2003)
4: Selviaridis and Spring (2007)
5: Marasco (2008)
6: Liu and Lyons (2011)
7: Aguezzoul (2014)

The contributions from Paper 1 are twofold. The first contribution is the identified driving forces and concerns listed in Table 3 and Table 4. An implementation of a TPL solution in a construction project will be facilitated if these factors are considered. The second contribution is the insight that TPL solutions are a

powerful tool that if used properly can mitigate some of the logistical problems in the construction industry. They can also be an effective tool for clients to take an active part in the integration of the construction supply chains. However, they are not a quick fix for the realization of SCM in construction.

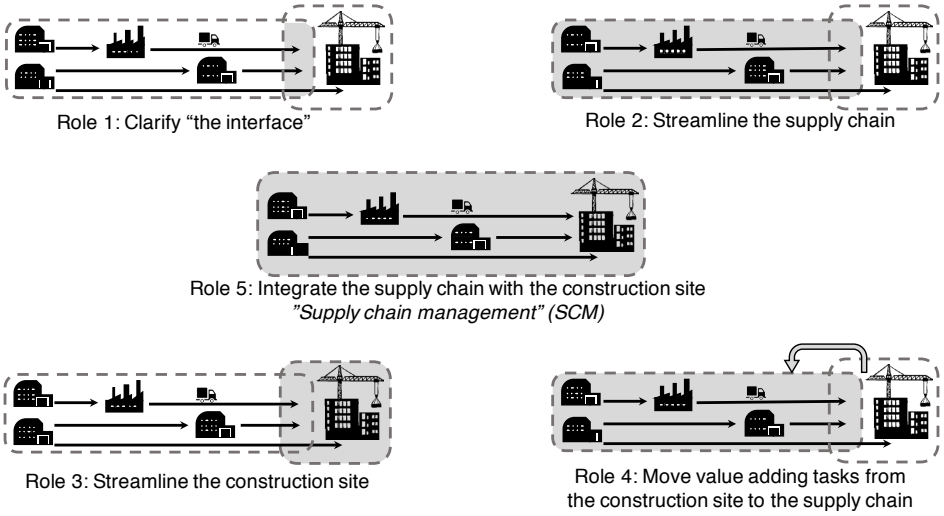


*Figure 16 - A reinterpretation of the different roles of SCM in construction described by Vrijhoef and Koskela (2000) with the newly identified role as role 3.*

## 4.2 Summary of paper 2

The purpose with Paper 2 is to investigate how suppliers and transport providers, as a part of a TPL solution in construction, is affected by the use of the TPL solution. Dedicated TPL solutions are a new phenomenon in the construction industry, establishing an interface between the construction site and the supply chain. A TPL solution will not only affect how the construction work is performed on the construction site. Regulations such as when and how deliveries should be made are something suppliers and transport providers have to adapt to. The study is done through a single case study on suppliers and transport providers connected to a large refurbishment project of a hospital that utilized a TPL solution. In the study manufacturers, wholesalers, building merchants and a transport provider are interviewed on their attitude towards the use of a TPL solution as well as what effects they have experienced. Furthermore, the different suppliers' and the transport provider's level of SCO is assessed as a measurement of their readiness towards the realization of SCM.

The results from the study found that in general were all interviewed companies positive towards the use of a TPL solution, even though two of the manufacturers had a more neutral attitude. Some of the interviewed companies also had or were developing TPL solutions of their own. The general opinion was that the TPL solution did effectively establish an interface between supply chain and the construction site (the first role of SCM in construction (Vrijhoef and Koskela,

2000)). The suppliers knew that their delivered materials would be taken care of in the proper manner. However, they all expressed that the TPL solution were more designed to benefit the contractors rather than the suppliers.

Four effects were identified as a result of the TPL solution by the suppliers and the transport provider. The experienced effects, were found in costs, planning, reduction in waste of materials, and number of deliveries. The most significant effects experienced by the suppliers and the transport provider where increased costs and planning efforts. However, the costs were in most cases forwarded to the contractors so the effect can be considered as moderate. Increased planning is a difficult effect to analyze, since it can be both positive and negative for the suppliers. If the increased planning has led to less last minute transports, decreased number of total transports and a reduction in waste it is a clear positive effect. Two of the suppliers reported a considerable reduction in waste of materials, the same two suppliers also reported decreased number of deliveries.

