Master's degree thesis

LOG951 Logistics

A case study of inbound transport challenges in the project-based purchasing of high value / high volume commodities

Kristin Ruud

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Preface

The publishing of this thesis marks the end of my experience-based master in logistics. Throughout the work with this thesis I have been given the opportunity to immerse myself in a real-life business case in Siemens by analyzing the current inbound transport process and using a theoretical framework to evaluate alternative sourcing strategies. This work has been both interesting and relevant, and through the work that was put down I am hoping that Siemens is better equipped to finding solutions contributing to a more cost-effective transport sourcing strategy in the future.

This study program has taken longer than expected and been a lot more demanding than I anticipated before I started. Every time I was ready to give up along the way I have been lucky to have someone willing to give me that extra push I needed to continue, and in the end complete my master´s degree. I would like to thank my hubby Vedran and my family for the patience and support I´ve received over the course of these years. I would also like to express my gratitude to Siemens for giving me the opportunity to do this program and for giving me the flexibility that I needed in order to complete the work with my thesis. In addition, I would also like to show my appreciation to everyone who contributed with their time and knowledge in the conducted interviews. A special thanks to Fredrik and Finn-Magnus for helping me with input, encouragement and feedback this past year in our regular progress meetings, as well as Rainer for giving me that extra push when I needed it the most. In addition, I´d like to thank my supervisor Harald Martin Hjelle from Molde University College for valuable feedback related to the structure and contents of this thesis.

Abstract

Siemens AS, division Energy Management (SEM), among other business areas, delivers solutions for distribution and transmission of energy in substation projects located all across Norway. High voltage equipment, steel structures and other installation materials are ordered from international suppliers, some of which have a delivery time of 6 months or more. When finished, the products are transported to site, where an installation company upon receipt starts mounting the equipment. Getting the products on site in time and without damages is critical in order to avoid idle time and associated costs for the installation company, as well as maintaining the end-customer milestones.

The main goal of this research is to see if it is possible to improve the current inbound transport process in SEM. In addition to a general interview with project participants, two case projects and their inbound transports to site for the largest foreign product groups are analyzed. The results reveal that in most cases inbound transports in projects are organized by the product suppliers, and that transport deviations are fairly common in projects and have a high risk of causing extra costs – in particular when the project runs on a tight schedule. Concluding that the current transport sourcing process of today is suboptimal, the outsourcing climate for Siemens is evaluated using a theoretical framework and two alternative sourcing strategies are presented and analyzed. Both strategies involve Siemens taking over the responsibility for the transports for the large product deliveries, but whereas the first alternative strategy involves Siemens negotiating strategic frame agreements with a few suppliers, the second strategy suggests using a freight exchange where transport assignments are auctioned off to the lowest bidder. Although both strategies are likely to improve the communication flow with the forwarders, more benefits seem achievable when using strategic frame agreements, particularly when it comes to qualifying forwarders, customizing the services and facilitating measures for continuous improvement.

The thesis reveals deficiencies related to tracking and documenting the incurred costs related to transport deviations in the projects. Before a final decision to change the transport sourcing strategy is made, monitoring measures should be implemented in order to get an overview of the scope that the deviations represent in the projects. This will enable SEM to estimate the total costs of the current transport solution with more accuracy and provide a better foundation from which the optimal sourcing strategy can be selected.

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1.0 Introduction

Over the years, the purchasing department in SEM has received several feedbacks and complaints from project management related to issues occurring in the delivery process that generates extra time and costs and reduces the profit margins in the projects. The purpose of this research is therefore to study the current logistics process of delivering materials from suppliers to site, with the aim to see if it could be possible to increase the quality of the transport arrangements without compromising on costs. The research design in this thesis is based on a case study approach, with the data for the study mainly being collected through interviews with project participants.

This thesis is split in two parts, with the first part analyzing the current inbound logistics process to determine the source and scope of the reported problem, and the second part exploring different transport sourcing strategies looking to find the optimal sourcing strategy under the given conditions. Problems are discussed and linked to relevant theory such as papers depicting logistics experiences of other engineer-to-order companies, incoterms® theory, third-party logistics and risk management.

The following introduction presents the background of the energy industry in Norway, and provides a short introduction of Siemens and the division and project organization studied.

1.1 The energy industry in Norway

In Norway, the electrical power grid consists of three different levels, all of which are illustrated in Figure 1. The top level, which is called the transmission grid, has a length of around 11 000 km and connects the different electricity producers with customers on a national level. The transmission grid operates on a high voltage level, with normal carrying capacities of 300 and 420 kV and is connected to the regional grid, carrying a lower voltage level of between 33 and 132 kV. This grid is connected to the distribution grid that delivers electricity to the end users. The distribution grid is divided into a low and high voltage segment that together carries a voltage capacity in the range from 230 V to 22 kV. Transformer stations located between the different levels of power grids transforms the power to the desired voltage level.

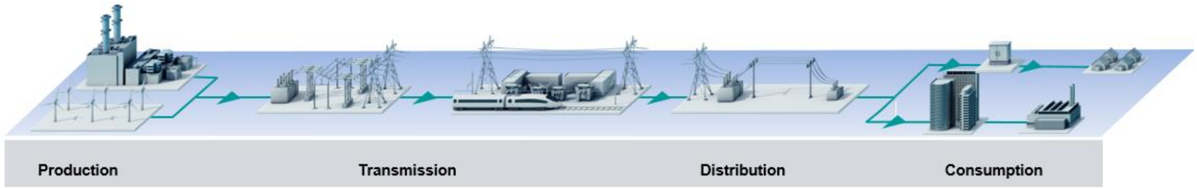


Figure 1 The different levels of the Norwegian power grid (Jahr 2016)

According to "Energy Facts Norway", a web page run by the Norwegian Ministry of Petroleum and Energy (The Ministry of Petroleum and Energy 2018), a new electricity production record was set in 2016, when 149 TWh of electricity was produced in Norway. 98 percent of this volume came from hydropower plants and windfarms, which by being renewable energy sources is making Norway the country in Europe that both has the lowest emissions in the power sector, as well as having the highest share of electricity produced by renewable sources. An illustration of the Norwegian energy system is shown in Figure 2. In the figure, the different sources of energy, their dispersion and the proportional distribution of consumption is illustrated. This master thesis will focus on business within the blue lines of the figure, between the production and distribution of electric power from the power production facilities.

As manifested on the front page of Statnett´s home page, "The future is electric". Statnett, the system operator of the Norwegian energy system, employing more than 1400 people is currently driving an upgrade of the Norwegian power grid (Statnett SF 2018). Within the next five years (2018-2022), the governmentally owned enterprise is planning to invest between 30 to 40 billion NOK in order to cover the needs resulting from an increased energy consumption, renewable power production, and an increasing number of connection points from Norway to the surrounding countries to facilitate export of electrical power (Borgen 2018). In addition to this, local governmental and privately-owned energy companies are also investing in the upgrading of their regional and local power and distribution grids. With the emergence of new wind power plants, electrification of industries that have earlier been dominated by fossil powered engines and a generally increased power consumption both in the private and public sector as well as for the average consumer, we are now more than ever depending on a smart and robust power grid equipped for overcoming these challenges. The increased investments are intended to act on these challenges before encountering capacity problems and forms an attractive market opportunity for suppliers like Siemens, able to deliver custom fit solutions at a competitive price level.

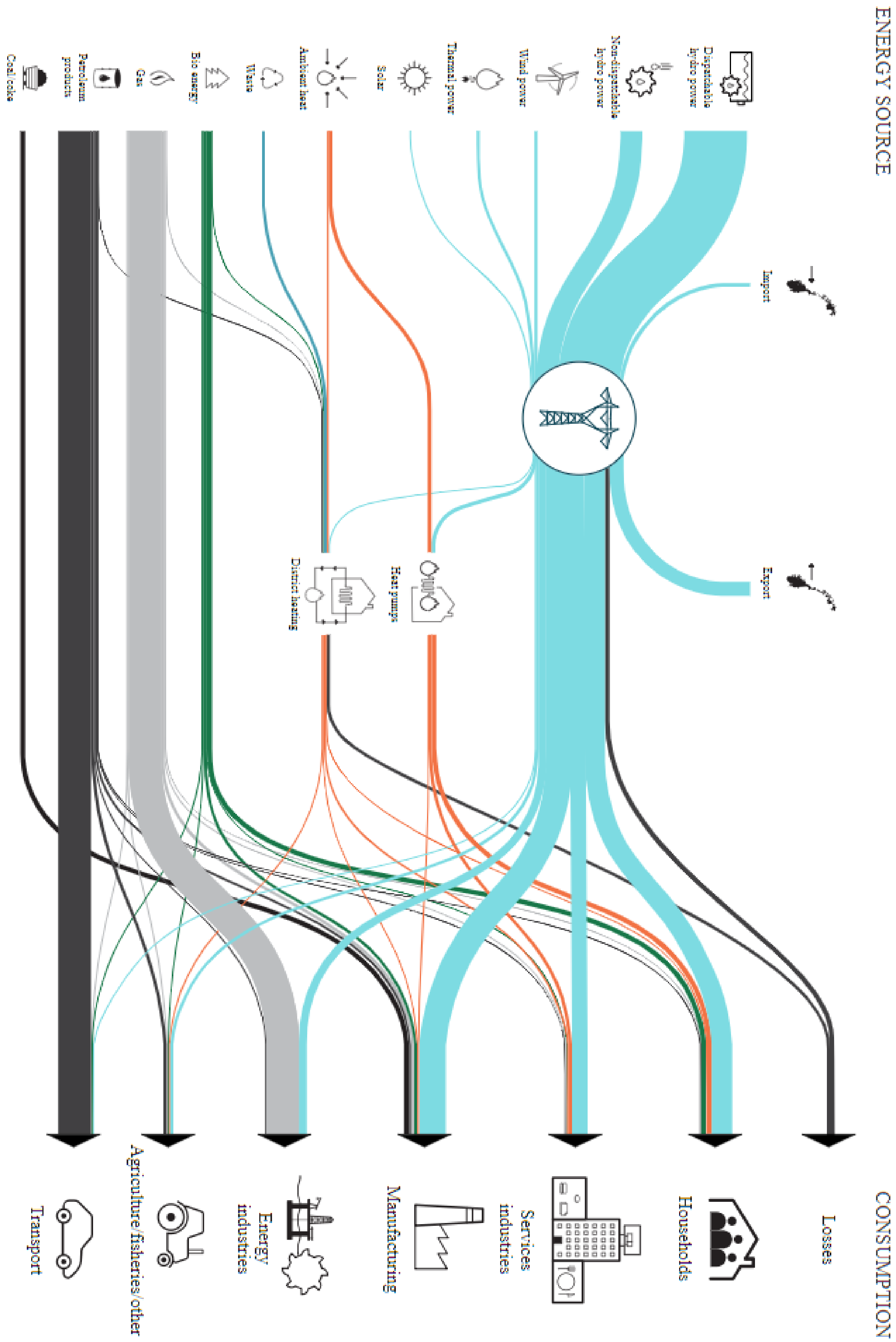


Figure 2 The Norwegian Energy System (The Ministry of Petroleum and Energy 2018)

1.2 Siemens and division Energy Management

Siemens as a company was established by Werner von Siemens in 1847 and soon became one of the world´s leading electrical engineering companies. Although now being more than 170 years old, the company still holds to the original idea of being a company that centers around electric solutions, and the company´s current strategic key business drivers is set up around some of the major trends in the market being electrification, automation and digitalization (Siemens AG 2018b). As of September 30th, 2017, the company had 377 000 employees worldwide, about 1 500 of which are working in Norway (Siemens AS 2019).

In August 2018, the company announced a structural change in the company, resulting from Vision 2020+, a strategy program first initiated in 2014 seeking to simplify and strip down the previous eight divisions. The new company structure consolidates many of the previous divisions into three operating companies called Gas and Power", "Smart Infrastructure" and "Digital Industries", as well as three strategic companies called “Siemens Healthineers”, “Siemens Gamesa” and “Siemens Alstom” (Siemens AG 2018a). The operating companies are based on the previous divisions and offers products and solutions ranging from energy effective buildings, transport and mobility solutions, productivity increasing solutions for the industry market, solutions for the oil and gas industry and power transmission and distribution to mention some. As these structural changes are planned to be implemented step by step until reaching a finalization by the end of March 2019, this thesis will be based on the old organization structure and specifically the business within Siemens´ division EM.

SEM is a division that delivers products, systems and solutions for all business related to power transmission and distribution of electricity ranging from low voltage to high voltage. In Norway, the division is divided into the four business areas of project business, system business, product business and service, all of which take care of different customer demands. Project business relates to the delivery of upgrading or the building of new high or medium voltage transformer substations and is the main focus of study in this research.

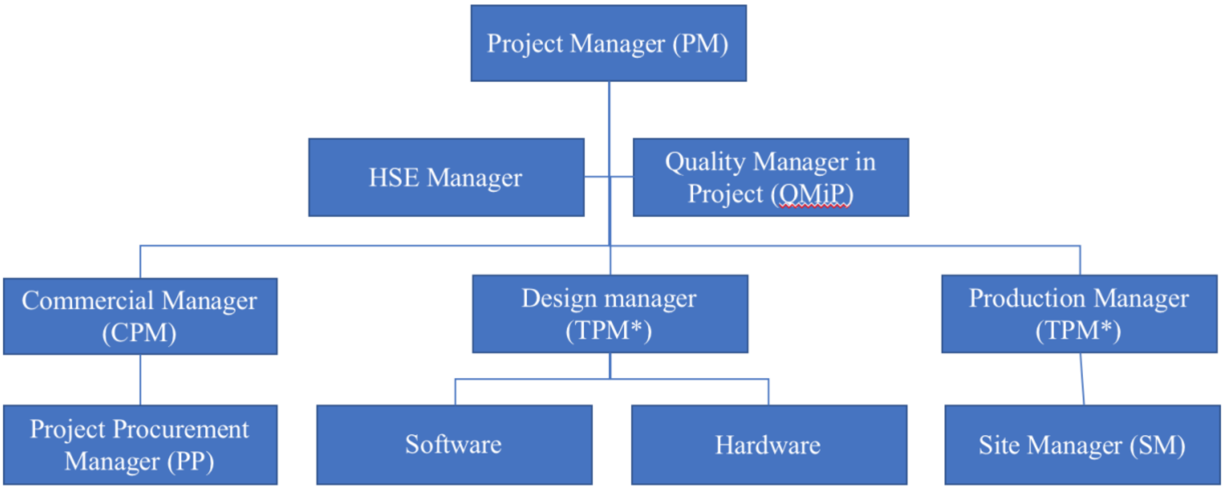
1.2.1 Project business and the project organization

As presented in the previous subchapter, project business within SEM relates to the upgrading or building of new transformer substations. The scope of work is naturally dependent on the nature of the job and may vary in size and complexity and how much of the work the customer decides to outsource to contractors. In the building of new substations, some customers may want to outsource the total scope of work in a so called "turnkey" project, where the inquiry includes all work associated with the ground and building work in addition to the technical components and installation, whereas in other cases the customer decides to split up the scope into work packages and maintain a coordinating role between the different subcontractors. Smaller projects may involve pure product deliveries.

Projects are split into two phases, the sales phase and the project phase. In the sales phase, the customer has not yet signed a contract and the work being done in this phase forms the basis of the offer given to the customer. The work includes finding good technical solutions and acquiring offers from suppliers, with the aim of giving the customer an offer meeting the minimum requirements at a competitive price. After a contract has been signed, the project is then handed over from the sales department to the project organization in a formal handover meeting. The strategic purchaser (SP) who was involved in acquiring offers in the sales phase also calls in the project purchaser (PP) and project manager (PM) to a separate purchasing hand over meeting before the project start up. In this meeting the expectations of the PP are clarified, critical deliveries are identified and planned, the offers for the main deliveries and the project timeline is reviewed. The aim of the meeting is to discuss and clarify all relevant purchasing specific details of the project delivery in order to enable the PP to do a satisfactory job.

Projects are managed using a project organization. Depending on the size of the project, some of the project participants may occupy several roles. Smaller projects generally operate with a leaner project organization and acquires assistance from the support functions if needed. A simplified overview of the main roles and responsibilities are shown in Figure 3.

The PM is the head of the project and is thus responsible for coordinating the project resources in such a way that the project finishes on time and within the planned budget and is also the focal point of contact for the customer. The project quality manager (QMiP) is responsible for handling all quality related problems in the project and ensuring that the delivery corresponds to the customer´s quality requirements. The project HSE responsible manages all health, security and environmental aspects of the delivery. The technical project manager (TPM) is responsible for ensuring that all technical aspects of the delivery are conforming to the requirements of the delivery, both related to the design and underlying software and hardware, as well as the production of the final customer product. In larger projects, a project site manager (SM) follows up and coordinates the activities on site to ensure that everything is proceeding according to plan. The commercial project manager (CPM) is responsible for handling all the commercial conditions of the delivery and keeping the PM informed of the project progress from an economic point of view. The CPM also tracks the work hours spent in the project and tracks and reports project savings. The PP is responsible for placing orders to suppliers in the project and following up the deliveries to make sure the products arrive on time with the agreed quality and to the agreed price.



* The Technical project Manager (TPM) usually carries the main responsibility both for overseeing the design and production of the end product

Figure 3 The Siemens project organization

1.2.2 Project deliverables

A project typically starts with pinpointing the technical details of the delivery. After this has been clarified, if necessary, offers are renegotiated and the products with a long lead time are ordered. Complex products may have a lead time of more than 6 months and therefore needs to be ordered early in the project.

It is of great importance that all material arrives on site at the requested delivery date. Building the end product requires the installation of the products and deliverables to happen in a particular order, and the materials are often delivered with a very limited time slack before they are needed on site. Delays may therefore have big cost implications due to risks such as idle time and overtime for the installation workers, shifting of the project milestones and associated penalties, and extra costs of the extended hiring of machines used for unloading. Similarly, products being delivered too early may also cause trouble. Groundwork on site may give limited storage opportunities, qualified personnel may not be present to do the unloading and unloading equipment may not yet have been acquired. Deliveries coming from countries with different requirements and driving conditions also poses risks of transport companies not following Norwegian regulations upon entering the country, giving an increased risk of damages not only to the products they are carrying, but also endangering the health and security of the drivers and the general public. This problem is of particular importance during the winter months, seeing that the Norwegian government has implemented special requirements for heavy vehicles to deal with challenging road conditions, as well as the project sites often being located in remote areas where adherence to rules and regulations may be essential to avoid problems. A thorough follow-up of the main deliveries in the project both in the production phase and during transport is therefore crucial in order to reduce the risk of deliveries not arriving on time or with damages, and forms one of the main responsibilities of the PP.

When the materials are delivered on site, another important task is checking the delivered materials for transport damages and quality deficiencies. This check is often performed by a representative from the installation company or the SM, who also fills out a checklist for goods receipt documenting any delivery deviations. The checklist is afterwards sent to the PP along with the delivery note and any defects or damages are followed up by the purchaser. Depending on the delivery terms negotiated, transport damages are communicated towards the supplier or the forwarder, and corrective measures or economic compensation is agreed upon.

1.3 Engineer-to-order

In getting a better understanding of the production environment of construction projects, it is necessary to explain how this type of production differentiates from other production environments. Olhager (2003) defines four supply chain structures to describe the range of possible operations: Engineer-to-order (ETO), make-to-order (MTO), assemble-to-order (ATO), make-to-stock (MTS), all of which are illustrated in Table 1.

Table 1 Order penetration points (Olhager 2003)

Product delivery strategy	*Design*	*Fabrication & procurement*	*Final assembly*	*Shipment*
Make-to-stock	----------------	----------------	---------------►	OPP ──────►
Assemble-to-order	----------------	---------------►	OPP ────────	──────►
Make-to-order	---------------►	OPP ────────	────────	──────►
Engineer-to-order	OPP ────────	────────	────────	──────►

The different manufacturing environments may be defined by the point in the manufacturing value chain where a product is linked a specific customer order, known as the order penetration point (OPP). As shown in the table, all four of the supply chain structures relate to a different positioning of the OPP, and different manufacturing strategies can be applied for pre-OPP operations versus post-OPP operations (Olhager 2003). While the pre-OPP operations are forecast-driven, the post-OPP operations are customer driven and as an example, the author notes that for pre-OPP operations, there competitive priority should be on price, while post-OPP, it should be delivery speed and flexibility. Thus, the production planning, control and performance measurement should be designed to conform with the different strategies.

In the article «Supply chain management: A strategic issue in engineer to order Manufacturing», the ETO environment of seven companies within the power generation, high-integrity materials handling and offshore sectors are studied, industries of which closely resembles the industry of the case firm studied in this thesis. According to Hicks, McGovern, and Earl (2000), the business processes within the ETO companies take place in three stages. In the first stage, marketing, there is a two-way communication between the company and the customer, making the customer aware of the company and their products. This stage also involves the identification of market trends, customer requirements and the customer's criteria's when assessing offers. In this phase the company also evaluates whether to respond to an invitation to tender. The second stage is the response to the tender for a contract and involves the early development of the conceptual design and the definition of major components and systems. In this phase the first contact with suppliers is made to gather information on costs and lead times and there is a negotiation to match these with the customer requirements. The technical specification, delivery terms, price and commercial terms are defined based on an understanding of the customer's expectations. In the third stage, the contract has been awarded and the project plan and detailed design is developed. Procurement of materials is initiated, followed by the component manufacturing, assembly, construction and commissioning.

Hicks, McGovern, and Earl (2000) find that even within the ETO supply chain structure there are differences in strategy. These differences are evident when considering the level of vertical integration applied in the companies. Vertical integration relates to the degree of ownership of the supply chain and the number of the activities that are carried out by the focal company in relation to the number of activities outsourced to external providers. In choosing the appropriate level of vertical integration, the companies are taking several factors into consideration, including weighing of capacity against customer delivery time, cost reductions, the availability of capital for investment in equipment, potential utilization of plant, internal and external capabilities and flexibility. The authors argue that these considerations in turn lead to different levels of vertical integration, spanning from in-house manufacturing of all components and assembly in one end (high level of vertical integration) to pure design and contract organization at the other (low level of vertical integration). Two different types of design and contract business are also identified, the first one being the ETO company carrying out the construction and commissioning phase of project, whereas in the other, also these physical activities are being outsourced to suppliers or subcontractors. In the second type, only marketing, design, procurement and project management are activities carried out internally and the rest is outsourced.

In SEM, we find that the organization has a varying degree of vertical integration depending on the type of project and customer specifications. Its expenditure on material from internal factories within Siemens AG can vary from 20% to as high as 80% of the total purchasing volume from suppliers in different projects. It is worth noting that the tendering process in procuring these products is for some product groups handled in much the same fashion as materials procured from third party manufacturers, and although internal suppliers are available, offers from third party suppliers are often also considered to find the best fit supplier for each project. In some cases, internal guidelines or customer specifications may also put strict regulations on the brand of the supplied materials to be used in the project and when considering this together with the scope of supply of the projects, we find that the amount of internal material and thus the degree of vertical integration related to the purchasing of commodities is varying from project to project. When it comes to the type of design related to the physical on-site activities, SEM outsources both the construction and commissioning of the final product to suppliers, although site activities in some cases are supervised by internal SM´s. The on-site activities thus can be stated to have a low degree of vertical integration.

2.0 Research Problem

2.1 Problem specification

The background for this thesis is a challenge that has received an increasing amount of attention in the SEM project organization in the recent years. The projects are reporting a number of transport related problems caused by insufficient delivery information, incoming deliveries not arriving on time, drivers not following their given instructions and transport damages, all of which are causing extra costs contributing to the reduction of project margins and possibly afflicting damage to the company reputation among customers. There is an expectation from the project management that the purchasing department takes these problems seriously and actively look at ways to improve the situation, which forms the basis of this research and leads to the following title for the thesis:

> **A case study of inbound transport challenges in the project-based purchasing of high value / high volume commodities**

There seems to be room for improving the situation, and the objective of this research is firstly to make a detailed analysis of the current situation of inbound deliveries to project sites and make an evaluation of whether alternative sourcing arrangements should be considered. Next, it seeks to estimate the costs of the current solution and make a comparison with the most suitable alternative sourcing strategy in order to determine if it is reasonable to assume that changing the sourcing strategy might lead to a higher quality of the service and/or a lower total cost.

2.1.1 Research questions

As a result of the issues raised in the previous section, a number of research questions were formed, the answers from which are expected to help identify the sources of the problems encountered and propose alternative risk mitigating measures if improvements in the current processes can be found. The research questions, including a short description are listed below.

RQ1 Which are the most important products bought from our suppliers?

Due to the large number of orders and commodities in the projects, it is necessary to limit the number of deliveries to be studied. The first research question aims to select the most important commodities in the projects. In this study, the importance is considered first of all to be related to the purchasing volume associated with the deliveries. A large purchasing volume indicates that the delivery is important from a financial point of view and is also information easily produced and unbiased by personal opinions. The question of which products are considered most important is also asked in the performed interviews, with the intention to validate the correctness of this assumption, and to check if getting these commodities delivered on time is also critical to the projects´ startup and progress.

RQ2 Where are the focal products sourced and which incoterms® are most commonly used?

The location and incoterms® of the sourced products may be relevant in several ways. If the delivery term requires that the supplier orders transport, the transport provider is often located in the country where the products are shipped from, which may have an influence on aspects such as driving experience in Norway, knowledge and adherence to rules and regulations in Norway and English language skills. The choice of incoterms® is relevant in evaluating the transport sourcing strategy used today.

RQ3 Which requirements do the different product types put on the transport solutions?

Different types of commodities may put different type of requirements related to the packing and transport solutions from the suppliers. Getting an overview of the type of requirements may therefore prove important in analyzing the inbound logistics, as well as in considering alternative strategies.

RQ4 How is the inbound logistics of the focal products organized today?

RQ4.1 Which processes could be defined related to the inbound logistics?

RQ4.2 How is the purchasing process of third party logistics (TPL) services organized?

RQ4.3 How many service providers are in use for the current inbound services?

RQ4.4 How competitive is the relevant part of the TPL sector

RQ4 and its sub questions aims to get a good overview of how the inbound transport is organized today. In order to find out if alternative transport solutions should be sought out, it is first necessary to thoroughly map the processes in use today, as well as the competitive environment in the marketplace of the required services to see if there is room for improvement by a change in strategy.

RQ5 How critical are the focal products for the projects?

RQ5.1 How critical are transport deviations?

RQ5.2 Are there examples where transport system disruptions have had major impacts on project performance?

RQ5.3 How resilient are the current solutions to disruptions?

The purpose of RQ5 is to measure the flow and robustness of the current inbound logistics process. The aim is to seek out any deviations to the processes found in the previous research question and see how well the projects are able to adapt to unforeseen changes such as delays or transport damages. If the projects are having many such deviations or if they don´t have adequate mechanisms to minimize consequences, there may be reason to believe that the projects may benefit from a change in sourcing strategy.

RQ6 Which alternative transport arrangements are relevant for the focal products?

RQ6.1 How relevant is a higher or lower degree of outsourcing of related processes?

RQ6.2 Which alternative terms of trade (Incoterms®) would be relevant?

