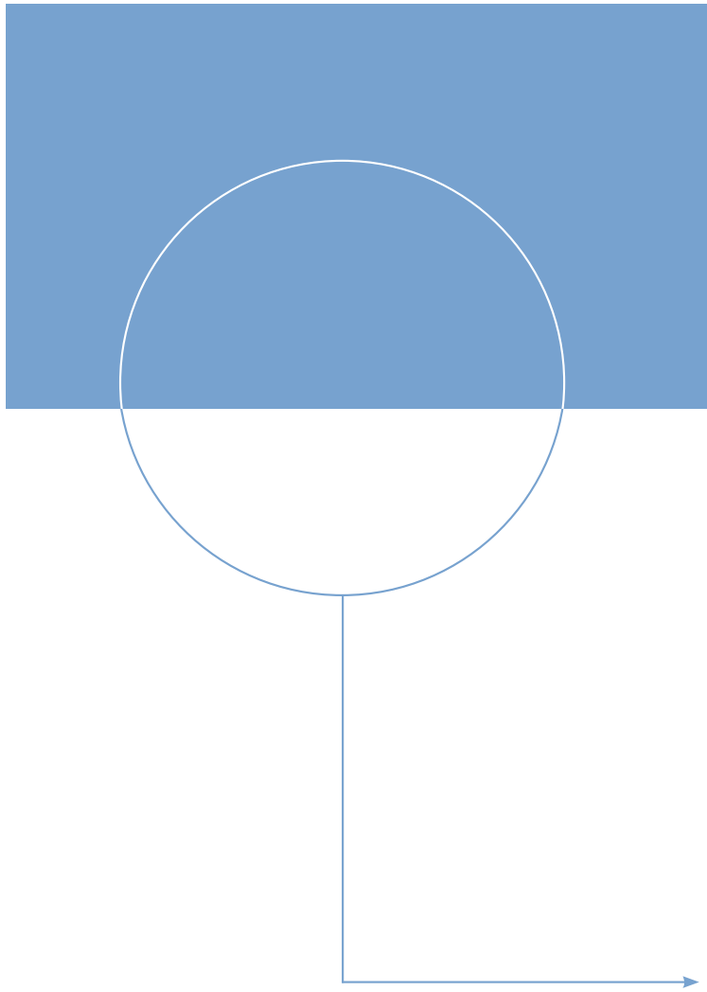

Master's thesis

2019

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An Empirical Study of the Relations Between Supply Chain Relationships and ICT

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An Empirical Study of the Relations Between Supply Chain Relationships and ICT

Ninni Kristina Andreassen

Production and Quality Engineering
Submission date: June 2019
Supervisor: Jan Ola Strandhagen
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Summary

The motivation for conducting this project has been threefold; *1)* Personal motivation, *2)* The focal case company's challenges and desire for improvement, and *3)* Findings from current research which creates an opportunity for improvement.

1) During my education at NTNU, I have developed an interest in the field of supply chain management (SCM). Through two summer internships at Jotun Norway, I have learned that Jotun is an interesting company with a complex supply chain and constant attention in improving their practices. *2)* The focal case company of this project is the Jotun Group, a globally leading supplier of paints and powder coatings. Increased customer demands mixed with global economic trends have led Jotun to wish for increased efficiency and responsiveness in their supply chain (Jotun Annual Report, 2018). *3)* Managing of trust and relationships between actors in a supply chain have been associated with increased responsiveness, improved performance and improved efficiency (Spekman et al., 1998; Handfield and Bechtel, 2002; Barratt, 2004; Majorique Léger et al., 2004; Fawcett et al., 2008; Chopra and Meindl, 2016). The use of information and communication technologies (ICT) in supply chain relationships have also been found to increase both responsiveness and efficiency (Rubiano Ovalle and Crespo Marquez, 2003; Chen et al., 2007; Cao and Zhang, 2013; Lin et al., 2014; Mirkovski et al., 2016). However, the potential benefits of ICT are often reduced due to the lack of ICT alignment among supply chain actors. (Li et al., 2009). The choice and use of new ICT systems are challenging for companies and are not found to be a focus in the literature, leading to a research opportunity.

Based on this motivation, this project aims to investigate, from a supply chain perspective, the relations between supply chain relationships and the choice and use of ICT systems. The first challenge is to find out if, to which extent, and how supply chain relationships affect the type of ICT systems companies choose to implement. Then to discuss, based on the theoretical fundament of the transaction cost theory (TCT), and the relational view (RV), how supply chain relationships could affect companies' further digitalisation. Additionally, to increase the generalisability of the findings, companies from both an emerging economy and a developed economy are included. Differences and similarities between these are highlighted.

The following research questions will be answered during the study; ***RQ1: How do the relations between supply chain relationships and choice of ICT systems affect one another? RQ2: How could the relations between supply chain relationships and choice of ICT systems affect one another in the future?***

The thesis is based on a structured literature study and empirical qualitative data. From the literature study, the following three propositions are formulated. ***1) ICT increase the supply chain relationship intensity, 2) The intensity of the supply chain relationships influences the selection of ICT systems,*** **and** ***3) High-intensity external supply chain relationships could enhance ICT alignment.***

The focal case companies of the study are two sister-companies, Jotun Group's production facilities in Dubai and Norway. Additionally, to provide insight to their supply chain relationships, a sample of their respective supply chain partners, consisting of a supplier, a transport provider and a customer to each of the production facilities have participated in the study. The empirical data are collected by eleven semi-structured interviews and three factory tours, performed in the eight individual case companies.

Findings from the empirical data agree with the literature on the fact that there are positive relations between supply chain relationships and ICT. ICT systems have simplified the information sharing in both internal relationships within a company and external relationships between supply chain actors. When choosing new ICT systems, internal relationships, company characteristics and operational characteristics highly influence the choice. There are also two examples of cases where external relationships have had an influence. For future alignment on ICT and improved supply chain visibility, actors should/could collaborate with strategic partners. According to TCT, this will tie strategic partners closer, reduce transaction costs, and create collaborative advantages according to the RV. Some challenges are also elaborated. Amongst others, the fact that many ICT systems require customisation, reducing some of the potential benefits.

Sammendrag

Motivasjonen for å gjennomføre dette prosjektet har vært tredelt. *1)* Min personlige motivasjon, *2)* Hoved-case bedriftens utfordringer og ønske om forbedring, og *3)* Funn fra aktuell forskning, som skaper en mulighet for forbedring.

1) I løpet av min utdannelse ved NTNU har jeg fått en interesse for verdikjedestyring. Gjennom to sommerjobber hos Jotun har jeg lært at Jotun Norge er et interessant firma med en kompleks verdikjede og et konstant fokus på forbedring av sine prosesser. *2)* Hoved-case bedriften i denne oppgaven er Jotun-Konsernet, en globalt ledende produsent av maling og pulverlakker. Økte kundekrav blandet med globale økonomiske trender har ført til at Jotun ønsker å forbedre både effektivitet og reaksjonsevne i sine verdikjeder (Jotun Annual Report, 2018). *3)* Styring av tillitt og relasjoner mellom aktører i en verdikjede har vært forbundet med økt reaksjonsevne, forbedret ytelse og forbedret effektivitet (Spekman et al., 1998; Handfield and Bechtel, 2002; Barratt, 2004; Majorique Léger et al., 2004; Fawcett et al., 2008; Chopra and Meindl, 2016). Bruken av informasjon og kommunikasjonsteknologi (IKT) i verdikjederelasjoner har også vist å øke både reaksjonsevne og effektivitet (Rubiano Ovalle and Crespo Marquez, 2003; Chen et al., 2007; Cao and Zhang, 2013; Lin et al., 2014; Mirkovski et al., 2016). Imidlertid blir de potensielle fordelene med IKT ofte redusert på grunn av manglende samkjøring av IKT-systemer blant verdikjedens aktører (Li et al., 2009). Valget og bruken av nye IKT systemer er utfordrende for bedrifter, og er ikke funnet å være et fokus i litteraturen, noe som fører til en mulighet for forskning.

Basert på denne motivasjonen, har dette prosjektet som formål å undersøke, fra et verdikjedeperspektiv, forholdet mellom verdikjederelasjoner og valget av IKT-systemer. Den første utfordringen er da å finne ut om, til hvilken grad, og på hvilken måte verdikjederelasjoner påvirker hvilke IKT systemer bedriftene velger å implementere. For så å diskutere, basert på det teoretiske grunnlaget fra transaksjonskostteorien (TCT) og relasjonssynet (RV), hvordan verdikjederelasjoner kan påvirke bedriftenes videre digitalisering. I tillegg, for å øke generaliserbarheten av funnene, er bedrifter fra både en fremvoksende økonomi og en utviklet økonomi inkludert. Forskjeller og likheter mellom disse er belyst.

De følgende forskningsspørsmålene vil bli besvart under studien: ***RQ1: Hvordan påvirker forholdet mellom verdikjederelasjoner og valg av IKT-systemer hverandre? RQ2: Hvordan***

kan forholdet mellom verdikjederelasjoner og valg av IKT-systemer påvirke hverandre i fremtiden?

Denne avhandlingen er basert på en strukturert litteraturstudie og empiriske kvalitative data. Fra litteraturstudien har tre følgende proposisjoner blitt formulert. ***1) IKT forbedrer relasjonene i en verdikjede, 2) Intensiteten av relasjonene i verdikjeden påvirker valget av IKT-systemer, og 3) Eksterne verdikjederelasjoner med høy intensitet kan føre til en samkjøring av IKT-systemer.***

Hoved-case bedriftene i denne studien er to søsterselskap, Jotun-konsernets produksjonsenheter i Dubai og i Norge. For å gi innsikt i deres verdikjeder har et utvalg av aktører fra deres respektive verdikjeder blitt inkludert. En leverandør, en transportleverandør og en kunde fra hver av produksjonsanleggene har deltatt i studien. Den empiriske dataen er samlet inn gjennom elleve semi-strukturerte intervjuer og tre fabrikkbesøk utført i de åtte individuelle bedriftene.

Resultatene fra den empiriske dataen er enige med litteraturen om at det er positive relasjoner mellom verdikjederelasjoner og IKT. IKT-systemer har forenklet informasjonsdeling både for interne relasjoner i et selskap eller et konsern, samt også eksterne forhold mellom verdikjedens aktører. Ved valg av nye IKT-systemer påvirker interne relasjoner, selskapets karakteristikker, samt operasjonelle karakteristikker valget i høy grad. Det finnes også to eksempler på at eksterne relasjoner har spilt inn. For fremtidig samkjøring av IKT-systemer og forbedret visibilitet i verdikjeden kan aktørene samarbeide med strategiske partnere om IKT-implementering. Ifølge transaksjonskostteorien vil dette knytte strategiske partnere nærmere og redusere transaksjonskostnadene, samt skape samarbeidsfordeler i henhold til relasjonssynet. Noen utfordringer med dette er også utdypet. Blant annet det faktum at mange IKT-systemer krever å bli skreddersydd og tilpasset til den enkelte bedriftens spesifikasjoner, som kan redusere potensielle fordeler.

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I would like to thank my supervisor, Jan Ola Strandhagen and my co-supervisor Olumide E. Oluyisola. Your feedback and guidance have been of great value in this academic process.

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To my contact person at Jotun, Kristoffer Holtan, I would like to thank you especially. For providing me with a lot of helpful insight about Jotun and for organising the trip to Dubai. You are such a kind person and I am grateful for what I have learned from you during this year.

I wish to thank my family, especially my grandfather for being so supportive and motivating, your feedback has been of great value. To my grandmother, for making sure that I am fine during this process. My uncle, Are, for helping with theoretical insight. To my supportive parents, and to Marius for believing in me, and putting out the fires.

10.06.2019

Ninni Kristina Andreassen

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List of Abbreviations

AIDC – Automatic Identification and Data Capture

AM – The Americas

B2B – Business-to-Business

B2C – Business-to-Customer

CPF – Collaborative Planning and Forecasting

CPFR – Collaborative Planning, Forecasting and Replenishment

CRM – Customer Relationship Management

EDI – Electronic Data Interchange

EECA – East Europe and Central Asia

ELM – Electronic Logistic Marketplace

ERP – Enterprise Resource Planning

FG – Finished Goods

GPS – Global Positioning System

HR – Human Resources

ICT – Information and Communication Technologies

IOS – Interorganisational Systems

IS – Information System

ISCM – Internal Supply Chain Relationship Management

IT – Information Technologies

KAM – Key Account Manager

LT – Lead Time

MEIA – Middle East, India and Africa

MP-IT – Manufacturing Plant Information Technologies

MPC – Manufacturing Planning and Control Systems

MRP – Material Resource Planning

MRP II – Manufacturing Resource Planning

MTS – Make to Stock

MTO – Make to Order

NEA – North East Asia

OR – Operations Research

OTIF – On Time in Full

PPC – Production Planning and Control

QHSE – Quality Health Safety and Environment

RBV – Resource Based View

RFID – Radio Frequent Identification

RM – Raw Material

RV – Relational View

R&D – Research and Development

SC – Supply Chain

SCA – Scandinavia

SCC – Supply Chain Collaboration

SCI – Supply Chain Integration

SCM – Supply Chain Management

SEAP – South East Asia and Pacific

SKU – Stock keeping Unit

SME – Small and Medium sized Enterprises

SRM – Supplier Relationship Management

TCT – Transaction Cost Theory

TMS – Transportation Management System

UAE – United Aram Emirates

UK – United Kingdom

VMI – Vendor Managed Inventory

VRI – Valuable, Rare and Inimitable

WE – West Europe

WMS – Warehouse Management System

1. Motivation, Introductory Information and Research Design

This project report is the outcome of my master's thesis in the course *TPK4930 – Production Management, Master's Thesis* at the Norwegian University of Science and Technology (NTNU). The project has been conducted during the spring semester of 2019. It is based on a structured literature study and a multiple-case study. The following chapter provides an introduction to the project. First, by presenting the motivation for conducting the project. Second, key concepts are defined to set the perspective of the thesis. Third, the focal case company is presented. Fourth, the research problem, research questions and research objective are elaborated. Fifth, the research scope is defined, and finally, the research process and the structure of the thesis is presented.

1.1 Motivation for Conducting the Project

The motivation for conducting this project is threefold; *1) Personal motivation, 2) The interest of the focal case company,* and *3) Findings and opportunities from current research.* These motivations are presented in the following paragraphs.