Evaluating a company's level of SCO is hard task and it has to be considered that it is done within the limits of single case study. Three of the participating companies were found to have a very high level of SCO, three of the participating companies were assessed to have a moderate level of SCO and three of the companies had a low level of SCO. The companies with the high level of SCO had logistics and SCM as a core competence of their businesses and worked actively to introduce SCM in the construction industry. The companies with the moderate level of SCO consider logistics important, however they also have a high willingness to serve the contractors which limits their work towards SCM. All of the companies with a low level of SCO are manufacturers. They are furthest from the construction site, tend to focus on their product and outsource the delivery and logistics to other companies, wherefore SCM is not at the core of their business.

The contributions from Paper 2 is that in general are the upstream tiers positive towards the use of TPL solutions and that several of them plans on starting up TPL solutions of their own. They also seem to not be affected too much by the TPL solution used in the construction project. The level of SCO among the suppliers must be seen only as an indication due to the conceptual nature of the analysis and that it is based on a single case study. However, the indication shows that the upstream tiers of the supply chain are in general well prepared in addressing SCM issues.

## 4.3 Summary of paper 3

Partnering and SCM are two concepts that have been put forward as possible methods to mitigate problems associated with the construction industry, such as low productivity, high costs, fragmentation, etc. The construction industry is also different compared to most other industry sectors because the work is organized in temporary organizations, i.e. projects. This type of organizational setup causes several circumstances that have to be addressed. In a construction project it is not only the end product, e.g. house or bridge, that is built but also the construction site that can be seen as a temporary factory. The temporary factories also inflict temporary supply chains, different from every other construction project. Some of the problems associated with the construction industry derives from the temporary organizational setup. Partnering is a concept that is designed to overcome

fragmentation and adversarial relationships caused by the temporariness of the construction industry.

SCM has not been as successful as partnering in the construction industry even though the concept has been researched and discussed for over 20 years in the construction industry. Recent years SCM has been under a lot debate, questioning if it is applicable in the construction industry. SCM derives from the manufacturing industry and is designed for long-term relationships. This might be a reason why the concept of SCM has not been a success in construction. Focus in construction has been on parts of SCM, such as logistics and often only on activities on the construction site.

The purpose with Paper 3 is to investigate how partnering can be of aid when SCM is to be realized in construction and to overcome the issues of different time horizons on relationships. The paper aims also to contribute to the ongoing debate on SCM in construction. The study is done through a conceptual literature review on the topics of partnering and SCM, with temporary organizations as the contextual background. Partnering has been a rather successful concept in the construction industry and aims to overcome the temporariness and the fragmentation in construction. A construction project is of typically adversarial nature with little or no collaboration and focus on lowest price. Partnering is a long-term collaborative agreement between the actors based on trust, dedication to common goals, and an understanding of each other's individual expectations and values.

The contributions from Paper 3 are that when partnering and SCM are compared, it is clear that they share many of the same components and issues that need to be addressed. Therefore, partnering might very well be a good facilitator for the realization of SCM in construction. However, this has to be done with care and the concept of focused partnering (Gadde and Dubois, 2012), when the different parts of the partnering agreement is addressed on different levels within the participating companies, is suggested as the appropriate approach. Furthermore, the two concepts of partnering and SCM have so much in common that partnering could be seen as a subset of SCM focusing on relationships.

## 4.4 Analysis and discussion

In a compilation thesis it is the combined results of all included papers that together make up the thesis' conclusions and contributions. The three papers in this thesis focus on three areas: TPL as a potential solution to mitigate problems in the construction industry, partnering and collaboration between different actors in the construction supply chain and the temporary organizational context of the construction industry. The research has been divided into two parts. The first part focused on client initiated TPL solutions and was studied in two papers, i.e. Paper 1 and Paper 2. The second part focused on how the realization of SCM in construction can benefit from the use of partnering. Both parts are done within the context of the temporary organizational setup of construction. It is a contextual factor of the construction industry that is important and cannot be neglected. It affects both the supply chain and the construction project. Furthermore, the two parts are also divided into three research questions.

### 4.4.1 Answering the thesis' research questions

The three research questions are all answered by the three papers, see Figure 12. However, naturally the papers have been affected by each other during the research process. In the following the three research questions are answered.