RQ6.3 Would concentrating the purchased TPL-services to one or fewer partners be an option?

RQ6 is highly dependent on the findings in the previous research questions. The findings in the previous research questions are analyzed together with relevant theory to evaluate whether a different transport solution seems justified from a theoretical point of view.

2.2 Delimitations

Since this research project was started, there has been a change in the organization structure of Siemens, splitting the previous division EM into two different operating companies. Seeing that the new organization structure was not yet implemented at the start of the research, this thesis will be based on the old organization structure and the area of focus for this study is limited to the area of project business.

Because of the limited time frame and resource capacity, in order to keep the data sources at a manageable level, a case study approach was followed, confined to two larger projects with completed product deliveries within the past year. Since each project contains a large number of product deliveries, the research was limited to the commodities accounting for the major product costs. Due to the fact that the transport related problems seem to be mainly connected to foreign deliveries, a choice was made to focus on the deliveries coming from abroad in particular.

2.3 Research integrity

Seeing that this is an experienced based master thesis, the matter of research integrity becomes a subject of particular importance. In choosing a research subject within one´s own organization, it is difficult, if not impossible to be unaffected by own presumptions in collecting data, and personal bias may be a potential risk. This is especially relevant when considering the fact that the author was directly involved in one of the projects used in the case study. In order to mitigate the associated risk, there was a continuous focus throughout the research on using several sources of data, in order to keep the risk of personal bias influencing the result to a minimum. Regular meetings were conducted with two purchasing managers in SEM to report progress and obtain feedback, and all interviewed subjects were given a chance to review their comments to ensure that their input had been depicted correctly in the interviews.

3.0 Literature Review

This chapter is dedicated to theory that is considered relevant for this research and the topics of which will be used to answer the research questions.

3.1 ABC analysis

The ABC analysis is based on the Pareto principle after the Italian economist Vilfredo Pareto who discovered that 20% of the Italian population owned 80% of the land used and that the same economical principle could also be applied to other situations. This formed what was later to be known as the Pareto 80/20 law, stating that in many projects, 20% of the total effort produces 80% of the total outcome (Rusănescu 2014). The Pareto law has been observed in many areas, some of which are listed below (Ultsch 2002):

- 20% of customers generate 80% of turnover
- 20% of products make 80% of turnover
- 20% of products make 80% of profit
- 20% of the goods in a stock sum up to 80% of the stock worth

The analysis is done by collecting data on the units to be analyzed and sorting them in a descending order. Then, the accumulated impact for each unit in percentage of the total is calculated, as well as the cumulative total percentage. The results can be visually presented in a Pareto diagram and the units of analysis can be split up in categories (A, B, C), depending on their impact on the total percentage. As an example, in a purchasing context, category A units could represent the commodities accounting for a purchasing expense of about 80%, but only representing 10-15% of the total number of commodities. Category B commodities represent somewhere close to 15% of the purchasing expense, and around 30-35% of the commodities. Category C commodities are commodities accounting for a very small percentage of the purchasing expense of around 5%, but close to 50% of the total number of commodities (Rusănescu 2014).

Gelderman and Weele (2005) presented some critique for using the ABC analysis, emphasizing the fact that the analysis only put weight on the financial value of the items and thus ignores other important factors such as cost of poor quality, performance risk, social risk and other components, as well as the fact that the analysis does not provide a strategic recommendation for the categories.

The choice of using the ABC analysis in this thesis was based on the fact that it is an easy way of finding the commodities that from an economic point of view can be considered the most important to the projects. In order to validate whether the A-type of commodities in the case projects were in fact the most important commodities in an inbound logistics setting, the project participants were also given questions about which commodities were considered the most critical in the projects.

3.2 Transport and logistics performance in the construction industry

Despite the fact that transport in some industrial construction projects can account for up to 20% of the total project expenditure, the importance of this service is often overlooked in planning of the material procurement and in evaluating the risks of delay, due to the perception in the industry that problems associated with transport is a consequence of other problems in previous steps of the supply chain (Ahmadian et al. 2014). In the article "Importance of Planning for the Transport Stage in Procurement of Construction Materials", the authors evaluated the current practice in managing the transportation stage for international transports in construction companies in Australia with two construction projects being studied in particular. In addition, the main factors influencing the efficiency of the transport stage were identified.

From the interviews performed in the study, Ahmadian et al. (2014) found that transport may play a significant role in the procurement process under the following circumstances:

- *Reducing Cost of Inventory:* Just-in-time and other methods used to decrease cost of inventory are used in some industries and requires precise planning of transport for its successful implementation.
- *Space Limitation:* Limited space on site in some cases leads to the PM having to postpone the deliveries of some materials until the time when the materials are needed. Careful planning of transport is therefore essential to avoid materials being delivered too early or too late.
- *Propagation of Delay:* When materials are already delayed from the factory, there is an extra focus on transport and alternative modes of transport are evaluated to accelerate delivery.

- *Mandatory Completion Date:* A tight schedule in the delivery of the project puts extra strain on all operations, including the scheduling of transport services.

Findings in the interviews showed that the contractor was often found to be risk aversive in the choosing of delivery terms, meaning that the contractor tries to transfer risk to the suppliers in the choosing of delivery terms and perceives the supplier as having more experience in material handling and movement (Ahmadian et al. 2014). In the study, 77% of the items bought were found to be categorized under C (CIP, CIF, CPT, CFR) and D (DAP, DDP, DAT) delivery terms, meaning that the suppliers orders the transport. When being responsible for transport themselves, the contractors were also generally found to choose the lowest cost option at the time of planning, founding the decision on personal judgements. Poor management of the delivery process was identified of having a root cause in the one-off and temporary relationships between the construction firms and their suppliers.

Another finding of the analysis was that the mode of transport and the delivery term used seemed to have an effect on the probability of a delay. As shown in Figure 4, road transport was found to have a very high probability of delay compared to sea, air or rail transport. The D and E (EXW) delivery terms also has a higher likelihood of delays compared with F (FCA, FAS, FOB) and C delivery terms. According to Ahmadian et al. (2014), the higher probability of a delay in road transport may be attributed to the intervention of external factors that are not fully controlled by the project team, e.g. restricted access for heavy vehicles, accidents, traffic management policies etc.

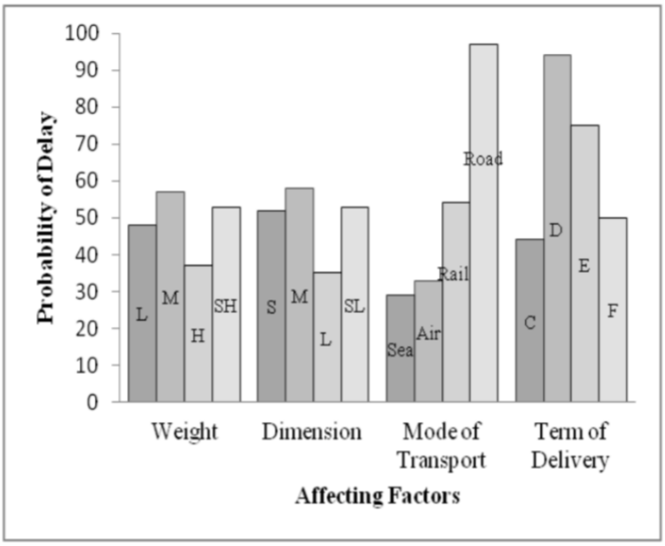


Figure 4 Effect of shipment variables on probability of delay in transportation period (Ahmadian et al. 2014)

Wegelius-Lehtonen (2001) introduces a new framework for measuring construction logistics performance. The author argues that there is currently a lack of process view in the typical construction project and that the projects performance measures are very limited, and mostly related to the conformance to the technical specification. Other performance measures related to the process itself are not considered or considered to be of secondary importance. Referring to an article by Davenport and Beers (1995), Wegelius-Lehtonen states that "a key aspect of success in process improvement is effective management of information about process performance, even independent of information technology" and continues by arguing that performance measures are keys to improving logistical processes in the construction industry.

The framework is grouped into a two-dimensional model based on the use of measure and focus of measure. The use of measure is further split into improvement and monitoring measures, whereas the focus of measure is split into general company/project level and specific subcontract/material supplier level. The dimensions are shown in Figure 5.

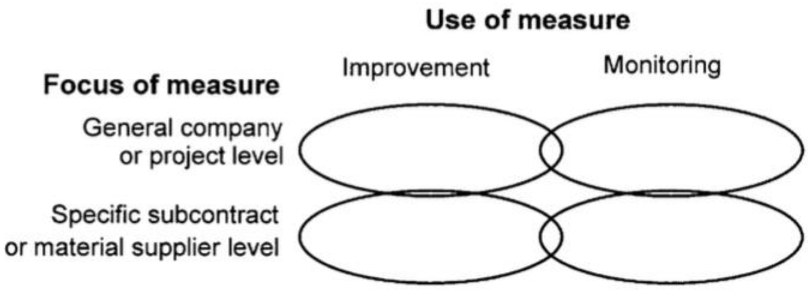


Figure 5 Dimensions of the performance measurement system (Wegelius-Lehtonen 2001)

Improvement measures are defined as measures that aims to find out the present logistical performance level and improvement potential. It can also be used for benchmarking different practices in order to find cost saving potential. A precondition for this type of measure is that objective information about the current situation is available. The monitoring measures are used for continuously measuring the day-to-day actions. The two dimensions of the focus of measure relates to the fact that measures can be used on different levels. It is possible to measure performance on a company level, project level and on supplier level and different measures are needed for the different levels of the organization.

Wegelius-Lehtonen presents several examples of practical ways of using this framework for measuring logistics performance in companies. A time analysis was made of a plasterboard supplier and a construction company, as shown in Figure 6. An order was sent to the supplier with a required delivery date one day later, although the planned date of assembly was one week later and the date when the assembly actually started was not until two weeks later. This may be used for measuring how well the company plans their deliveries and to which extent they manage to carry out the plans. In this case the delivery is not well planned. They are putting extra strain on the supplier by placing the order late, and the material is delivered to site two weeks before it is actually needed, which again may lead to extra storage costs. In addition, quality deviations or transport damages may not be detected until the actual assembly of the product, increasing the risk of extra costs of not detecting the damages early enough to claim compensation.

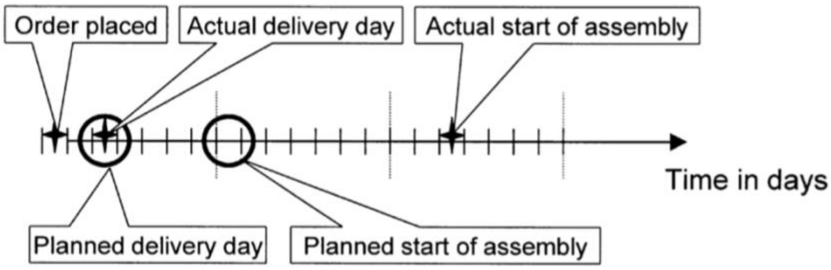


Figure 6 Time analysis of a plasterboard delivery to site (Wegelius-Lehtonen 2001)

The author suggests that the focus of improving and development efforts can be determined on a company level using a logistics costs summary where the logistical costs are shown as a percentage of the total purchasing price for the different material categories. In an example presented in the article, there was a significant variation both within and between the different material groups when this was analyzed with material groups having a logistical average cost varying from less than 10% to over 50% of the purchasing price of the material. Analyses like this may prove very useful in setting improvement and development measures.

3.3 Incoterms® and the mode of transport

Incoterms®, short for «international commercial terms» is a set of trade rule terms that was first published by the International Chamber of Commerce (ICC) in 1936. Before the introduction of the incoterms®, trade partners negotiating an agreement sometimes had different interpretations of the terms used, which often led to conflicts and disagreements and the aim of its introduction was therefore to create an industry standard for governing international trade and to provide a legal framework from which the different trade terms could be interpreted (Malfliet 2011). Throughout the years, the ICC have updated and improved the Incoterms® several times with its last revision being in 2010, and the organization anticipates that there will be an update to the trade terms yet again in 2020 (The International Chamber of Commerce 2018).

The incoterms® as of 2010 are split into eleven trade terms, with each trade term defining different rights and obligations of the buyer and seller, as well as the cost and risk transfer associated with the shipment (Hien, Laporte, and Roy 2009). Malfliet (2011) split the different trade terms in four categories:

- *E-terms (only EXW):* the goods are placed at the disposal of the buyer at the seller's premises – 'come to collect the goods';
- *F-terms:* the buyer is responsible for the cost and risk of the main international carriage – goods are 'sent from';
- *C-terms:* the seller pays for the main international carriage, but does not bear the risks thereof – goods are 'sent to, freight prepaid';
- *D-terms:* the seller bears all costs and risks up to the delivery point in the country of destination – goods are 'delivered at'.

It is important to distinguish between the differences in delivery for the different trade terms. Delivery in an incoterm® context means that the buyer is taking ownership of the product supplied and marks the point when the risk passes from the seller to the buyer. The trade terms may therefore be split into departure and arrival contracts, depending on the point in time when the delivery happens. For the E-, F- and C-categories, delivery happens at the agreed place of departure, whereas for the D-category, delivery happens at the agreed place of delivery (Malfliet 2011).

3.3.1 Selecting the right incoterm®

Since the choice of delivery terms is associated with different risk levels and costs, it is of interest both to the seller and buyer to choose a delivery term that is best suited for the intended transaction.

Hien, Laporte, and Roy (2009) studied the impact of the choice of incoterms® had on the export performance in a number of companies in Canada. By comparing different studies, they found that for a company to select the right delivery term it is important that they consider the business environment factors associated with the delivery. These factors were defined to be either ”the set of forces to which the company must respond (Lawrence and Lorsch 1967), or the set of factors that tend to influence the organization (Dill 1958)”. Some of these factors were listed to be risk associated with the destination country, the size of the delivery, the resources or negotiating power of the company, the degree of competitiveness and regulatory measures of the target market, the product characteristics and the company´s international experience and knowledge of the target market (Hien, Laporte, and Roy 2009). The authors were able to validate in their study that, from a seller´s point of view, “companies that considered international experience, client negotiating power and the competitive intensity in the destination country when selecting Incoterms® have a better export performance than those that do not”. They also found that companies taking pertinent environmental factors into consideration in the selection also had a better export performance.

Although the former paragraph relates to a study for exporting companies, the results are still interesting from an importer´s point of view, seeing that the importer encounters many of the same problems, although mirrored, in their choosing of the right delivery term. International experience, negotiating power and competitive intensity should therefore also be relevant factors for an importer when selecting incoterms®.

Malfliet (2011) presents four elements that needs consideration when choosing the right incoterm®:

1. *The nature of the goods.* The size and characteristics of the type of goods to be transported. As an example, a different incoterm® may be considered when transporting semi-finished raw materials of relative low value per kg compared to high value lightweight sensitive electronic equipment due to the different volume and risk associated with the deliveries.

2. *The means of transport, and whether the transport will be by a single mode or multimodal.* Multimodal means the goods are shipped by at least two different modes of transport. The most common modes of transport of goods are by road, rail, sea and air. An important consideration related to the second element is also the number of

off-loadings and reloadings of the goods, as this may be points in which there is a higher risk of transport damages occurring.

3. *The conditions of payment and documentary requirements*. For example, if using the EXW incoterm® in international shipments, the importer is responsible for clearing the goods for export. This may prove difficult in countries where the legislation states that the company arranging the export needs to be registered in the country where the goods are exported, and the seller may also be dependent on the buyer to deliver proof of export in order for the seller to exempt his invoice from VAT (Malfliet 2011). In addition, a departure type of delivery term gives the seller an opportunity to invoice at the time the goods are shipped. If this is a long-haul shipment, the payment terms may require payment before the goods arrive and put extra risk on the buyer since the goods can´t be inspected before payment is made.

4. *Which of the parties are able to arrange the transport at the lowest cost*. The shipper has an advantage with everything being shipped from one location, a limited number of product groups and possibly a more stable demand, whereas the buying firm has shipments coming from suppliers in different countries and locations and with a high variety in the product groups to be delivered.

Malfliet (2011) presents further arguments of why the seller is generally in a better position to arrange transport. Some of the arguments include the exporter being able to make arrangements with a forwarder who has proven capable to transport the type of goods that is being shipped, the exporter being able to align the pickup with production planning and having good knowledge of how the goods should be packaged, as well as being able to instruct the carrier to deliver proof for export in cases where there is a VAT exemption for exports. Some of these points are also supported by Ramberg (2011, 57-58) who argues that there is an increasing trend towards the choice of D-terms because the seller often finds it inappropriate to limit his obligations of sale before the product has reached the end destination, in addition to the seller being in a better position to obtain competitive freight rates. According to Malfliet (2011), a disadvantage of the seller organizing the transport is that a seller operating on a delivery term where he is accepting risk until end destination is not able to inspect the state of the goods upon arrival. In cases of transport damages, a liability gap may therefore occur when the recipient has not made note of the damages in the forwarder´s waybill.

In an ETO perspective, is also interesting to look at the study presented in chapter 3.2 and Figure 4, where the term of delivery seemed to have an impact of the probability of a delay in the study. Further, the mode of transport also seemed to have an impact on the probability of a delay, with the road transport having a higher probability of delays than the other modes of transport (Ahmadian et al. 2014). It may therefore be wise also to consider the delivery timeliness when choosing the appropriate incoterm®, especially if the material is located on the critical path in the project.

3.3.2 Risks and opportunities

In order to choose the right incoterm®, risk is something that should be considered carefully. The different incoterms® entail different types of risk, and since there is generally a tradeoff between risk and cost, where a decrease in risk may lead to a higher cost, choosing the right incoterm® should be a calculated decision.

The C-terms will not be considered in this thesis because this type of incoterm® involves the buyer agreeing to bearing the risk of loss or damage to the goods while in transit, although the cost of transport is assumed to be approximately the same as for the D-terms. When the transport is also organized by the seller who has a self-interest in keeping their costs low, the quality of the service might suffer as a consequence and thus lead to a higher risk of damages or delay than the D-terms. In addition to this, for the incoterm® CIP, the insurance cover is generally very restrictive and an amendment is often necessary to get a satisfactory insurance cover (Ramberg 2011, 27). In this thesis, the main focus will therefore be on the incoterms® at the ends of the spectrum, meaning FCA and DAP/DDP. EXW will not be considered due to Siemens´ policy of not ordering EXW from foreign suppliers. The Incoterm® EXW brings substantial extra risk when it comes to loading of the goods and export customs clearance, since contractually the buyer is responsible for both operations. According to Malfliet (2011), a seller loading the goods on behalf of a buyer also leads to a risk gap, because the transport insurance of the buyer will not take effect until the goods are loaded on the means of transport, and the goods are basically uninsured during the loading.

The seller is also in a position where he can charge the buyer for the process of loading the goods since EXW means he is contractually not responsible for this operation.

FCA

The incoterm® FCA, short for Free Carrier, means that the seller delivers the goods to a carrier nominated by the buyer, with the hand over usually taking place at the seller´s premises. It is important that the place of delivery is specified in detail due to the fact that the risk passes from the seller to the buyer at the specified point. In using this incoterm®, the seller is responsible for loading the goods as well as clearing the goods for export. If the goods are transported to a specified point of delivery on the seller´s means of transport, the risk passes to the buyer when the goods are ready for unloading. The seller is responsible for sufficient packaging of the goods for the intended mode of transport, to the extent that he is aware of which transport mode will be used before the contract of sale is concluded (Ramberg 2011, 64). The buyer is responsible for buying and organizing the transport, as well as taking care of import formalities and making sure the goods are sufficiently insured. Although the ordering of the transport is a responsibility of the buyer, the seller in many cases organizes the transport on behalf of the buyer at the buyer´s risk and expense (Ramberg 2011, 51).

D-terms (DAP, DDP, DAT)

DAP, DDP and DAT are the delivery terms that places the least amount of risk on the buyer. DDP, short for Delivery Duty Paid, means the risk passes to the buyer when “the goods are placed at the disposal of the buyer, cleared for import on the arriving means of transport ready for unloading at the named place of destination” (Ramberg 2011, 149) . The seller is responsible for all costs associated with the transit and is thus also responsible for paying all duties both for export and import, as well as VAT and other taxes, unless the sales contract specifies otherwise.

When using DAP, short for Delivery At Place, “the seller delivers when the goods are placed at the disposal of the buyer on the arriving means of transport ready for unloading at the named place of destination” (Ramberg 2011, 137). What separates DAP from DDP is that in using DAP, the seller is not obligated to carry out import customs formalities with its associated costs and risks.

DAT, short for Delivered At Terminal, means the risk passes from the seller to the buyer "when the goods, once unloaded from the arriving means of transport, are placed at the disposal of the buyer at a named terminal at the named port or place of destination" (Ramberg 2011, 127). The terminal is generally not the end destination of the goods, and as is also valid for DAP, the seller is responsible for clearing the goods for export, whereas the buyer is responsible for taking care of customs import formalities.

3.3.3 Insurance

When it comes to insurance under the incoterms®, with the exception of the C-terms (CIF, CIP), it is for the parties themselves to arrange insurance as they see fit (Ramberg 2011, 34). For D-terms, this is a responsibility of the seller, and any delays or damages discovered by the buyer upon receiving the goods is a matter to be settled between the seller and the insurance company or carrier. The buyer is entitled to claim compensation in accordance with the contract of sale, provided that he discovers the deviation in due time.

For FCA deliveries, in choosing insurance, the buyer needs to consider the risk associated with the delivery as well as the value or criticality of the goods being delivered. Generally, when procuring transport, unless a detailed contract agreement is negotiated between the buyer and service provider, the service provider is only responsible for covering damages, delays and losses to a very limited extent in accordance with "Lov om vegfraktavtaler" (1974). This means that for international transports, the compensation for damage or loss cannot be higher than 8,33 SDR per kg of the transported goods and for delays, the claimed sum is limited to the total value of the transport service. SDR, short for Special Drawing Rights, is a currency that as of January 3rd 2019 constitutes 12,15 NOK (Norges Bank). There are several red flags to consider here. In cases of severe damages or loss of goods, if the goods are of light weight and high value, this compensation will not be able to cover anything close to the actual value of the goods unless the goods are additionally insured. Furthermore, if the goods are located on the critical path in a project and delays may cause consequential costs, the forwarder is only required to cover costs up to the total freight cost amount. This means that if a critical product is delayed, unless he is sufficiently insured, the buyer will need to cover the major part of the extra costs himself. In choosing incoterms® where the buyer is ultimately responsible for the transport, it is therefore very important that he considers the circumstances surrounding the transport, especially related to the value, fragility and criticality of the goods, and takes action to make sure deliveries are additionally insured where this is necessary. For transports in Norway, this also means considering extra risks associated with wintertime deliveries or deliveries to remote locations, as forwarders located in countries located in countries outside of Scandinavia may be unaccustomed to Norwegian driving conditions, thereby posing extra risks of delay or accidents due to inexperience, ignorance or by failing to comply with local requirements and regulations for winter transports.

3.4 Third-party logistics (TPL) providers

Bask (2001) defines TPL as being "relationships between interfaces in the supply chains and third-party logistics providers, where logistics services are offered, from basic to customized ones, in a shorter or longer-term relationship, with the aim of effectiveness and efficiency". TPL providers can therefore be defined as being strategic suppliers fulfilling the logistical requirements of a buyer, in parts or fully, thus enabling the buying firm to focus on their core competencies. The use of TPL´s has had a massive growth in the recent years, for reasons which may largely be attributed to increased global competition and the companies increasing focus on core competencies, increasing logistics service requirements, deregulation of the transport industry, Just-in-time (JIT), as well as the IT revolution which enables the parties to communicate in a more efficient way than what was earlier possible (Sheffi 1990).

In understanding TPL, it is important to also consider the differences in the procurement of services compared to the acquisition of goods. Services differ from goods in being intangible, heterogeneous (not standardized), inseparable (difficult to separate production from consumption) and perishable (not possible to store) (Zeithaml, Parasuraman, and Berry 1985). In logistics, services involve relationships where the buyer is not necessarily the only critical stakeholder but also the buyer´s customer, and the logistics service provider may both interact with the client as well as the client´s customer in the delivery of the services (Andersson and Norrman 2002). With the inability to store services, quality assurance difficulties also follows, since in many cases it is not possible to measure the delivery of a service until it is already provided, and if a delivery is unsatisfactory it may be too late to do anything about the results (Sink and Langley Jr. 1997). Careful consideration and preparation is therefore crucial before deciding to outsource logistics services in order to facilitate success.

3.4.1 Factors influencing the logistics outsourcing decision

Rao and Young (1994) identified three main drivers influencing a company´s decision to enter into a TPL relationship:

1. *Network complexity*: This driver relates to the geographical distribution of the company´s trading partners, as well as the intensiveness of transactions with the partners. From a higher number of trading partners follows a higher number of transactions that needs managing, and the physical location of the trading partners also has an impact on the transaction difficulty.

2. *Process complexity:* This driver refers to time and task compression in the supply chain. When a number of tasks is required to be performed and coordinated within a short time span, many cost/service tradeoffs can be identified. Three key variables used for measuring this driver is time sensitivity of transactions, manufacturing cycle times for products and order cycle times for customer orders. With a high time-sensitivity of transactions, significant costs could incur in cases of performance failures and the company needs to consider if they are capable of handling these transactions to a satisfactory degree.

3. *Product complexity:* This driver relates to the special nature and characteristics of the products and materials in relation to the environment governing the transportation, storage and handling. As an example, hazardous or fragile goods will make logistics more challenging in international trade.

From these three drivers, an additional five key factors emerge in the company´s decision to either utilize third-parties or maintain in-house execution of logistics services, with the relationship between the variables illustrated in Figure 7.

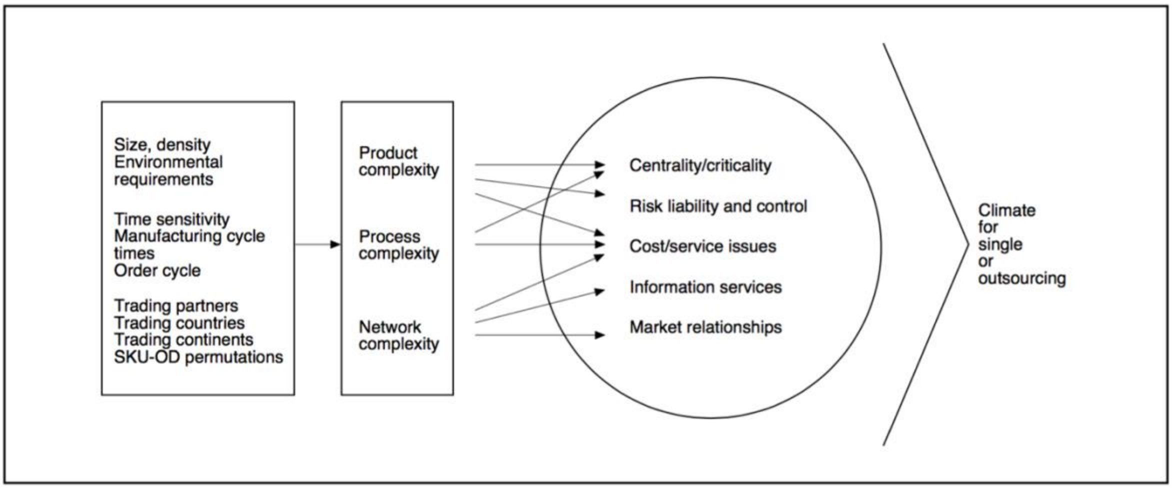


Figure 7 Drivers and key factors for outsourcing logistics services (Rao and Young 1994)

- *Centrality* relates to whether the any of the international logistics functions are central to the core competency of the company.
- *Information technology* (IT) relates to information and other administrative functions associated with logistics functions, such as implementation of booking systems and electronic data interchange (EDI) shipment tracking systems which may be desirable but not an option for the company if running the operation in-house due to high implementation costs.
- *Cost and service* means providing a cost-effective service at a quality level which is competitive in the marketplace.
- *Risk and control* relates to the risks associated with the transactions and whether it is possible to build in special requirements minimizing potential risks and stipulating penalties for non-conformance into the service agreements with TPL´s.
- *Market relations* is a factor addressing the relationship between the shipper and the logistics service provider and potential benefits thereof.