Personal motivation

During my education at NTNU, I was introduced to the subject TPK4160 – Supply Chain Management. The subjects immediately caught my attention and interest, and I wanted to write my master's thesis in this field of study. Through two summer internships at Jotun Norway, I have learned that the Jotun Group is an interesting company with a complex supply chain. Its constant interest in improving practices has been inspiring for me. This autumn, I did another project with Jotun, the specialisation project. That project resulted in a paper that can be found in Appendix 1. The findings from that project were the first initiative to start this project. The company's interest in the topic shows that it is highly relevant to the industry, making me even more motivated. Personal interest in the topic has been of great value for my work ethic and high efforts during this semester.

The interest of the focal case company

Jotun Group is currently facing two significant market challenges. The first challenge is increased customer demands, both on the level of customisation and on faster response time. The second challenge is fluctuating prices on raw materials, oil, and currencies. As a global manufacturer buying large volumes of raw materials, transporting goods and negotiating prices globally, this strongly influences Jotun's cost of production. Because of these two challenges, they aim to invest in new tools and systems to better meet customer demands, and at the same time reduce the per unit cost of production, by improving every stage of the value chain (Jotun Annual Report, 2018).

Findings and opportunities from current research – The research gap

It has been widely acknowledged that businesses now compete as supply chains rather than autonomous entities (Lambert et al., 1998). Sharing information between the supply chain actors can increase both responsiveness and efficiency of the chain (Chopra and Meindl, 2016). Managing of trust and relationships between actors in a supply chain have been associated with reduced cycle times and increased responsiveness (Handfield and Bechtel, 2002). Supply chain relationships also have a positive effect on supply chain performance, leading to reduced costs and improved efficiency (Spekman et al., 1998; Barratt, 2004; Majorique Léger et al., 2004; Fawcett et al., 2008). However, managing trust, relationships, and information sharing between actors become increasingly challenging in complex supply networks.

An industry associated with complex and global supply networks is the chemical process industry. Here the manufacturers usually are positioned in the middle of wider supply chains with many suppliers and customers scattered worldwide (Shah, 2005; Barbosa-Póvoa, 2012). Existing research on this industry matches Jotun's challenges and addresses the fact that there is a need to reduce both costs and inventories. It also highlights the need to reduce the time to market, due to increased competition. Hence, the conclusion is that there is a need for both improved efficiency and responsiveness in the chemical process industry (Shah, 2005; Papageorgiou, 2009; Barbosa-Póvoa, 2012; Liu and Papageorgiou, 2013).

The use of information and communication technologies (ICT) both improve the quality of the information shared and also simplify the sharing of information (Rubiano Ovalle and Crespo

Marquez, 2003; Chen et al., 2007; Cao and Zhang, 2013; Lin et al., 2014; Mirkovski et al., 2016). “By having a common system across supply chains, the complexity of communication is reduced, and a number of benefits have been achieved” (Wang et al., 2011). However, the potential benefits of ICT implementation are often reduced due to the lack of ICT alignment among supply chain actors. (Li et al., 2009). The choice and use of new ICT systems are challenging for companies and are not found to be a focus in the literature, leading to a research opportunity. The rapid development of technological solutions makes this topic also relevant to companies' future digitalisation.

Several researchers also highlight the need to apply holistic perspectives on supply chain relationships. In their research on supply chain relationships and performance, Rosenzweig (2009) highlight that their research only collects the manufacturers perspective of the relationship, and that the customers' point of view might be different. They and others, therefore, claim that future research should incorporate both upstream and downstream linkages to enlarge the perspective of supply chain relationships (Rosenzweig, 2009; Bartezzaghi and Ronchi, 2003; Sanders, 2007). Additionally, Jean et al. (2014) claims that the effect of national cultural differences on the adoption of ICT have been given little attention in the past. Mirkovski et al. (2016) stress the fact that findings from developed economies are not directly applicable to emerging economies due to differences in infrastructure and culture.

1.2 Definitions of Key Concepts

The key concepts used in this project are described here to unify the understanding of these concepts before they are used to further define the project. An extended number of concepts and the theoretical fundament of the thesis are further elaborated in Chapter 3.

Supply Chain

A supply chain consists of all actors involved in fulfilling a customer request. The actors might be involved either directly or indirectly, and include, for example, raw material suppliers, manufacturers, transport providers, wholesalers, retailers and customers. "Each stage in a supply chain is connected through the flow of products, information and funds” (Chopra and Meindl, 2016, p.15). The objective of a supply chain is to maximise the overall value generated, and the

only source of revenue is the end-customer. A supply chain *actor* is a collective term, describing a company that is involved, acts, in a supply chain. The term *chain* implies a linear chain of supply, with only one actor involved in each stage. However, in reality, the supply chains are better described as *networks*, consisting of multiple actors (Chopra and Meindl, 2016).

Operations Management and Supply Chain Management

Operations management (OM) concerns how organisations create and deliver products (Slack et al., 2013). Supply chain management (SCM) is defined as the management of processes, and internal and external relationships in a supply network (Lambert et al., 1998). SCM includes a holistic view of all the actors in the supply chain and aims to achieve the supply chain objective. OM and SCM are closely linked, and SCM is often viewed as a part of OM. (Slack et al., 2013).

Supply Chain Relationships

The definition of a supply chain yields that not all actors in a supply chain are directly involved with one another. For example, a retailer is not necessarily directly involved with a raw material supplier, even though they are both actors in the same supply chain. The term supply chain relationship is used as a generic term and is defined as the case where a relation exists either within or between supply chain actors that are directly involved with each other. *Internal relationships* describe the relations that exist within a company, for example, between facilities, departments or employees. While *external relationships* are relationships that exist between two independent actors in a supply chain. Two supply chain actors having a supply chain relationship are referred to as supply chain *partners* (Cao and Zhang, 2013). When discussing external relationships, it is common to distinguish between *vertical* and *horizontal* relationships. Vertical relationships exist between two supply chain partners, while horizontal relationships exist between two supply chain competitors, being at the same stage of the supply chain (Mason et al., 2007).

Information and communication technologies (ICT)

Information technology (IT) is defined as the hardware and software used to collect, store and process information. The past decades, both the range, scope and nature of IT has changed radically, pushing the boundaries of production and consumption. The term, therefore, now

includes communication, to also focus on the outreach and communication possibilities of IT (Hand, 2011). Information and communication technologies (ICT) are therefore used in this thesis as a generic term, to describe the electronic information technologies used for information gathering, processing and sharing in a supply chain, both internally, and externally.

Relation-specific investment

A relation-specific investment, also called asset-specific investment describes an investment, where the value of the investment is reduced outside the exchange relation (Riordan and Williamson, 1985). Relation-specific investments are a key concept of the transaction cost theory (TCT) and the relational view (RV). These theories and relation-specific investments are explained in detail in Chapter 3.

1.3 Introduction to the Focal Case Company – The Jotun Group

The focal case company of the project is the Jotun Group, hereafter called Jotun, a globally leading supplier of paints and powder coatings. Its products are divided into four different segments; decorative paint, marine coatings, protective paints, and powder coatings. As of 2018, Jotun has a total number of 9872 employees, and yearly operating revenue of 17 660 MNOK. Jotun is represented in more than 100 countries and has 40 production facilities in 24 countries. The operations are divided into seven regions, The Americas (AM), Scandinavia (SCA), West Europe (WE), East Europe and Central Asia (EECA), Middle East, India and Africa (MEIA), North East Asia (NEA) and South East Asia and Pacific (SEAP) (Jotun Annual Report, 2018).

In this project, two of Jotun's production facilities are used as focal case companies. These are the two sister-companies, Jotun Dubai representing the MEIA region and Jotun Norway, which represents the SCA region. Even though Jotun as a group produce paint in several different segments, the emphasis of this project is on the decorative paint supply chain. This is because both Jotun Dubai and Jotun Norway mainly produce decorative paint. Additionally, six of their supply chain partners, three partners from each of the two production facilities are included. These are two suppliers, two transport providers, and two customers, one from each facility's respective supply chain. The supply chains are illustrated in Figure 1.

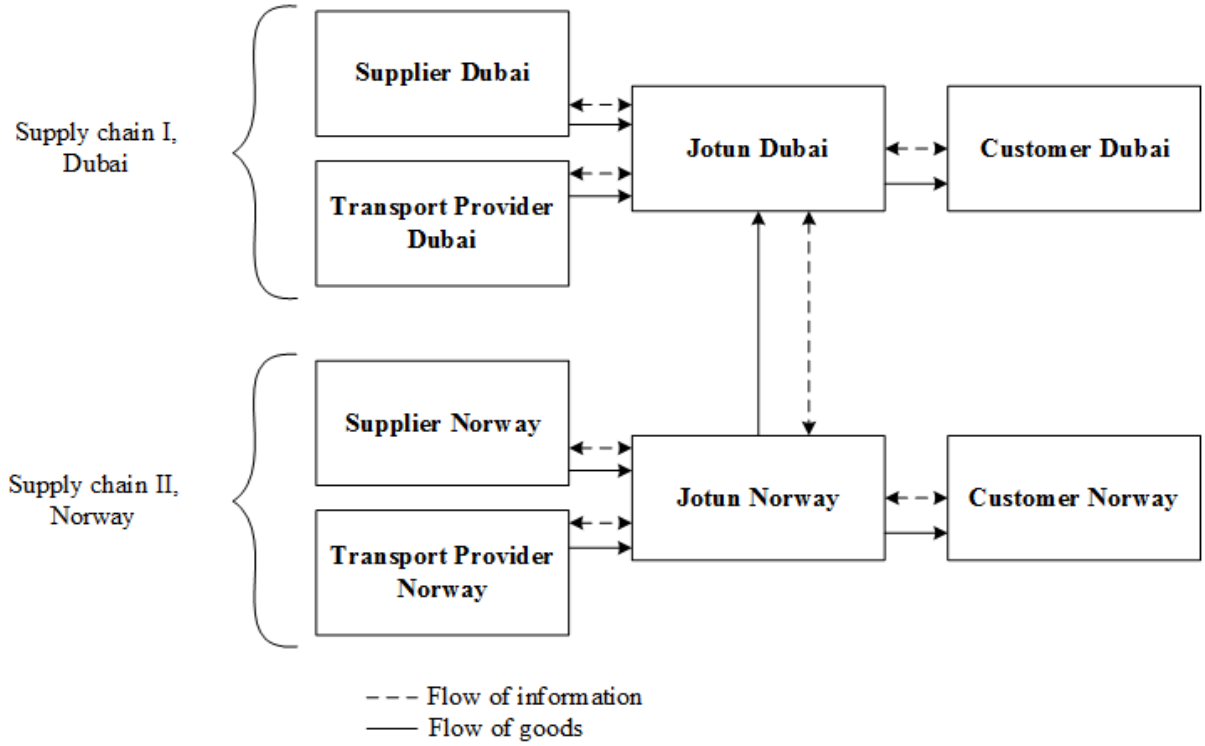

Figure 1 Supply Chains of Jotun Norway and Jotun Dubai

1.4 Research Problem, Research Questions and Research Objective

Originating from the motivation presented in Subchapter 1.1, this project aims to investigate the relations between supply chain relationships and ICT. Also, the project seeks to examine differences and similarities of these relations in an emerging economy compared to a developed economy. Hence, the objective of this project is to discover the relations between high-intensity supply chain relationships and the choice of ICT systems. Further, to discuss how high-intensity supply chain relationships and the choice of ICT systems could relate to one another in the future. In order to achieve these objectives, two research questions (RQ) are defined. Being the common thread in this thesis.

RQ1: How do the relations between supply chain relationships and choice of ICT systems affect one another?

RQ2: How could the relations between supply chain relationships and choice of ICT affect one another in the future?

The objective of the first research question (RQ1) is to discover and present the relations existing between high-intensity supply chain relationships and the choice and use of ICT, to see how they affect one another in the case companies used in the study. The objective of the second research question (RQ2) is to discuss, based on information from the cases and existing theories and literature, how the relations between supply chain collaboration and ICT could affect one another in the future. To introduce and provide arguments for focus areas that companies should pay attention to when they chose ICT systems, or emerging technological solutions, to implement in their supply chain. The differences and similarities of companies acting in an emerging economy compared to a developed economy will also be reflected. Table 1 shows an overview of the research questions, their objective and what type of data that will be used when answering the questions.

Table 1 Research Questions and their related Objectives

RQ	Objective	How is the insight provided
RQ1: How do the relations between supply chain relationships and choice of ICT affect one another?	Discover and present relations between supply chain relationships and the choice and use of ICT	Literature study Empirical data
RQ2: How could the relations between supply chain relationships and choice of ICT affect one another in the future?	Discuss how high-intensity supply chain relationships could affect supply chain digitalisation. Introduce focus areas to emphasise when implementing new technological solutions in the supply chain.	Literature study Theoretical fundament Empirical data

1.5 Research Scope

The research scope defines the boundaries of the research, describing what is included and not in the project. The concepts used here are defined in Subchapter 1.2. The scope of this research is presented in the following paragraphs, and an illustration, created to provide an overview, is presented in Figure 2.

Supply chain management

The fundamental perspective of this research considers supply chain management, indicating that businesses compete, and are viewed as supply chains rather than autonomous entities (Lambert et al., 1998), allowing a holistic view of the chain.

Supply chain relationships

The relationships existing within and between partners in a supply chain are included. The theoretical part of the research is concerned around internal and external supply chain relationships in general. The empirical part of the research does emphasis on the supplier's relation to the manufacturer, the transport provider's relation to the manufacturer, the internal relationships that exist within the manufacturer and the customer's relation to the manufacturer of the supply chains illustrated in Figure 1.

Information and communication technologies

Further, ICT is included in the scope. The study emphasises on the ICT systems deployed by the companies. These fall under the three categories of Sharing technologies, Planning and control systems and Track & trace technologies. How the different ICT systems work and are developed and implemented will not be focused in this project.

The supply chains

As highlighted in Subchapter 1.2, a supply chain is usually better explained as a supply network, consisting of multiple actors. However, this project uses a simplified focus, modelling one chain consisting of a supplier, a transport provider, a manufacturer and an end customer. By using this supply chain perspective, actors from two separate supply chains are included, as illustrated in Figure 1. The company characteristics, market characteristics, relationship characteristics and ICT-characteristics of the companies are presented and compared. In each of the two supply chains, the manufacturer is considered the base and the other actors included are supply chain partners of the manufacturer. By this follows that the supplier to the manufacturer is hereafter called the supplier. The transport provider to the manufacturer is called the transport provider. The manufacturer itself is called the manufacturer, and the customer to the manufacturer is hereafter called the customer.