The first research question (RQ1) is formulated:

*To what extent can a third-party logistics solution be a facilitator for client driven SCM in the construction industry?*

In Paper 1 it was concluded that a TPL solution is not a quick fix towards the realization of SCM in the construction industry. A TPL solution is more of an effective tool for managing logistical issues on the construction site and to establish an interface between the supply chain and the construction site, in accordance with the first role of SCM in construction described by Vrijhoef and Koskela (2000). Paper 1 also concluded that a TPL solution can be a powerful tool to actively involve the client in the integration of the supply chain, in accordance with the reasoning in Briscoe *et al.* (2004). Vennström (2008) argues that the construction clients are in a position to influence change in the construction industry. A TPL solution is used because of the logistical competence of the TPL provider. By initiating a TPL solution the client signals to the contractors and the other actors involved in a construction project that logistical competence is important. This means that a client initiated TPL solution could be a first step towards the realization of SCM in the construction industry.

The second research question (RQ2) is formulated:

*How will upstream and downstream tiers be affected when a third-party logistics provider is used in a construction project?*

In Paper 2 it was shown that there were only small and moderate effects on the suppliers when a TPL provider was used in a construction project. The effects were mainly found to be increased costs and planning. However, this may depend on what type of TPL solution that is used. In Paper 1 various effects concerning the actors of the downstream were identified affecting the downstream tiers on strategic, financial and operational level. Some of the effects were found to also exist in other industries using TPL solutions, while other effects are new compared to what has previously been found to exist in other industries. The effects on the construction site could be interpreted as an increase in productivity. Several contractors reduced their number of personnel compared to what was planned because of the TPL solution, i.e. the amount of value adding time increased in favor of materials handling. Furthermore, was the TPL solution found to establish an interface between the supply chain and the construction site, fulfilling Vrijhoef's and Koskela's (2000) first role of SCM in construction. This benefits both the upstream and the downstream tiers since it easier to deliver and to receive construction materials.

The TPL solution used in the construction project studied in Paper 1 and Paper 2 focused on the construction site, other types of TPL solutions can have other focuses. Several of the suppliers interviewed in Paper 2 were developing TPL solutions of their own and such TPL solutions would probably have an increased

focus on the supply chain in accordance with the second role of SCM in construction described by Vrijhoef and Koskela (2000). It is likely that a TPL solution developed by a supplier would affect the upstream tiers in different ways. However, it is important to point out that a TPL solution should work for the greater good of the construction project, and preferably for the entire construction supply chain. As concluded in Paper 1 it is the logistical competence of the TPL provider that is sought after. A risk with a TPL solution from a specific supplier is that the supplier will favor its own deliveries. Another risk that have to be considered is how materials from competitive suppliers will be managed. However, it is important to point out that TPL solutions are a new phenomenon in the construction industry, and most of the research that has been done on TPL solutions in construction has focused on effects for the downstream tiers (cf. Lindén and Josephson, 2013). The identified driving forces and concerns listed in Table 3 and Table 4 are examples of this. This indicates that more research on how TPL solutions affect upstream tiers are needed.

The third and final research question (RQ3) is formulated:

*How can partnering be used as a mean to facilitate the realization of SCM in the construction industry?*

The answer to this question is that partnering would be a good facilitator for the realization of SCM since both concepts share many of the same key components. A strategic partnering agreement with suppliers included is hard to distinguish from a SCM relationship. The success of partnering for bridging the temporariness and overcoming the adversarial relationships that are common in construction projects will benefit the realization of SCM. However, partnering also needs to be developed further and focus beyond the dyadic relationship between client and contractor that is most common in partnering agreements. In order for partnering to be a facilitator for SCM the suppliers have to be included.

### 4.4.2 Discussing the thesis' purpose

The purpose with this research *is to explore how client initiated TPL solutions and partnering can be facilitators for SCM in the construction industry*. Paper 1 and Paper 2 contribute in fulfilling the thesis' purpose by studying how a client initiated TPL solution affects the downstream tiers, as well as the upstream tiers of the construction supply chain. Paper 3 contribute in fulfilling the thesis' purpose by comparing investigating partnering as a mean for realizing SCM in the construction industry.

There are different types of TPL solutions that may affect the supply chain actors in different ways. The TPL solution studied in Paper 1 and Paper 2 utilized a checkpoint and deliveries were directed to deliver on a specific time. There were also regulations on how materials were to be stored on the construction site. These regulations affected both contractors as well as suppliers in the construction project. A TPL solution that includes warehousing for interim storage of materials (cf. Gadde and Dubois, 2012) would allow the contractors to procure materials in advance. The ability to store materials also allows the suppliers to deliver the materials in advance and not just-in-time to the construction site. This would affect the planning of the construction project and the material deliveries. However, the risk is that the contractors' poor planning of materials procurement (Frödell, 2014;

Vidalakis and Sommerville, 2013) will not be improved. A TPL solution of this kind have to find incentives for the contractors to plan ahead.