The outsourcing decision can also be made using transaction cost economics (TCE), where an analysis determining which of the actors is best suited to economize on transaction costs can be used to decide whether an activity should be maintained in house (hierarchical governance structure) or outsourced (market governance structure) (Logan 2000). If the external transaction costs are lower than the internal transaction costs, the activity should be outsourced to a third party. The efficiency of these costs can be found by comparing the cost of planning, adapting and monitoring of task completion under the two governance structures, and the contributors to these costs include uncertainty, transaction frequency and asset specificity. Asset specificity is defined as "the degree to which specific investments are required to realize least cost supply" (Logan 2000).

According to Logan (2000), changes in the market environment can trigger a change in transaction costs and points to two specific changes in the transportation industry that has facilitated a higher degree of logistics outsourcing; the deregulation of the trucking industry causing a price decrease and transportation specialization, as well as the changing technology allowing the logistics providers to invest in technical services too costly for a client to maintain in-house. A TPL provider may have the advantage of economies of scale enabling him to invest in specialized assets fulfilling the customers need at a lower cost than the client since they are able to spread the costs across their entire customer base. The logistics provider also holds the leverage of economies of scope, generating advantages such as being able to serve customers with similar needs, spread costs of research and development across more paying customers, reapplying developed solutions to new customers and consolidating shipments (Logan 2000).

Upon analyzing the variables presented in the above sections, a company should be in a favorable position to evaluate whether outsourcing logistics services should be part of the future strategy or if these services are sufficiently or better sustained if kept in-house. According to Sink and Langley Jr. (1997), the final decision to outsource also calls for the involvement and approval of top management in order for the idea to ensure the consideration, time and resources needed.

Successful TPL outsourcing arrangements, especially those founded on a cooperative and partnership-like basis have proven to give companies competitive advantages such as reduced logistic costs, improved service levels and end-customer satisfaction, improved access to and use of technology, increased flexibility and productivity, new competencies and improvement of employee morale (Marasco 2007). Marasco notes that the high level of commitment and integration that characterize long-term TPL relationships have also shown to improve the logistics provider´s performance over time. Rao and Young (1994) found that companies can experience benefits in several areas from outsourcing logistics services to third parties, some of which includes learning about sourcing alternatives in remote locations, learning of options related to volumes, specific commodities, origins and destinations, the TPL provider´s ability to monitor the supply chain and providing feedback to the company as a consequence of the provider´s unique position of being in direct contact with the company´s suppliers.

3.4.2 TPL structures

In choosing to outsource logistics activities, a company also needs to consider the type of relationship to establish with the TPL provider. The type of relationship can vary from an arm´s length transactional type of relationship, to a strategic alliance or partnership between the company and TPL provider.

The Kraljic matrix is a tool developed by Peter Kraljic (1983) used for analyzing the purchasing portfolio of a company based on the axes of profit impact and supply risk. The profit impact is defined as either the volume purchased, percentage of total purchase cost, or impact on product quality or business growth. The supply risk is defined as availability, number of suppliers, competitive demand, make-or-buy opportunities, storage risks and substitution possibilities. Based on an analysis, items are then placed in one of four categories; non-critical, bottleneck, leverage or strategic, with each category requiring a different purchasing approach. Andersson and Norrman (2002) used the Kraljic matrix to position the traditional logistics services at the border between leverage and non-critical items arguing that logistics is normally not the major competitive advantage or cost element for a company, and that supply risk is often quite low due to a large number of providers and a strong negotiating position of the buyer. The general strategies used for buying these services has thus been to use competitive bidding and global sourcing, as well as consolidating services to a few providers in order to achieve economies of scale and reduce transaction costs. The authors further explain that there is a change in the market context driving several shifts in the positioning of logistics in the Kraljic matrix, as illustrated in Figure 8.

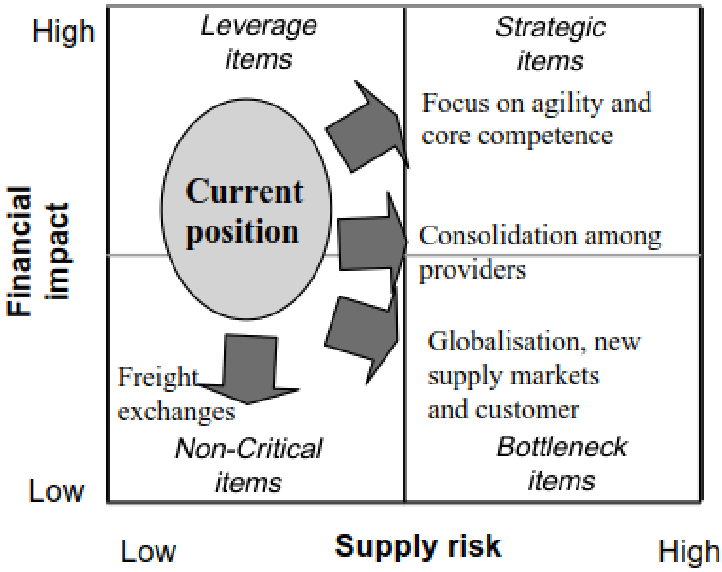


Figure 8 Trends impacting the positioning of logistics services in the Kraljic matrix (Andersson and Norrman 2002)

Andersson and Norrman (2002) state four main reasons for these shifts:

- *Increasing globalization:* As products are procured from new areas there is an increasing need of global logistics, resulting in an increased supply risk since the number of partners capable of delivering reliable and trustworthy services on a global scale is lower and the existing providers enjoy a better negotiating position. This pushes logistics toward the bottleneck part of the matrix.
- *Focus on agility and core competence:* The increased focus on core competence drives the outsourcing of more advanced logistics services to TPL providers, thereby enabling the companies to leverage their resources, spread risks and concentrate on ensuring survival and future growth. With the complexity of the activities outsourced, this pushes the logistics services toward the strategic part of the matrix.
- *Consolidation of the logistics market:* The increased globalization has forced the logistics industry to consolidate, thereby making the service providers more powerful since the number of competitors declines. A reduction in the number of capable providers increases the supply risk for the buyer, forcing a shift of logistics services to the right side of the matrix.
- *IT and e-commerce:* IT and e-commerce facilitate web-based freight exchanges, making low-complexity transport assignment easier to execute, shifting the logistics services towards the non-critical part of the matrix.

The authors identify two types of purchasing situations and processes that will be increasingly more common in the future; deep strategic alliances with providers of advanced logistics services and transactional purchases of basic logistics services.

Behavioral differences in transactional and strategic TPL structures

Moore and Cunningham III (1999) analyzed the differences in social exchange behavior in logistics alliances and transactional relationships. Social exchange behavior can be defined as behavioral traits such as trustworthiness, fairness, equality, commitment, opportunism and conflict. The social behavior was found to be influenced more by the relationship effectiveness (i.e. productivity, worthwhileness and satisfaction) than the type of relationship, and shippers in effective relationships generally perceived higher levels of trust, equity and commitment, and lower levels of conflict and opportunism than shippers in less effective relationships. Moore and Cunningham III (1999) therefore emphasize that shippers should focus on creating effective logistics relationships regardless of the type of relationship. In the areas of trust and commitment, shippers in alliances were found to trust their logistics partners more, showing confidence that they have the intentions, motives and expertise needed, as well as the having a stronger sense of loyalty and commitment compared to shippers in transactional relationships.

Lambert, Emmelhainz, and Gardner (1996) from a case study of 18 relationships, identified three types of supply chain partnerships. Type I are relationships where the parties only consider themselves to be partners on a very limited basis and the cooperation is short-term oriented. In type II relationships, the parties are integrating activities instead of just coordinating them, they have a longer-term view and the partnerships involve more activities. In type III, the parties are involved in a strategic collaboration with a more permanent perspective, identifying each other as an extension of their own firm.

From the basis of the three types of supply chain partnerships, Knemeyer, Corsi, and Murphy (2003) compared the differences between the relationship types in terms of *key relationship marketing elements*. Marketing elements are defined by the authors as activities aiming to establish, develop and maintain successful relational exchanges. Short definitions of the different elements are provided below.

- *Trust:* Reliability and confidence in one´s partner.
- *Commitment:* “Implicit or explicit pledge of relational continuity between exchange partners” (Dwyer, Schurr, and Oh 1987)
- *Investment:* Irreversible specialized assets or resources that cannot be used elsewhere or be recovered if the relationship is terminated.
- *Dependence:* Both parties gain benefits from the relationship that they would not be able to obtain alone or by other business alternatives.
- *Communication:* ”The formal as well as informal information sharing of meaningful and timely information between firms” (Anderson and Narus 1990)
- *Attachment:* A sense of genuine feelings toward the other company
- *Reciprocity:* The action of joint efforts for mutual benefits, going beyond the tangible specifications of the agreement.
- *Shared benefits:* In the study, shared benefits is defined as “performance improvements that the outsourcing relationship has provided the customer” (Knemeyer, Corsi, and Murphy 2003).

The study found no significant differences between type II and III relationships for the elements studied, but did however find significant differences between type I and the other two types with the exception of the elements “attachment” and “reciprocity”. The type II and III relationships were found to sustain a higher level of trust, commitment, investment, dependence, communication and shared benefits compared to type I. The authors however warn against developing higher-level relationships with all partners, emphasizing the importance of evaluating the drivers, facilitators and components of the relationships before making relationship changes. They also note that a firm who wishes to establish a closer relationship to a TPL in order to gain advantages should be aware of the need to become more interconnected, as the gains seem to be connected to an increased integration in both tangible and intangible relationship marketing activities.

3.4.3 The TPL purchasing process

Based on the trend of TPL services shifting toward both a transactional and strategic direction, Andersson and Norrman (2002) defined a framework for buying both types of logistics services. The framework is depicted in Figure 9 and illustrates the differences in the purchasing process for the two types of services. The different steps are further explained in the subsections below.

	Define/ specify the service	Understand currently bought (vol & delimits)	Simplify/ standardise	Market survey	RfI	RfP	Negotiations	Contracting
Advanced outsourcing	Difficult as service often new for both shipper and provider + it is complex	New service not bought before and changed context	Standard operating procedures and IT interfaces to be developed	Few providers available – must find "potential" to develop or new entrants	Difficult to communicate the scope and nature the of service	Complex to answer and analyse. Not directly compareble answers	Long time due to new type of negotiations and requirements and complex service	Detailed due to uncertainties and complexity
Freight exchanges	Simple service – from A to B	Not necessaray as spot buy	Exchanges bidding format is standard	Exchange is the market	Not applicable	"Direct order" on the exchange	Short and directly on the web	Direct buy - Exchange "market maker" and handles deal

Figure 9 The TPL purchasing process (Andersson and Norrman 2002)

Define/specify the service

Whereas the service purchased on a freight exchange is simple and based on a real demand, the purchase of an advanced logistics service is more difficult. The reason for this is the fact that the service is new for both the buyer and provider and that the service is complex of nature.

Understand the volume bought

Understanding the volume and specification of service bought is important both in order to evaluate tenders as well as giving the providers a better basis for developing offers. This is particularly important when buying advanced logistics services, since this is a new type of advanced service that has not been purchased earlier. For transactional purchases, the volume and circumstances are generally known, and this step is therefore not as relevant.

Simplify and standardize

Whereas for the basic logistics services this step is already standardized, for advanced logistics services, there is a need for developing a new type of service to be optimized by the provider.

Market survey

For basic logistics services, the freight exchange is in the market place, and getting information is usually not an issue. For TPL´s, the authors explain that the development of services at the time the article was written, was mostly based on trial and error, with shippers often having to develop concepts and services and teaching the providers how to manage the operations. A market survey would therefore include finding potential providers or looking at the possibility to develop present or new providers in line with the needed qualifications.

Request for information (RFI)

The purpose of the RFI is to screen potential suppliers by gathering information about their services and reduce the number of suppliers to continue with. This step is not necessary for the basic logistics services since the suppliers delivering the services in the freight exchange are capable, but for the advanced logistics services this step poses a challenge due to the complexity of the service and knowing what the screening criteria should be is a difficult task.

Request for proposal (RFP)

Based on the remaining providers resulting from the screening process, an RFP is sent to the suppliers. The RFP should specify the services and forecast volumes and is often designed in a standardized input format to make the proposals easy to analyze and compare, thereby forming a solid platform for further negotiations. It is also possible to send a more solution-oriented RFP. Andersson and Norrman (2002) emphasize the importance of the service definition in doing this. The company should define what the service is, what demand it should fulfill and what problem it should solve. In defining the service, they should also be careful not to over specify, as this may put restraints on the providers and limit their abilities to develop new processes that in turn may be more cost effective and give a better service. There are tendencies indicating that there may be a shift in the responsibility for defining the services in the future, where the provider will be more involved in the final design of the solution (Andersson and Norrman 2002). In the purchasing of an advanced service, the providers should then be given information to develop a process, plan and cost structure. Sink and Langley Jr. (1997) notes that a common approach is to give each provider a likely business scenario with transactions and volumes reflective of a typical time period from which they can develop a solution. The providers are then initially considered based on their service capabilities, and after confirming their capabilities they are subsequently evaluated on cost. This gives the providers more flexibility to come up with alternative solutions, but also makes the incoming offers more difficult and time consuming to compare.

In the evaluation of the offers, traditionally used selection criteria for basic logistics providers include quality, cost, capacity and delivery capability, whereas in the selection of a TPL providers the providers should also be evaluated on references from current customers, cultural compatibility, financial strength, the depth of management expertise, operating and pricing flexibility and information system capabilities (Sink and Langley Jr. 1997).

For basic logistics services, an RFP in the traditional sense is not used, but an order is initiated whereupon the providers are able to submit prices.

Negotiations

After the offers are evaluated, the negotiation phase starts. The final selection of providers is often not chosen based only on price or costing principles, but also evaluation criteria such as reliability, transit time, carrier considerations and product characteristic constraints. The negotiation phase may therefore take a long time due to the complexity and novelty of the services to be bought. Sink and Langley Jr. (1997) points out the importance of trust in the selection of a provider and suggest the use of on-site visits to the supplier facilities and the supplier´s customers in order to validate the supplier´s capability and build trust. In a transactional basic logistics service, the negotiation, if any, is short and performed on the marketplace.

Contracting

After finishing the negotiations, a provider is chosen, and the contract is developed. For basic logistics services there is usually not a specific contract and the order given to the provider, either on the freight exchange marketplace or by the issuing of a purchase order, functions as the contract. For advanced logistics services the contract will be very detailed. Sink and Langley Jr. (1997) advocate the use of a written transition plan to supplement the contract, specifying the chain of command in both organizations, key contact points, assets to be employed or shared, processes to be assumed, handling of proprietary data, timing of changeover events, and a procedure to handle tasks not identified in the contract.

3.4.4 Contract design

Logan (2000) identifies the main causes of failed TPL relationships to be unrealistic expectations, poor communication and a lack of trust based on a lack of mutual benefits and shared goals, and presents two solutions to deal with these problems. The first solution is to diagnose the relationship from both sides of the contract in order for the parties to feel they are entering a mutual beneficial relationship. The second solution is to use agency theory to design contracts and relationships, facilitating an environment of trust.

In agency theory, the relationship between the customer (principal), who delegates the work to a provider (agent) performing the work, is studied. The goal is to develop the most efficient contract to govern the relationship, assuming self-interested people and corporations. The agency problem happens when the two parties involved have different goals or when it is difficult or expensive for the principal to measure what the agent is doing. Problems can also arise as a consequence of differences in risk preferences, goal conflicts among groups and information availability. Logan (2000) introduces two contract designs that can be used in the agency theory model – by behavior or by outcome.

In *outcome-based contracts*, the agent is paid a flat rate fee based on the delivery of the service and this is the traditional contract design for transportation service contracts. The risk in the contract is on the agent, since the principal is paying the same rate regardless of any problems or uncertainties.

In *behavior-based contracts*, in transport terms, the agent is paid on behavioral outcomes like pay for hours, miles and cubic feet. The risk involved in the contract is mainly on the principal, since the agent is paid for the behavior regardless of the results. The agent is then compensated for waiting time and other uncertainties. The behavior-based contracts also support open-book cost plus pricing, meaning that the principal pays for the service rendered based on the provider´s cost plus a negotiated margin. Using cost plus pricing gives both parties an incentive to reduce costs. In behavior-based contracts, there is also the possibility to combine behavior-based measures with bonuses based on predetermined performance goals or exceeding set goals, which may give the principal a higher sense of control. Metrics that can be used are on-time deliveries, shipment-tracking accuracy, percentage of damage, surveys of the principal´s customer and audits. Many of these metrics requires that the agent make data available to the client, allowing a real-time performance rating. This can be facilitated through the use of information systems.

According to Sink and Langley Jr. (1997), continuous improvement by the provider should also be specified in the contract to ensure competitive performance. Additionally, in the cases of non-performance or unacceptable cost overruns, it is essential that the contract also addresses the terms under which the contract may be canceled. The contract should also contain penalty clauses if the provider should fail to achieve the agreed performance targets, and may include provisions requiring the initiation of root cause analysis and plans to solve the problem (Andersson and Norrman 2002).

4.0 Methodology

4.1 Research design

Yin (1994) describes research design as being "the logical sequence that connects the empirical data to a study´s initial research questions and, ultimately to its conclusions". The research design can therefore be viewed as a plan describing which steps to take in order to find answers to the research questions. The research design should address at least four problems: what questions to study, what type of data is relevant, what data to collect and how to analyze the results and its main purpose is to avoid a situation where the evidence does not address the research questions (Yin 1994).

Ellram (1996) splits the research design into two classifications: The type of data used and the type of analysis, both of which are illustrated in the matrix in Table 2. Two types of analysis can be distinguished: Primarily qualitative and primarily quantitative. Qualitative methods are preferred if explanation of a phenomenon is a goal of the research and is frequently expressed verbally and often to create an understanding of relationships or complex interactions. Quantitative methods on the other hand is usually expressed in numerical, quantifiable terms. The author notes that the type of data can be either empirical or modeled. Empirical data represents data from the real world gathered for analysis purposes, whereas the modeled data is either hypothetical or real-world data to be manipulated by a model. Empirical data can use quantitative analysis, qualitative analysis or a mixture of both.

According to Ellram (1996), research has four primary objectives from which can be used to select the right methodology. The first objective is "exploration", relating to the issue of how or why something is done. The second objective is "explanation", seeking to find the explanation of a phenomenon. The third objective is description, looking to describe the nature of a phenomenon and who is participating. The fourth objective relates to prediction. The author notes that case studies can be used for providing description and prediction on a smaller scale to describe a phenomenon or predict outcomes based upon past occurrences in similar cases.

Table 2 Research methodologies (Ellram 1996)

	Type of analysis	
Type of data	**Primarily Quantitative**	**Primarily Qualitative**
Empirical	Survey data, secondary data, in conjunction with statistical analysis such as: factor analysis cluster analysis discriminant analysis	Case studies, participant observation, enthnography. Characterized by: limited statistical analysis, often non-parametric
Modeling	• simulation • linear programming • mathematical programming • decision analysis	• simulation • role playing

The goal of the research is to:

1. Describe the current practice related to the sourcing of transport in SEM by the use of case studies
2. Use theory to predict the outcome by the use of alternative sourcing strategies in order to make a recommendation for the most suitable strategy.

The focus of the first part of this thesis can therefore be described as being mainly exploratory of nature and the second part as being predictive. The data used for this study will be empirical due to the case being grounded in a real-world problem, and a mixture of qualitative and quantitative methods will be used. A copy of the research plan for this thesis, based on the template of Ellram (1996), is included in Appendix 1.

4.2 Case study

According to Yin (1994), the situation where the case study holds a distinct advantage over other research strategies is when "a "how" or "why" question is being asked about a contemporary set of events over which the investigator has little or no control". This research is studying events that have already happened, and therefore the events cannot be controlled or influenced in any way. Also, seeing that the major number of the research questions are "how" questions and considering that the first part of the research is essentially exploring how the current inbound transport process in SEM works, the case study format is therefore likely an appropriate research strategy for this study.

The qualitative method of case studies, can be defined as focusing on holistic situations in real life settings, and tending to have set boundaries of interest, such as an organization or an industry (Ellram 1996). Three primarily qualitative techniques are generally used as part of the case study method; direct observation, indirect observation (records) and interviews. Quantitative data may also be used, including observing the number of occurrences of a phenomenon, determining the level of occurrence of an activity or the use of questionnaires.

Good research design quality in case studies requires external validity, reliability, construct validity and internal validity (Ellram 1996). External validity relates to the accuracy of the results in the phenomenon studied, and the generalizability of the results. Reliability addresses the repeatability, and whether a replication of the study would generate the same result. Ellram (1996) highlights two keys to reliability; the use of a case study protocol and a case study database, and emphasizes the importance of this in particular when several cases are studied. Construct validity relates to the making of operational measures for the concepts being studied. Three elements can be associated with this; using several data sources to corroborate evidence, establishing a chain of events, as well as having key informants reviewing and approving the overall case study report. Internal validity is only a concern in explanatory cases and will therefore not be discussed here.

According to Yin (1994), the use of several cases facilitates the development of a rich theoretical framework that provides a broader evidence to support or reject the initial set of propositions. Due to the limited number of suitable projects, as well as the extensive work associated with the in-depth research of more projects and the limited time frame of the thesis, this research will study two projects where the main deliveries to site have been conducted. Although the number of cases is quite limited, the quality of the data collected in the cases should be good, considering the fact that the deliveries were made less than a year before the interviews were conducted and the interview subjects have a fresh recollection of the project events. Also, in choosing to analyze two cases instead of one, if the cases produce similar results they provide a higher support for the initial proposition than a single case study would. A general interview which was not related to any to the cases in particular was also performed, in order to check if the findings in the projects also matches the general opinions about the subject, as well as to gather information and opinions from the head of project management and other key personnel about the inbound logistics performance in the projects.

4.3 Data collection

Seeing that this study is based on the workplace of the author for the past 7 years, as well as the direct involvement of the author in one of the projects studied, it was of particular importance to reduce the risk of personal bias influencing the result of the study. Special care was taken to include several data sources whenever possible to construct validity of the results. This is also in line with the recommendation of Ellram (1996), who emphasized that the triangulation of data by the use of several sources helps overcome the problem of informant bias. The research plan in Appendix 1 has functioned as a guideline for ensuring good research design quality and making sure that the case study was aligned with the research questions at all times.

Table 3 illustrates the different sources of data used in this study. Primary data can be classified as data collected for this specific analysis, whereas secondary data is data collected by others for purposes nonrelated to the study. Internal sources are sources found within the SEM organization, and external sources are sources found outside of Siemens. Since the unit of analysis in this case is SEM, no external primary data was collected.

Table 3 Data sources

Data sources	Internal	External
Primary data	Interviews	
Secondary data	SAP SCM CoRe (internal reporting system) Internal documents	Textbooks Scientific articles Newspaper stories

The internal primary data was collected through the means of interviews with project participants and key stakeholders. Yin (2011) separates between two interview styles: Structured interviews and qualitative interviews. In the structured interview, all questions in the interview are listed before the interview starts, the interviewer tends to use closed-ended questions with a limited set of responses defined by the interviewer, and the interview is generally designed to ask all respondents the same set of questions. The qualitative interview is different from the structured interview in several ways. The relationship between the interviewer and the interview object is not as strictly scripted and the questionnaire does not contain the complete list of questions asked. Rather, the questions will differ based on the context of the interview and it is conducted in a conversational way, enabling a two-way interaction. The questions used are generally open-ended, which enables the researcher to gain insight into the respondent's own experience. There are advantages and disadvantages to both of the interview styles. Yin (2011) notes that many survey researchers believe that close-ended question leads to more accurate data and a more definitive analysis. On the other hand, they are limited in their ability to appreciate trends and contextual conditions across a respondent´s lifetime, which is better reflected in the qualitative interview.

The nature of the structured interview makes it is easier to compare the responses in order to find consistent patterns between cases. A mainly structured interview style was therefore chosen for this study, seeing that two projects were going to be studied and compared. Some of the questions were open-ended in order to pick up on facts that would otherwise not have been captured in a close-ended structured interview. Two interview guides were made, one containing case specific questions and one general interview guide, non-case specific. The non-case specific interview guide was created to improve the validity of the case study findings by cross checking the results with the general opinion of other employees in the division working with project deliveries, as well as the head of project management (HPM) and QMiP. The formed questions in the interview guides were linked to specific research questions to ensure adherence to the research problem as well as making the analysis of the findings easier. In addition, the type of questions assigned to each respondent differed according to his or her role in the organization to ensure that the respondents were asked relevant questions only. The interview guides were quality checked by two purchasing managers in SEM before use. Both interview guides are added in Appendix 2.

In total 18 interviews were performed. 3 interviews were performed related to case number A, 3 interviews related to case number B and 12 interviews related to the non-case specific interview. In the case specific interviews, the roles of the respondents were limited to the PM (1), the PP (1) and the SP (1), of which the number of respondents is indicated in parenthesis. In the general interview, the roles of the respondents were limited to PM´s (4), PP´s (4), SP´s (2), QMiP (1) and HPM (1).

The interview subjects were asked to provide their input voluntarily and were given questions to be asked in the interviews about a week prior to the interview with an encouragement to reflect upon the questions to be discussed. After concluding the interview their responses were sent back to them for review and they were given a chance to revise their statements before the results were analyzed. All participants were also given the opportunity to review the thesis after publication.

Secondary data sources used in the research were both gathered internally and externally. The internal data coming from SAP and SCM CoRe (internal reporting system) was mainly used for generating reports related to the purchasing volume, incoterms®, required delivery date and supplier location. Internal documentation was also gathered, providing information from contract specific data, delivery documents, delivery instructions and supplier offers, and the information was useful in forming the interview questionnaire and validating its responses. In addition, external data sources from books, research papers and webpages were used, mainly for building the theoretical framework around this study and providing information about relevant research in the area studied for best practice references.