The relations between supply chain relationships and ICT

The key focus is the relations that exist between the supply chain relationships and ICT. Being is the main scope of this project. The emphasis is on the technological level, differences in the market characteristics and

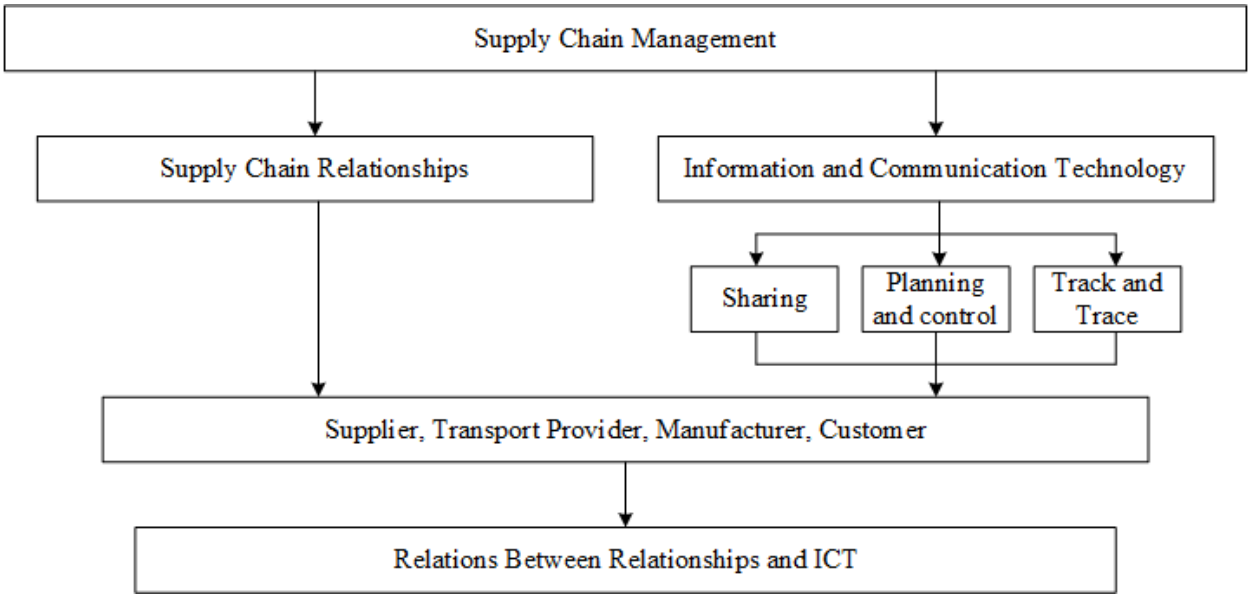

Figure 2 Research Scope

1.6 The Research Process and Structure of the Thesis

The topic of the project has developed during the study and had to be slightly adjusted according to the findings. Initially, the study was supposed to have a main-focus on collaboration and digitalisation technologies. However, ICT was found to be more appropriate.

As stated in Subchapter 1.1, this project has originated from an earlier project. During the other project, the terminology of internal collaboration, vertical collaboration and horizontal collaboration was used. For this reason, this literature study focuses on internal and vertical collaboration. During this project, the literature study showed that there exist different types of supply chain relationships; collaboration, coordination, cooperation, and integration. Understanding this, new literature searches were performed including these terms, in order to improve the search. However, this resulted in thousands of hits, and it was not possible to reduce the number of hits without reducing the terminology. The literature study has, therefore, been focussed around internal and vertical collaboration and not relationships in general.

The structure of the thesis is illustrated in Figure 3. Chapter 1 builds an understanding of the motivation and background of the problem, describing the problem and scope of the study. In Chapter 2, the research methods applied and how and why these methods have been used are presented. Chapter 3 aims to define concepts, to unify the understanding of these concepts, and to introduce theories, that will later be applied when discussing the findings. Chapter 4 presents the findings from the literature study. Chapter 5 and 6 present data collected from the empirical study, first by presenting the case companies in Chapter 5, then by presenting the relevant findings from the case companies, and a cross-case comparison in Chapter 6. Chapter 7 presents the reflections and discussion of the empirical findings in light of the literature study and the theoretical fundament. Finally, Chapter 8 provides the conclusion, limitations and opportunities for further work.

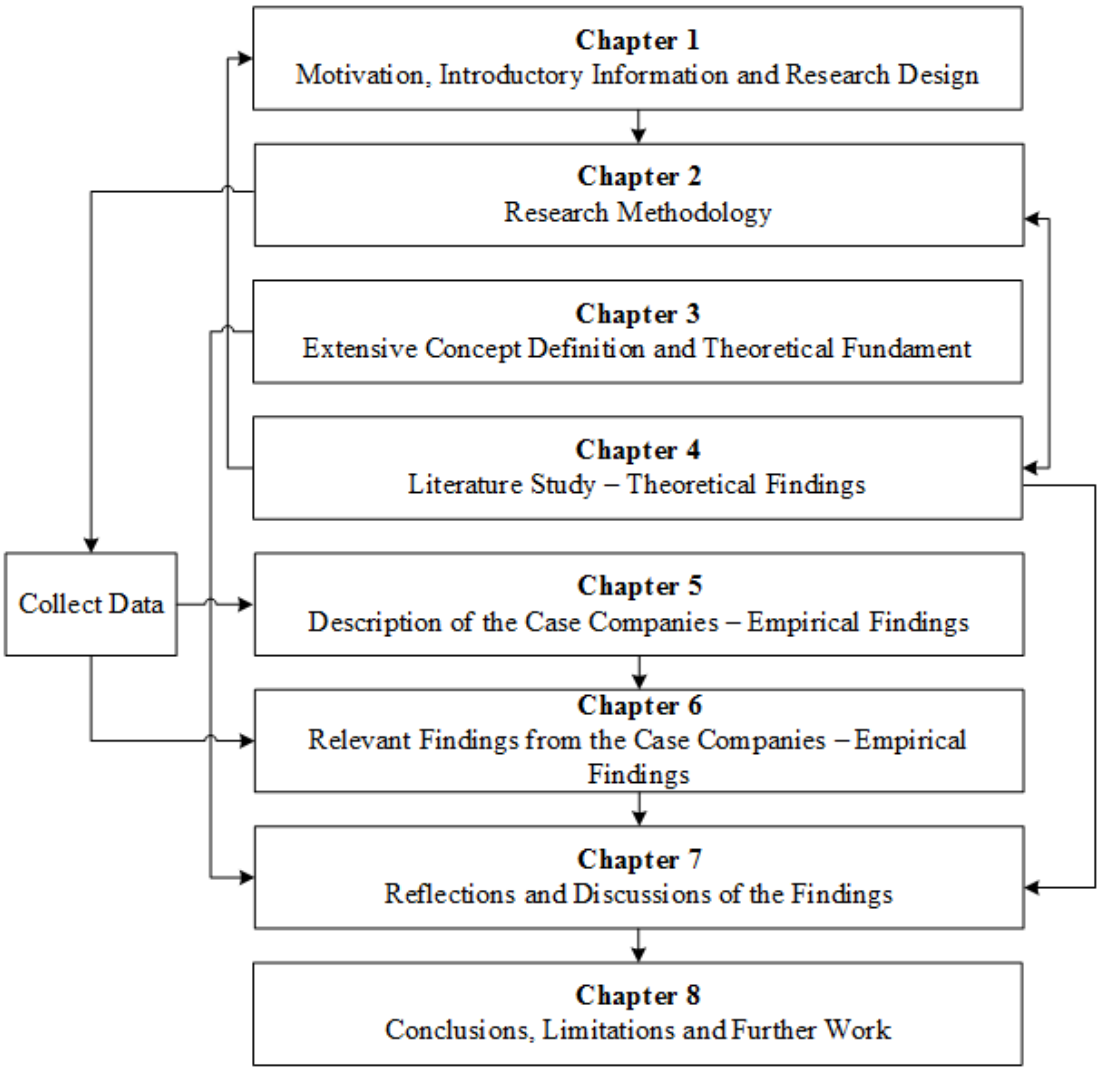

Figure 3 Structure of the Thesis

2. Research Methodology

The research methodology concerns not only the research methods applied but also the logic behind choosing these particular methods when researching a particular problem in a particular context (Kothari, 2004). In this chapter, the research methods applied, and the logic behind choosing them are elaborated.

Before the research methodology is decided, the first step of the research process is to define a research problem (Kumar, 2019). The research problem is presented in Chapter 1. The research problem is defined based on the motivation presented in Subsection 1.1, and a gap in the existing research on the field of study. The method used to explore current research and find the research gap is a structured literature study, and the approach is explained in detail in the following Subchapter 2.1. The next step of the research process is then to construct the instrument for data collection, and a sample to investigate should be selected before the data is collected (Kumar, 2019). This process is described in Subchapter 2.2.

2.1 Theoretical Methodology – Literature Study

"A fundamental part of any academic research is to review the existing academic literature on the field of interest. This helps to establish the authority and legitimacy of the research, but more importantly, it ensures the "research-ability" of the topic before the empirical analysis begins" (Karlsson, 2008, p. 49). Therefore, a structured literature study has been conducted. The intention of this literature study is not to conduct an in-depth literature review, but to call attention to research and findings from the current academic literature on the field of interest.

First, to obtain a general overview of the topic and terminology used in this field of research, textbooks from Chopra and Meindl (2016), Slack et al. (2013), Christopher (2016), and Cohen (2005) were examined. After that, several "random searches" in Google Scholar were conducted to get a general impression of what has been done in the field (Karlsson, 2008). Also, the literature provided by the supervisor was included in this part of the theoretical research.

The aim of the literature study was threefold. *1)* To gather sufficient and relevant knowledge on the topics of supply chain collaboration and the use of ICT. *2)* To get knowledge about what has already been researched in the field. *3)* To design the interview guides used in the multiple-case studies. The outcome of this literature study is presented in Chapter 4.

2.1.1 The Building Block Search

As knowledge was gained on the topic of supply chain collaboration and ICT, the strategic selection of keywords for the building block search (Ridley, 2012) was conducted. The keywords selected for the search are illustrated in Table 2. The keywords were chosen through an iterative process and split into three levels. The first level gives a general context for the topic, while the second and the third level are conjunctions, to narrow the search and find the most relevant articles. It was challenging to select the appropriate keywords due to the large amount of research done on this topic. Therefore, some keywords have been skipped to reduce the number of hits, these are "industry 4.0", "Supply chain relationships" and "Supply chain integration" and only the following, specific words were kept, limiting the search.

Table 2 Keywords

Level 1	Level 2	Level 3
Supply chain	Digitalisation	Internal Collaboration
Logistics	Digitalization	Vertical Collaboration
Operations Management	Information Technology	E-collaboration
Supply Network	Track and Trace	
Value Chain	Planning	
	Information and Communication Technology	

These keywords were then applied in three different databases, by the following algorithms. The algorithm used in the database of Emerald insight is shown in Table 3. The algorithm used in the database Science direct is shown in Table 4, and the algorithm used in the database Web of Science is illustrated in Table 5:

Table 3 Search Algorithm used at Emerald Insight

	("Supply chain" OR "logistics" OR "operations management" OR "Supply network" OR "Value chain")	Anywhere
AND	("Digitalisation" OR "Digitalization" OR "Information Technology" OR "Track and trace" OR "Planning" OR "Information and Communication Technology")	Anywhere
AND	("Internal Collaboration" OR "Vertical Collaboration" OR "e-collaboration")	Anywhere
Article types	Articles/Chapters	
Publication Date	01/01/1999 – 31/01/2019	
Number of hits	208	

Table 4 Search Algorithm used at Science Direct

Find articles with these terms	("Digitalisation" OR "Digitalization" OR " Information Technology " OR "Track and trace" OR "planning" OR " Information and Communication Technology ") AND ("Internal Collaboration" OR "Vertical Collaboration" OR "e-collaboration")
Title, abstract or keywords	("Supply chain" OR "logistics" OR "operations management" OR "Supply network" OR "Value chain")
Article types	Review articles and Research articles
Years	1999 – 2019
Number of hilts	124

Table 5 Search Algorithm used at Web of Science Core Collection

	("Supply chain" OR "logistics" OR "operations management" OR "Supply network" OR "Value chain")	Topic
AND	("Digitalisation" OR "Digitalization" OR " Information Technology " OR "Track and trace" OR "planning" OR " Information and Communication Technology ")	Topic
AND	("Internal Collaboration" OR "Vertical Collaboration" OR "e-collaboration")	Topic
Timespan	Custom year range (1999-2019)	
Number of hits	18	

The total number of papers found in the search was 350, where10 papers occurred twice, resulting in a total amount of 340 papers. The papers were then sorted by relevant journals. All papers should be from relevant research community journals and peer-reviewed. Therefore, the first step was to remove book sections and conference papers and keep only papers from journals concerning topics of logistics, supply chain management, operations management, and technology used in logistics, or collaboration in supply chains directly. This resulted in 264 papers, from journals, shown in Appendix 2.

Then, titles and abstracts of all these 264 papers were read, and they were sorted by relevance by the following criteria:

- Only articles concerning vertical or internal collaboration are accepted.
- Only articles concerning both the use of ICT and collaboration are accepted.
- Only B2B relationships were accepted
- Only supply chain-focus were accepted
- Only empirical articles are accepted

The literature search, with all sorting criteria, resulted in 37 papers. An overview of these is presented in Table 7.

2.2 Empirical Methodology – Multiple-Case Study

After the theoretical fundament of the research has been established, empirical data are collected to test or strengthen the arguments (Kothari, 2004). In the following paragraphs, first, some methodological concepts are presented, then the research methods used for collecting empirical data, together with the logic behind the method selection, are provided.

Validity and reliability

The quality of the research is often determined by the validity and reliability of the empirical findings. The validity refers, among other things, to the domain where empirical findings can be generalised, while the reliability refers to the extent to which the data collection can be repeated. To improve the quality of the study, several data sources, so-called data triangulation could be used to gather the information (Yin, 2003).

Primary or secondary sources of data

When discussing empirical data, it is common to distinguish between primary and secondary sources of data. The primary data are original and collected afresh for the project. Secondary data have already been collected (Kothari, 2004).