A TPL solution is a logistics management initiative and as such it is part of a SCM initiative. By initiating a TPL solution the awareness of the importance of logistics is raised. However, the main reason does not have to be to improve productivity or reduce costs. The main reason for the client to initiate the TPL solution in the construction project studied in Paper 1 and Paper 2, was to make sure that the hospital was not disturbed by the construction works. Of particular importance was that no ambulances were hindered or delayed. The positive effects such as increased value adding time, was a secondary bonus to the construction project. Similar reasons for initiating a TPL solution can be seen in other construction projects in Sweden, i.e. the main reason is to reduce disturbances on other parties affected by the construction project. For a client other factors than improving the work on the site and the performance of the supply chain can be important. The clients are often not involved in the day to day operational activities in a construction project and are therefore not aware of the problems. Other clients may not want to interfere with how the contractors perform their work. However, Briscoe *et al.* (2004) argue that, that is just what the client should do. This research has shown that even if the client's main motive behind initiating a TPL solution could be other than to improve productivity, this does not stand in the way of improvements on the performance of the construction project.

However, in order for a TPL solution to be optimized the client should involve the TPL provider at an early stage. It can be compared with how the architects and designers share information early on with the actors in the supply chain in Olsson's (2000) conceptual model of construction SCM (see Figure 9). If the TPL provider is included in the planning of the construction project it will be easier for the suppliers to adjust to the TPL solution and for the contractors to have accurate bids and budgets in the procurement phase.

A construction project is a collaborative effort of several actors in a complex setting. Just as SCM can be facilitated by partnering and since TPL is long-term partnerships (van Laarhoven *et al.*, 2000; Skjoett-Larsen, 2000), there is no reason to doubt that this is also the case for TPL solutions. A TPL solution will only function if the contractors and suppliers comply by the regulations set up by the TPL provider. At the same time must the TPL provider be responsive to the contractors and suppliers. By cooperating with the greater good of the construction project in mind, the construction project will both minimize disturbance on third parties and increase performance of the construction project.

# 5. Contribution and further research

*This final chapter of the thesis present the contribution from this research as well as directions for further and future research.*

## 5.1 Contribution

This research has been of exploratory nature and since dedicated TPL solutions are a new phenomenon in the construction industry they will continue to be developed. The research presented in this thesis do not cover all there is about TPL solutions, on the opposite it only grasps on the surface of this new phenomenon. The findings in this thesis contribute on some aspects when a TPL solution is to be used in the construction industry. The thesis also adds to the ongoing debate on SCM within the scientific community of construction management researchers.

### 5.1.1 Scientific contribution

The main scientific contribution with this thesis is the exploration of dedicated TPL solutions from two perspectives; how a TPL solution affects both the downstream tiers, i.e. the actors on the construction site, as well as the upstream tiers, i.e. suppliers and transport providers. This study has shown that TPL is not a quick fix to realize SCM in the construction. However, if used right it is an effective tool to manage logistical issues in a construction project. Being a new phenomenon in the construction industry, the realized and potential effects of the use of a TPL solution listed in Table 3 and Table 4 provide valuable insights on driving forces and concerns with a TPL solutions. Table 3 provides a summary of driving forces and concerns with TPL solutions, from other contexts. In Table 4 some of these factors have been validated to exist in a construction industry setting, together with additional new ones not previously identified. The new identified factors could also be of interest when studying TPL solutions in other types of contexts.

This research also contributes by addressing the importance of the temporary organizational setup of the construction industry as an important contextual factor. Being an industry that typically organize in temporary organizations affects the outcome of projects as well as the performance of the supply chain. This is a variable all industry stakeholders have to address and is important to consider when the construction industry is studied.

This research contributes also on a conceptual basis with insights on how partnering can be of aid when SCM is to be realized in the construction industry. Partnering and SCM are two concepts that are very similar, especially strategic partnering with several suppliers included in the partnering agreement. Both concepts depend on high trust between the involved actors and share several of the same components and issues that have to be addressed. This research provides

insights on how partnering and SCM should be viewed as concepts. Partnering can be seen as a subset to SCM in construction, focusing on relationships. The question is not if partnering can be of aid when SCM is to be realized in construction, but how and in what way. It also shows that the construction industry is not too unique to learn from successful initiatives from other industries.