5.0 Discussion and Case Study Findings

In this chapter, the findings of the case studies and general interviews are presented, discussed and connected to the relevant research questions and associated theoretical framework. Due to the high number of research questions, each main research question is addressed in a dedicated subchapter in order to maintain a better overview.

5.1 The case study projects

In order to get a better insight in the case projects being studied, the PM´s were asked to describe the end-customer delivery. A short presentation of the two case projects follows.

Project A is located in the south-western part of Norway. The project scope included 300kV and 132kV bays, where Siemens was responsible for the complete delivery in an Engineering, Procurement and Construction (EPC) contract. This means that Siemens was responsible for delivering all high voltage products, steel structures, control system, auxiliary system and the electrical installation of all components. The PM noted that the biggest challenge for the project was the short timeline from the customer order to the delivery date and being able to deliver according to plan despite the short timeframe. All of the main product deliveries were made in the summer months of 2018.

Project B is located in the northern part of Norway. The project scope included deliveries to two sites. Site 1 is receiving wind power from over 40 windmills, and required a delivery of transformers, air insulated switchgear, high voltage switchgear, protection, auxiliary power, a station transformer, control system and emergency power aggregate. Site 2 is receiving wind power from about 20 windmills and required a delivery of one transformer, air insulated switchgear, high voltage switchgear, protection, auxiliary power, a station transformer, control system and emergency power aggregate. The PM mentioned several challenges related to material deliveries to the stations. With the transformer stations being located on mountains, forwarders faced a steep road with an incline approaching 18% and some of the product delivered needed to be specially designed to withstand the rough incline. The project also faced a race against time trying to deliver all main components to the station before the snow made it too challenging and several of the transports encountered problems during delivery as a result of winter deliveries. The transformer deliveries which were to be delivered by sea, also faced problems when the port being built to receive them was not completed in time.

5.2 Commodity selection

In order to keep the data at a manageable level for this study, it was decided to limit the study to the commodities accounting for the highest purchasing volume (PVO), presuming that these are also the most important product groups in an inbound logistics context. To check which product groups accounted for the largest PVO, an ABC analysis was conducted, analyzing the volume bought in all projects in the time period from October 2016 to October 2018. The volume was sorted in descending order, and 25 product groups accounting for 80% the total product purchasing volume were identified. A similar analysis was afterwards conducted for the two case study projects.

A simplified overview of the findings is shown in the Table 4, where the product groups are sorted alphabetically according to their product code in SAP (ESN) and the associated purchasing volume as a percentage of the total expenditure is indicated in the last three columns. The actual expense is excluded from the overview for confidential reasons. When considering the two case projects together, 12 of 25 product groups are represented when compared with the product groups in the total PVO analysis, as indicated with a blue color in the table. All of the case projects largest commodities, in total accounting for 85% of the product PVO in the case projects, are represented in the top 25 product groups in the total PVO analysis.

A few things should be noted regarding the result of the ABC analysis, with the first being the finding that not all large product groups are represented in the case study projects. In fact, product groups accounting for about 44% of the total purchasing volume are not represented in the selected case projects. The main reason for this likely relates to the type of projects studied. Generally, projects are split into different categories depending on the type of delivery to the customer. The selected projects are some of the largest individual projects in terms of product deliveries, but do not contain the same type of products found in the smaller projects with differing scopes. Because of the time limitation of this study, a tradeoff needed to be made in the choosing of case projects, and two larger projects were selected at the expense of the product groups characterizing the largest product deliveries in smaller projects. The rationale behind this decision lies in the assumption that the larger projects have a higher number of products and deliveries compared to the smaller projects. Since inbound logistics forms the subject of study in this research, this validates the choice of two larger projects. It is also worth noting that each ESN may contain more than one purchase order and several deliveries from different suppliers.

Table 4 ABC-analysis – simplified

ESN (material code)	Material description	ABC all projects	ABC Project A	ABC Project B
ADQ	Copper Busbars for Power Current	0,0039		
BBG	Aluminum Tubes	0,0053	0,0283	
BCA	Aluminum Products, Other	0,0038	0,0232	
BCC	Aluminum Lines	0,0041		
HCA	Steel Sheets not coated with thickness 0-6mm	0,0035		
JDA	Supporting Structures, Other	0,0218	0,0838	
JDK	Equipment Support Structures	0,0131	0,0893	
KHB	HV circuit breaker	0,0954	0,4033	
KIC	Power cord plug & socket	0,0081		
MBM	Inverters for Power Supply	0,0123		
MEO	Oil Transformers > 3.15 MVA to 30 MVA for Power Distribution	0,0343		0,4653
MEW	(high) Current / Voltage Transformers for High Voltage	0,0489	0,1352	
MFK	Ceramic Insulators	0,0079	0,0184	
MGA	High-Voltage Components, Other	0,0159		
MHC	High-Voltage Switchgear, Gis (SF6)	0,2067		0,2911
MHD	Med.-Voltage Switchgear, Air-Insulated Circuit Breaker Techn.	0,0337		
MHF	Med.-Voltage Switchgear, Gas-Insulated Circuit Breaker Techn.	0,0565		
MHG	LV-Switchgear, Withdrawable & Non-Withdrawable	0,0470		
MHK	Switchgear Accessories	0,0093	0,0180	
MHL	Building & LV Distribution Boards	0,0806	0,0359	0,0936
MHS	Med.-Voltage Switchgear, Gas Insulated Load-Break Switching Techn.	0,0037		
MMA	Cable Assemblies, other	0,0395		
MTO	Acoustic Alerting Facilities	0,0076		
NME	Electronic-Manufacturer-Service Product (EMS Product)	0,0097		
OCJ	Measuring Instr. Protection	0,0374	0,0189	
Total acc. PVO		**0,8101**	**0,8543**	**0,8500**

What also should be noted is the differing scopes of the case projects studied. This is illustrated in the pareto diagrams in Figure 10 and 11, showing the product purchasing volume associated with each of the large product groups, as well as the cumulative percentage indicated by the grey line. In project A, in total ten product groups are identified as category A type of commodities representing 85% of the purchasing expenditure, whereas in project B there are three commodities. Only one product group (MHL) is overlapping between the projects.

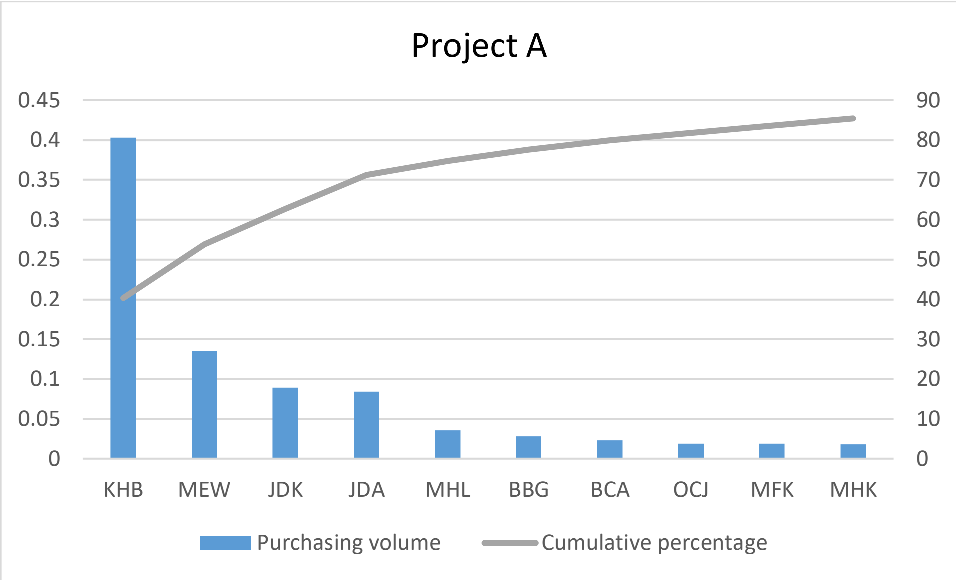


Figure 10 Pareto diagram project A

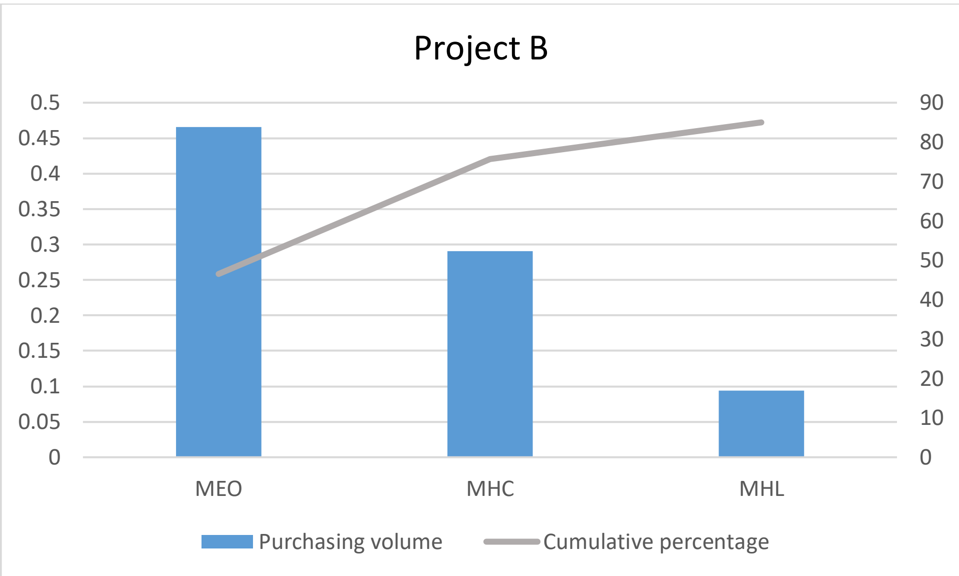


Figure 11 Pareto diagram project B

Although the scopes and main product types of the two case projects are differing, the inbound logistics in the projects should still make for an interesting study. If there are matching patterns related to problems associated with inbound logistics found in both projects, it may be reasonable to assume that other projects are facing similar challenges.

Since the projects have different product groups they may also face different types of problems, which would not have been discovered if the scope of the projects were similar. On the other hand, it is difficult to generalize problems related to the product groups when the products in the projects are different. Since it is the inbound logistics that is the focus of this study and not the product groups directly, this should not be a big issue unless there are specific logistical requirements related to some of the product groups.

With reference to chapter 3.1, it should be underlined that in using the ABC analysis, only the financial value of the goods is considered in choosing the commodities, and so other factors that may or may not have an influence on the importance of the goods are disregarded. In order to validate the choice of product deliveries to be studied, the respondents in the case study interviews were therefore asked which product groups were considered the most critical to the projects. In addition, in the general interviews, respondents were asked if the high value commodities are generally considered to be the most critical to the startup and progress of the projects.

The choice of focusing on the high value commodities was to a high degree validated in the case study interviews, whereupon the respondents when asked, both for project A and B in most cases listed some of the largest product deliveries as being the most critical commodities. Seeing that the question did not define in which way to interpret the criticality, each respondent may have somewhat different interpretations of the word depending on their role. Upon being asked about the reasons for ranking these products as being the most critical, several reasons were found. For project A, steel was ranked as the most critical from all three respondents, with the explanation being that bad experiences from previous projects suggested an increased focus to avoid problems upon receiving the material. The same reasons were suggested by some respondents also for the transformers and disconnectors. Two respondents stated that aluminum tubes were also critical deliveries, for which one of the respondents noted that the criticality was related to a new product design. For project B, all respondents mentioned the transformer delivery and the AIS system delivery as being two of the most critical deliveries. Reasons for the criticality were stated to be related to the size and weight and uncertainty related to delivery time for the transformer delivery being transported by sea, in addition to the time criticality related to the installation on site for the AIS system. One respondent also noted that the winter transport of the AIS system also added to the criticality in large part due to the fact that the transport was delivered by foreign trucks and drivers, thus adding to the transport risk. Other product groups mentioned as being critical were the GIS delivery, surge arresters and end sealings, for which the last two were stated to be critical due to having a large cost impact on the project if not delivered on time.

The findings in the case studies reflects the findings in the general interview, whereupon most respondents were in agreement that the highest value commodities were often the most critical in the projects. In the general interview, the respondents were specifically asked to put the criticality in relation with the installation startup and project progress. Especially products with long lead times and/or requiring technical processing and calculations were perceived as being critical to the projects in the sense that if these commodities arrive with deviations or damages, the projects may face serious consequences.

5.3 Supplier locations and incoterms®

After doing the ABC analysis, an analysis of the supplier shipping location and incoterms® was performed, using supplier master data from SAP. As mentioned in the chapter 5.2, the ESN´s may contain more than one purchase order from different suppliers and of different purchase value, and the small value deliveries and suppliers were therefore removed, as well as suppliers shipping from Norway, before going further with the analysis. Category OCJ and MHL from project A were also omitted from the case study, seeing that these commodities were not shipped directly to site from the suppliers. An overview of the supplier shipping locations and incoterms® for each main commodity are shown in the figures and tables for each case project on the next page.

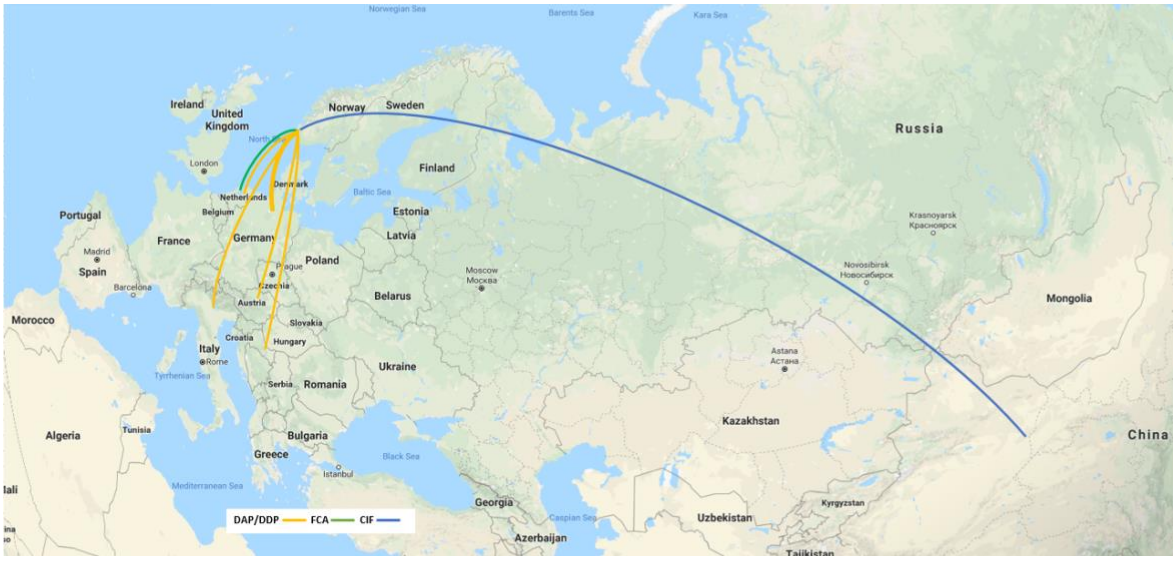


Figure 12 Supplier shipping locations project A

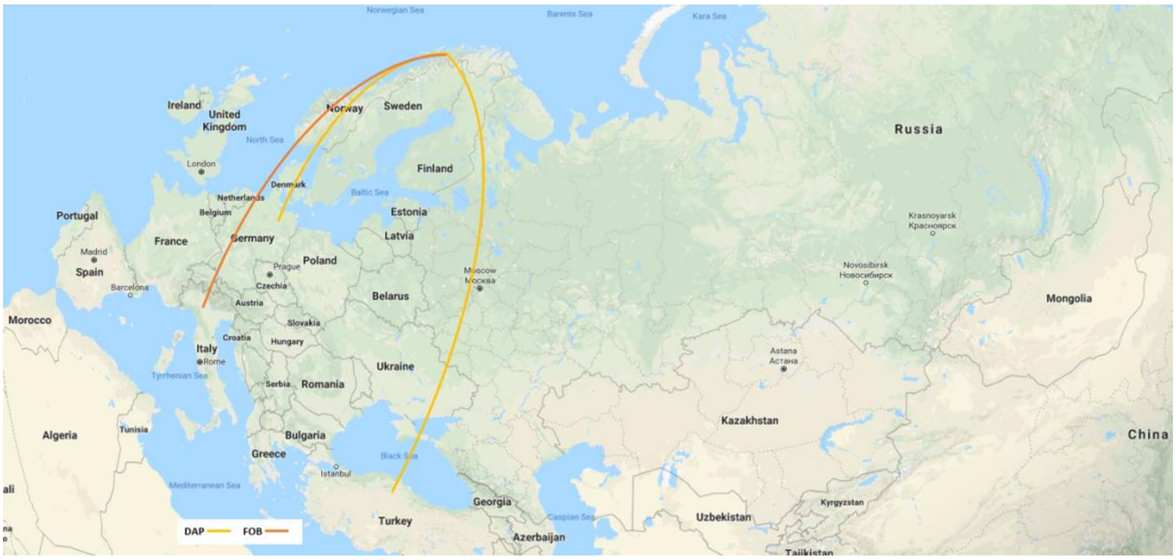


Figure 13 Supplier shipping locations project B

The following suppliers and deliveries will be studied in detail:

Table 5 Commodities to be studied - Project A

PROJECT A				
Supplier	**Commodity (ESN)**	**Incoterm**	**Country**	**PO number**
1	Disconnectors (KHB)	DDP	Netherlands	4509485317
2	Circuit Breakers (KHB)	DAP	Germany	4509599434
3	Transformers (MEW)	DAP	Italy	4509491304
4	Steel (JDA, JDK)	DAP	Hungary	4510101962
5	Aluminum tubes (BBG)	FCA	Netherlands	4510105704
6	Clamps/Connectors (BCA)	DAP	Austria	4510076184
7	Ceramic insulators (MFK)	CIF	China	4509854097
8	Earthing lance (MHK)	DDP	Germany	4510098402

Table 6 Commodities to be studied - Project B

PROJECT B				
Supplier	**ESN**	**Incoterm**	**Country**	**PO number**
9	Oil Transformers (MEO)	FOB	Italy	4509675319
10	High-Voltage Switchgear (MHC)	DAP	Germany	4509896039
11	AIS system (MHL)	DAP	Turkey	4510348034

It is evident that DAP/DDP delivery terms are the most commonly used incoterms® in the case study projects. There are three exceptions to this, related to the delivery of aluminum tubes and ceramic insulators in project A, as well as the transformer delivery in project B. In the general interview, the PP´s and SP´s were asked which incoterms® are most commonly used for the large product deliveries, whereupon all respondents stated DAP to be the incoterm® ordinarily used.

5.4 Transport requirements

In the case specific interviews, the respondents were asked if there were any specific requirements related to the product packing, to the transport itself and to the delivery on site.

In project A, for all but one of the product groups, the standard packing from the supplier was considered sufficient. For the delivery of steel, based on previous experiences additional detailed packing requirements were included as an amendment to the supplier contract agreement to minimize the risk of transport damages. In the contract, the supplier was instructed to present a packing instruction describing how each typical product part should be packed, from which Siemens was to approve prior to shipping. Additional requirements detailed which packing materials should be used and how to use them in such a way as to avoid rubbing and damage to the surface of the steel. It also described how the material should be marked in order to easily locate the right individual parts on site. Further, the contract also stated that the supplier was responsible for all legal requirements following the safe uploading and road transport of goods until completion of unloading at site. In project B, no additional packing requirements were put forth, although it should be mentioned that the supplier of the FOB transformer delivery ensured that the products were packed with seaworthy packing.

For the transport itself, for most commodities in project A there were no specific product related transport requirements, except for the delivery of steel and aluminum tubes. For the steel delivery, several demands were stated in the contract, including a requirement that the drivers were to speak English or a Scandinavian language, that they were to be equipped with personal protective equipment, that Siemens should be given contact details to the drivers or forwarder directly and were to be contacted without undue delay in cases of delay or deviations during transport, as well as requiring that the driver was to contact the contact person on site at least one day prior to delivery to inform of the estimated time of arrival (ETA). In addition, the supplier was made responsible for ensuring that the forwarder was made aware of the regulations for driving in Norway, and that tri axeled trucks were to be used in cases of wintertime deliveries. Siemens also preserved the rights to make instructions regarding driving route, performing checks along the route and arranging convoys on the last stretch to site if proven necessary. For the aluminum tubes, a requirement of English speaking drivers was passed on to the chosen forwarder as well as detailed specifications, weight and measurements of the materials to be shipped. The forwarder was entrusted in finding appropriate trucks and following the given regulations for transporting the tubes to Norway. In project B, the suppliers of the GIS and AIS were provided with information about the requirements for winter transports in Norway, as well as the general requirements for transports from the Norwegian government for which they were required to comply. The transport of the transformers required special transport arrangements due to its size and weight, of which the selected forwarder was entrusted to abide by after carrying out a road survey in addition to being given information about all relevant details surrounding the delivery, such as weight, dimensions, delivery location and details surrounding the receiving port.

In project A, all suppliers were given detailed delivery instructions drawn up by Siemens, which they were asked to distribute to the forwarders and drivers of the trucks delivering the materials to site. The delivery instruction contained the GPS location of the site, limitations related to the time window when the materials could be delivered, a map with detailed information describing the transport route for the last stretch to site, as well as the safety equipment requirements and contact details to the receiving personnel on site. In project B, for the GIS and AIS, similar driving instructions were given to the suppliers to distribute to their forwarders. In addition, some suppliers were given instructions by e-mail related to which order the trucks were to arrive. For the transformer delivery, regular meetings were conducted with the chosen forwarder clarifying all details surrounding the transport, ensuring that the forwarder and receiving personnel would be well prepared for the on-site delivery.

Based on the findings in the case interviews, as well as a study of the transport offers and delivery instructions, it can be concluded that for most commodities and DAP deliveries, standard transport requirements were used in preparing the transport of the goods. For the average commodity, the general approach placed a high level of trust in the suppliers in that the suppliers were left to find suitable packing for the commodities without guidance from Siemens. The suppliers were also free to use the forwarders of their own choosing, as long as they followed the rules and regulations for winter transports when this was relevant, and the suppliers were trusted to load and secure the goods sufficiently on the trucks. Detailed delivery instructions were prepared and distributed to the suppliers and forwarders to ensure that the forwarders notified the contact persons prior to delivery and for ensuring that they could easily find the road to site and were made aware of the site-specific requirements.

Some of the commodities in the projects required a more thorough follow-up. In project A, the delivery of steel, although being a DAP delivery, required extra contractual requirements related to both packing, loading and transport of the goods due to previous bad experiences. The transport of aluminum tubes also required some extra follow-up, likely due to it being an FCA delivery, although the supplier to a large degree was trusted to pack the goods appropriately for transport and the forwarder was trusted in adhering to the transport regulations. The delivery of transformers in project B was the delivery placing the highest number of requirements for the transport solution in the case projects, in the sense that the transport needed to be very carefully planned due to its size and weight, requiring a close collaboration between the forwarder, Siemens and the end customer to ensure a smooth delivery. All in all, based on the two case projects studied, it seems that the incoterm® as much as the type of product delivery has an influence on the type of involvement and requirements placed on the transport solution used. With a D-term non-complex delivery, only basic transport requirements are used. This approach is aligned with the risk inherent in the incoterm® for D-type of deliveries. As described in chapter 3.3.2, D-terms places the least amount of risk on the buying firm. With the supplier being responsible for the delivery and thus responsible for most types of deviations related to delays and damages from shipping the materials to the delivery on site, the supplier should be inclined to prepare the shipment of the goods in such a way as to minimize the risks of any deviations occurring. As a result, the buying firm should not need to place as much resources in following up the shipments as they would have if using a different incoterm. On the other hand, in complex product deliveries such as the steel and transformer orders, or different than D-term deliveries, more requirements and involvement is deemed necessary. It should be noted that since the findings of this study is only based on two projects, there may be variations compared with other projects which are not reflected in this particular study.

5.5 Inbound logistics

5.5.1 Processes related to inbound logistics

The delivery process in the case projects

In the case specific interviews, the PP´s were asked to describe how the incoming deliveries were handled in their project, from issuing the purchase order to the delivery on site, and the delivery process in both project A and B were found to be quite similar. In both projects the process starts with a requisition from a project engineer or the PM based on a previously negotiated offer, from which the PP creates a purchase order to the supplier. In project A, the orders were followed up using a progress plan which the suppliers were asked to fill out and return on a regular basis. In project B, the orders were followed up on an individual need-to-know basis, through regular dialogue with the supplier factories. Upon approaching the delivery date from the factories, in both projects the suppliers were given detailed delivery instructions for distribution to their forwarders. All project deliverables were added to a transport plan which was made available for site personnel in order for them to prepare for the incoming deliveries. The transport plan included key information related to the type of material delivered, the supplier, quantities, shipment dates and estimated date of arrival, the number of trucks and the shipment status. In project A the transport plan was kept up to date by the PP, as well as the site personnel, who registered incoming material as received and the date of receipt.

In project A, representatives from the installation company on site were responsible for the registering and unloading of incoming deliveries. They were responsible for checking the goods thoroughly for damages, taking photos of the deliveries and filling out a checklist for goods receipt. The checklist contained information about whether the driver contacted the site personnel before arrival, if he had the required safety gear and the truck was equipped satisfactory, information related to whether the cargo was sufficiently secured in the truck and notes related to any damages to the delivered goods. The list was afterwards sent to the PP who followed up any deviations towards the supplier or forwarder and registered the goods receipt in SAP. Project B did not have the same presence on site and the receival of the goods was supervised by a Siemens nominated SM. Efforts to get the SM to fill out checklists for receipt and distribute delivery notes to the PP proved futile in this project, and goods receipt in SAP was to a large degree performed following a manual check from the PP.

For both case projects, most deliveries were delivered by road from the supplier to site. In project A, with one exception, all of the commodities in this project were delivered on dedicated trucks with no reloading of the goods along the route. The exception related to the delivery of insulators from China which were delivered by containerized sea transport to the port in Oslo, and from there reloaded onto two trucks for direct transport to site. In project B, the transformer delivery represented the only exception where the goods were reloaded from the sea vessel onto waiting trucks.

Information flow in the delivery process

Generally, for deliveries from most of the suppliers in project A, the communication from the suppliers related to the transport of the commodities was considered insufficient by the PP, with little to no communication related to the transport being distributed from the suppliers after the goods were shipped. In many cases the suppliers informed only of the date of shipment, and there was no information about the estimated date of arrival on site. The communication related to the delivery of steel and aluminum tubes were the only deliveries where the PP considered the communication related to the transport as being satisfactory. Much the same experiences were found in project B, with the information exchange related to the transport of the transformers being the only delivery where the communication was considered completely satisfactory by the PP. For the other deliveries information about the deliveries was requested by the PP, but only to a limited extent provided by the suppliers and the information received was not considered sufficient.

For the D-term deliveries in the case projects, the communication related to the transport was requested and provided by the product suppliers and the suppliers were the ones communicating directly with the forwarders, with one exception being the steel delivery in project A where a direct phone number to the drivers was provided. For commodities where Siemens was responsible for the transport, there was a direct communication link to the forwarder. Based on the case study interviews, for both the case projects, on a general level the communication for the non D-term deliveries was considered better than the deliveries where the suppliers organized the transport.