Qualitative or quantitative data

When researching a phenomenon, there are two basic approaches. The *quantitative* approach and the *qualitative* approach. The quantitative research approach focuses on measuring data based on quantity or amount (Kothari, 2004) and often includes the use of mathematical and statistical tools to test hypotheses or build upon existing knowledge (Karlsson, 2008). However, the label *qualitative method* "has no precise meaning, and should rather be seen as an umbrella covering an array of interpretive techniques that seek to describe, decode, translate and come to term with the *meaning* of naturally occurring phenomena" (Van Maanen, 1979). Whether the empirical data should be gathered in the form of quantitative or qualitative methods, depends on the maturity of the current research on the field (Edmondson and McManus, 2007).

Deciding the empirical research methodology

When deciding which research methodology to apply, one significant consideration is the substance and the form of the research question(s) (Yin, 2003). The majority of research found in the literature study has been based on surveys, which often provides quantitative data. However, this study, are mainly based on qualitative data, gathered through a multiple-case study method. This has been chosen due to the following reasons:

According to (Yin, 2003), when the research question(s) concerns "how"-questions, case studies are especially suitable. Since the research questions in this project concern two “how”-questions, it is especially suitable for case research. Also, case study research has been a popular research method in operations management (Karlsson, 2008). Multiple-case studies include more than one unit of analysis, which is more appropriate when researching a complex issue (Cassivi et al., 2005). This research aims at researching more thoroughly the relationships between the supply chain partners, and the multiple-case study provides qualitative knowledge and more in-depth insight into the technological and relational factors. The multiple-case study also allows for data triangulation. In this research, data triangulation has been used by having three individual site-visits, eleven semi-structured interviews at eight different companies and case presentation and other documents from the participating companies have been used in addition to literature and theory insight. Both primary and secondary data have also been used. The secondary data have been gathered in the literature study, from case presentations and other documents provided by some of the case companies, and by interviews done for my earlier project with Jotun, shown in Appendix 1.

Creating the Interview questions

There exists only a limited amount of literature on this field of study, a so-called *nascent* state, of prior theory and research. Therefore, qualitative data, collected through interviews, are suggested as the empirical research method (Edmondson and McManus, 2007). The semi-structured interview format has been used here in order to gain both in-depth knowledge from expert managers but also to easier relate the answers to the theory. The interview questions have been carefully defined and based on the literature and expert input from my supervisor. An interview guide is attached in Appendix 3. To be able to compare the companies best possible, and to increase

the validity and reliability, the interview questions have the same for all participants, with only small individual variations. For example, the transport providers were not asked about their production processes, but rather about whether they were operating as freight forwarders, carriers or 3rd party logistics providers.

Selection of informants

The selection of informants has been based on three main conditions. *1) Practical conditions*: since I am in contact with Jotun already, it is practical to use Jotun as the focal case company. *2) Expediency*: It has been expedient to interview other actors in Jotun's supply network when getting in touch with their supply chain partners. *3) Strategic selection*: the selection of the other actors to interview has been strategic in the way that they in total cover the whole (simplified) supply chain.

In total, 18 people have contributed to the empirical data of this research. The empirical data sources are shown in the following Table 6. The secondary empirical data was collected during the project found in Appendix 1.

Table 6 Sources of the Empirical Data

Company	Title	Personal Responsibilities	Method	Primary/ Secondary
Jotun Dubai	Purchasing Manager	Purchase orders	Semi-structured interview	Primary
	Planning Manager	Production planning	Semi-structured interview Factory Tour	Primary
	Warehouse and Logistics Manager	The FG warehouse Outbound Transportation	Semi-structured interview	Primary
	Logistics and Customer Service Manager	Logistics Customers Outbound Transportation	Semi-structured interview	Primary
Balmer Lawrie LLC	Head of marketing	Marketing and procurement	Semi-structured interview Factory Tour	Primary
PrimeLink	Business Development Manager	Bring new business to the company	Semi-structured interview	Primary
Mohd. al. Qama	Purchase Manager	Purchasing	Semi-structured interview	Primary
	Inventory Manager	Inventory control	Semi-structured interview	Primary
Jotun Norway	Change Agent – Production	Change management	Factory Tour	Secondary
	Supply Manager	Supply or RM, packaging and merchandise	Introductory interview	Secondary
	Assistant Supply Manager	Supply of RM, packaging and merchandise	Semi-structured interview	Secondary
	Planning Manager	Production planning	Semi-structured interview	Secondary
	Transport Manager	Outbound transportation	Introductory interview	Secondary
	Logistics and Distribution Manager	RM storage Supply department Customer service Transport department FG warehouse Company cars	Factory Tour Introductory interview 2 Semi-structured interviews	Primary and Secondary
	Group Logistics Manager	Logistics optimisation Framework agreements Synergies in Jotun Sharing of best practice	Introductory interview, background information, documents,	Primary and Secondary
Emballator Ulricehamn	Key Account Manager	Manage customer portfolios	Semi-structured interview, phone	Primary
Schenker	Key Account Manager	Manage customer portfolios	Semi-structured interview	Primary
Farveringen	Operation and Logistics Manager	Operation Warehouses Purchasing department	Semi-structured interview	Primary

3. Extensive Concept Definitions and Theoretical Fundament

This chapter provides definitions of an extensive amount of concepts to the ones provided in the introduction. Following, the theoretical fundament of the project is presented.

3.1 Extensive Concept Definitions

Keeping in mind the definitions provided in Subchapter 1.2, this subchapter defines an extended number of concepts used in this thesis.

Relationship management

Relationship management is defined as the supervision and maintenance of relationships. There are three main areas to emphasise when managing supply chain relationships. These are called supply chain macro processes and consist of *supplier relationship management* (SRM), *internal supply chain management* (ISCM) and *customer relationship management* (CRM). These and their corresponding processes, called macro-processes, are illustrated in Figure 4. In order to plan, produce and sell a product by the smoothest possible flow and to the lowest possible price, these macro processes need to be managed carefully (Chopra and Meindl, 2016). These three types of relationship management will be focused on this project.

Figure 4 Supply Chain Macro Processes. Adapted from: Chopra and Meindl (2016)

Supply chain cooperation, coordination, collaboration and integration

The term relationship is broad and generic. To distinguish one relationship from another, they are categorised by several factors, describing the nature of the relationship. According to Spekman et al. (1998), one can categorise the *intensity* of a relationship based on the level of trust, commitment

and information sharing that exist between the partners. They have created a framework to describe the supply chain relationship intensity, shown in Figure 5. Differentiating between open market negotiations, cooperation, coordination and collaboration. Further, they conclude that the developments of relationships are comprehensive, and a company needs to select partners and relationship strategies carefully. The strategy should be selected based on the buyer or supplier strategic importance and complexity.

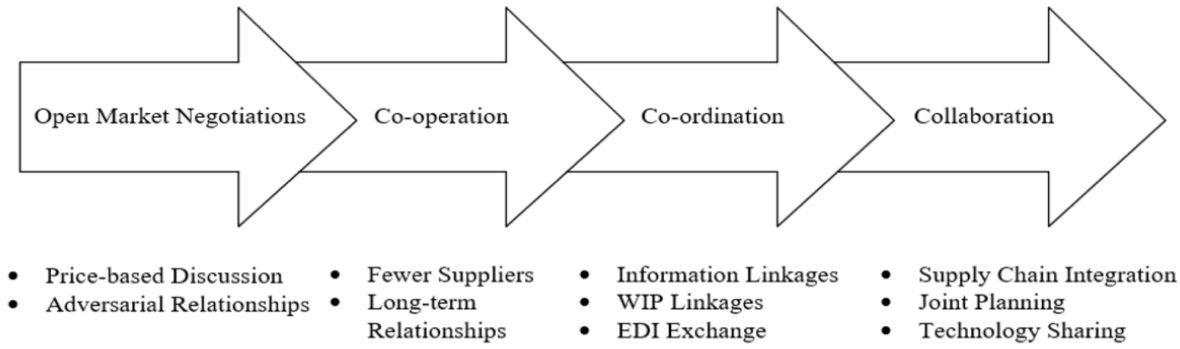

Figure 5 Supply chain relationship intensity model. Adapted from: Spekman et al. (1998)

Open market negotiations correspond to a low relationship intensity. The only type of information that is shared is price-based discussions, and the relationship is adversarial (Spekman et al., 1998). Even though actors with this type of relationships might exist in a supply chain, it is left outside the scope of supply chain management, because the objective of the price-based discussion is to optimise the single company surplus and not the supply chain as a unity (Lambert et al., 1998).

Cooperation is considered as the starting-point for supply chain management and defined as the case where firms exchange bits of essential information and have some long-term contracts (Spekman et al., 1998). It is defined as a relation where the actors stay autonomous from each other, but achieve unity of motivation, by, for example, alignment of incentives (Cao and Zhang, 2013).

Coordination is considered the next level of intensity, where workflow and information are shared by seamless linkages between actors (Spekman et al., 1998). The supply chain actors still operate as autonomous units, but they strive to achieve unity of action, for example, synchronisation of

decisions. They do this to obtain improved supply chain outcomes and reduce suboptimalities (Cao and Zhang, 2013).

Collaboration and *integration* have, in many cases, been used interchangeably, and they both refer to an intense relationship between two autonomous supply chain partners. However, *integration* is defined as the case where the control of processes is unified, with an emphasis on contracts and central control. *Collaboration*, on the other hand, is an intermediate form of hybrid governance and emphasise more on governance through relational means in addition to the contractual means. "Thus, supply chain collaboration is a better concept to capture the joint relationship between autonomous supply chain partners." (Cao and Zhang, 2013). In Figure 5, Spekman et al. (1998) claim that supply chain integration is a segment of collaboration. However, Cao and Zhang (2013)'s arguments are based on the transaction cost theory (TCT), which is one of the theories used in this thesis. For this reason, this thesis views integration and collaboration is as two different types of relationships, and the emphasis of the thesis is on collaboration more than integration.

Collaboration has been defined in numerous of ways during the past decade (Hyland and Soosay, 2015). Another descriptive definition, made by Simatupang and Sridharan (2002) reads “Supply chain collaboration is often defined as two or more chain members working together to create a competitive advantage through sharing information, making joint decisions, and sharing benefits which result from greater profitability of satisfying end customer needs than acting alone.” This definition is also added to the concept of collaboration.

Efficiency and responsiveness

Supply chain responsiveness is defined as the supply chains ability to: “Respond to wide changes of quantities demanded, meet short lead times, handle a large variety of products, build highly innovative products, meet a high service level and handle supply uncertainties” (Chopra and Meindl, 2016, p.38). This is, however, very costly. In contradiction to responsiveness, the supply chain efficiency is defined as "the inverse of cost of making and delivering a product to a customer" (Chopra and Meindl, 2016, p.38). Drawing on Jotun’s wish to both manage increased customer demands and reduce the per unit cost of production, this means they wish to improve both the responsiveness and the efficiency of their supply chain.

Trust and reduction of uncertainties

Volatile market conditions increase uncertainties for a company. According to the transaction cost theory, uncertainties are among the underlying reasons for increased transaction costs. Entering supply chain relationships might contribute to reducing uncertainties. The amount of reduced uncertainty relies on the intensity of the relationship, which is dependent on mutual trust in the relationship. Several incentives can be used to increase trust in a supply chain relationship. For example, increase the time-horizon, the frequency of contact and the mutual dependency of the companies. By increasing the mutual trust and dependency between two supply chain partners, the risk of opportunistic behaviours is also reduced (Cao and Zhang, 2013). Opportunistic behaviour means that either information, actions or both are hidden from supply chain partners in order to obtain an advantage (Lyons and Mehta, 1997).

3.2 Theoretical Fundament

In this subchapter, the theoretical fundament of the project is introduced. This project is based upon two main theories, the transaction cost theory and the relational view. Common for the theories is the concept of relation-specific investments and will be one of the fundament concepts in the discussion presented in Chapter 7.

Transaction cost theory (TCT) and Asset-specific investments

The core goal of a supply chain is to maximise the overall supply chain surplus. By reducing costs, the overall surplus increases (Chopra and Meindl, 2016). A transaction cost is considered as the cost of a transaction, representing all expenses incurred with buying or selling a good or service. Therefore, to reduce the cost of a product, it is vital to find organisational solutions that reduce transaction costs. This is recognised as the fundamental argument of the transaction cost theory (TCT). The origin of TCT was first introduced by (Coase, 1937), later the theory was developed during the 1960's and 1970's by Oliver E. Williamson (Williamson, 2010). TCT is one of the most dominant theories used in external collaboration and ICT use (Cao and Zhang, 2013). There exist considerable opportunities for researching supply chain management problems with the application of TCT (Grover and Malhotra, 2003).

Cao and Zhang (2013) state that supply chain collaboration reduces uncertainties, opportunism and can lead to competitive advantages because it 1) reduces the transaction costs, 2) requires asset-specific investments and 3) is imperfectly imitable. *Asset-specific investments*, or asset specificity, is one of the key segments in the TCT. It describes a cost, where the value of the investment is reduced outside the exchange relation (Riordan and Williamson, 1985). "Investments in information systems that primarily serve the needs of one unique customer and cannot be leveraged across other external parties would also be another form of asset-specific investment" (Grover and Malhotra, 2003). Therefore, asset-specificity is a central concept of this thesis.

The Relational View (RV)

Few supply chain collaboration-relationships are based on the pure consideration of transaction costs (Cao and Zhang, 2013). Therefore, one complementing theory is introduced, the relational view (RV). The RV also considers asset-specific investments; however, usually, referring to *asset-specific investments* as *relation-specific investments* or *relation-specific assets.*

The RV argues that companies could earn relational rents by investing in relation-specific assets. A relational rent is defined as a common benefit, generated through a joint contribution between the partners, to amongst other things, reduce transaction costs (Dyer and Singh, 1998). The RV further claims that relational rents lead companies to obtain collaborative advantage because of their relationships. One can view ICT systems as relational rents that are valuable, rare and inimitable (VRI). "E-collaboration can be seen as a valuable and rare IT capability for suppliers in dealing with their international customers." (Jean et al., 2014). Therefore, this project will rely on both the TCT and RV when discussing the findings in Chapter 7.

Omitted theories

The presented theories are all more comprehensive. However, the central extraction is the relation-specific investments, which will be the main focus area in this project. Also, there exist several other theories that could have been used but were omitted. Amongst others, the resource-based view (RBV) implies that the variance of companies' performance is due to internal resources, capabilities and strategic assets (Cao and Zhang, 2013). RBV builds on the TCT and highlights

that a company should look inside to obtain competitive advantages. The relational view (RV) is developed based on the RBV but claims that the essential resources are the ones at the interactions between companies. Therefore, RBV is omitted in this thesis, while RV highly relevant and included in this thesis. Also, the Resource Dependency Theory was omitted because of its emphasis on natural resources, more than technical resources. These and several other omitted theories might be found in (Cao and Zhang, 2013).