### 5.1.2 Contribution to practice

The contribution to practice is mainly aimed towards the construction industry. However, some of the insights regarding TPL solutions can be used in other industries as well. The driving forces and concerns listed in Table 3 and Table 4 are important to consider when a TPL solution is to be used in a construction project, or in another type of industry setting. A TPL solution effectively address the first role of SCM in construction by managing the interface between the supply chain and the construction site. A TPL solution can also streamline the logistics on the construction site and effectively address the newly interpreted third role of SCM in construction.

A TPL solution can also be a good way for a client to both address problems a construction project can inflict on third-parties, such as increased traffic or obstructing ambulance traffic, and to improve working conditions on the construction site. The logistical competence a TPL solutions brings about can increase the productivity of a construction project. However, it is important to emphasize that a TPL solution is a mean to address logistical issues; it is the logistical competence that is sought after and a TPL solution in a construction project is not a mean of its own.

This research also contributes to the construction industry by showing that in order to realize SCM, the construction industry stakeholders should collaborate throughout the supply chain. Partnering agreements is an appropriate approach if SCM is to be realized in construction. But the construction industry stakeholder will have to address a number of issues if SCM is to be successfully realized. Becoming SCO is an important step in that process.

## 5.2 Further research

This licentiate thesis is a milestone in this research project and draws up guidelines for the future development of this research project. As being conceptually based research with empirical results from single case studies the theories and findings have not yet been tested and further research is needed in order to validate them. Listed below are suggestions for further research. Some of the suggestions will be carried out within the boundaries of the continuance of this research project, while others are left for other researchers to perform.

- Since dedicated TPL solutions are a new phenomenon in the construction industry further research on their use is needed. Both upstream as well as downstream in the construction supply chain. What effects do they have on the actors in the supply chain? Future research must include the perspectives of all actors. This could be done by following certain materials through the supply chain.
- Further investigating the use and development of TPL solutions in the construction industry. Being a new phenomenon means that they are not

fully developed and the construction industry has yet to adapt to them. What types of TPL solutions will be dominant? Both in terms of how they are operated, but also in terms of who operates them, i.e. contractors, suppliers or a specialized TPL provider. A multiple case study comparing different TPL solutions would be an interesting study that covers several perspectives and enables comparisons between different setups.

- To further validate and identify driving forces and concerns with TPL solutions, both in the construction industry as well as in other industry contexts. This can be done through surveys among different actors in the construction supply chains on their experiences from the use of TPL solutions. The survey should also be combined with further case studies of different setups of TPL solutions. Further literature reviews to validate the new driving forces and barriers, as well as to find more driving forces and concerns with TPL solutions is needed.
- To investigate further how partnering can be a facilitator for realizing SCM in the construction industry. Can partnering truly be seen as a subset of SCM focusing on relationships? Empirical research on how partnering can be of aid when realizing SCM in the construction industry is also needed, such as comparing how companies address the issues of partnering and SCM. This can be done in case studies following construction projects, but can also be done through literature studies among practitioners in the construction industry on how they address the necessary issues.
- To investigate clients' attitudes to and experiences from the use of dedicated logistics solutions and partnering. If the clients have a positive attitude towards logistics and partnering initiatives similar to the studied TPL solution in Paper 1 and Paper 2 should increase. What is the main reasons for the clients to take the initiatives? Is it to avoid disturbance on third parties or is to increase the performance of the construction project? To get a general understanding of clients' attitudes and experiences a survey among clients is a suitable approach. A large survey could also map differences between clients from different parts of a country. It would also be possible to do a survey in several countries and compare different countries with each other.
- Further investigate how clients can actively be involved in the change process towards the realization of SCM in the construction industry. What are the client's responsibility? What do clients do to actively improve the construction industry towards the realization of SCM? This can be done by a survey among clients comparing their different approaches towards SCM. Case studies of several projects with several different clients are also possible methods to study how clients work towards SCM.

This research has been done within the boundaries of a doctoral research project focusing on client perspectives on SCM in the construction industry. Client initiated TPL solutions are one perspective. Further research will include other client perspectives as well and also portray a larger input from several clients.

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