In the general interview, the PM´s and PP´s were asked how they perceived the information exchange related to the transport in the cases where the supplier was responsible for organizing the transport. 7 out of 8 of the respondents regarded the information as generally being inadequate, which matches the findings of the case study projects. Problems mentioned by the respondents were not being informed of shipping dates, delays or the whereabouts of the deliveries, poor information flow with difficulties getting information to the forwarder and missing control over the transport operation. Some of the participants noted that the cause of the problems could be related to not having a direct communication link to the forwarder. Upon being asked if the information exchange was considered better in cases where Siemens was responsible for organizing transport, the respondents had somewhat more differing opinions. Most of the respondents were in agreement that the information flow was better when having direct communication with the forwarder, however there were differing opinions related to whether the quality of the service itself could be considered better when compared with cases without direct communication. Some participants did not have much experience with other than D-term deliveries.

Communication problems in the delivery process could also be traced in the checklists for goods receipt filled out in project A, the findings of which are summed up in Table 7 below. For 8 out of 45 truck deliveries, the forwarder did not call the site contact person to inform about the delivery, for 7 of the deliveries, delivery instructions were missing or not followed and for 3 of the deliveries the drivers did not have the required safety equipment. The summary supports the findings in the interviews related to the difficulties of getting all the necessary information out to the forwarders. Some of the steel delivery checklists also mentioned communication problems with the truck drivers due to their inability to speak English, despite the fact that English language skills was incorporated as a requirement in the supplier contract.

Table 7 Deviations in checklist for goods receipt - Project A

Commodity	No. Of trucks in total	Did not call site personnel	Did not follow delivery instructions	Unsatisfactory loading of goods on truck/transport damages	Missing safety equipment
Steel	20	5	6	5	3
Disconnectors	4	1	1		
Alu. tubes	2			1	
Circuit breakers	10			3	
Transformers	4			2	
Alu-products	2	2			
Insulators	2			2	
Earthing lance	1				
SUM	45	8	7	13	3

5.5.2 The transport purchasing process

In the case study projects, the PM, SP and PP were asked the reason behind the choice of incoterm for the different commodities. In project A, the PM declined to answer due to a lack of knowledge. For the D-term deliveries in project A, by the remaining participants, the reasons for choosing a D-term delivery were stated to be the result of a risk evaluation, as well as a simplification of the delivery process by not having to inquire and follow up transport in the projects. For the deliveries in project B the choice of D-term was also stated to be the result of an evaluation of risk, due to a high monetary value, a long-haul transport, an expected wintertime delivery, as well as a confidence in that the supplier would be able to handle the transports without problems. For all D-term deliveries in both projects, the product suppliers were entrusted to acquire appropriate forwarders and the forwarders were unknown to Siemens. For all of these deliveries, the product supplier included a DAP delivery in their offer to Siemens.

For the non D-term deliveries, the reasons for the choice of incoterms® were both for the aluminum tube delivery in project A, as well as for the transformer delivery in project B, stated to be an issue of cost. For both deliveries the forwarder used by Siemens was a trusted Norwegian company that had been used for similar deliveries in the past, implicating a lower risk, and there was also an anticipation that having a direct link to the forwarder would induce a better control of the delivery process. This overlaps with the findings of Ahmadian et al. (2014), who found that when contractors were responsible for transport themselves, they generally chose the lowest cost option at the time of planning, founding the decision on personal judgements. For the delivery of insulators, the CIF incoterm® was based on a frame contract with the supplier and the fact that for a Chinese supplier it is difficult to estimate the freight costs in Norway due to large in-country distances. For this delivery, a local shipping agent was used for shipping the goods from the port of Oslo to the final destination. The choice of FOB over FCA for the transformer delivery in project B was based on the supplier having a better knowledge and experience of the local conditions in delivering the transformers to the shipping port.

For the transformer delivery, an inquiry for transport was initially sent to three forwarders. Incoming offers were evaluated, and discussions and negotiations were continued with two of the suppliers after ensuring that they would be able to deliver the required service. Both quality and price were evaluated and the chosen forwarder, in addition to having the most competitive price, also proved to have the best delivery solution. For the delivery of aluminum tubes, only one forwarder was inquired due to that forwarder´s ability to perform in past projects. The price of the service was compared to the transport price provided by the product supplier, and when it was found to be lower, it was decided to switch to an FCA delivery. For the delivery of insulators, transport to site was arranged by a shipping agent located at the port of arrival due to convenience, earlier experience with the agent and competitive prices. For the chosen forwarders, after being awarded the transport assignment, a purchase order was issued by the PP.

When looking at the results from the case study questionnaire related to the reasoning behind the choice of incoterms®, it becomes clear that the question of risk plays a big role when the delivery term is chosen. Considering the fact that most of the deliveries are D-term deliveries, the projects are in most cases inclined to letting the supplier carry the major part of the delivery risk from loading of the goods to delivery on site. This corresponds with the findings of Ahmadian et al. (2014), who concluded that the contractor is often risk aversive in choosing the incoterm.

Looking at the purchasing process in the case study projects where Siemens is ordering the transport, the process is based on an arms-length transactional relationship with the forwarders. Call-offs are made after a cost-risk trade-off evaluated project by project, and the choice of forwarder is to a large degree is based on the lowest-cost option able to deliver the required service at a reasonable risk-level. Thus, after a thorough specification of the service and finding qualified forwarders, in the end the choice of forwarder is based on the lowest bid.

The transport purchasing process loosely resembles the transactional freight exchange purchasing process depicted in Figure 9 by Andersson and Norrman (2002) with some modifications. Based on the feedback from the case interviews, the current SEM purchasing process is illustrated in Figure 14. Unlike a delivery ordered on a freight exchange, the projects inquire freight forwarders directly for offers and the process is a little more complex for large and/or heavy transports, such as the transformers in project B compared to transports not requiring specialized transport arrangements. Defining the service required (step 1) is therefore not necessary for normal truck deliveries, but may prove necessary for deliveries of such complexity that clarifications related to the delivery needs to be made beforehand. Step 2 involves clarifying in detail the size and measurements of the products to be shipped, which is information provided by the product supplier. This is a prerequisite for step 3 which involves finding qualified logistics service providers able to do the job. For more complex deliveries, a thorough screening may be necessary, and in step 4 the service providers are then asked to provide a plan for how they will deliver the specified service. In step 5, comparable offers are acquired from freight forwarders, and in the following step the offers are evaluated and compared, also with the offer for a D-term delivery from the product supplier. In complex deliveries the offers and terms of delivery may be negotiated. Provided that the final offers are competitive compared to a D-term delivery, the process concludes with the issuing of a PO to the chosen forwarder.

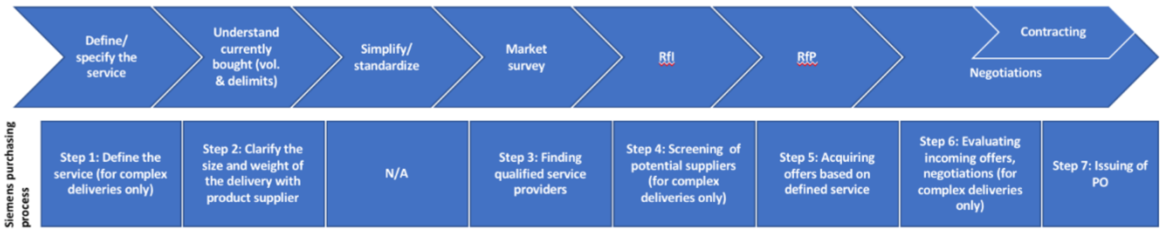


Figure 14 Siemens transport purchasing process

Seeing that this purchasing process is defined based solely on the two case projects studied, other variations of the process may be found in projects which are not part of this study.

5.5.3 TPL´s and competition in the marketplace

With most of the deliveries today being found to be D term-deliveries, the forwarders are freely chosen by the commodity suppliers and are unknown to the project participants due to the fact that transport issues ordinarily are discussed with the product supplier and not the forwarder directly. As a result, many different forwarders are used, and although difficult to prove, it is likely that each supplier uses different forwarders due to a large number of providers in the marketplace and the fact that many of the suppliers are located in different countries.

For the non D-term deliveries, forwarders in the individual cases were inquired on a commodity basis, meaning that there was no pooling of transport demands in the projects. Looking at the case study projects, two different forwarders were used for the three deliveries where Siemens was responsible for organizing transport. Assuming that for the D-term deliveries different forwarders were used for each commodity, it can be estimated that the total number of forwarders used in the projects equals the total number of commodities for D-term deliveries and in addition adding the transport after the goods are handed over to a Siemens nominated forwarder for the non D-term deliveries. In project A, the transport of insulators likely involves at least two different forwarders, since the insulators are first brought to port in China, then transported by sea to the port in Norway and from there transported by the Siemens nominated forwarder to site. When assigning different forwarders for all the remaining deliveries which were road transports, the total number of forwarders amounts to 9. Similarly, in project B, the transformer delivery is first transported by truck to port, and from where the goods are handed over to the Siemens nominated forwarder for delivery by sea and road to site. The total number of forwarders for the main commodities in this project therefore amounts to 4.

In the general interview the PP´s and SP´s were asked about the number of available transport providers and how they experienced the competition between the providers when inquiring forwarders. All of the respondents who had experience with this type of inquires stated that there is a large number of forwarders available in the marketplace. Most of the respondents were also in agreement that there is good competition between the providers, enabling reasonable transport prices.

The findings of the case study interviews matches the statement by Sheffi (1990) that TPL´s have had a massive growth in the recent years resulting in an increased global competition. Looking closer, it is also interesting to note that Andersson and Norrman (2002), who used the Kraljic matrix to place the traditional logistics services at the border between leverage and non-critical items also seems to be on point in light of the findings in the interviews. In their study they argued the positioning of the service as a result of it not being a competitive advantage or of a high supply risk because of a high number of providers and strong negotiation power of the buyer. The same looks to be true for the case study. Seeing that transport in most cases is sourced via the product suppliers, in the current situation it cannot be considered a source of competitive advantage. Neither can it be considered of a particularly high supply risk due to a high number of potential TPL´s in the marketplace. Andersson and Norrman (2002) further explained the normal sourcing strategy for buying logistics services to be competitive bidding and consolidating services to a few providers in order to reduce transaction costs and achieving economies of scale. In the case study, lower transaction costs have been achieved by mainly using D-term deliveries, with the exceptions being times when it has been possible to obtain lower prices from the market without compromising on risk.

It should be noted that in the case study projects only a limited number of forwards were inquired, and in just one out of three transport assignments the prices were gathered from more than one forwarder. In addition, only Nordic forwarders were inquired, although two of the transports came from outside of the Nordic region. Based on the answers given in the case project interviews, there seems to be a tendency in the projects to inquire known and trusted forwarders based on previous experiences. Although this is likely done as a means of reducing the risk associated with the delivery, it may decrease the competition and give rise to higher transport prices than if a larger selection of forwarders had been inquired.

5.6 Causes and effects of transport deviations

5.6.1 Transport deviations in the projects

In the case study interviews, the project participants were asked to provide detailed descriptions of problems related to the delivery of the products, and of any delays or damages caused by transport to site. Both project A and B experienced problems with more than half of the product groups in connection with delivery on site. In project A, the problems reported in the interviews matches the findings of the checklists of goods receipt depicted in Table 7 and includes many of the forwarders not following the driving instructions, drivers not speaking English, not carrying the required safety equipment, not being able to find their way to site and trucks not being appropriately loaded. In project B, for two out of three product groups there also were problems with forwarders not following the driving instructions. Other problems included truckers ignoring a driving ban, as well as a change of transport solution due to an unfinished port not ready to receive the transformers.

For project A, a comparison between the date of receival in the checklist of goods receipt and the agreed delivery date revealed that out of eight product groups, only the delivery of insulators from the port of Oslo to site was delivered on time. All of the other product groups had varying degrees of transport deviations causing the products not being delivered to the agreed date. The largest number of deviations was found in the delivery of steel, where 14 out of 20 trucks did not deliver on time. The average deviation for all deliveries was about two work days delay, however one of the transports also delivered a day early. Some of the deviations were notified by the suppliers or forwarders, but in most cases they were not. In the cases where reasons for delays were expressed, they were stated to be caused by the suppliers not shipping the materials on time, customs processing, waiting time for a driving permit and a request by the supplier to change the day of delivery due to expensive freight charges. For project B also, only one of the product groups was delivered on time. Both the AIS and transformer delivery were delayed due to weather challenges, the transformer additionally being delayed as a consequence of the change of transport solution.

Transport damages were found to be an issue in project A, which reported transport damages occurring on 3 out of the 8 product groups. None of the goods were damaged to such an extent that the materials could not be repaired on site and most of the damages were superficial rubbing damages caused by unsatisfactory packaging or securing of the goods on the truck. Most of the reported damages came from the steel delivery, where damages assumed to have come from transport were also discovered after the goods were unloaded. The steel delivery also had some larger damages that required inspection from supplier representatives before being repaired. Project B had no reported transport damages.

The deviations in the projects did not come without consequences. Upon being asked about the effects of the deviations on the projects, both respondents in project A and B described an extensive number of internal hours spent on following up the deviating deliveries. Many hours were spent by the PP in both projects to follow up the transports and providing site personnel information about the changes. In project A, the PM spent hours helping out coordinating deliveries and discussing changes in the installation schedule with the installation company, seeing that they were not able to follow the originally planned schedule. In project B, the PM also helped in coordinating the deliveries and also needed to book an extra trip to site to get control of the situation. In both projects, the SM´s also spent hours on site following up the deviating deliveries. In addition, as a result of trucks not paying attention to the driving ban and causing a traffic jam, the deliveries also created some bad press coverage in the local community for project B. Both projects additionally suffered direct costs. Project A received change orders from the installation company due to a rescheduling of their planned activities, as well as change orders related to repairing the transport damages on site. Project B suffered costs related to reloading of goods and ordering of tractor units for the towing of trucks to site.

When comparing the finding of the case study interviews with the findings in the general interview, it is clear that logistical problems related to incoming deliveries is a challenge in many projects. In the general interview, the HPM, the PM´s and PP´s were asked how regularly they experienced these problems, upon which the respondents on average experienced incidents happening at least once in each project. Common problems included deviations in delivery dates, reloading or towing of trucks due to the trucks not being equipped for Norwegian conditions, trucks not finding their way to site, smaller transport damages, drivers not speaking English and challenges related to receival and storage of goods on site. As for the causes of the problems, most of the respondents noted more problems happening when goods were delivered from foreign truckers, as well as for wintertime deliveries. Some respondents experienced a higher number of transport damages for bulky deliveries such as steel and tubes which requires different packaging than other less bulky commodities. Other reasons for problems were stated to be customs clearance, insufficient packaging and goods not being stowed securely onto the trucks, too many links between Siemens and the forwarders resulting in an insufficient communication flow, drivers not experienced with driving in Norway or the Norwegian requirements for heavy vehicles and remote and inaccessible delivery sites. Reported consequences of the deviations included changes in the installation schedule, extra internal hours spent, ordering of rescue cars and tractor units, change orders for waiting time and damage repair and risks of liquidated damages from the end-customer in cases where delivery milestones are pushed back.

Looking at the effects that transport deviations have on the projects, there seems to be a correlation with the findings of Ahmadian et al. (2014), who found that transport played a significant role in circumstances where JIT methods were being used, as well as in cases when materials are already delayed from the suppliers and when mandatory completion dates put extra pressure on all parts of the supply chain. There appears to be a matching pattern, considering that projects in the Siemens case study are equally dependent on receiving commodities on time and without damages in order to avoid problems causing potentially large consequential costs in the projects.

5.6.2 Effects on project performance

Diving into the details of the effects of the deviations described in the previous sub-chapter, it is possible to make an estimate of the impact that the deviations caused in the case projects. In the case projects, for each commodity the PM´s were asked if occurred transport deviations had any critical consequences for the project overall. In project A, the steel delivery was the sole commodity in which the deviations were considered to have serious repercussions. The deliveries, being delayed as well as arriving with transport damages, resulted in a rescheduling of activities on site and a suboptimal progress for the activities that could be executed. The PM estimated a total number of 300-400 internal hours spent in the project in total for all transport deviations, of which 2/3 related to the steel delivery. In addition, change orders from the installation company amounted to an estimated 600 000 NOK, of which 300-400 000 NOK were caused by the steel delivery deviations and the consecutive rescheduling of installation activities. Transport damages inflicted costs for repairing the damages, as well as causing a delay in the planned installation schedule, resulting in change order costs amounting to about 150 000 NOK. In addition, an estimated 20 hours were spent by the PM, SM and PP in following up the deviations. For the remaining 7 commodities, an estimated 117 internal hours and 250 000 NOK in change orders were spent on transport deviations.

Based on the input from the PM and the PP, a rough estimate of the transport deviation costs for project A is found in the overview in Table 8. The stated hourly rate represents an average of the internal hourly rate for the PM and PP. Most of the numbers in the overview are difficult to validate due to them not being allocated to separate cost elements in the project, and therefore they may be mixed with other costs such as costs related to quality issues. Some of the deviations related to the delay and transport damages were claimed towards the steel supplier. The steel was not only delayed in transport, but additionally delayed from the factory, and so the liquidated costs claimed from the supplier amounted to 250 000 NOK. In addition, the transport damages were also claimed, resulting in a credit note of 131 000 NOK, reducing the total deviation costs. Still, the claimed amounts did not cover the total costs for the project, and taking a 25% margin of error into consideration the total costs are likely to add up to somewhere between 550-920 000 NOK. When comparing this to the originally planned costs calculated for the project overall, it amounts to 1-1,6% of the total calculated costs, and this additional cost reduces the profit margin in the project equivalently.

Table 8 Transport deviation costs in project A

	Unit price (NOK)	Number	SUM
DEVIATIONS STEEL			
Delivery delay			
Internal hours	1 000	233	233 000
Change orders	350 000		350 000
Approved claimed amount			-250 000
Transport damages			
Internal hours	1 000	20	20 000
Change orders	150 000		150 000
Approved claimed amount			-131 000
SUM steel deviation costs			372 000
DEVIATIONS OTHER COMMODITIES			
Internal hours	1 000	117	117 000
Change orders	250 000		250 000
TOTAL SUM all deviation costs			739 000

In project B, both the deviations in the delivery of the transformer and the delivery of the AIS system were considered to have critical consequences for the project. The transformer delivery was first a week delayed due to bad weather, and additionally somewhat delayed as a result of the port not being ready to receive the goods and having to work out an alternative freight solution. The deviation caused about 50-100 extra hours spent by the PM for coordinating the delivery, carrying out road surveys and risk analysis following the change in transport solution. In addition, the PM had to make an extra trip to site to follow up in person, which resulted in additional 15 000 NOK. Due to the port not being finished, there was also an additional cost for transport of the transformers on a barge, which amounted to 2-3 million NOK. This was covered by the customer and the project manager decided not to claim the additional administrative hours resulting from the deviation.

Project B also suffered consequences resulting from a 2-3 week delay in the delivery of the AIS system due to the delivering trucks having big challenges driving on Norwegian winter roads. In total an estimated 120 hours was spent by the PM and the PP in coordinating the deliveries to site, as well as an additional 37 500 NOK´s for reloading of goods and pulling some of the trucks to site. An overview of the total costs in project B is found in Table 9. Similar to project A, in project B there was also no allocation of the extra costs to a specific cost element in the project. Verifying the costs is therefore difficult and some margin of error should be taken into consideration. Given a 25% margin of error, the costs add up to somewhere between 166 000 and 280 000 NOK. For project B, when comparing these costs to the total costs calculated for the project, it amounts to 0,2-0,35%, a cost share significantly lower than in project A.

Table 9 Transport deviation costs in project B

	Unit price (NOK)	Number	SUM
DEVIATIONS TRANSFORMERS			
Delivery delay			
Internal hours	1 000	75	75 000
PM´s trip to site	15 000		15 000
Barge (covered by the customer)	2 500 000		-
SUM transformer deviation costs			90 000
DEVIATIONS AIS SYSTEM			
Delivery delay			
Internal hours	1 000	95	95 000
Reloading and towing of trucks	37 500		37 500
SUM AIS system deviation costs			132 500
TOTAL SUM all deviation costs			222 500

Project B was also at risk of suffering reputational damage both to Siemens and the end customer due to the problems the delivering trucks caused in the local community at the time of arrival, although in this case the press coverage did not specifically mention either of the parties. The trucks were not equipped for the driving conditions and caused two severe traffic jams that led to the drivers being reported by the local police (Henriksen et al. 2019, Pedersen 2019).

Looking at the case study interviews and comparing the findings with the responses in general interview, it becomes apparent that the deviations found in the case study are not unfamiliar in the project portfolio. Upon being asked about the consequences of transport deviations, the PM´s, QMiP and HPM listed changes in the installation plan, internal hours, rescue cars, reloading, repair of damages, waiting time for the installation company and reputation in the local community, all of which reflects the findings of the case study projects. The PM´s and PP´s were asked if the total costs of the transport deviations were mapped in the projects, whereupon the answers revealed that the total deviation costs are usually not summarized in any way. Whereas direct costs are sometimes allocated to a separate cost element in the projects, the internal hours are generally not. One of the PM´s and the HPM commented the deviations often had substantial cost consequences of 100 000 NOK´s or more, which corresponds to the findings of the case studies. Upon being asked if it is usually possible to recover incurred costs, the respondents indicate that although it is sometimes possible to recover the direct costs, deviation costs are often not claimed. In the cases where costs are claimed towards the supplier or forwarder, most respondents agreed that it is not possible to recover all of the associated costs.

Looking at the results of the case study and general interview it appears that it is often difficult to recover the deviation costs, although the deviations in general are caused by either the product supplier or the forwarder delivering the goods to site. The larger purchases of Siemens are normally governed by the major version of the Siemens purchasing conditions developed by the legal department, which also dictates the degree of compensation one is able to claim following delays or damages to the delivered products. The purchasing conditions are enclosed in Appendix 3. In accordance with paragraph 4.5 in the purchasing conditions, the claim for liquidated damages for third party suppliers resulting from a delay is limited to 0,2% per calendar day up to 10% of the contract price and may be claimed from suppliers without documenting that the delays caused economic damages for Siemens. Unless additionally specified in the contract agreement, additional compensation for consequential costs resulting from the delay cannot be claimed unless the supplier failed to inform about the delay. In the cases of transport damages, due to the difficulty proving that internal resources would not have been spent regardless, claiming additional internal costs may be problematic unless it can be documented that hired resources have been used.

The purchasing conditions paragraph 19 limits the supplier´s liability to 100% of the contract price. It also specifies that Siemens is obliged to indemnify Supplier from Siemens' indirect losses, including loss of earnings, loss of profit and loss of production, which to a large degree relieves the supplier for the responsibility of consequential costs. In the cases of Siemens internal purchases, different conditions apply, which for confidential reasons are not revealed in this thesis.

Overall, it can be concluded that getting the main commodities to site in time and without damages is critical in order to avoid major costs affecting the bottom line in the projects. It is difficult to claim internal hours spent following up transport deviations in the projects as well as consequential costs resulting from the deviations. Reflecting on the statement of Olhager (2003), who noted that for post-OPP processes the competitive priority should be on delivery speed and flexibility, it seems a paradox that in the planning of the transport stage in the projects there is a high focus on the price of the service, although the consequence of the suppliers organizing the transport seems to be correlated to a higher number of reported deviations causing extra costs in the following execution phase of the projects. The responsibility of the transports is in most cases left in the hands of the product suppliers who only to a limited extent may be held responsible for costs resulting from deviations. At the same time, as illustrated in Figure 15, it is known that changes and deviations in the later stages of a project has a far higher cost impact than in the early stages, all of which underlines the importance of being able to deliver the main components on time and without damages.

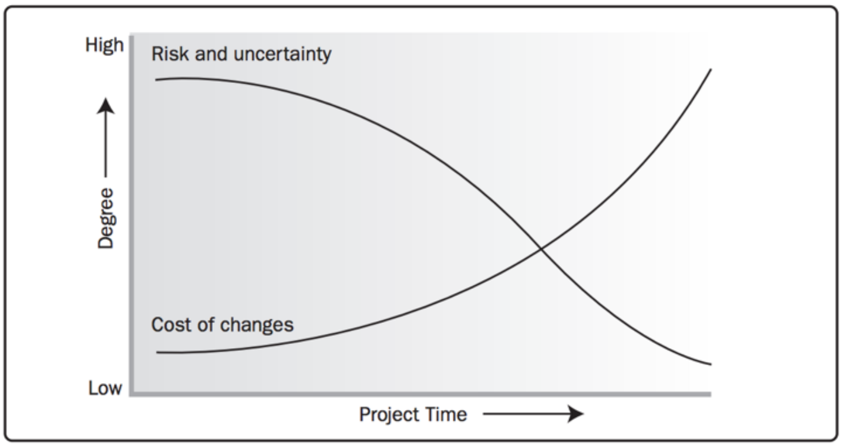


Figure 15 Cost of changes in the project phases (Project Management Institute 2013)

5.6.3 Mitigation measures

In the case study interviews, the PM and PPM were asked which measures were taken to minimize the consequences of deviations in case of delays and transport damages. In project A, many of the commodities were delivered a while prior to when they were actually needed on site. This reduced the risk associated with delays both in the production of the commodity as well as in the delivery process, and for these commodities delays only had minor effects. For the steel delivery, a rescheduling of the installation activities made it possible for the installation company to reduce idle time on site and to keep some installation progress despite the deviations. In addition, for all commodities, the transport plan was continuously kept up to date with the latest delivery information enabling the site personnel to take the known deviations related to delays into account in their planning of activities. For the transport damages related to the steel delivery, the deviations were documented and reported back to the supplier with instructions to improve the packing of the remaining deliveries. Some of the larger damages were assessed by a supplier representative before repair and the remaining damages were repaired on site by the installation company.

In project B, for the transformer delivery, the hands-on handling of the situation by the PM in cooperation with the customer and forwarder upon realizing that the receiving port would not be finished on time ensured that the delay did not suffer any consequences for the project´s planned progress. The AIS system originally planned to be delivered in October was delayed to January, adding extra risk due to the wintertime delivery. The PM and PPM spent hours trying to reduce the risk associated with the delivery, both in preparation of the delivery as well as when the delivering trucks ran into trouble, and assisted the supplier and forwarding agent in sorting out the situation and getting the trucks to site. Their efforts minimized the delays and consequences given the circumstances. As for some of the commodities in project A, also in project B the materials were delivered some time before installation start, which prevented the project from receiving potential costly change orders resulting from delays and changes in the installation plan.