4. Literature Study – Theoretical Findings

Getting familiar with current research, find the research-ability of the topic, and establishing the research gap is a fundamental part of the research process, and the rest of the research project depends on this (Karlsson, 2008). In this chapter, findings from the literature study are presented in order to establish the research gap. How the papers have been found is explained in Subchapter 2.1. The author, year of publication and number of citations in Google Scholar of the papers are illustrated in Table 7. All articles selected for the literature study are empirical. Empirical articles have been used to establish the gap in the empirical operations management (OM) and supply chain management (SCM) research. A more extensive table of the papers focus areas and findings are provided in Appendix 2.

Table 7 Result of Literature Search

Author (year)	Journal	Method ([1])	Industry and/or role in SC	#GS citations[2]
Bartezzaghi and Ronchi (2003)	IMS	Multiple-case (4)	Several	73
Cagliano et al. (2003)	IJOPM	Survey (276)	Several	314
Majorique Léger et al. (2004)	IJLM	Case & Survey (53)	Telecommunication OEM	67
Schroeder et al. (2004)	BPMJ	Survey (40)	Automotive	8
Cassivi et al. (2005)	BPMJ	Multiple case (7)	Telecommunication OEM	23
Cassivi (2006)	SCMIJ	Survey (53)	Actors in same SC	213
Hadaya et al. (2006)	IMDS	Survey (159)	Wireless communication	42
Sheu et al. (2006)	IJOPM	Multiple-case (5)	Supplier & Retailer	422
Mason et al. (2007)	ECMIJ	Multiple-case (3)	Road transport	258
Potter et al. (2007)	IMDS	Multiple-case (6)	Several & FMCG	40
Russell and Whipple (2007)	IJLM	Multiple case (10)	Manufacturer & retailer	241
Sanders (2007)	JOM	Survey (245)	Several & Manufacturers	424
Bergeron and Raymond (2008)	IMDS	Survey (107)	Several & Manufacturers	206
Lalwani et al. (2008)	JMTM	Survey (29)	Several & Manufacturers	66
Chang et al. (2009)	JMTM	Case	Textile	16
Chong et al. (2009)	IJPE	Survey (109)	E&E organisations	138
Cullen and Taylor (2009)	IJOPM	Database (1824)	Pharmacy	82
Gunasekaran et al. (2009)	IJPE	Survey (39)	Several	149
Nakano (2009)	IJPDLM	Survey (65)	Several & Manufacturers	105
Rosenzweig (2009)	JOM	Survey (50)	Several & Manufacturers	179
Plomp and Batenburg (2010)	SCMIJ	Case & survey (24)	Retail	30
Iyer (2011)	JBIM	Survey (152)	Several & Manufacturers	66
Wang et al. (2011)	IMM	Case	FMCG	44
Chan et al. (2012)	IJPE	Survey (505)	Several	138
Saldanha et al. (2013)	JOM	Survey (52000)	Several & Manufacturers	43
Jean et al. (2014)	IM	Survey (240)	Electronics manuf.	27
Iyer (2014)	JBIM	Survey (115)	Several & Manufacturers	13
Kim et al. (2015)	JBIM	Survey (137)	Several & Manufacturers	27
Migdadi et al. (2016)	IR	Survey (258)	Several	13
Mirkovski et al. (2016)	SCMIJ	Case	SMEs	10
Zhao et al. (2016)	IMDS	Survey (604)	Several & Manufacturers	7
Vanpoucke et al. (2017)	IJOPM	Survey (563)	Assembly	30
Afshan et al. (2018)	BIJ	Survey (166)	Several & Manufacturers	0
Alsaad et al. (2018)	EMJB	Questionnaire (81)	Pharmacy	3
Shee et al. (2018)	SCLMIJ	Survey (105)	Retailers	0
Upadhyay et al. (2017)	APJM	Survey (556)	Several	2
Yang et al. (2018)	IJLM	Survey (203)	Several & Manufacturers	0

APJM – Asia Pacific Journal of Management; BIJ – Benchmarking: An International Journal; BPMJ – Business Process Management Journal; EMJB – EuroMed Journal of Business; IMDS – Industrial Management & Data Systems; IMM – Industrial Marketing Management; IM – Information & Management; IMS – Integrated Manufacturing Systems; IJLM – The International Journal of Logistics Management; IJOPM – International Journal of Operations & Production Management; IJPDLM – International Journal of Physical Distribution & Logistics Management; IJPE – International Journal of Production Economics; IR – Internet Research; JBIM – Journal of Business & Industrial Marketing; JMTM – Journal of Manufacturing Technology Management; JOM – Journal of Operations Management; SCMIJ – Supply Chain Management: An International Journal.

[1] Number of participating companies. Regarding the method "Case", only one case study is used
[2] Number of citations in Google Scholar

4.1 ICT Applications in Supply Chain Relationships

In the literature study, there are found several types of supply chain relationships and also several types of technologies discussed in different combinations. The following section aims to present the three main types of ICT systems found in the literature and used in this thesis, *1) Sharing technologies*, *2) Planning and control systems*, and *3) Track & trace technologies*.

4.1.1 Sharing Technologies

To maintain successful supply chain relationships, companies need the support of technical factors such as inventory systems, information sharing channels, and IT capabilities (Sheu et al., 2006). Electronic data interchange (EDI), developed in the 1970s is considered the first tool that enabled electronic communication between actors in a supply chain. However, it was proprietary and expensive to implement (Chopra and Meindl, 2016). Since then, the internet rapidly expanded, and technological development has exploded. New ICT systems and innovations that overcome most of EDI's original limitations now flourish (Cagliano et al., 2003).

The development of emerging Internet-based tools is based on the premises of EDI, but communication is internet-based. The tools are given different names and have different focus-areas, but a common trend is to denote them with an *e*-. The *e* stands for electronic, and when *e*- is coupled to different activities, it indicates that they are done with the help of electronic devices through the internet. For example, *e-collaboration* is defined as business-to-business collaboration via electronic devices on the internet, and *e-procurement* is defined as procurement via electronic devices on the internet (Bartezzaghi and Ronchi, 2003).

4.1.2 Planning and Control Systems

The internet and the emerging ICT systems enhanced the development of technological planning systems for *internal* production and enterprise planning. These are characterised as manufacturing planning and control systems (MPC). These systems are used to plan and control the manufacturing process, and examples are materials requirements planning (MRP), manufacturing resource planning (MRPII) and enterprise resource planning (ERP) (Lalwani et al., 2008).

Additionally, systems for *external* planning and control have emerged. Examples of these type of systems are vendor managed inventory (VMI), and collaborative planning, forecasting and replenishment (CFPR) (Afshan et al., 2018). A typical VMI relationship consists of manufacturers and retailers that electronically share demand and replenishment data. The aim is that the manufacturers can use this information to decide replenishment quantities (Russell and Whipple, 2007). Cassivi (2006) claims that the main advantages of CPFR are reduced time to market, better visibility and accessibility of information. The main obstacles were found to be human resistance and training skills, security and reliability in the program, and the cost. Nakano (2009) concludes that there is a positive relation between *internal* and *external* use of collaborative forecasting and planning (CFP).

4.1.3 Track & Trace Technologies

When managing transportation, usually transportation management systems (TMS) are used (Wang et al., 2011). Collaboration with supply chain partners improves logistics performance and reduce costs. Current developments in automatic identification and data capture (AIDC) systems, assist the collaboration by enabling real-time information capture of the movement of goods through the supply chains. Radio-frequent identification (RFID) is a common AIDC method (Mason et al., 2007). For tracking the real-time motion of a vehicle, global positioning systems (GPS) can also be used (Wang et al., 2011). Another emerging segment of collaborative transportation management technology is the electronic logistic marketplace (ELM). “ELM is defined as an electronic hub using Web-based systems that link shippers and carriers together for the purpose of collaboration or trading” (Wang et al., 2011). The ELM business model is at an emerging stage but has a huge potential in optimising supply chain networks (Potter et al., 2007, Wang et al., 2011).

4.2 Relations Between Supply Chain Relationships and ICT

The main findings of papers in the literature study, relating to the topic of this thesis are presented in the following subsection. Based on these findings, three propositions have been created.

4.2.1 The Effect of ICT on Supply Chain Relationship Intensity

The main motivation driving companies to adopt internet-based tools in supplier-customer relationships is the wish to reduce transaction cost by increasing the procurement process efficiency (Bartezzaghi and Ronchi, 2003). In volatile conditions, it is especially at the inbound and outbound processes that companies can gain the most benefits from internet-based supplier-customer collaboration (Saldanha et al., 2013). Both Majorique Léger et al. (2004) and Vanpoucke et al. (2017) claim that e-collaboration tools have a higher efficiency when dealing with suppliers than with customers. However, Alsaad et al. (2018) suggest that efficiency instead is contingent on the companies' mutual resource synergy and joint collaboration.

Creating a seamless interconnecting supply chain is the ultimate goal of many companies, and internet-based tools are found to be beneficial in the way that they provide end-to-end visibility in the supply chain (Cassivi et al., 2005). They might also be used as a safeguarding mechanism against opportunistic behaviours (Hadaya et al., 2006). Additionally, they positively impact commitment (Afshan et al., 2018) and organizational performance, both directly, and by having a positive impact on intra- and inter-organizational collaboration. Thus, emphasising the importance for companies to encourage collaboration and invest in e-business technologies (Sanders, 2007), and e-collaboration (Rosenzweig, 2009). For successful use of e-commerce, the information quality, system quality and trust are considered the most critical factors (Cullen and Taylor, 2009). E-procurement is found to positively impact strategic sourcing and firm performance (Kim et al., 2015), while e-commerce strengthens business relationships (Cassivi et al., 2005) and enhance competitive advantages (Jean et al., 2014). Based on the findings of these papers, the following proposition is formulated:

Proposition 1: ICT increase the supply chain relationship intensity

4.2.2 The Effect of Relationship Intensity on ICT Choices

Organisational factor influences the e-business implementation (Migdadi et al., 2016). There is a close connection between the level of collaboration with suppliers and customers and the adoption of internet tools (Cagliano et al., 2003). When maintaining supply chain relationships and when

implementing and using ICT, it is the attitude of the employees that play a vital role (Chang et al., 2009; Gunasekaran et al., 2009; Zhao et al., 2016; Upadhyay et al., 2017).

In their research, Majorique Léger et al. (2004) finds that the manufacturer and several of its most significant assemblers initiated and sponsored the investment in e-collaboration tools, in order to support collaboration initiatives. Creating trust between the supply chain actors, and especially amongst the suppliers, is a barrier to ICT implementation (Schroeder et al., 2004). Managing trust in supply chain relationships have the most substantial impact on the successful implementation of ICT tools (Schroeder et al., 2004; Sheu et al., 2006; Chong et al., 2009; Gunasekaran et al., 2009; Chan et al., 2012). Trust also influence the use of ICT, and the information shared (Mirkovski et al., 2016). Other essential factors are also product complexity, and trading volumes (Chong et al., 2009). It is beneficial to have a strong connection between the technological and organisational dimension, i.e. the level of technologies and collaboration, in interorganisational chains, in this way, branches can learn from each other. (Plomp and Batenburg, 2010).

Proposition 2: The intensity of the supply chain relationships influences the selection of ICT systems

4.2.3 The Effect of Relationship Intensity on ICT alignment

Alignment of e-business activities provides improved growth, productivity and financial performance (Bergeron and Raymond, 2008). From a transaction cost theory (TCT) perspective, the use of e-procurement and e-collaboration will reduce the transaction cost (Gunasekaran et al., 2009) by reducing the governance cost of transacting (Chong et al., 2009), and providing cheap and easy exchange of knowledge (Hadaya et al., 2006). Collaborating on transactions is the most supported type of collaboration since it enables inventory extraction from the supply chain (Russell and Whipple, 2007). To assure quality, the top management should take actions to reduce transaction costs, inventory costs and cycle time uncertainties (Yang et al., 2018).

Companies should build specific IT capabilities, enabling collaborative activities (Iyer, 2011). Also, managers have to strategically leverage and develop relation-specific resources, such as specialised IT-systems, to generate operational productivity improvements (Iyer, 2014). The

manufacturers performance increases with the extent of internet-enabled collaborative activities conducted with its customers, creating collaborative advantages (Rosenzweig, 2009).

Proposition 3: High-intensity external supply chain relationships could enhance ICT alignment

4.2.4 Emerging Computer Technologies

Even more recent developments in computer technology, introduce cloud computing, which offers several advantages to traditional ICT systems. Typical cloud computing systems are software as a service (SaaS), infrastructure as a service (IaaS) and platform as a service (PaaS) (Shee et al., 2018). Due to the nature of this study, the keywords defined for the literature contained mostly ICT technologies. Emerging technologies, such as cloud computing were therefore not focused in this literature study, nor yet implemented in any of the companies participating in this study. Hence, they are not the primary focus of this project. However, it is important to keep in mind that these types of technologies, are emerging. Stressing the importance for companies to learn about them to be able to leverage the benefits of these technologies. Some examples are; the internet of things (IoT), where connected devices and machines, benefitts from cloud computing (Tu, 2018), big data analytics, and machine learning which utilise the large amount of data created through moving towards industry 4.0 (Ardito et al., 2018).

4.3 Summary of Literature Findings

Table 2 summarises the main highlighted benefits of ICT and supply chain relationships in the literature. It is also vital to understand and highlight the limitations and challenges of ICT. Most researchers focus on improvements in ICT, but some also have highlighted challenges (Schroeder et al., 2004, Cassivi, 2006, Sheu et al., 2006). Some challenges of ICT found in the case studies will be elaborated in the discussion chapter, but the main focus is on possible benefits of ICT. Therefore, benefits are highlighted in Table 8, together with the main relationship factors that enhance ICT-adoption.

Table 8 Highlights from the Literature

	Findings related to Supply Chain Relationships	References
Sharing technologies	Reduce costs and improve efficiency	Bartezzaghi and Ronchi (2003), (Cagliano et al., 2003), Gunasekaran et al. (2009), Mirkovski et al. (2016), Afshan et al. (2018), Alsaad et al. (2018), Yang et al. (2018)
	Improve supply chain performance	Bartezzaghi and Ronchi (2003), Majorique Léger et al. (2004), Sheu et al. (2006), Sanders (2007), Bergeron and Raymond (2008), Lalwani et al. (2008), Rosenzweig (2009), Iyer (2011), Saldanha et al. (2013), Jean et al. (2014), Iyer (2014), Kim et al. (2015), Migdadi et al. (2016), Vanpoucke et al. (2017)
	Improve information sharing and visibility	Bartezzaghi and Ronchi (2003), Cagliano et al. (2003), Majorique Léger et al. (2004), Schroeder et al. (2004), Cassivi et al. (2005), Hadaya et al. (2006), Sheu et al. (2006),
Planning and control Systems	Reduce costs and improve efficiency	Chang et al. (2009)
	Improve supply chain performance	Russell and Whipple (2007), Nakano (2009),
	Improve information sharing and visibility	Cassivi (2006), Nakano (2009), Russell and Whipple (2007),
Track & Trace technologies	Reduce costs and improve efficiency	Mason et al. (2007)
	Improve SC performance	Mason et al. (2007), Potter et al. (2007), Wang et al. (2011)
	Improve information sharing and visibility	Mason et al. (2007)
Cloud computing	Improve SC performance	Shee et al. (2018)
Main Relationship-factors that enhance ICT adoption and ensure successful use of ICT	Trust	Chong et al. (2009), Cullen and Taylor (2009), Gunasekaran et al. (2009), Chan et al. (2012), Mirkovski et al. (2016),
	Attitude of employees	Chang et al. (2009), Gunasekaran et al. (2009), Zhao et al. (2016), Upadhyay et al. (2017)
	Product complexity, production volume, frequency	Chong et al. (2009)
	System quality, information quality, management and use, WWW-assurance and empathy	Cullen and Taylor (2009)
	Organisational factors (learning, knowledge management, adhocracy culture, top management support)	Migdadi et al. (2016), Plomp and Batenburg (2010)

5. Description of the Case Companies – Empirical Findings

In this chapter, a detailed case description of all the companies that participated in the research is presented. The intension has been to gather the view on relationships from different actors' perspectives across two different supply chains in two different parts of the world. Actors are suppliers, transport providers, manufacturers, and customers. One supply chain represents an emerging country, Dubai, and the other supply chain represents a developed country, Norway. The reason why this has been possible is that the manufacturer in each of the countries are sister-companies under the same Group company. In the supply chains presented, Jotun Dubai and Jotun Norway are considered as the manufacturer. All the companies that have participated, and their role in the supply chains are illustrated in Figure 6.

Empirical findings are presented in both chapter 5 and chapter 6. First chapter 5 presents the companies, then chapter 6 focus on the relevant findings from the interviews. Chapter 5 and chapter 6 are structured the same way for consistency. The findings presented in the following two chapters are based on the company characteristics, the relationships and the ICT systems mentioned by the interview objectives and are grounded on their insight.

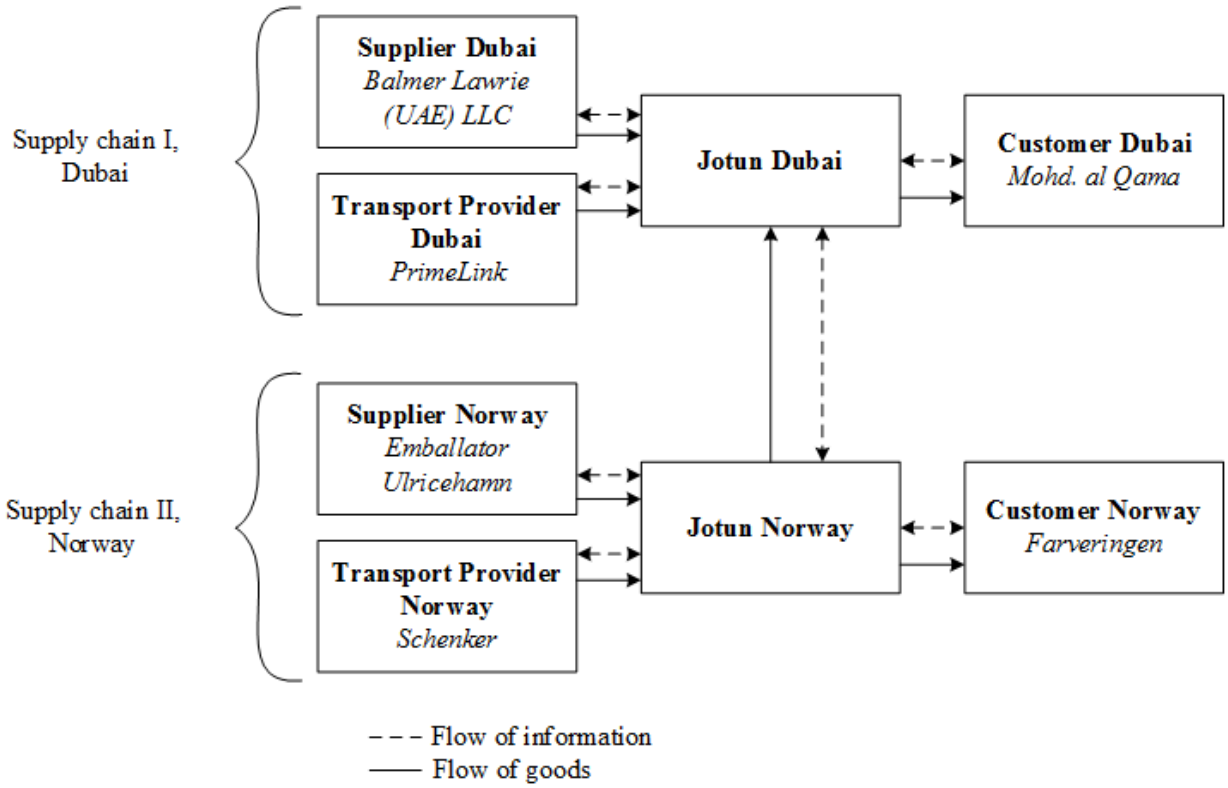

Figure 6 Case Study - Overview

5.1 Structure of the Company Presentations

This subchapter presents the companies that participated in the multiple-case study. Background information of the company characteristics, the characteristics of the market the operate in, and their relation to Jotun are highlighted. A deeper description of their relationships to Jotun are further elaborated in Chapter 6. All the information presented here is collected from the semi-structured interviews and interpreted by the researcher. For this reason, the amount of company and market characteristics highlighted are a bit varying and dependent on the interview answers. In the end, a table, to summarise the company characteristics is presented, Table 9. The actors are presented in the order of their country, first the actors in Dubai and then the actors in Norway. Jotun Dubai and Jotun Norway being the two focal case companies of this study are presented first. Further, supplier, transport provider and customer are presented respectively.

Company and market characteristics

The following terms are used to characterise the companies: *Business-to-business* (B2B); meaning that one business makes a commercial transaction with another business. *Business-to-customer* (B2C); the business sells products or services directly to the end-user, the consumer. *Stock keeping unit* (SKU); refers to the number of different products a company produces or keeps at stock. *Make to stock* (MTS); the production is push-driven, and the company produces to stock before knowing the actual demand. *Make to order* (MTO); the company does not start the production until an order is placed. *Lead time* (LT); is the time it takes from an order is placed by the customer until the customer has received the goods, denoted as delivery LT. Sometimes LT is defined as the time it takes from production is initiated and until the product is finished, then it is denoted as production LT. *Small, medium and large sized businesses*; these are usually categorized based on the number of employees. *Small-sized businesses* has 1-50 employees, *medium-sized businesses* have usually 51-250 employees, while *large businesses* have >250 employees. A *key account manager* (KAM) is responsible for a customer portfolio and the contact with the customer. *Raw materials* (RM) are all the materials or component used to produce the final product, the *finished goods* (FG).

5.2 Supply Chain I, Dubai

5.2.1 Jotun Dubai

The Jotun Group has 14 production facilities in the MEIA region. In Dubai, there are one production facility, one R&D department and the regional HQ of the MEIA region. For this thesis, the emphasis is on the production plant. Hence, the term Jotun Dubai is used to describe Jotun's production facility, located in Dubai. Jotun Dubai produces mainly decorative paint and has been in Dubai since 1975. It has 386 employees, operates in the B2B-market, and has approximately 185 RM suppliers and 800 customers. Additionally, it also supplies finished goods to Jotun Kuwait and Jotun Bahrain. The production volume for 2018 was 83,5 million litres. The finished goods are divided into three categories, A, B and C. A-category items are fast moving and kept in stock. B-category items are slow moving and kept in stock. C-category items are MTO. Of the A and B items, there are 700-800 SKUs, the amount of each SKU is based on the last 3 months sales. Due to large market fluctuations, it is not possible to plan the production for more than one day. The delivery LT to the customer is 1 day, supplied by the stock. The production LT is 1-2 days for A-category items, and 3-4 days for B-category and C-category items. Jotun Dubai has two separate production lines, one for water-based paint and one for solvent-based paint. Production planning is done by master scheduling with a material and resource planning (MRP)system.

5.2.2 Supplier Dubai – Balmer Lawrie (UAE) LLC

Balmer Lawrie is a rigid packing company, manufacturing steel drums, metal cans, plastic drums and plastic cans. Everything is manufactured in-house, and the finished goods are supplied at the B2B-market to companies in the paint, lubricants, edible oils and chemicals industries. Balmer Lawrie has been in Dubai for more than 40 years and has a joint-venture with a company in India. It has a total of 800 employees, more than 200 customers and ten suppliers, where two or three of these are their main suppliers. It is Jotun Dubai's largest supplier of cans, and the production plant is located in Dubai, in close distance to Jotun Dubai. Additionally, the company supplies cans to Jotun Abu Dhabi, Jotun Oman and Jotun Pakistan. Jotun is their largest customer in the paint industry, responsible for 8-10% of the sales.

The metal packaging industry consists of two main activities: printing of metal sheets and manufacturing of the metal sheets into metal cans. There are long lead times on the raw materials,

up to five months, so Balmer Lawrie has to keep a large stock of raw materials. The printing of metal sheets takes up to three weeks. The drums and cans are produced in different sizes with different prints, which results in a large number of SKUs, approximately 4000. Due to long LTs on raw materials, up to 5 months, high production LTs, up to three weeks, and significant fluctuations in the market, it keeps three months stock of printed templates.

5.2.3 Transport Provider Dubai – PrimeLink

PrimeLink is a medium-sized transport-provider. It owns, operates and maintains its own fleet of vehicles and also provides customs clearance. It has been in the Middle East for nearly 40 years, and has a head office is in Dubai, not far from Jotun Dubai. PrimeLink is specialised in transportation for chemicals, petrochemicals and other complex transport solutions. The company has 200 employees and more than 70 customers, and a strong focus on quality, health, safety and environment (QHSE). Jotun is one of their largest customers.

5.2.4 Customer Dubai – Mohd. Al Qama

Mohd. Al Qama is a medium-sized business in the retail industry in Dubai. They own eight branches and sell goods mainly to B2C customers, but also have some B2B customers. Most of their customers are small-medium sized painters, applicators and contractors, and they estimate that they have above 2000 customers daily. Jotun Dubai is their number-one supplier and provides almost 40% of its sales volume. Of this, 80% of this is decorative paint, and 20% is protective coatings. Jotun is the anchor-brand of their stores. The market is very volatile and competitive.

5.3 Supply Chain II, Norway

5.3.1 Jotun Norway

Jotun has two production facilities in the Scandinavia (SCA) region, and one is located in Norway. The Jotun Group originated in Sandefjord Norway in 1926, and the company HQ is located here together with the group-functions and an R&D department. However, for this thesis, the emphasis is on the production facility. The production plant in Norway produced approximately 40 million litres of paint in 2018, and their production is mainly MTS. They produce roughly 1300 SKUs of FG and buy 300 SKUs of commodities from subcontractors. They have approximately 450 suppliers and seven main customers. The FG are packed and shipped the same day as the order is placed, providing a delivery LT on 0 days. Production planning is done in the ERP system. The planning horizon is four days, but monthly forecasts are made. An MRP degradation is done, resulting in purchasing suggestions for the supply department. The production planning horizon is four days.

5.3.2 Supplier Norway – Emballator Ulricehamn

Emballator is a medium-sized business that manufactures metal packaging. It has three production facilities, two in Sweden and one in Finland, and also a sister-company in the UK. The company operates in the B2B market, and produce almost everything in-house, but uses a 3rd party producer to manage peak season. Emballator has approximately 200 employees, 50 suppliers and 550 customers, however, 20 of these account for most of the sales. Cutting and printing of metal sheets are made to stock, but the manufacturing of metal sheets into cans is based on customer orders to save storage space. It is Jotun Norway's largest supplier of metal cans. Additionally, supplying cans to Jotun Russia, Jotun Germany, and also to Jotun UK, Jotun Spain Jotun Abu Dhabi, Jotun Malaysia and Jotun Indonesia, but these are tiny?? volumes. The delivery LT to Jotun Norway is two days.

5.3.3 Transport Provider Norway – Schenker

Schenker is a large, global company, with roughly 90 000 employees worldwide. Its origin is German, and the HQ is located in Germany. The Norwegian department has 1100 employees. Schenker Norway is a freight forwarder, which means that it owns containers, semitrailers and loading materials, but does not own any vehicles. Instead, buying services from subcontractors on

land, sea and air freight. Operating both in the B2B and in the B2C market. One challenge in the transport industry is that there are small margins, and everything is about volume. Also, there is a lack of drivers, which will affect the industry even more in the future. Jotun Norway is one of Schenker's largest customers in Norway, and Schenker is responsible for all Jotun Norway's export to other Jotun facilities, all over the world.

5.3.4 Customer Norway – Farveringen

Farveringen is a small-sized wholesaler and is one of Jotun Norway's largest customers. It has 40 employees and is the daughter-company of Malorama AS. The company has two warehouses, one at 15000m^2 and the other at 1400m^2. Farveringen operates in the B2B market, but plan to start B2C business with internet sales in a few months. It has 120 individual suppliers and 1100 individual customers. Jotun Norway is their largest supplier, responsible for approximately 40% of its goods. Farveringen buys 650 articles from Jotun and receives Jotun-goods only from Jotun's production in Norway, communicating purchase orders through EDI.

5.4 Summary of the Companies

Some general information about the companies to summarise this chapter is presented in Table 9.