The PM and PP in the case projects were asked whether the delay or transport damage could possibly have been avoided and how. For many of the product groups that were delayed during transport, feedback indicates that the delay might have been avoided if Siemens organized the transport. This is particularly interesting when looking at the AIS system, where the projects suffered costly consequences. Both the PM and PP in the project noted that the problems would likely have been avoided if a Norwegian forwarder had been used, seeing that the forwarder would be familiar with the challenges of winter deliveries. The possibility of using a Norwegian forwarder in the project was assessed early in the project, but disregarded due to a high transport price. For the delivery of steel, using a different incoterm® was not considered to have much of an effect, due to much of the delay being caused by late shipment from the supplier. For the transport damages in project A, both the PM and the PP stated that the damages could have been avoided by a more thorough check during uploading of the goods and ensuring that the goods were packed sufficiently.

In the general interview, all of the respondents were asked if they were familiar with preventive measures that has been done in the projects in order to avoid transport deviations. Feedback included direct contact with the forwarders, shock/tilt watches attached to the goods during transport, information about appropriate unloading equipment, ensuring site unloading capacity, distributing information about Norwegian laws and regulations for transports, establishing meeting points for the incoming deliveries to check if they are equipped for driving to site, escorting cars, detailed driving instructions, control of packing procedures, observation of the uploading of goods, contractual demands related to the packing and shipping of goods, strict contractual demands for the forwarder when ordering FCA, avoidance of JIT-deliveries and maintaining contact with the forwarder during transport. Upon evaluating the effects of the preventive measures, the responses were inconclusive, and the respondents had differing opinions. 3 out of 4 of the PM´s, as well as the HPM and the SP´s, noted that a good direct dialogue with the forwarder or local initiatives such as inspection and/or escorting of the trucks in addition to the driving guides has resulted in transport deviations having totally been avoided. The PP´s and the QMiP evaluated the mitigating measures to have partial to no effect.

When asked about the projects´ ability to manage transport deviations, most of the respondents were in agreement that transport deviations carry a high risk of impacting the project progress. Some of the PM´s and the HPM noted that when the projects are planning for installation start a short time after receiving the material, any transport deviation carries a high risk of impacting the installation plan and will in most cases have costly consequences. Several of the respondents mentioned that there is also a high risk associated with transport damages to long-lead commodities, although based on the responses, a high focus on packaging procedures for these commodities results in a low risk of critical damages happening in the first place.

Comparing the answers of the case interviews with the general interview, it seems as though the projects to some degree are able to prevent transport deviations from happening in the first place by the use of preventive measures. When a deviation happens, many resources are being deployed to minimize the consequences, and although it is difficult to estimate the degree of damage having been avoided by the measures taken, there is no doubt that projects are still at risk of suffering additional costs resulting from delays and transport damages. Feedback from the general interview indicates that these types of incidents are not uncommon and are also clearly found in the case projects. Judging from the interviews, there seems to be a high focus on costs in the preparation of the deliveries and an assumption that the deliveries will avoid problems, which results in a cutback on preventative measures. As an example, for the AIS delivery in project B, both the PM and PP stated that in hindsight they should have used a Norwegian carrier despite a higher transport price to reduce the transport risk. When things go wrong, the costs may end up getting high and reduce the profitability of the projects despite efforts to reduce the consequences, as seen in both case projects. Although the costs were high, if the project plans had been delayed, the possible consequences could be even more substantial considering that liquidated damages often amounts to a daily penalty of 0,1-0,2% of the total contract value, which for a project with a sales price of 40 million NOK may add up to 40-80 000 NOK for each day of delay. Mitigating measures may therefore be well worth the costs and efforts, especially if the project milestones are reached.

5.7 Evaluation of results and alternative transport arrangements

5.7.1 Analysis of the current inbound logistics process and risk profile

Based on the performed interviews, it is evident that the projects in Siemens EM have gathered a lot of experience with D-term deliveries where the suppliers are responsible for the transport, and a somewhat more limited experience related to non D-term deliveries where Siemens is responsible for the transport arrangements. When choosing incoterms® in the case projects, a lot of emphasis has been put on price of the service in combination with the risk associated with the deliveries and based on the results, D-term deliveries are in most cases preferred. However, the findings of the research suggest that deviations are still happening more or less in every project, and that in using D-term deliveries it is still only possible to recover a limited amount of costs by claiming the supplier. It was also found difficult to claim compensation for the indirect costs suffered.

Deviations are likely to have large consequential costs

Although the deviation costs found in the case study to a large degree are not possible to document other than in feedback given by the PM and PP during the interviews, it is highly probable that deviations can have large consequential costs. For the deviations related to delays, there seems to be some connection between the type of delivery term used and the deviations that occurred, although based on the limited number of non D-term deliveries this is difficult to determine with certainty. This link appears to be particularly evident in the delivery of the AIS in project B where the deviation was considered likely to have been avoided if Siemens had nominated a forwarder. Although it was only the Siemens internal costs that was mapped in the case studies, it is reasonable to assume that also other parts of the supply chain spent costs and resources trying to resolve the deviations.

Risk mitigation strategies may pay off

In trying to assess the relevancy of changing the transport strategy, it is important to determine how to best reduce the risk and limit the costs. Chopra and Sodhi (2014) found that underestimating the likelihood of deviations in the long run is a lot more expensive than overestimating the likelihood, and that the costs of deviations over time generally overwhelmed the savings from not investing in risk mitigation strategies. By simulation, the authors found that error margins in the risk estimates have a very limited cost consequence and that investments made to overly ensure against disruptions were found to be more economic in the long run than underestimating the risks and wager that one is able to avoid problems.

Chopra and Sodhi´s research can be linked to the findings in both of the case studies and the general interview, where risk mitigating actions that were implemented only seem to have a limited effect when considering that deviations happen in every project. In order to be competitive in the long run and maintain a good relationship with the suppliers, it is in everyone´s interest that a more thorough risk mitigation strategy is put into action to minimize risk and associated costs in the supply chain, spanning from the suppliers to delivery on site. In doing this, it is important to not just focus on how Siemens can reduce their own risk and move the risk to other members of the supply chain, but how to reduce the total risk for all parties involved. An important question in this matter becomes to assess which of the parties in the supply chain are best suited to implement a good transport process, and whether this should be a responsibility of Siemens or the suppliers.

Early deliveries may reduce costs associated with deviations

Independent of the question of a change in the transport strategy, finding of the research indicates that the risk of the delivery is reduced significantly if it is possible to deliver material well in advance of the installation start on site. This is also aligned with the recommendations of Chopra and Sodhi (2014), who emphasize that executives need to ensure that the consequences of deviations need to be confined within the part of the supply chain where the deviation happened, and in this way avoid a domino effect implicating the remaining part of the supply chain. In doing this, more time is freed for repairing transport damages, there is less risk of delays implicating the project progress, less internal time is spent in following up and coordinating the deliveries, idle time or waiting time for the installation workers is limited and changes in the installation plan are avoided. Both in project A and B a similar approach was tried, and project B did not suffer any change order costs from the installation company resulting from delivery delays. Due to the short timeline of project A some of the commodities had to be delivered JIT and this project suffered high costs resulting from the deviations related to these deliveries, with the highest proportion of the costs coming from installation change orders. Unfortunately, early deliveries are not always possible due to short timelines in the projects that makes early deliveries impossible and remote locations may not have qualified people available to receive goods before installation start. The project site may also be inaccessible before the planned startup.

Even if some commodities need to be delivered JIT because of a tight schedule, it is still possible to steer the remaining deliveries of the main components to be delivered within a limited time frame and before their scheduled installation. This will ensure that at least some of the product groups are delivered some time before they are needed for installation, and thus reduces the risk associated with transport deviations for these products. For commodities on the critical path in the projects there is still a high risk associated with the deliveries and therefore additional risk mitigating measures should be implemented. If materials need to be delivered JIT due to space limitation or limited accessibility to site, as an alternative it may be possible to arrange temporary storage of the goods at a location close to site. This option, however, needs consideration of the potential risks related to the additional unloading and loading the goods as well as the extra cost of transport to site, renting of storage space, personnel and unloading equipment.

Direct communication as a means to limit or avoid deviations

Feedback from the interviews clearly shows that a good communication flow with the forwarders is important to limit or avoid deviations. Despite time spent by the purchaser in the projects distributing important information related to the transport, it is evident that the information flow when using D-term deliveries has generally proven inadequate, something that was confirmed both in the case interviews, the general interview, as well as in the overview of deviations from the checklist of goods receipt in project A. Since different forwarders are likely used for all commodities with D-terms, it is reasonable to assume that it is difficult to improve the situation, unless a direct communication link can be established with the forwarders. Due to the high number of different suppliers and commodities, this would presumably be easier to implement if Siemens ordered the transport. Based on feedback in the interviews, and given that it is not always possible to shift the deliveries to an earlier stage, it seems that D-term deliveries where the responsibility of the transport is assigned to the suppliers carries an unreasonably high risk considering the low degree of control over the delivery process together with the fact that the supplier to a very limited degree can be held accountable for the indirect costs in case of deviations.

Increased public pressure to reduce transport deviations for foreign transports

By moving the responsibility of the transport to the suppliers, one also loses more control over the safety requirements related to the trucks, as well as the competency of the drivers coming to Norway. In a research paper published in 2016 by the Institute of Transport Economics (TØI), findings suggests that although the foreign trucks only make up 6% of the total driven kilometers on Norwegian roads, they are involved in 11% of accidents with personal injury, 33% of traffic jams and 17% of the fatal accidents (Nævestad et al. 2016). In the recent years a high number of newspaper articles describe accidents related to foreign trucks driving in Norway. In January 2019, an accident had fatal consequences when a Lithuanian truck not equipped for the winter conditions collided with a car and the 22 year old man who drove the car died from the injuries, and in February the same year, three persons were seriously injured in a collision with a foreign truck (Eriksen 2019, Rosenlund-Hauglid 2019).

Serious accidents have led to more foreign trucks being checked on the border crossing and have also caught the attention of unions and politicians who are working towards higher requirements for using foreign trucks and drivers on Norwegian roads (Lien 2019). Efforts are put down to make the companies ordering the transports take a higher responsibility, and it may only be a matter of time before the importing companies can be held accountable for consequences in cases where rules and regulations for driving in Norway have not been followed, even in cases of D-term deliveries where the suppliers order the transport. SEM´s suppliers are in most cases located in central Europe and do not have the same knowledge of the challenges faced by driving in the Nordic countries. At the same time, Siemens as an international company has a social and ethical responsibility in moving forward and setting an example for the industry. Considering the event of a serious accident where it becomes clear that one did not take the necessary precautions to minimize risks, the consequences could damage the company´s reputation considerably.

Overcoming the challenges of risk mitigation

According to Chopra and Sodhi (2014), management needs to overcome two challenges in the work of reducing risk. Firstly, they need to be willing to invest in risk mitigating measures and associated costs, despite the fact that results may not be visible immediately. In the general interview both the PM´s and the HPM who has a high influence on the execution of the projects were generally positive to Siemens taking a higher responsibility of the transport of the main commodities, given that a cost and risk assessment is made, that forwarders used are qualified and that there is enough time, competence and good systems to follow up the deliveries. Chopra and Sodhi´s second point relates to convincing the global supply chain about the advantages of overestimating the likelihood of risks and being willing to implement global mechanisms to handle disruptions. In light of the findings in the interviews it will be important to distribute information about deviations in the projects to the suppliers to provide them with a credible risk profile, from which they can use to implement risk mitigating measures from their side in the process of finishing the products to packing, loading and securing the goods on the trucks.

Implementation of performance measures to gain control of deviation costs

When assessing the possibility of changing the transport strategy, it is also interesting to look at the research of Wegelius-Lehtonen (2001), who studied performance measures in the construction industry. The study concluded that there is an absence of performance measures and that measuring the performance is a key to improve logistics processes. In light of the findings in this case study, it is clear that there is also a lack of measuring the logistics performance within SEM. As of today, there is no system in place to map the total costs related to transport deviations, and only the direct costs are being registered. Internal hours spent and other indirect costs are not made visible or measured in any way.

If planning to implement improvement measures and making a change in the transport strategy, it is important to keep a record of the current deviations and costs in order to be able to assess if the implemented measures have the desired effect. Linking this to the framework of Wegelius-Lehtonen, it is necessary to implement monitoring measures on a project level to get a tracking of deviation related costs, as well as on a material supplier level to establish and supervise routines related to the shipping from the supplier factories. On a higher level this can be achieved by registering hours, indirect and direct costs towards separated cost elements in the projects as soon as a deviation happens. On a material supplier level, breaches in the shipping routine can be registered in an evaluation of the supplier. After this is implemented, it is possible to introduce improvement measures both on a project level and on a material supplier level. The improvement measures will then be based on measurable, objective data gathered over time and can be adapted from patterns found after analyzing the deviations. Following the implementation of risk mitigating measures, the effects will be visible given some time by a reduction in recorded deviations.

5.7.2 Evaluating the transport outsourcing climate for Siemens

The findings of the previous chapter 5.7.1 indicate that the transport sourcing process used in Siemens EM today is not an optimal way to handle incoming deliveries, both seen from an economic and a risk perspective. A relevant question thus becomes to evaluate whether it is possible to achieve a lower risk and total cost over time by choosing a different incoterm®. Considering the findings of the interviews, an alternative of shifting to an FCA delivery term where the responsibility of transport transfers to Siemens emerges as a possibility, but this also needs to be analyzed from a theoretical perspective.

Incoterm selection criteria

Hien, Laporte, and Roy (2009) found that it was important to consider certain business environment factors that particularly related to international experience, negotiation power and competitive intensity in choosing the right incoterm. Evaluating the Siemens business case, the suppliers are likely to have more experience with international shipments, seeing that they in most cases will have a number of international customers and will be used to delivering products on with D-terms since this is a standard delivery term for most suppliers. SEM on the other hand, only has limited experience with organizing international transports. Another relevant point is that while the suppliers are shipping their products from the same location, a buying firm in an ETO environment, as is the case of Siemens, deliveries are made to different locations for each project, as shown in Figure 16. This may lead to different risk profiles associated with the delivery location from project to project. The scopes of the projects are also differing, which influences the volume and type of products to be delivered for every project. The suppliers are only delivering a limited number of products and with a stable customer group the demand will be more predictable and give the suppliers a better negotiation position towards forwarders. They also have the advantage of being able to compile shipments from a common starting point, whereas Siemens requires products from suppliers located in many different countries, suppliers which are also changing from project to project.

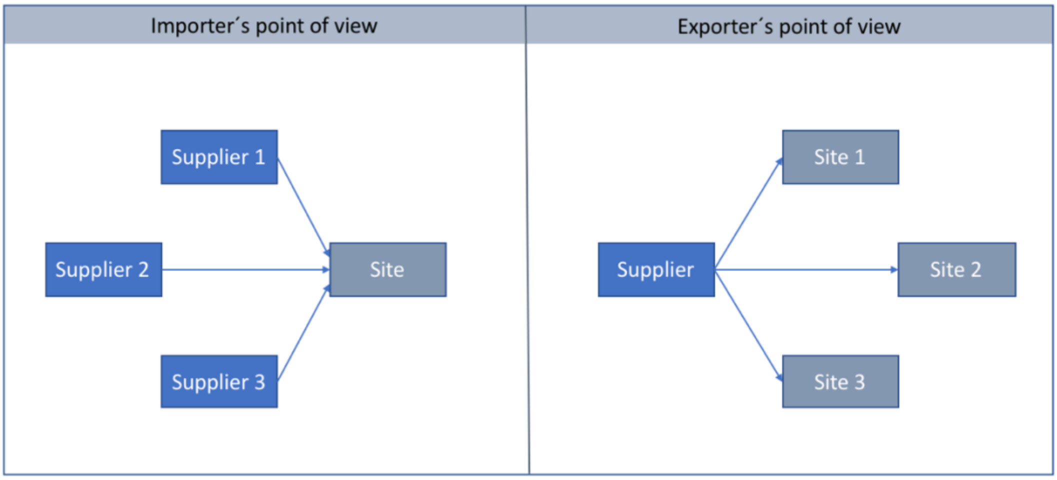


Figure 16 Importer´s and exporter´s perspective

Malfliet (2011) presented four elements that should also be considered in choosing the right incoterm®; the nature of the goods, means of transport, documentary requirements and which of the parties are able to organize the transport at the lowest cost. In evaluating *the nature of the goods,* it is relevant to note that Siemens orders many different products from time to time, and that some of the products may be subject to a higher risk of transport damages, as was confirmed in the case study. *Means of transport* will for most deliveries relate to direct transports by truck without reloading of the goods, whereupon in an evaluation of FCA vs. D-term deliveries, *documentary requirements* will not be relevant because Siemens nevertheless will be responsible for import clearance of the goods in most cases. Considering which of the parties are able to *organize transport at the lowest cost*, this is a more complex question, but looking at the transport price by itself, the suppliers will in most cases be able to negotiate better prices, one of the arguments in which Ramberg (2011) presented as speaking in favor of D-term deliveries.

From an incoterm® standpoint it can be established that D-term deliveries are preferred because the suppliers are in a better negotiation positions towards the forwarders, they know their products better and thus know which requirements should be presented to the forwarders in loading the goods on the trucks, and D-term deliveries from a theoretical perspective minimize risks for the buyer because the supplier is made responsible for risks associated with transport damages and delays. Malfliet (2011) also pointed out that the suppliers are in a better position to align the pickup of the goods with their production planning.

Outsourcing relevancy

Rao and Young (1994) identified drivers and key factors for outsourcing of logistics services that are also relevant in considering a change of sourcing strategy from D-term to FCA. Although their study related to an assessment on pure outsourcing vs. insourcing, this can still be put in connection with the Siemens case, since one wants to find out if SEM is more capable of handling transports than their suppliers. The three main drivers relate to network complexity, process complexity and product complexity.

Network complexity is about the geographical spread and intensity of the transactions with the company´s business partners. In the case of Siemens, the number of commodities and business partners will vary from project to project, they are geographically spread across a large area and the supplier of the same product may also change based on which supplier provided the most attractive offer. This paints a complex picture and as found in the interviews there are big problems related to distributing all necessary information to the forwarders, indicating a bad communication flow which consequently has led to deviations and associated costs in the projects. In the general interview, the PM and PP´s were asked if they experienced that transport related problems that were communicated to the suppliers improved for the next delivery, whereupon most of the respondents stated that there was usually no improvement.

Process complexity relates to time and task compression in the supply chain. Particularly relevant for Siemens is the time sensitivity of the transactions. In the cases where products in the projects are on the critical path, there is no time slack, which makes it very important to ensure that the products are delivered on time to avoid extra costs. In their analysis of delays in ETO companies, Ahmadian et al. (2014) found that delivery terms played a role in the probability of delays and that D-term deliveries had an almost twice as high chance of delays compared to FCA. Also in the case study of SEM it was established that most of the product groups had delays, but due to a limited number of non D-term deliveries it is difficult to evaluate if there are differences between the incoterms® in SEM´s case. Feedback from the case study and general interviews still indicates that the respondents feel like they have a higher degree of control over the transports when ordered by Siemens, although this can´t be objectively proven due to the low number of occurrences.

The third driver, *product complexity*, is relates to the nature and characteristics of the goods. The supplier in this case holds an advantage seeing that they know their products best and how they should be transported to avoid damages. In an FCA situation where SEM takes over responsibility of the goods as soon as it is loaded onto the trucks, it is therefore of great importance to keep a good dialogue with the supplier related to the packing and securing of goods to the trucks in order to minimize risks of damages.

Rao and Young (1994) further describe five key factors to be considered in an outsourcing decision. The first relates to *centrality*, and whether the logistics function is central to the core competency of the company. In the D-term delivery strategy used by Siemens, inbound transport has not traditionally been seen as a core focus area of the purchasing department in Siemens and thus it has been outsourced to the suppliers with an assumption that this has led to a reduced risk. The result of the case study on the other hand shows that this strategy carries a high risk of transport deviations and associated costs. This may indicate that the ownership of the logistics function should be reconsidered.

The second key factor relates to *IT associated with the transports* and whether this is handled best by the suppliers or Siemens. In the case study, it became apparent that there was a big communication problem and hard to be in control of the shipments in D-term deliveries. There is currently no common IT system dealing with the freights, something that would be hard to implement due to the many different forwarders being involved and the lack of a direct communication link to the forwarders. With an FCA solution there is reason to believe that would be possible to use a common platform for booking of the transports and where information and changes can be communicated and implemented seamlessly in real time. Using FCA it should also be possible to add supplementary functions such as shipment tracking and detailed shipment information to the system, customizing the interface to Siemens´ requirements.

The third factor, *cost and service*, relates to giving a cost-effective service at a competitive quality level. Although D-term deliveries has proven to give a competitive transport price, the case study clearly indicates that it is not maintaining an acceptable quality level. Due to missing experience and documentation related to FCA deliveries, it is not possible to establish for certain if a higher quality level is achieved when Siemens orders transport themselves, but feedback from the interviews indicates that a higher level of satisfaction is achieved through an improved communication flow with the forwarder. The price level in the cases where Siemens ordered transport was also found competitive when compared to the offers including transport from the suppliers.

Risk and control is the fourth factor and relates to risk associated with the transactions and the possibility of incorporating requirements to minimize risks in the agreements. In the analysis of the D-term deliveries, it was concluded that the suppliers can be claimed penalties for delays and be held responsible for transport damages, but it was also found that holding the suppliers accountable for indirect cost associated with the deviations is all the more difficult, despite the fact that these costs may hold a large proportion of the total costs. Siemens has tried to incorporate a number of risk minimizing measures by adding requirements to the agreements with the suppliers, but as seen in the steel delivery of project A, the measures only has a limited effect, something that was also confirmed in the general interview. In using FCA it is possible to hand over requirements to the forwarders directly, and by using a limited number of suppliers it is possible to negotiate a service level agreement (SLA) specifically detailing the quality level in which the forwarders can be evaluated and benchmarked against. This facilitates an acceptable quality level and gives an opportunity to change the forwarder if the quality of the service is unsatisfactory over time.

The fifth factor relates to t*he relationship between the party ordering the transport and the forwarder*. SEM currently has no connection to the forwarders in D-term deliveries when the suppliers order the transports and is not able to gather any advantages from the relationship with the forwarders. By ordering transports themselves from known forwarders, it is possible to gain advantages over time since the forwarders will be accustomed to the Siemens´ way of working and of the normal quality requirements associated with the transports. It is also possible to continuously improve the processes.

Although incoterm® theory suggests that D-term deliveries should be the optimal transport strategy, after evaluating the SEM ETO project business it can be established that a more complex production environment makes the risks and stakes associated with inbound transports higher than in a traditional company where incoming goods are always delivered to the same location. Put in connection with the drivers and factors identified by Rao and Young (1994) it appears that there may be advantages to be gained by steering the delivery strategy towards an FCA solution where SEM takes a higher responsibility of ordering transports themselves, to a large degree promoted by the ability to place requirements on the forwarders directly and thereby altering the risk picture.

The transaction cost perspective

Logan (2000) connects the outsourcing question with transaction cost theory and notes that if the external transaction costs are lower than the internal transaction costs, the activity should be outsourced to a third party. He states that in measuring the efficiency of the different governance structures one can compare the costs of planning, adapting and monitoring task completion. The performed case study indicates that Siemens suffers high transaction costs by leaving transports in the hands of their suppliers. By implementing good monitoring functions to survey the delivery process and the total costs associated with deviations, it should be possible to find the exact costs of D-term deliveries and track which deviations are linked to the highest risks and costs. From there it is possible to make a solid assessment of the current transport sourcing strategy and evaluate whether a change of delivery terms where Siemens orders the transport is likely to reduce the transaction costs over time. A thorough analysis in advance of choosing a final transport strategy is also likely to aid in gaining the approval of top management, from which Sink and Langley Jr. (1997)

emphasized to be important in order to ensure the consideration, time and resources needed to go through with the change.

Changing to an FCA delivery strategy also involves losing some benefits related to the D-term deliveries, especially related to the risks associated with transport damages. By taking over responsibility as soon as the goods are loaded onto the trucks it becomes particularly important to reduce the risk associated with the transport as much as possible to avoid transport damages. In light of chapter 3.3.3, since the forwarders only to a small degree can be held responsible for the damages, with compensation limited to 12,15 NOK per kg and consequential costs limited to the transport price, additional insurance should be considered to cover the costs of damages, loss or delays. The cost of insurance is also relevant in a total cost analysis of the FCA transport sourcing strategy.

5.7.3 FCA sourcing strategies

In choosing an FCA sourcing strategy, there are two alternative variants, each with their own advantages and disadvantages. When placed in the Kraljic matrix, today´s transport solution in Siemens is placed between leverage and non-critical item as depicted by Andersson and Norrman (2002). A competitive bidding strategy is followed where price and risk is compared to a D-term delivery, and a subjective choice is made based on the transport solution estimated to give the lowest cost. According to the authors, a more common approach in the future will be that companies either choose to go for a strategy with transactional purchases of basic logistic services or a strategic alliance for the purchase of more advanced services. This involves a shift in the Kraljic matrix, either towards a low supply risk and low financial impact as a non-critical item, or towards a high financial impact and high supply risk as a strategic item.

In the *transactional variant*, the arms-length relationship that is found with the forwarders today is maintained. The transport assignments are put on a freight exchange where forwarders prequalified by the freight exchange are able to price the assignments, and the forwarders are chosen based on the lowest bid. This method can be compared with a simplified variant of the way in which transport offers are acquired today, and should result in a reduction in the time spent obtaining offers when compared to the current comprehensive purchasing process for FCA deliveries in SEM. The transactional method is easy and quick to implement since the system is already available for use and the assignments can be placed in an IT system adapted to the purpose, which simplifies the follow-up despite using different forwarders. Another advantage of this solution is a low switching costs, since it is possible at all times to change the transport volume to be placed on the freight exchange and there is no need to commit for a longer time period.

In the *strategic variant*, one enters a closer cooperation with one or a few qualified forwarders. This involves a comprehensive procurement process to find suitable forwarders and establishing the framework for the cooperation, and it is necessary to commit to placing orders for a certain volume from the carriers. Both Andersson and Norrman (2002) and Sink and Langley Jr. (1997) promotes letting the forwarders take part in designing the final solution and giving them sufficient information to develop a process, plan and cost structure. Although the selection process will be more complicated in doing this, the forwarders will be in a position where they are free to come up with alternative solutions that can provide better processes and lower costs than if setting more restrictions to the requested solution. When choosing the final forwarders, one will end up with a customized transport solution specifically adapted to the challenges proposed and the suppliers are contractually obliged to deliver services that maintain a certain quality level.

When deciding which of the relationship types that works best for Siemens, it is first necessary to look at the root causes of the challenges experienced and evaluate whether it is likely that Siemens will have less deviations if choosing one of the options. In addition, it is necessary to weigh the advantages against the disadvantages of the two alternatives presented.

Communication likely to improve in both FCA strategies

The main cause of the transport deviations experienced in Siemens today relates to poor communication. It is difficult to pass on necessary information to the forwarders, there is limited or no possibility to reach the drivers of the trucks after the goods are shipped, often there is no information about the transports until they reach site and the estimated time of arrival cannot be trusted. Moore and Cunningham III (1999) found in their study that regardless of the type of relationship, shippers achieved a higher level of trust, equity and commitment and a lower level of conflict and opportunism in effective relationships. In both FCA strategies there is reason to believe that communication will improve compared to the situation of today when considering that a direct communication link is established with the forwarders, which facilitates a more satisfactory collaboration.