Table 9 General Case Information

Company	Industry	#Suppliers	#Customers	#Employees	#Market
Jotun Dubai	Paint & Powder	185	800	386	B2B
Supplier Dubai, Balmer Lawrie LLC	Packaging	10	>200	800	B2B
Transport Provider, Dubai PrimeLink	Transport	-	>70	200	B2B
Customer, Dubai Mohd. Al Qama	Retail	400	>2000 /day	145	B2C & B2B
Jotun Norway	Paint & Powder	400	7 large, 1500 smaller	1100	B2B
Supplier, Norway Emballator Ulricehamn	Packaging	50	20 large, 550 smaller	200	B2B
Transport Provider, Norway Schenker	Transport	-	65 customer accounts	1100	B2C & B2B
Customer, Norway Farveringen	Wholesaler	120	1100	40	B2B

6. Relevant Findings from the Case Companies – Empirical Findings

In this chapter, relevant findings from the case studies are presented. The case data has been collected through semi-structured interviews and interpreted by the author. First, the relevant findings from each case company are presented in Subchapter 6.1 and 6.2. Then a summary of the findings is provided in Subchapter 6.3. These findings will then be discussed and reflected in the light of theory and literature findings, in Chapter 7. The companies are presented in the same order as for Chapter 5. In this chapter, the current (as-is) situation is presented, and includes:

Characteristics of supply chain relationships

Characteristics of the companies' relationships with Jotun are presented. For Jotun Dubai and Jotun Norway, both internal and external relationships within and between actors in their supply chain are presented. The content of the relationships, what types of information is shared, how and how often, if there are some kinds of integration, technology sharing, and joint projects are presented. Also, some information of other supply chain relationships is provided to give an impression of usual practice and relationships in the companies.

The company's choice and use of ICT

The types of ICT technologies implemented and used for internal and external collaboration is presented. Also, how they are used, the challenges and benefits of using them and how and why these technologies have been selected and implemented are elaborated.

6.1 Supply Chain I, Dubai

6.1.1 Jotun Dubai

Characteristics of supply chain relationships

Internal relationships: They have daily one-hour central planning meetings with the production, purchase, logistics, and customer service departments. Here, all challenges and new information are discussed between the departments. There are also meetings with other Jotun plants in the MEIA-region to share best practice. They both visit and get visits from other Jotun plants. They also borrow raw materials from one another due to the short distances. Dubai is a very challenging site, with large production volumes, so usually, other sites visit them to learn from Dubai. They also have pilot projects with other plants in the same region, but not with Jotun units in other regions.

> *"In Abu Dhabi, we borrow raw materials when we are short, also, in Oman, we do this. Because they are close units."*
>
> *Purchase Manager*

There were not found to be many challenges with the internal relationships in Jotun. However, one was highlighted.

> *"All collaboration happens on a top-level or a manager level. So, the operational working people we have no collaboration […] this is a challenge."*
>
> *Warehouse and Logistics Manager*

External relationships: At Jotun Dubai, there are many cases of external relationships. Both with the suppliers, the transport providers and the customers. They have regular meetings and visit each other to solve problems and learn from each other. They also do joint projects together. For example, Jotun had a joint pilot project with one of their transporters on GPS implementation, elaborated later in this section. Another example is the training of customers to use web-orders (e-commerce).

"Some customers come here, and we train them to order on the web. Also, we have started a deco [decorative paint] project, train the customers to use the web, result in less work and fewer mistakes. And by this, which we started recently, we get the order on web 80%."

Logistics and Customer Service Manager

The company's choice and use of ICT

Jotun Dubai uses several ICT systems; ERP (IFS Matrix), Office 365, Jotun Operation System JOS, Join (Intranet), SharePoint and MRP master scheduling. The MRP master scheduling pilot started in Dubai, and now they are rolling out on other Jotun sites as well. All of Jotun's facilities use the ERP system. The implementation of this system was a Jotun global decision.

"The ERP system is used by all of Jotun's facilities, so we learn from each other. […] A lot of local requirements and customization and language updates etc. is needed for every plant."

Planning Manager

The main benefits of this are that they can get information from other sites as well. It is also easier to communicate with other employees and other departments. Earlier orders came through fax and other mediums but now they come directly into the system. Leading to reduced complexity and improved visibility.

"Less complexity, sharing of information is easier, and there is more visibility. And there will be more benefits for the customer also. The time benefit, orders come to all sites."

Planning Manager

Jotun Dubai also use programmed logistics control (PLC) system in production for levelling and charging of RMs, and in the warehouse, they are also using a system, called PDF, for barcode scanning of FG. These were both implemented because some other Jotun sites were using it. However, neither PLC nor the barcode scanning system is integrated into the ERP system.

When it comes to transportation management, in Dubai, it is common to lease vehicles for outbound transportation on a monthly basis and manage the transportation planning self.

"By this leasing system, it is up to us how we manage the fleet. If we manage it well, it is beneficial for us, if not it is costly. We pay only a fixed salary. That's why this system is so useful. We have three coordinators who plan everything."

Warehouse and Logistics Manager

In this way, it is beneficial for Jotun Dubai with effective transportation management. Therefore, Jotun Dubai has developed its own transportation management system, called Jotun smart distribution system (JSDS). JSDS is used for fleet utilization, to optimize the routs, and provide real-time information about the delivery to the customer. They use GPS to track the vehicles, because they identified the need to improve transport deliveries, due to a large number of deliveries and communication. To develop the system, they contacted an IT company they had used before.

"We want to be the best in Jotun. […] We have a local supplier of PDF [The barcode scanning system] that deliver other types of systems to us. So, we contacted them, and they contacted someone in India who specialized in this kind of software, and later on, we got in touch with them."

Logistics and Customer Service Manager

Even though the JSDS was developed internally, the implementation of GPS trackers in the vehicles was provided by one of their transport providers.

"[PrimeLink] was the one who told us. […] Very high cost, so we said that for the first years we will pay part of it and they would pay part of it, and after that, I think they are the ones paying for it now. So, with the supplier, we shared the cost of implementing the new technology. We did not say "you have to pay because you are giving the service", but we shared the cost. And now we are doing this same GPS system in our warehouse also. So, we can use it also."

Purchasing Manager

6.1.2 Supplier Dubai – Balmer Lawrie (UAE) LLC

Characteristics of supply chain relationships

Balmer Lawrie has a long-term and high-intensity relationship with Jotun.

> *"We have a very long relationship with Jotun – more like a collaboration than a supplier-customer relationship. We have always worked together to find out what we can do together to support."*
>
> *Head of Marketing*

The company has few suppliers and long-term relationships with its suppliers. Having regular meetings and doing joint projects together. Transportation makes an essential cost for them since they are "transporting air". They use both their own trucks and also rent third-party trucks. They have many customers and measure performance by on time in full (OTIF) when delivering to the customers. They have meetings with the customers and also some joint projects with some of them. The most challenging part about collaborating with customers is the forecasting.

The company's choice and use of ICT

They use Oracle software for invoicing and delivery notices. They plan their production in Microsoft Excel but will implement Oracle ERP system in about three months. The decision was purely based on their own needs and not due to external supply chain relationships.

> *"We have so many, 4000 SKUs, so we needed to have a customised software, so we designed through a software company for us. It gives us a lot of reports, which helps us to make strategic choices. Order sizes, customer orders etc. reports about procurement helps me for strategic planning and also finance reports."*
>
> *Head of Marketing*

They have implemented GPS in the trucks so that they can monitor them for transportation management. However, they do not share the location of the trucks with their customers. The implementation of GPS in the trucks was their own idea to improve in terms of delivery and transportation planning.

> *"We also have trucks with GPS. So, we track the trucks. Measure OTIF when it is delivered to the customer and when it is shipped from here."*
>
> *Head of Marketing*

6.1.3 Transport Provider Dubai – PrimeLink

Characteristics of supply chain relationships

They have a long and intense relationship with Jotun Dubai, one of their largest customers. Have an accounting department that deals with Jotun accounts, and are communicating with both the regional office and the operation department.

> *"Wherever Jotun need special attention, we are there."*
>
> *Business Development Manager*

PrimeLink also has close communication, formal meetings, root-cause analysis and some joint projects with their other customers. The main challenge with the customers, in general, is that not all of them care so much about HSE and technology. The market is rate-driven, not quality-driven. Making the implementation and use of new technologies more challenging, and some customers see transportation as a necessity and want it as cheap and fast as possible.

> *"Not all customers care about HSE. […] Have experienced that customers are behind, normally customers should be ahead of us, but they are not always. Saying no, we don't need those things, just cheap price."*
>
> *Business Development Manager*

The company's choice and use of ICT

They have GPS tracking on all vehicles for real-time fleet visibility and cargo traceability. However, this information is not visible for the customers yet. The customers will get access to this information in about 6-12 months. They are currently using Cargo Wise [Logistics Software, TMS?] to plan transportation, but are going to migrate to another ERP system soon, to give access to the customers.

"One supplier used Oracle transportation management system, had to check if that one was compatible with Cargo Wise before implementing cargo wise but luckily it did, so we did not have to make any changes."

Business Development Manager

The key challenges of using new technologies are to train the drivers. Change is always difficult and a slow and iterating process. However, there are several key benefits of using this type of technologies.

"Training the driver is the key challenge in this part of the world. Drivers are available, but the right driver, to train them for the chemical transport and the MSDS [material safety data sheets]. Benefits are maximised usage of the fleet and customer satisfaction and their cost savings."

Business Development Manager

When deciding which new ERP system to implement, they have interviewed many technology providers about which features that are available. One of the most important aspects was what information they could provide to the customers.

"[Future idea] From the application you can book the truck, so then you can track it from the mobile […] it will cut down [on work for] the customer side also."

Business Development Manager

6.1.4 Customer Dubai – Mohd. Al Qama

Characteristics of supply chain relationships

There is generally a low intensity of the relationships towards their suppliers. They have introductory meetings with new suppliers, then price-based discussions and orders by phone calls, fax or email. The Dubai procurement market is challenging.

> *"There is a lot of volatility in the market. A supplier might have a standard stock, and maybe one day they get an export order, then they send all their goods to the foreign market, and there will be nothing left for the trader. So that happens all the time, except for the big manufacturers as Jotun where they have a proper system of inventory forecasting. All the other suppliers, if they get a big order from an African customer, they don't keep anything for the traders. […] This is the nature of business here. […] With Jotun, we don't have problems like that."*
>
> *General Manager*

The nature of the retail business in Dubai makes intense relationships difficult to obtain. However, Jotun and Mohd. al Qama has a quite high intensity of their relationship, due to the large amounts of goods transactions between the companies. They have a contact person at Jotun, a KAM, which they are in regular contact with. When ordering goods, Mohd. al Qama sends web orders to the Jotun factory.

Dubai is a competitive market on the sales perspective, with a lot of price-undercutting, and very little collaboration with the customers. Since the customers are B2C, they come into the shop and buy what is needed, and leave, like the open market negotiations, shown in Figure 5.

> *"This was a very fast-growing market, but then it has slowed down, so everyone is trying to manage this slow-down. Result in a lot of undercutting"*
>
> *General Manager*

The company's choice and use of ICT

To some B2C customers and large customers, Mohd. al Qama offers transportation of goods. They have their own vehicles that are managed by the brands. Each brand has 2-3 vehicles each and manages the deliveries. They tried once to centralise the management of the vehicles, and have one fleet-coordinator, but this did not work well, and they had to go back to the original solution. Therefore, they do not use any track and trace technology or planning technology for transportation. They do not experience many suppliers providing tracking of goods as Jotun does. Other suppliers send the phone number of the driver, so they call him if the goods do not arrive on time.

"Jotun are the only ones providing GPS tracking of materials."

General Manager

Mohd. al Qama has an ERP system (Sage) and keeps levels for most items. The stock calculations are only based on historical data. They want to use technology for forecasting and stock keeping but have not managed this yet. Due to recent expansions of both the number of shops/branches and the number of SKUs, the ERP system has recently been updated. The main challenge with this has been the training of employees. They selected this ERP system solely based on the company needs. When they order goods from Jotun, this is done from the factory by web-orders, by EDI. When asked about why they believed that full supply chain visibility would be challenging, they said that trust was the most crucial factor.

"It all depends on how much you what to open up your system to your customer and the trust […] the full visibility cannot happen without trust."

General Manager

6.2 Supply Chain II, Norway

6.2.1 Jotun Norway

Characteristics of supply chain relationships

Internal relationships: There is a particularly close relationship within Jotun SCA. In SCA, they work together to discuss how Jotun SCA could perform better as a region, not only in each country. They have regular meetings and a lot of joint projects, and also a joint strategy. Additionally, there is a high intensity of their relationship to Jotun UK, Jotun Norway's leading supplier of marine protective coatings.

> *"Within other Jotun units, there are not such close relationships, but we benefit from the network […] We try to see and learn from those that are best in class."*
>
> *Logistics and Distribution Manager*

External relationships: Generally, they have a high-intensity relationship with their suppliers, have frequent meetings with several of them. However, they have many suppliers, and the intensity of their relationship depends on the size of the trade. For the large and critical suppliers, the relationship is with high intensity, but for smaller and less critical suppliers, the relationships are less intense.

> *"We have realised that we need to make our suppliers good, both in terms of good information and forecasts that we send to them. So, working together at the supply chain level is important, focusing on a good total flow between suppliers and us. […] Trust is important, and we also have collaborative projects to improve ourselves there. We have especially much contact with the packaging suppliers, running collaborative projects and meet them four times a year."*
>
> *Logistics and Distribution Manager*

Some suppliers are good at being forward-thinking and innovative. They have been pushing and inspiring Jotun to improve as well. During the last twelve years, Jotun has reduced the number of transport providers from 15-20 down to less than five, to rather work with large, professional transporters.

"This is because we want to collaborate with professional operators. So, in recent years we have had a lot of collaboration with Schenker and Post Nord, two major transporters in Norway. Schenker is also big worldwide. We have had a collaboration with them for many years now. It has varied how much of our contract they have had, now they all have exports but nothing of inland transport."

Logistics and Distribution Manager

With Schenker, they collaborate in several ways, strategically and operationally. Also, a pilot project is running with Schenker right now on backhauling on trucks from Sweden.

"Now we have quite a few trucks that go in and out of Sweden every day. It is a good idea for Schenker because it ties us to them as a carrier when making custom-made solutions. That's good for us too."