Customization and improvement measures more difficult to implement in a transactional strategy

Despite the fact that freight exchange systems have a lower implementation cost and are likely to achieve a lower transport price per truck, there is an increased risk in letting different forwarders handling the transports from one assignment to the next and not being able to have an influence on which qualifying requirements are put on the forwarders. Although having an opportunity to directly communicate with the forwarders, the forwarders will not have the same incentives for doing a good job as they have in a strategic relationship, considering the low volume of a single transport and the fact that the forwarder is not likely to be used again. This makes it difficult to establish a relationship with the forwarders, evaluate them and make improvements in case of problems. In addition, it is difficult, if not impossible, to make changes to the freight exchange system in cases where individual customization of the services is necessary. It is also not possible to implement the same penalties or incentives in the agreements on a freight exchange that is possible in a framework agreement, and entering into a freight exchange solution may therefore be risky for Siemens when taking the cost implications of deviations into account.

Relational benefits and performance measures in a strategic collaboration

Moore and Cunningham III (1999) found that shippers in alliances trusted their partners more and had a higher commitment and loyalty level than shippers in transactional relationships. Knemeyer, Corsi, and Murphy (2003) found the same in their study, and in addition they found that strategic relationships also achieved a higher level of investment, dependence, communication and shared benefits than transactional relationships. These findings seem to be related to a higher interconnection between the shipper and forwarder and indicates that although a strategic relationship has a high investment cost, there are also benefits to gain for both parties by moving away from the arms-length relationship towards a closer strategic alliance.

A strategic collaboration is more committing to both parties and in order to ensure a good cooperation it is essential to make agreements that are mutually beneficial and based on shared goals, which Logan (2000) pointed out in his study. By using an outcome-based contract with a cost-plus pricing, both parties have an incentive to reduce costs, and behavior-based measures with bonuses based on performance goals can be added to ensure that the forwarder is doing its utmost to provide a good service. In SEM´s case, this could be based on the checklist of goods receipt and registered deviations associated with the deliveries, as well as deviations related to the planned delivery date against the actual delivery date. Similarly, the contract should also include penalties in cases where the carrier is in breach of the contract, and poor performance over time should provide opportunities to cancel the contract. By using a limited number of forwarders, it is possible to carry out performance evaluations after each completed project to find out if they did a satisfactory job and it is possible to set up development measures in cases where potential for improvement is found. In fact, Marasco (2007) found that long-term relationships can improve the logistics provider´s performance over time, and that successful outsourcing arrangements in a strategic relationship can provide benefits including reduced logistics costs, increased service levels and end-customer satisfaction, new technology and new expertise. Rao and Young (1994) found that outsourcing logistics services to a TPL could also give benefits from the TPL´s ability to monitor the supply chain, something that may be a possibility for reducing the risk associated with transport damages if the forwarder to a higher degree can be trained and involved in safeguarding the loading process and ensuring that the goods are packed and securely stowed onto the truck before departure.

Chopra and Sodhi (2014) emphasized that in order to minimize risk and reduce fragility, the company should always have more than one supplier in case one of the suppliers is not able to perform. Although the cost of keeping several suppliers is likely higher as a result of the total volume being split between the suppliers, the risk is substantially reduced. In order to be able to negotiate more favorable conditions, SEM may therefore be advised to check if it is possible to pool transport demands across other Siemens divisions to gain a more attractive volume before negotiating potential transport agreements with TPL´s.

6.0 Conclusion

The background for this study was based on the perceived problems with inbound transports from foreign countries in SEM´s projects. The inbound logistics process of today was analyzed and linked with relevant literature, with the aim of finding measures to reduce costs and improve the quality of the transports. Findings in the case interviews and general interviews revealed that the current transport strategy has led to transport deviations generating large consequential costs in the projects, and that measures taken to reduce the risk associated with the deliveries only have had a limited mitigating effect. These findings correlate with studies of transports on a country level, where it was found that foreign transports accounted for a higher proportion of accidents. There is an increasing political pressure on improving the quality of the foreign transports, and Siemens as a large multinational company with a social responsibility thus has a lot to gain in being an early adapter and trying to limit the problems associated with these deliveries.

Taking the high cost of deviations into account, it seems that a strategic collaboration with a few qualified TPL´ is the alternative that can best accommodate the high quality standard necessary to reduce the number of deviations to a minimum. This enables Siemens to make requirements of the TPL´s that can be followed up contractually, the services can be adapted to the needs of Siemens, and it is possible to develop the selected forwarders over time. This option, however, requires a volume that is considered attractive by the forwarders as well as a commitment to take over the responsibilities for the transports from the suppliers for a large number of commodities and over a longer period of time. In order to achieve a better negotiating position towards potential TPL´s, other Siemens divisions should also be involved to see if it is possible to pool transport needs across the company.

Before implementing a measure of such strategic importance, which is also likely to involve a considerable investment cost and a long-term perspective, it will be important to first get an overview of the size of the problem that inbound transports actually represents in the projects, and getting in place routines to monitor the logistics performance in the projects. Although the findings from case study A and B indicate that deviations give rise to high costs in the projects, the actual costs were found to be difficult to validate due to missing registration and allocation of deviation related costs, especially related to internal hours spent. By getting control of the costs it will be easier to evaluate where the problems are located and which measures should be implemented also on a short-term perspective, and it will be easier to verify if measures have the intended effect.

In getting an overview of the total costs it will also be possible to calculate the real costs of D-term deliveries with more accuracy and compare it to the estimated costs of entering into strategic framework agreements in an FCA solution, thereby facilitating a better foundation for choosing a strategy to reduce the transport risk in the long run. An important measure in the work of reducing the risk of deviations short term will nevertheless be to deliver the commodities early on site and paying attention to transport risk already in the sales phase of the projects by adding transport risk to the risk contingency if one finds that the project requires JIT deliveries, or if other relevant factors such as winter transports or fragile goods increases the risk exposure in the project. In doing this, there will be a cost buffer in the projects until more permanent long-term solutions to reducing the transport risks are implemented.

6.1 Limitations of the study and further research

Due to the restricted timeline it was necessary to limit the scope of the thesis, and in doing this, not all factors could be explored in detail.

In the case studies, it was necessary to limit the number of commodities to be studied to the commodities representing the highest purchasing volume. Not all large product groups on a total PVO level were represented in the two projects studied and an analysis of incoterms® of all the large product groups was therefore not performed. It should be noted that smaller product deliveries may also be on the critical path in the projects, seeing that all deliveries in essence are part of the final customer product. Due to the high number of orders and different suppliers for small parts deliveries, these types of deliveries are difficult to incorporate in any FCA strategy, although it would have been interesting to study the extent to which these types of deliveries may also give rise to deviation costs in the projects.

During the interviews it became apparent that some delays in the projects seemed to originate from late deliveries from the supplier factories and it was sometimes difficult to differentiate between which delays were supplier caused and which were caused by the forwarder. This thesis did not take supplier caused delays into account when studying the effects of the deviations, although delays from suppliers may also be common, and it only studied the supply chain from the shipping of the goods until arrival on site. Ideally, it should have been possible to extract a report from SAP from which the latest confirmed delivery date from the supplier could be compared to the actual delivery date of goods receipt to find the transport delays, but due to a time lag in the goods receipt registration process, the date of receipt in SAP at the current time cannot be trusted to give credible data.

An important aspect to consider in deciding to go for an FCA sourcing strategy relates to insurance of the goods. Due to a lack of time it was not possible to study different types of insurance arrangements, their cost and the possible insurance cover related to indirect costs associated with transport deviations.

In writing this thesis it soon became apparent that there is only a limited amount of research conducted that relates to the incoterm® choice and transport strategy for importing companies in ETO environments. Considering the fact that ETO environments are very complex due to the nature of the final product to be delivered, an opportunity for further research would be to study the inbound transport sourcing arrangements across different ETO companies to find best practice solutions.

Abbreviations

ATO	Assemble to Order
CIF	Costs Insurance and Freight (incoterms®)
CIP	Carriage and Insurance Paid (incoterms®)
CPM	Commercial Project Manager
C-terms	Collection of incoterms® (CIF, CIP, CFR, CPT)
DAP	Delivery at Place (incoterms®)
DAT	Delivered at Terminal (incoterms®)
DDP	Deliverred Duty Paid (incoterms®)
D-terms	Collection of incoterms® (DAP, DDP, DAT)
EDI	Electronic Data Interchange
EPC	Engineering, Procurement and Construction (a type of contract)
ESN	Product code in SAP
ETA	Estimated Time of Arrival
E-terms	Collection of incoterms® (EXW)
ETO	Engineer to Order
FAT	Factory Acceptance Test
FCA	Free Carrier (incoterms®)
FOB	Free on Board (incoterms®)
F-terms	Collection of incoterms® (FAS, FCA, FOB)
IAT	Internal Acceptance Test
Incoterms®	International commercial terms
IT	Information Technology
MTO	Make to Order
MTS	Make to Stock
PM	Project Manager
PP	Project Purchaser
PVO	Purchasing volume
QMiP	Quality Manager in Project
RFI	Request for Information
RFP	Request for Proposal
SAP	A type of enterprise resource system
SEM	Siemens Energy Management
SLA	Service Level Agreement
SM	Site Manager
SP	Strategic Purchaser
TCE	Transaction Cost Economics
TPL	Third Party Logistics providers
VAT	Value added Tax

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Appendices

Appendix 1

CASE STUDY PROJECT
Transport sourcing in Siemens EM Research Plan

1. Goal: In-depth case study of transport sourcing within Siemens EM project business

A. Research Questions

RQ1 Which are the most important products bought from our suppliers?

RQ2 Where are the focal products sourced and which incoterms are most commonly used?

RQ3 Which requirements do the different product types put on the transport solutions?

RQ4 How is the inbound logistics of the focal products organized today?
RQ4.1 Which processes could be defined related to the inbound logistics?
RQ4.2 How is the purchasing process of TPL services organized?
RQ4.3 How many service providers are in use for the current inbound services?
RQ4.4 How competitive is the relevant part of the TPL sector

RQ5 How critical are the focal products for the projects?
RQ5.1 How critical are transport deviations?
RQ5.2 Are there examples where transport system disruptions have had major impacts on project performance
RQ5.3 How resilient are the current solutions to disruptions?

RQ6 Which alternative transport arrangements are relevant for the focal products?
RQ6.1 How relevant is a higher or lower degree of outsourcing of related processes?
RQ6.2 Which alternative terms of trade (Incoterms®) would be relevant?
RQ6.3 Would concentrating the purchased TPL-services to one or fewer partners be an option?

B. Statement of Purpose:

The purpose of this study is to examine the current practices of transport sourcing within the project business part of Siemens Energy Management Norway with the aim to evaluate whether a different sourcing strategy should be considered.

C. Unit of Analysis

Siemens AS, division EM is the unit of analysis.

2. Methology/Case Study Design

A. Multiple Case Design

1. Each case as an experiment, a replication, not as a single response to a survey. Not sampling.
2. Write up each case individually – develop a standard case format
   a. Pattern match
   b. Implications
3. Do overall write up of findings based on patterns, inferences.

B. Sample Selection

1. Two projects with a sales price >50 MNOK where main components are delivered within the last two years
   1.1 Cooperation
   a. 2 people from purchasing dept (strategic + operational purchasing)
   b. 1 project manager
2. General interview
   2.1 Cooperation
   a. 4 project managers
   b. 1 person from quality dept
   c. 4 project purchasers
   d. 2 strategic purchasers
   e. 1 Head of project managers

C. Basic outline of Overall Master Thesis

1. Introduction
2. Research Problem
3. Literature Review
4. Methodology
5. Discussion and Case Study Findings
6. Conclusion
7. Abbreviations
8. Bibliography
9. Appendices

D. Collecting Evidence

1. Three essential ideas
   a. Multiple sources of evidence where possible – of particular importance where evidence cannot be backed up by tangible/traceable numbers
   b. Case study database
   c. Chain of evidence linking question asked, data collected and conclusions drawn
2. Sources of evidence
   a. Documentation
      - Internal reports from ERP-system
      - Offers from suppliers
      - Product delivery documentation
   b. Interviews
   c. Theory

3. Data analysis

A. Pattern Matching

1. Look for similar patterns for the two projects studied
   - Type of materials ordered
   - Incoterms used
   - Reasons for incoterm choice
   - Season of the material delivery
   - Site location
   - Supplier locations
   - Patterns related to delays caused by transport
   - Patterns related to quality defects caused by transport
   - Patterns related to other transport related problems

4. Proposal Case Study Format – Individual Case Write-Ups

A. General project information

- Project timeline
- Project deliverables

B. Purchasing of materials in the project

- How was the inbound transport arrangement sourced in the project
  - Reasons for choice of incoterms
  - How many logistics/transport service providers
- Were there any particular requirements to the transport solution used that can be related to particular product types / location / season
- Where were the suppliers for the main components located
- How vulnerable was the project to lead-time fluctuations caused by delays or damages in the transport phase

- Were materials planned to be delivered just-in-time, or with a time buffer until they were needed
- Were there any delays caused by transport – reasons
- Were there any quality issues/damages caused by transport – reasons
- If yes – did the delay or quality issues cause any extra costs (change orders, penalties, man hours)
- If a different incoterm had been chosen, would the same extra costs likely have occurred – why/why not

Appendix 2

Interview guide 1 - project specific interview

	Abbreviations:	PM - Project Manager PPM - Project Purchaser SPM - Strategic Purchaser

1.	**BAKGRUNN**	**Hvem**
1.1	Hva skal leveres til kunden – prosjektets omfang	PM
1.2	Hvor ligger prosjektet geografisk	PM
1.3	Spesielle utfordringer (tidsplan, beliggenhet site, veiforhold, årstid)	PM
1.4	Hadde kunden noen forventninger som la ekstra press på utførelsen av prosjektet	PM
2	**PRODUKTLEVERANSENE - GENERELT**	
2.1	Hvilke produktgrupper sendt fra utlandet ble ansett som mest kritiske i prosjektet	PPM, PM, SPM
2.2	Hvorfor	PPM, PM, SPM
2.3	Hva ble gjort på generelt grunnlag for å følge opp disse produktene for å sikre levering til rett tid	PPM, PM
2.3.1	Fra fabrikk (statusrapporter, fabrikkbesøk etc)	PPM, PM
2.3.2	For selve transporten (informasjonsutveksling)	PPM, PM
2.4	Hvordan ble innkommende leveranser håndtert i prosjektet – fra bestilling til levering, på generelt grunnlag	PPM
3	**FOR HVER PRODUKTGRUPPE**	
3.1	Hvilken incoterm ble brukt, som oppgitt i tilbud?	PPM
3.2	Hva var bakgrunn for valg av incoterm	PPM, PM, SPM
3.2.1	For leveranser hvor Siemens AS var ansvarlig for transport, hvordan foregikk innkjøpsprosessen	PPM, SPM
3.3	Hvilket land ble leveransen sendt fra	PPM
3.4	Var det noen spesielle krav til pakking	PM, PPM
3.5	Var det noen spesielle krav til transporten (sikring, type bil, lengde el størrelse på transporten etc)	PPM, PM
3.6	Var det noen spesielle krav til leveringen (leveringsinstruks)	PPM, PM
3.7	Hvordan ble det transportert (bil, båt, tog)	PPM
3.8	Var transportør kjent på forhånd, eller bestemt av leverandør?	PPM
3.9	Hvor mange biler/containere	PPM
3.10	Direkte transport eller transport med omlastinger	PPM

3.11	Hvordan ble transporten fulgt opp, hvilken informasjon ble delt fra transportør/leverandør underveis	PPM
3.12	Var kommunikasjonen tilfredsstillende eller mangelfull	PPM
3.13	Skjedde det noen problemer underveis i transporten?	PPM
3.14	Skjedde det noen problemer ved levering? Hva var i så fall grunnen? (språk, feil leveringssted, ikke skodd for forholdene etc)	PPM
3.15	Ble evt. leveringsinstrukser fulgt?	PPM
3.16	Kom leveransen til avtalt tid	PPM
3.47	Ble leveransen levert av en utenlandsk transportør/sjåfør?	PPM, PM
3.48	Fikk evt avvik i leveringstid som følge av tidlig/sen levering eller transportskader noen kritiske følger for prosjektet overordnet - i så fall hvilke	PM
	Ved forsinkelse eller for tidlig levering:	
3.17	Hvor mye ble leveransen forsinket/for tidlig levert (kun transportfrelatert, ved flere forsendelser - per bil)	PPM
3.18	Hva var grunnen(e)	PPM
3.19	Hvordan håndterte prosjektet avviket for å minimere konsekvensene	PPM, PM
3.20	Fikk avviket(ene) konsekvenser for prosjektet:	PPM, PM
3.21	Kostnader fra montasjeselskap eller andre underleverandører	PPM, PM
3.22	Kostnader egne timer	PPM, PM
3.23	Andre kostnader	PPM, PM
3.24	Andre ikke-monetære konsekvenser	PPM, PM
3.25	Ble forsinkelsen registrert/dokumentert noe sted	PPM, PM
3.26	Ble informasjon om forsinkelsen videreformidlet transportør/leverandør	PPM
3.27	Hvis ja, hvordan og hvilke tilbakemeldinger ble gitt fra transportør/leverandør	PPM
3.28	Kunne man fått og ble det gitt noen kompensasjon for forsinkelsen	PPM, PM
3.29	Dekket kompensasjonen det forsinkelsen kostet prosjektet	PPM, PM
3.30	Kunne forsinkelsen vært unngått, hvordan	PPM, PM
	Ved transportskade:	
3.31	Ble det oppdaget transportskader under lossing?	PPM, PM
3.32	Ble det oppdaget skader i senere tid som antas kommet fra transporten?	PPM, PM
3.33	Hvor omfattende var skadeomfanget	PPM, PM
3.34	Hva var grunnen	PPM, PM
3.35	Hvordan håndterte prosjektet avviket for å minimere konsekvensene	PPM, PM
3.36	Fikk skaden konsekvenser for prosjektet	PPM, PM

3.37	Kostnader fra montasjeselskap eller andre underleverandører	PPM, PM
3.38	Kostnader egne timer	PPM, PM
3.39	Andre kostnader	PPM, PM
3.40	Andre ikke-monetære konsekvenser	PPM, PM
3.41	Ble skaden registrert/dokumentert noe sted	PPM, PM
3.42	Ble informasjon om skaden videreformidlet transportør/leverandør	PPM, PM
3.43	Hvis ja, hvilke tilbakemeldinger ble gitt fra transportør/leverandør	PPM, PM
3.44	Kunne man fått og ble det gitt noen kompensasjon for skaden?	PPM, PM
3.45	Dekket kompensasjonen det skaden kostet prosjektet	PPM, PM
3.46	Kunne skadene vært unngått, hvordan	PPM, PM

Interview guide 2 - General interview

Abbreviations:

PM - Project Manager
PPM - Project Purchaser
SPM - Strategic Purchaser
QMiP - Quality manager in project
HPM - Head of Project Management

1.	PROSJEKTENE	Hvem
1.1	Er de dyreste produktgruppene ofte de mest kritiske i prosjektene mtp prosjektets oppstart og fremdrift	PM
1.2	Hvor vanlig er det med logistikk/transportutfordringer i prosjektene fra utsending fra fabrikk til levering på site på en skala fra 1 til 4. (1 - flere ganger i hvert prosjekt, 2 - ca en gang i hvert prosjekt, 3 - ca hvert andre prosjekt, 4 - sjeldnere)	QMiP, PPM, PM, HPM
1.3	Hvilke typer problemer oppstår oftest	QMiP, PPM, PM, HPM
1.4	Opplves det som mer eller mindre vanlig at utenlandske sjåfører er involvert når det oppstår transportproblemer	QMiP, PPM, PM, HPM
1.5	Oppleves det som at årstid for leveransene har mye å si for antall problemer	QMiP, PPM, PM, HPM
1.6	Oppleves det som at type materiell har noe å si for antall problemer	QMiP, PPM, PM, HPM
1.7	Andre grunner til at transportproblemer oppstår	QMiP, PPM, PM, HPM
1.8	Er du kjent med forebyggende tiltak som har vært gjort for å unngå transportproblemer	QMiP, PPM, SPM, PM, HPM
1.8.1	Har tiltakene hatt noen effekt - ranger tiltakene du er kjent med på en skala fra 1- 3 (1 - transportproblemer har blitt totalt unngått, 2 - transportproblemer har delvis blitt unngått, 3 - tiltakene har ikke hatt noen effekt)	QMiP, PPM, SPM, PM, HPM
1.9	Har prosjektene gode måter å håndrere avvik i leveringstid på leveransene som følge av tidlig levering, forsinkelser eller skader, eller er avvik ofte forbundet med høy risiko mtp prosjektets fremdrift	QMiP, PM, HPM
1.9.1	Hvilke konsekvenser har avvikene hatt for prosjektene	QMiP, PM, HPM
1.10	Dersom avvik i leveringstid/kvalitet har fått økonomiske konsekvenser, er du kjent med om det blitt gjort noen estimater på hvor store kostnader problemene har utgjort i prosjektene	QMiP, PPM, PM, HPM
1.10.1	Er det vanligvis mulig å innhente alle kostnadene ved claims o.l.	PM, HPM
1.11	Hvilke incoterms brukes oftest på de store produktleveransene i dag	PPM, SPM
1.12	Hvordan oppleves informasjonsutvekslingen mtp transporten i de tilfeller hvor leverandøren er asvarlig for å organisere denne	PPM, PM
1.12.1	Oppleves informasjonsutveksling som bedre i de tilfeller hvor vi har organisert transporten selv	PPM, PM

1.12.2	Oppleves det som at tilbakemeldinger som gis leverandør på transportproblemer tas tak i og forbedres til neste leveranse fra samme leverandør	PPM, PM
1.13	Ved transportforespørsler, oppleves det som at det er mange aktører å forespørre og konkurranse mellom aktørene	PPM, SPM
1.14	Sett bort fra ønske om at transporter kommer frem til riktig tid og uten skader, har du noen andre toppønsker for en bedre transportopplevelse (eks sporing av leveranse, tlf-nr til sjåfør, ingen omlastinger, nordisk-språklige sjåfører, treakslede biler , senkbar lem - max tre ønsker)	PM, HPM
1.15	Er du generelt positiv til tanken om at innkjøp tar et større eierskap til de største transportene (FCA), istedenfor å overlate transporten til leverandørene (DAP/DDP)	QMiP, SPM, PPM, PM, HPM
1.15.1	Hvorfor/hvorfor ikke	QMiP, SPM, PPM, PM, HPM
1.16	Er det ønskelig med rammeavtaler med en/noen få faste transportører	PM, HPM, SPM
1.16.1	Er du fremdeles positiv dersom dette innebærer en noe høyere total kostnad for transport enn dagens løsning	PM, HPM, SPM
1.17	Ved en sammenslåing av volum for våre største produktgrupper, anslår du at vi kan få en konkurransedyktig pris på transport ved å gå inn i en langsiktig rammeavtale med en/noen få transportører - dvs en pris tilsvarende eller lavere enn vi får gjennom leverandør	SPM

Appendix 3

SIEMENS

STANDARD TERMS AND CONDITIONS FOR PURCHASE OF PRODUCTS AND SERVICES – MAJOR

1. GENERAL PROVISIONS

1.1 "**Agreement**" means the framework agreement, contract, purchase order or other commercial agreement of which these general terms and conditions ("**Terms and Conditions**") are a part entered into between Siemens AS ("**Siemens**") and a supplier ("**Supplier**").

1.2 "**Supply**" means the products, services, documents, software and/or other deliverables which Siemens purchases from Supplier under the Agreement.

1.3 The parties are hereinafter referred to individually as a "**Party**" or collectively as the "**Parties**".

1.4 For the avoidance of doubt, these Terms and Conditions shall apply between the Parties in relation to all future orders by Siemens from Supplier under the Agreement unless the Parties separately agree to the contrary in writing.

Siemens shall be not bound by the General Terms and Conditions of Supplier unless Siemens explicitly agrees to such in writing, and neither the acceptance of deliveries or services nor the making of payments by Siemens to Supplier shall constitute such agreement.

2. GENERAL OBLIGATIONS OF SUPPLIER – HEALTH, SAFETY AND ENVIRONMENT (HSE)

2.1 Supplier shall provide the Supply in a professional and careful manner in accordance with the Agreement.

2.2 Supplier shall handle the Supply, any items provided by Siemens ("**Siemens-provided Items**") and all materials with all due care and skill and shall ensure that they are kept in good order and condition.

2.3 Supplier shall comply with all statutory provisions on health, safety and environment. Supplier shall use its best efforts to minimize and if possible eliminate hazards for the health, safety and environment for the performance of the Works and ensure that no persons nor the environment suffer any injury. Supplier shall give priority to safety in order to protect life, health, property and environment.

2.4 If any incident occurs in connection with the Work leading to one or more days of incapacity of any person or if the Supplier becomes aware of any event or circumstances in connection with the Work which could have caused this, Supplier shall immediately inform Siemens and shall without undue delay, a) execute a root cause analysis of the incident, b) determine appropriate measures to exclude similar incidents in the future, c) define time periods for the measures to be implemented and d) provide Siemens with a written report containing sufficient detail on the root cause, the measures determined and the time periods defined. Supplier shall support any additional investigation conducted by Siemens.

3. SUPPLY PROPERTIES

3.1 Supplier warrants that the Supply shall be in accordance with the Agreement, free of any liens or defect in title, new and produced with raw materials which are free of any defect and which are new and fully functional. The Supplier further warrants that the Supply shall be fit for its intended purpose and that it shall comply with official and legal provisions and safety regulations of the countries of production and destination. Siemens may return any defective goods to Supplier at Supplier's cost and demand replacement in accordance with the Agreement.

3.2 All work performed in connection with making the Supply ("**Work**") shall be carried out to the highest standard of care and workmanship, using only qualified and trained personnel.

3.3 The Supply shall be developed and delivered in accordance with the latest version of ISO 9001 or other equivalent quality standard, as applicable. The warning concept (use of the signal words and the warning triangle, and structure of the warning text) shall comply with the standards of the International Organization for Standardization (ISO) for equipment to be used outside U.S.A., and the American National Standards Institute (ANSI) for equipment to be used in U.S.A.

3.4 Siemens and its authorized agents and representatives and/or a third party appointed by Siemens and reasonably acceptable to Supplier, shall be entitled (but not obliged) to conduct – also at Supplier's premises – inspections and audits in order to verify that Supplier adheres to such quality standard(s).

3.5 Any inspection or audit may only be conducted upon prior written notice of Siemens, during regular business hours, in accordance with the applicable data protection law and shall neither unreasonably interfere with Supplier's business activities nor violate any of Supplier's confidentiality agreements with third parties. Supplier shall reasonably cooperate in any inspection or audit conducted. Each Party shall bear its expenses in connection with such inspections/audits.

4. DELIVERY AND DELAY

4.1 Unless otherwise agreed, and subject to Article 8, the delivery term shall be DAP (Delivered at Place) Incoterms 2010, and the point in time and place at which delivery occurs ("**Delivery**") shall be determined accordingly.

4.2 Siemens shall be notified immediately if Supplier becomes aware of a potential delay to delivery of the Supply or parts thereof and/or to the Agreement schedule ("**Agreement Schedule**"). Such notice shall state the reason for the delay and proposed measures to mitigate such delay. If Supplier fails to inform Siemens of a potential delay, Supplier shall be liable for any losses Siemens may suffer due to Supplier's failure to notify, subject to the limitations in Article 19.1.

4.3 Supplier shall undertake all reasonable measures (e.g. shift work, overtime) in order to avoid delays. The costs for such measures shall be borne by Supplier.

4.4 If Supplier's delivery of the Supply is delayed in relation to the Agreement Schedule, Siemens shall be entitled to claim liquidated damages in the amount of 0,2 % of the total sum payable by Siemens under the Agreement as adjusted in accordance with the provisions of Article 10 ("**Agreement Price**") per commenced calendar day of delay, said liquidated damages not to exceed 10% of the Agreement Price.

4.5 If Supplier's delivery of documents relating to the Supply is delayed in relation to the dates specified in the supplier document list (where applicable), Siemens shall be entitled to claim liquidated damages in the amount of 0,1% of the Agreement Price per commenced calendar day of delay, said liquidated damages not to exceed 5% of the Agreement Price.

4.6 Siemens may withhold any liquidated damages to which it becomes entitled from any payments due to Supplier under the Agreement. Upon receipt of notice from Siemens, Supplier shall issue Siemens with a credit note for the amount of liquidated damages withheld. The payment of liquidated damages by Supplier shall not affect any of Siemens' other contractual or legal rights arising from Supplier's late Delivery or performance, and shall not release Supplier from its other contractual or legal obligations arising under the Agreement.

5. PACKING AND DISPATCH

5.1 Packing shall be suitable for the Supply and the intended method of transport and in compliance with the requirements specified in these Terms and Conditions and elsewhere in the Agreement. Any loss or damage to the Supply resulting from defective packing shall be made good by Supplier.

5.2 Unless otherwise agreed, the costs of transport and packaging shall be borne by Supplier.

All additional costs arising from Supplier's failure to conform with the transport requirements for the Supply shall be borne by Supplier.

5.3 Each shipment shall include where applicable one or more of the following packing/shipping notes:

- i) Export Document/Declaration; and/or
- ii) Pro forma invoice; and/or
- iii) Consignment note, CMR/AWB/BL.

These notes shall include details of the contents as well as the complete order number for the Supply. Notice of dispatch shall be provided immediately with the same information.

5.4 If the transport is performed by a carrier commissioned by Siemens, Supplier shall submit any necessary information and data to the carrier concerning dangerous goods in accordance with legal requirements.

5.5 Supplier shall be liable for any expenses and/or damages incurred by Siemens due to any breach of the provisions of this Article 5.

6. INVOICES

6.1 The Agreement number as well as any other supporting documentation required in the Agreement shall be detailed in or submitted together with each Invoice ("**Invoice**"). Invoices shall not be payable by Siemens unless they include this information.

6.2 If the Parties have agreed that Supplier shall provide a performance bank guarantee, such bank guarantee shall, unless otherwise expressly stated in the Agreement, be: (1) issued by a a bank or financing institution acceptable to Siemens, (2) issued on Siemens standard format for "on demand" guarantees, and (3) submitted to Siemens within 14 calendar days of the effective date of the Agreement. The guaranteed amound shall be 10% of the Agreement Price from issuance of the performance bank guarantee up until 1 month after the scheduled Delivery date. Thereafter, the guaranteed amount shall be reduced to 5% of the Agreement Price. The performance bank guarantee shall expire 1 month after the scheduled expiry of the Warranty Period. Siemens shall not be required to make payment under any Invoices until such bank guarantee has been provided to Siemens.

7. PAYMENT

7.1 Unless otherwise agreed, payments are to be made within 60 days of receipt of invoice.

7.2 Subject to Article 6.2, where the Agreement provides for payment pursuant to payment milestones, the period for payment shall commence upon Siemens' receipt of an Invoice supported by required documentation confirming Supplier's fulfillment of the conditions for the applicable payment milestone. In all other cases, the period of payment shall commence as soon as any milestone or service is completed and an Invoice is received. Where Supplier is required to provide material testing, test records or quality control documents or any other documentation, such deliverables shall be a part of the requirements of the completeness of the milestone and service.

7.3 Payment does not constitute an acknowledgement that the Supply was provided in accordance with the Agreement (in particular in relation to quantity or quality), and Siemens retains the right to claim against Supplier after paying for the Supply.

8. TRANSFER OF RISK AND TITLE

8.1 For Supply involving installation, commissioning or other services subsequent to equipment delivery ("**Services**"), risk shall transfer to Siemens upon acceptance of the Services. For Supply not involving Services risk shall transfer to Siemens on Delivery to Siemens.

8.2 Without prejudice to Siemens' right to reject the Supply thereafter, title to the Supply shall pass to Siemens when:

(a) Siemens pays for the Supply; or

(b) Siemens receives the Supply;

whichever occurs first.

8.3 Any portion of the Supply with respect to which title has passed to Siemens but which remains in the care, custody and control of Supplier or its subcontractor shall be clearly identified in a manner acceptable to Siemens as being the property of Siemens and shall be segregated from Supplier or its subcontractors' property to the extent possible.

9. INSPECTIONS AND AUDIT

9.1 Supplier shall inspect the Supply for quantity and quality before dispatch.

9.2 Subject to Siemens obtaining appropriate confidentiality declarations from Siemens' immediate customer and the end customer, Supplier shall permit Siemens, Siemens' immediate customer and the end customer to enter upon Supplier facilities to carry out such audits of technical documentation, data, records and transactions connected to the Supply and for the purpose of verifying the production process and/or the witnessing of any test. Supplier shall also ensure that Siemens, Siemens' immediate customer and the end customer have similar rights to audit and inspect Supplier's subcontractors at any tier.

10. VARIATION ORDERS

10.1 Siemens has the right to order any variation to the Supply which in Siemens' opinion is desirable. Such a variation to the Supply may include an increase or decrease in the quantity, or a change in character, quality, kind or execution of the Supply or any part thereof ("**Variation**")

10.2 Within seven (7) days of receiving Siemens' instruction for a Variation or within seven (7) days of the date when Supplier discovered or ought to have discovered a situation requiring a Variation, Supplier shall submit a variation order request ("**VOR**") in a format to be agreed between the Parties detailing how the Variation will affect the Agreement Schedule, the Agreement Price and/or any other conditions under the Agreement. If Supplier fails to submit a VOR within the stated time limit, Supplier shall be deemed to have agreed to the Variation without any increase in the Agreement Price or extension to the Agreement Schedule and shall have waived any right to claim for any compensation in connection therewith.

10.3 The cost impact of any Variation shall be determined in accordance with the rates specified in the schedules for the Agreement Price. If there are no rates, applicable rates for Work performed in connection with a Variation shall be prepared reflecting the general level of pricing set out in the Agreement. If the cost impact cannot be mutually agreed by the Parties, then the cost impact shall be finally determined by Siemens in its reasonable judgement (without prejudice to the Parties' right to dispute resolution).

10.4 Supplier shall minimize the time impact of any Variation on the delivery of the Supply. The Parties shall use their best endeavors to agree on the time impact, taking into account the overall deadlines under the Agreement. If the time impact cannot be mutually agreed by the Parties, then the time impact shall be finally determined by Siemens in its reasonable judgement (without prejudice to the Parties' right to dispute resolution).

10.5 If Supplier requests a VOR which in Siemens' opinion is not a Variation, Siemens shall issue a disputed variation order ("**DVO**") in a format to be agreed between the Parties ordering Supplier immediately to proceed with the Work described in the VOR. If no court proceedings pursuant to Article 32 have been instigated within five (5) months of the date of issuance of the DVO, the subject matter of such DVO shall be deemed to be part of the Supply.

10.6 Supplier shall implement a Variation Order ("**VO**") or a DVO promptly upon receipt, even if the effects of such VO or DVO have not yet been determined. Under no circumstances shall delivery of the Supply be delayed due to pending agreement or determination of any VO or DVO.

11. TERMINATION FOR CONVENIENCE

11.1 Siemens may by notice to Supplier terminate the Agreement with the consequence that the performance of the Work ceases.

11.2 Following such termination, Siemens shall pay: a) The unpaid balance due to Supplier for that part of the Work already performed; b) All documented costs incurred by Supplier and its subcontractors in connection with materials ordered prior to receipt of the notice of termination by Supplier, and compensation for Work performed on such materials prior to said date, provided that such costs are not covered by payment under Article 11.2 a); c) All necessary termination charges and administration costs incurred by Supplier in connection with the termination; and d) Supplier's and its subcontractors' other expenses directly attributable to an orderly close-out of the Agreement, calculated as far as possible in accordance with the rates specified in the Agreement.

11.3 Supplier shall, in accordance with Siemens's instructions, make its best efforts to terminate the Subcontracts on terms acceptable to Siemens. If Siemens cannot accept the termination terms, Supplier shall assign such Subcontracts to Siemens.

12. SIEMENS' RIGHT TO TEMPORARILY SUSPEND THE WORK

12.1 Siemens may temporarily suspend the performance of the Work or parts thereof, by giving notice to Supplier.

The notice shall specify which part of the Work shall be suspended, the effective date of suspension and the expected date for resumption of the Work. Furthermore, it shall state the mobilisation plan and any support functions which shall be maintained while the Work is suspended.

Supplier shall resume the Work after notification by Siemens. The date of resumption of the Work shall be determined with due consideration of the mobilisation plan, and the support functions that have been maintained during the suspension.

12.2 Siemens shall compensate Supplier for all necessary expenses arising from: a) Demobilisation of personnel and equipment; b) Safeguarding the Supply, Siemens-provided Items and related materials and equipment; c) Personnel, subcontractors and equipment which must be kept available in accordance with the mobilisation plan; d) Moving the Supply, if necessary, so that it does not interfere unreasonably with Supplier's other activities; and e) Other expenses incurred by Supplier as a result of suspension of the Work.

Supplier's claim for Work performed shall be calculated as far as possible in accordance with the rates specified in the Agreement.

12.3 If suspension of the Work affects the Agreement Schedule or if Supplier claims that it does, then the provisions of Article 10 concerning Variations to the Agreement Schedule and the Agreement Price shall apply accordingly.

13. TERMINATION DUE TO SUPPLIER'S BREACH OF CONTRACT

13.1 Siemens is entitled to terminate the Agreement with immediate effect by notifying Supplier when: a) Siemens has become entitled to be paid or it is evident that Siemens will become entitled to be paid the maximum amount of liquidated damages in accordance with Article 4.4 and/or Article 4.5; b) It is evident that completion of the Supply will be delayed by more than 15 % of the time from start of the Work until the Delivery date(s) specified in the Agreement, or by 60 Days - whichever is the shorter period; c) Supplier is in material breach of the Agreement; or d) Supplier becomes insolvent or ceases to make its payments, an interim insolvency administrator is appointed or insolvency proceedings are applied for or are commenced in relation to Supplier's assets.

13.2 Upon termination of the Agreement in accordance with this Article 13, Siemens is entitled to take over from Supplier the Supply, Siemens-provided Items, subcontracts, and other rights necessary to enable Siemens to complete the Supply, either by itself or with the help of others.

13.3 If the Agreement is terminated, Supplier shall be entitled to payment for the part of the Work performed and for plant and equipment taken over by Siemens pursuant to Art 13.2, less any amounts due from Supplier to Siemens.

13.4 If the Agreement is terminated in accordance with 13.1(d), Siemens shall be entitled to deduct its costs and losses caused by Supplier's insolvency from such payment and may continue to utilize existing facilities, deliveries and services already performed by Supplier in exchange for reasonable payment.

13.5 Siemens shall also be entitled to claim damages for defects in the Supply ("**Defect**") and may make other claims under the Agreement or at law, subject to the limitations in Article 19.

14. WARRANTY

14.1 Unless otherwise agreed, the warranty period is 24 months ("**Warranty Period**") and shall commence upon delivery and acceptance of all parts of the Supply.

14.2 Siemens shall endeavor to notify Supplier of any Defects within a reasonable period of time after detection.

14.3 If Siemens notifies Supplier of a Defect within the Warranty Period, Siemens may elect at its discretion to negotiate a reduction in the Agreement Price or to have Supplier rectify or replace the Defect (as applicable) at Supplier's expense.

14.4 Supplier shall be liable for any and all costs, expenses and damages incurred by Siemens as a result of Defects, subject to the limitations in Article 19.

14.5 If Supplier does not carry out rectification or deliver replacement(s) for Defects as requested within a reasonable timeframe set by Siemens, Siemens may, at Supplier's expense, undertake any rectification or replacement itself or arrange for a third party to do so.

14.6 If Supplier performs warranty Work during the Warranty Period, the Warranty Period for the redelivered or rectified part of the Supply shall be extended by one year. For the remaining part(s) of the Supply, the Warranty Period shall be extended only by the period of time during which the Supply is not fully operative due to the Defect(s).

15. INTELLECTUAL PROPERTY AND RIGHTS OF USE

15.1 Subject to the terms of this Agreement, Supplier (and its licensors) grants to Siemens and its customers (including any party acting on their behalf) a non-exclusive, perpetual, worldwide, sublicensable and royalty free license to use any intellectual property rights and similar rights ("IP Rights") necessary in order to sell, offer to sell, export, import, operate, repair, modify, maintain, enhance and extend the Supply, in addition to any other IP Rights necessary to fulfill the purpose of this Agreement. In addition to the rights granted under the preceding sentence, if Supplier is or ought to be aware of any IP Rights Siemens have granted or will grant to its customers in relation to the Supply, the rights granted by Supplier under this Agreement to Siemens shall be sufficient for Siemens to fulfill Siemens' obligation to license IP Rights to its customers.

15.2 Without the prior written consent of Siemens, Supplier may not include in the Supply any software (or other materials) subject to a copyleft or share-a-like license, i.e. a license which requires that a derivative work based on software (or other materials) subject to said license must be distributed and/or made available subject to said license, or a license which contains similar terms.

15.3 All drawings, specifications, and any other property or materials to be furnished to Supplier by or for Siemens, for use in the performance of this Agreement, shall remain the property of Siemens. The Supply and all drawings, specifications, and any other property or materials to be furnished to Siemens by or for Supplier, shall become the property of Siemens, unless otherwise agreed in writing.

16. INTELLECTUAL PROPERTY INFRINGEMENTS

Supplier will defend, indemnify, and hold Siemens (and its customers and any party acting on their behalf) harmless against any third-party action, suit, or proceeding ("Claim") against Siemens (and its customers and any party acting on their behalf) to the extent such Claim is based upon an allegation that the Supply infringes IP Rights granted to Siemens (and its customers and any party acting on their behalf) under this Agreement.

17. CONFIDENTIALITY, DATA PROTECTION, INFORMATION SECURITY

17.1 Supplier shall treat as confidential the the knowledge and findings, documents, terms of reference, business processes or other information that it receives from or about Siemens in the context of performing and concluding the Agreement which are - whether disclosed in tangible form or orally, visually or via electronic communication, including internet-based provision of information - marked as or pronounced to be "Confidential" or similarly legended by Siemens ("**Confidential Information**").

17.2 Supplier shall keep the Confidential Information confidential beyond the term of the Agreement, for as long as and insofar as such Confidential Information has not become publicly known through legal proceedings or Siemens has not consented in writing to its transfer in the individual instance.

17.3 Supplier shall however be entitled to disclose Confidential Information where the Confidential Information: (a) was in the public domain prior to Supplier's receipt thereof; (b) was in Supplier's possession prior to its receipt thereof through no breach of any confidentiality obligation; (c) was received from a third party through no breach of any confidentiality obligation, and where it is necessary to disclose Confidential Information to: (d) subcontractors for performance of the Agreement (however subject to their giving equivalent confidentiality undertakings); and (e) government bodies and other public authorities to comply with applicable laws and regulations.

17.4 Supplier shall take appropriate measures for storage of data and for protection of its IT systems against software bugs and viruses and unauthorized access by third parties, in order to reasonably protect information received from Siemens and the Results against loss, modification, forwarding or access by unauthorized third parties.

17.5 Insofar as Supplier is granted access to personal data in connection with the Agreement, Supplier shall comply with the statutory provisions relating to protection of personal data and data privacy and shall enable Siemens to keep itself informed that such provisions are being complied with.

18. PRODUCT LIABILITY

18.1 If Siemens is made subject to any claims by third parties based on domestic or foreign product liability law in connection with the Supply ("**Claims**"), Siemens shall notify Supplier thereof. Supplier shall indemnify Siemens against all Claims as well as the costs arising from such Claims (including but not limited to legal assistance and court costs), provided the Claims are caused by a Defect in the Supply.

18.2 Supplier shall also reimburse Siemens for all costs caused arising from any reasonable risk mitigation measures Siemens takes in connection with the Claims, including but not limited to warnings or precautionary recalls of a defective product. Any costs arising in connection with the determination of the risks involved with the Claims (including but not limited to expert costs) as well as Siemens' internal administration and processing costs shall be borne by Supplier provided the Claims are caused by a Defect in the Supply.

19. LIABILITY

19.1 Supplier's liability for breach of this Agreement shall be limited to 100% of the Agreement Price. However, this Article 19.1 shall not exclude or limit Supplier's liability for: a) all taxes, duties and fees arising in connection with its provision of the Supply; b) Supplier's infringements of the intellectual property rights of third parties and/or Siemens Group; c) Supplier's failure to comply with applicable laws; d) payment of any fines and penalties imposed on Supplier by any governmental authority due to Supplier's default; e) Supplier's own costs in connection with performance of Supplier's warranty obligations under Article 14; and f) Supplier's failure to comply with its obligations concerning confidentiality under Article 17, and shall not affect Supplier's obligation to perform the Agreement.

19.2 Supplier shall indemnify Siemens from Supplier's indirect losses, and Siemens shall indemnify Supplier from Siemens' indirect losses.

Indirect losses under this Article 19.2 include loss of earnings, loss of profit and loss of production.

19.3 The limitations in Article 19.1 and 19.2 above do not apply in case of gross negligence or wilful misconduct.

20. SIEMENS-PROVIDED ITEMS (Free Issued)

20.1 Siemens-provided Items remain the property of Siemens and shall be stored, identified as the property of Siemens, administered separately at no expense to Siemens, and used only in providing the Supply. If there is any reduction in value, damage and/or loss to such

Siemens-provided Items, Supplier shall replace the damaged item(s).

Supplier shall sign the Delivery Note/Packing List upon accepting delivery of Siemens-Provided Items, and submit this to Siemens stating the actual delivery date.

20.2 Any processing or transformation of Siemens-provided Items shall take place on behalf of Siemens, and Siemens shall immediately own the resulting new or transformed product ("**New Product**"). If this is impossible for legal reasons, Siemens and Supplier hereby agree that Siemens shall own the New Product at all times during its processing or transformation. Supplier shall safeguard the New Product on Siemens' behalf at no extra cost to Siemens and in so doing shall exercise the duty of care of a merchant.

20.3 Supplier shall at no added cost to Siemens ensure the import and export of Siemens-Provided Items from Siemens, DAP Siemens-specified location (Incoterms 2010).

21. INSURANCE

21.1 Supplier shall provide and maintain the following insurance policies ("**Insurance Policies**"): a) general third party liability insurance (including liability assumed under the Agreement) in a sum of not less than €5,000,000 (five million euros) per occurrence or series of occurrences arising from any one event; b) employer's liability insurance which shall cover losses arising from illness, personal injury or accidental death in Supplier, or to the extent required by applicable laws if such are stricter, under which the insurance amount shall at a minimum be equivalent to 20G in case of death and 40G in case of 100% disability (where "G" means "Base amount in Norwegian National Insurance (Folketrygden)"); and (c) all risks property cover for all of Supplier's property, plant and equipment.

21.2 The Insurance Policies shall include Siemens as co-insured and Supplier's insurers shall waive all and any rights of subrogation against any member of Siemens.

21.3 The Insurance Policies shall cover and be effective from the date of signature of the Agreement and shall not expire until the end of the Warranty Period. Siemens shall have no obligation to make payment to Supplier until and unless Supplier furnishes certificates evidencing compliance with this Article 21. Supplier shall notify Siemens in good time in the event that one or more of the Insurance Policies is/are cancelled, expire(s) or is/are changed so that it/they no longer meet(s) the requirements of the Agreement.

22. ASSIGNMENT

Siemens is entitled to assign, novate or otherwise transfer its rights and obligations under the Agreement, fully or partly to any third party, provided that Siemens can demonstrate that the assignee has the financial strength required to fulfill Siemens' obligations under the Agreement. Supplier may not assign its rights and obligations under the Agreement without Siemens' prior written consent, such consent not to be unreasonably withheld.

23. SUBCONTRACTING TO THIRD PARTIES

Supplier shall not subcontract to third parties not listed on the approved vendor list contained in the Agreement (if applicable) without obtaining Siemens' prior written consent thereto.

24. EXPORT CONTROL AND FOREIGN TRADE REGULATIONS

24.1 Supplier shall comply with all applicable export control, customs and foreign trade regulations ("**Foreign Trade Regulations**"). Supplier shall advise Siemens in writing within two weeks of receipt of Siemens' order for the Supply - and in case of any changes without undue delay - of any information and data required by Siemens to comply with all Foreign Trade Regulations relating to export and import as well as re-export, including without limitation: a) All applicable export list numbers, including the Export Control Classification Number in accordance with the U.S. Commerce Control List (ECCN); b) the statistical commodity code in accordance with the current commodity classification for foreign trade statistics and the HS (Harmonized System) coding; and c) the country of origin (non-preferential origin), and – at Siemens' request – Supplier's declaration of preferential origin (from European suppliers) or preferential certificates (from non-European suppliers).

24.2 Supplier shall be liable for any expenses and/or damages incurred by Siemens due to any failure to perform the obligations in Article 24.1 unless such failure is due to factors beyond Supplier's control.

25. CODE OF CONDUCT, SECURITY IN THE SUPPLY CHAIN

25.1 Supplier is obliged to comply with the laws of the applicable legal system(s) and Siemens shall have the right to audit Supplier's compliance with the provisions of this Article 25, such right to be exercised reasonably. In particular, Supplier shall not engage, actively or passively, nor directly or indirectly in any form of bribery or corruption, in any violation of basic human rights of employees or any child labour. Moreover, Supplier shall be responsible for the health and safety of its employees, shall act in accordance with applicable environmental laws and shall use best efforts to promote this Code of Conduct among its suppliers.

25.2 Supplier shall provide the organizational instructions and take measures, particularly with regard to security of premises, packing and transport, business partners, personnel and information necessary to guarantee supply chain security in accordance with the requirements of internationally recognized initiatives based on the WCO SAFE Framework of Standards such as AEO or C-TPAT. Supplier shall protect the Supply provided to Siemens or third parties designated by Siemens against unauthorized access and manipulation. Supplier shall only deploy reliable personnel in providing the Supply and shall require its suppliers to implement equivalent security measures.

25.3 In addition to other rights and remedies Siemens may have, Siemens may terminate the Agreement if Supplier fails to perform its obligations under this Article 25. However, if Supplier's breach is capable of remedy, Siemens' right to terminate is subject to the proviso that Supplier has not remedied such breach within a reasonable grace period set by Siemens.

26. ENVIRONMENTAL PROTECTION, DUTIES TO DECLARE DANGEROUS GOODS

26.1 Should the Supply contain goods which are subject to statutorily-imposed substance restrictions and/or information requirements (e.g. REACH, RoHS), Supplier shall declare such substances in the web database BOMcheck (www.BOMcheck.net) or in a format reasonably required by Siemens no later than the date of the first delivery stipulated in the Agreement. The foregoing shall only apply with respect to laws applicable at the registered seat of Supplier or Siemens or at the place of Delivery designated by Siemens.

26.2 Supplier shall also declare all substances which are set out in the "Siemens List of Declarable Substances" applicable at the time of Delivery in the manner described above.

26.3 Should the Supply contain goods which are classified as dangerous goods under international regulations, Supplier shall no later than at the date of confirmation of the order for the Supply inform Siemens thereof in a form agreed upon between Supplier and Siemens.

27. FORCE MAJEURE

27.1 Neither Party is liable for such delay or damages which are due to events including but not limited to wars, civil riots, hostilities, public disorder, nationwide strikes, epidemics, currency and other restrictions imposed by governmental authority or other events falling outside the scope of control of a Party, ("**Force Majeure**"), provided that the Party affected could not reasonably have been expected to take such event into consideration while entering into the Agreement and could not avoid or overcome its effects. Force Majeure shall not include shortage or lack of material and/or resources or shortage of transport or non-performance of sub-suppliers.

27.2 If the fulfillment of the Agreement is delayed by more than four (4) months due to Force Majeure, either Party shall have the right to terminate the Agreement by informing the other Party thereof in writing.

28. RESERVATION CLAUSE

Siemens' obligation to perform under the Agreement is subject to the proviso that its performance is not prevented by any impediments arising out of national and international foreign trade or any embargos or other sanctions.

29. GENERAL APPLICATION OF WAGE AGREEMENTS

Supplier shall ensure that its employees and all employees of its sub-contractors as a minimum receive such wages and employment conditions as required pursuant to the applicable law, including the Act Relating to General Application of Wage Agreements etc. ("Allmenngjøringsloven").

If requested by SIEMENS, Supplier shall produce valid proof of fulfillment of these requirements.

In the event of non-compliance with the obligations pursuant to this clause, Siemens may withhold remuneration to the extent necessary to cover possible claims.

30. PERMITS AND TAX RELATED ISSUES

Supplier shall ensure that all personnel working for Siemens have all necessary permits required to perform the work in question, including, but not limited to work and residency permits and ID-cards required within building and construction industry if applicable.
All necessary permits for all assigned personnel shall be acquired before the work for Siemens shall begin. If requested by Siemens, Supplier shall produce valid proof of all necessary permits.

Supplier shall ensure that all taxes related to the work performed by the assigned personnel are reported and paid in accordance with all applicable tax regulations. If requested by Siemens, Supplier shall produce valid proof of tax payments and reporting.
Supplier shall upon request provide Siemens with a copy of the current certificates of proper payment of its taxes and VAT (RF-1244), which are not older than six months.

Supplier shall upon request provide a valid official certificate from the tax authorities relieving Siemens of any responsibility with regards to any obligation in accordance with the Tax Payments Act ("Skattebetalingsloven"), including but not limited to calculation, reporting and payment of taxes in relation to this agreement.

Should Siemens by the authorities be held liable for taxes as mentioned above, Siemens may withhold an equal amount from any remuneration owed to Supplier or offset the amount against outstanding debts between the parties.

31. CHOICE OF LAW

The Agreement shall be governed by and interpreted in accordance with the laws of Norway.

32. DISPUTES

32.1 The Parties shall attempt, in good faith, to settle all disputes amicably.

32.2 Unless otherwise agreed, all disputes arising in connection with or as a result of the Agreement which are not settled amicably shall be finally settled in the ordinary courts with Oslo tingrett/District Court as legal venue.