Logistics and Distribution Manager

They have especially high-intensity relationships with many of their customers. They collaborate on lead times, development projects, transporters, purchasing systems, and every order is sent seamlessly through EDI messages.

"We are perhaps a little lucky here in Norway. For our biggest customers are wholesalers, and the concept of wholesalers is that they should be good at logistics and have an effective displacement of goods. So, it is essential to have close cooperation with them. They do not become good at logistics without having a close collaboration with us."

Logistics and Distribution Manager

The company's choice and use of ICT

When it comes to ICT, Jotun as a group have decided to implement the same ERP systems for all Jotun factories, by this, it is possible to see all the information on other sites as well. Everyone in Jotun also uses Office 365, which creates possibilities for more accessible? communication with,

for example, Skype for business and SharePoint. The decision to implement these two systems was made by top management.

The Jotun Norway production factory was newly refurbished, and in 2012 they started producing at the new factory with a lot of new technological solutions. In the beginning, this was surprisingly challenging, despite a large amount of prior training and organisational preparations that had been done.

> *"Both to train employees, but not least, to change the culture from which they came. It takes time. One should never underestimate the importance of communication, information and training."*
>
> *Logistics and Distribution Manager*

Jotun Norway also uses other, smaller types of planning systems. For production management, they use Workflow. For warehouse management, they have a WMS system (Epics). For transportation, they use another system called KSD, making freight papers. There is an interface between these systems and the ERP system. When goods are produced or sold, this is registered by the ERP system. They are the only Jotun factory to use these systems yet but believe that the demand for implementing Workflow will increase. This is because Workflow improves "right first time" and reduces production errors.

> *"The factory manager in China has been here several times to see how we work in Workflow. This has triggered him to implement it further in China."*
>
> *Logistics and Distribution Manager*

The large customers send orders by EDI. These are either directly placed in Jotun's system or processed by some messenger-convey transforming the data so Jotun's system can read it. They are currently working on a web-page so that smaller customers can order by web.

“So, the purchase order they make in their system pops up just like an order in our system. Here we are far ahead. Not only in Jotun but also in Scandinavia and Europe they are far behind us in the electronic data processing.”

Logistics and Distribution Manager

For the transport providers, Jotun Norway uses a similar system that communicates through EDI. When it comes to the suppliers, there is no EDI. The procurement orders are sent by e-mail and order confirmations are also received by e-mail.

"The focus has been on the customers because they are more important for us."

Logistics and Distribution Manager

There is no GPS tracking on vehicles, but the transport providers offer track and trace by scanning goods at different locations. This works well.

6.2.2 Supplier Norway – Emballator Ulricehamn

Characteristics of supply chain relationships

The relationship to Jotun Norway is long and with high intensity. Jotun, Norway is one of its largest customers. Every year, Emballator negotiates min/max volumes on what to keep in stock with Jotun Norway. Every Monday, receiving a two-week forecast from Jotun Norway on what Jotun Norway plan to produce. Also, Emballator sends back updated information of what they have on stock at the moment.

The general relationship intensity is high with both suppliers, transport providers and customers. Their contact is by phone and mail. In order to maintain a good relationship, Emballator also has individual meetings with their supply chain actors to discuss specific issues concerning the flow of deliveries and information. Planned production meetings are conducted with large customers, and they have improvement projects together as well.

The company's choice and use of ICT

Emballator has an ERP system, SAP, which is used to plan the production and also in marketing, planning and logistics. It also uses a separate production planning system, Baltazar. The company does not have any track and trace technology implemented. There have been some projects on implementing VMI, but they have not fully accomplished this implementation yet.

> *"The challenge here is that we must maintain the system, and the customer must use the system, but this has not yet worked optimally […] I believe this is something the customers will request in the future"*
>
> *Key Account Manager*

However, their attitude towards VMI is positive.

> *"As a supplier, we think it is good that the customers can see what they can order because sometimes, customers order goods that we don't have the materials to produce — resulting in a lot of extra communication back and forth. So, we are positive towards such a system. However, the initiation of it is expensive, so then it is important for us that it is used. […] The request for VMI has been customer-driven."*
>
> *Key Account Manager*

6.2.3 Transport Provider Norway – Schenker

Characteristics of supply chain relationships

Schenker has a high-intensity relationship with both Jotun Norway, and Jotun Sweden. Being responsible for Jotun Norway's export orders and distributing FG from the production facility in Norway. Generally, Schenker has monthly meetings with their customers. However, the themes of the meeting vary. Often, customers suggest what could be improved. Also, the company has ongoing projects with customers. One current project going on with Jotun is backhauling, bringing FG to Sweden and packaging materials on the way back to Norway.

The company's choice and use of ICT

For transportation management, Schenker uses its own internal systems. For business management, it uses SAP. The company has its own portal, called eSchenker, providing track and trace worldwide, by scanning containers at portals. Schenker is managed from Germany, and when it introduced eSchenker, the Norwegian customers were disappointed.

> *"The problem is that Norway lay so far ahead when it comes to IT. We ended up suddenly ten years back when we introduced eSchenker. While other countries in Europe, they rejoiced for eShcnker and said they advanced ten years."*
>
> *Key Account Manager*

This has been challenging in Norway since the competitors have spent a lot of resources on developing their track and trace portals. eSchenker does not provide real-time data yet, but soon, it will be possible to see real-time as well. All containers have installed GPS, but data transfer from GPS to the customers is expensive and has not been an investment yet.

> *"We have GPS on all our containers and semitrailers. So, our material department can see where all the materials are in Norway at all times. It is also expensive with transfer from the GPS to a computer. That's where the challenge is. If you want to pay for it then it is possible, it certainly is costly now, but becomes cheaper over time."*
>
> *Key Account Manager*

In general, Schenker uses EDI solutions to communicate with customers. They are also working with some customers to implement an application programming interface (API) solution. However, the challenge with this is to get server capacity. Since Schenker does not own the vehicles, they have to book vehicles and drivers. The booking of vehicles is done by email and phone calls. Schenker has its own IT-department in Germany, responsible for monitoring and following technological opportunities and innovations.

6.2.4 Customer Norway – Farveringen

Characteristics of supply chain relationships

The relationship with Jotun Norway has lasted for more than 40 years. They have regular meetings, and they also have joint projects together. All procurement orders to Jotun are sent by EDI. Generally, there are some key suppliers with whom Farveringen has regular meetings about sales and logistics. Also, having joint projects together with some of these suppliers.

Additionally, regular meetings with the customers and some joint projects with customers are conducted. Farveringen employs only one transport company and has a particularly close relationship with them. This transport company handle all of Farveringen's outgoing transport and also some of the incoming transport, resulting in full visibility between them.

> *"We do not own this company, but had it not been for us then they had not started up."*
>
> *Operations and Logistics Manager*

The company's choice and use of ICT

Farveringen's main managing system is a WMS system, where all goods that go in and out of the warehouse are controlled. For company management, an ERP system is used, which has an electronic interchange with the WMS system. Both the ERP system and the WMS system are delivered by the same IT-company. For tracking of materials, Farveringen uses barcodes, and their warehouse has newly been upgraded with automation. Sales and pricing are also done in the ERP system. When purchasing goods, a separate system that has an interface with the WMS is used. However, there is no ICT-alignment across the supply chain. This can be challenging.

> *"When it comes to the big [retail] chains, it can be challenging. Their ERP system wants us to send a confirmation in the same order as sent the purchase order to us. So, technical things can be challenging. Our customers have different systems from us, so it is not always everything we can accommodate."*
>
> *Operations and Logistics Manager*

This also applies to suppliers.

> *"I have visited many warehouses and logistics sites, and they all use different systems. As an example, if you visit ten sites in succession, you will find that none of them uses the same system. This can be demanding at times."*
>
> *Operations and Logistics Manager*

6.3 Cross-Case Comparison

Jotun

Jotun Norway export a lot of finished goods and also raw materials that they produce to other Jotun factories around the world. Jotun Dubai produce finished goods to the MEIA-region market. They both produce mainly decorative paint, and the production volume in Dubai is larger than in Norway, almost the double amount. There is also more volatility in the market characteristics in Dubai, resulting that they have to plan the production with a planning horizon of only one day. The plant in Norway are able to have a planning horizon of four days, increasing their flexibility. There are high intensity relationships internally in Jotun. Although the relationships are stronger between production facilities belonging to the same region, all the Jotun Group members benefit from the network, sharing best practice and learning from each other.

Suppliers

Both suppliers interviewed supply packaging to Jotun. Their relationship with Jotun is of high intensity both in Dubai and in Norway. The reason for high intensity of the relationships is apparently due to the large amount of materials that Jotun buy from them. In both cases, Jotun buy almost all their packaging from these two suppliers. This is favourable for Jotun because it allows them, as the customer, to obtain benefits from the economy of scale. They get better deals and are favoured in competition with smaller customers. Also, uncertainties are reduced because Jotun know they can trust that the supplier delivers the right amount of goods at a high quality at the right time. This intense relationship is also of course beneficial for the suppliers. When a customer is more dependent on them, uncertainties are reduced since sales are assured. With some individual differences, the market characteristics are generally quite similar. The main challenge of the companies in this industry is the long production lead times and receival of raw materials lead times. In addition to the fact that the finished goods use a lot of storage and transportation space, due to the nature of packaging products.

Transport Providers

Concerning the transport providers, operation and transportation norms in Norway and in Dubai are quite different. For transportation in Norway, the transport provider is responsible for executing the freight. For transportation in Dubai, companies usually lease vehicles on a monthly basis and arrange the transportation themselves. In this way, Jotun Dubai is responsible to make the most out of the trucks they lease, whilst for Jotun Norway, this is the transport providers' responsibility. However, in both cases the transport providers have high-intensity relationships with Jotun, and they are responsible for a large amount of Jotun's transportation. PrimeLink is mainly responsible for clearance and transport of inbound materials to Jotun Dubai, and Schenker is responsible for Jotun Norway's export orders.

Customers

Regarding the decorative paint, produced at Jotun Norway, the customers are mainly wholesalers. For decorative pain produced at Jotun Dubai, the customers are mostly retailers. Therefore, the operations of the two customers interviewed in this study are quite different. Farveringen, operating mainly in the B2B market and Mohd. al Qama mainly in the B2C market. Farveringen receives orders from their customer through EDI. While customers visit the shops of Mohd. al Qama, buy what they need, and leave. Both companies have a high-intensity relationship with Jotun, as they both buy approximately 40% of their total goods from Jotun. However, it seems like Farveringen have a more intense relationship with Jotun Norway, compared to Mohd. al Qama's relationship to Jotun Dubai. This might be because they are wholesalers instead of retailers, or it might be due to the different market characteristics. In Dubai, the uncertainties and market fluctuations are higher than in Norway. Farveringen have newly atomised a lot of their warehouse, while in Mohd. al Qama there is still only manual work at the warehouse. Therefore, the amount of technological solutions implemented by the companies are very different.

Summaries of the findings are presented in the following tables. Characteristics of supply chain relationships are presented in Table 10. The ICT systems applied by the companies are presented in Table 11, and how the companies selected the ICT systems are presented in Table 12.

Table 10 The Case Companies' Relationship Maturity

Company	Relationship	With	Content of the relationship
Jotun Dubai	Internal	Jotun Dubai	Daily planning meetings, Other regular meeting, Regular projects, Technology sharing, Joint Strategy
		Jotun MEIA region	Regular meetings, Visits, Resource sharing, Joint projects, Technology sharing
		Other Jotun factories	Visits, Best practice sharing, Technology sharing
	External	Suppliers in general	Procurement orders& receival, Regular meetings, Visits, Problem solving, Joint projects
		Transport Providers in general	Transport orders, Regular meetings, Visits, Problem solving, Joint projects, Technology sharing (GPS)
		Customers in general	Sales, Regular meetings, Visits, Problem solving, Joint projects
Supplier, Dubai	External	Jotun Dubai	Daily sales & delivery of goods, Long-term relationship, Regular meetings, Visits, Joint projects
Transport Provider, Dubai	External	Jotun Dubai	Daily transport, Long-term relationship, Regular meetings, Visits, Joint projects
Customer, Dubai	External	Jotun Dubai	Procurement orders& receival, Long-term relationship, Discuss issues, Regular meetings, Visits, Joint projects
Jotun Norway	Internal	Jotun Norway	Daily planning meetings, Other regular meeting, Regular projects, Technology sharing, Joint Strategy
		Jotun SCA	Regular meeting, Visits, Resource sharing, Joint projects, Technology sharing, Joint strategy
		Other Jotun factories	Visits, Best practice sharing, Technology sharing
	External	Suppliers in general	Procurement orders& receival, Regular meetings, Visits, Problem solving, Joint projects
		Transport Providers in general	Transport orders, Regular meetings, Visits, Problem solving, Joint projects, Strategy meetings
		Customers in general	Sales, Regular meetings, Visits, Problem solving, Joint projects
Supplier, Norway	External	Jotun Norway	Sales & delivery of goods, Long-term relationship, Regular meetings, Visits, Joint projects
Transport Provider, Norway	External	Jotun Norway	Long-term relationship, Regular meetings, Visits, Joint projects, Strategy meetings
Customer, Norway	External	Jotun Norway	Long-term relationship, Regular meetings, Visits, Joint projects

Long-term relationship> 5 years; Regular meetings= meetings one or more times in a year

Table 11 Implemented ICT systems at the Case Companies

	EDI	MRP	ERP	WMS	TMS	GPS	Barcodes	RFID	MS Office	VMI	CFP/ CPFR	ELM	Cloud computing
Jotun Dubai	✓	✓	✓	✓	✓	✓	✓		✓				
Supplier Dubai	✓		⊕			✓			✓				
Transport provider Dubai	✓		⊕		✓	✓			✓				
Customer Dubai	✓		✓						✓				
Jotun Norway	✓	✓	✓	✓			✓		✓				
Supplier Norway	✓		✓	✓						⊕			
Transport provider Norway	✓		✓		✓	✓	✓		✓				⊕
Customer Norway	✓		✓	✓			✓						

✓ = *have implemented,* ⊕ = *initiation phase /are soon implementing*

Table 12 Summary of Factors Affecting the Case Companies Choice of ICT systems

Company	ICT systems used	How and why did they choose these solutions
Jotun Dubai	EDI, ERP (IFS Matrix), MS Office 365, Jotun Operation System JOS, Join (Intranet)	A Jotun global decision (*internal relationships*).
	PDF, and PLC	Implemented because some other Jotun sites was using it (*internal relationships*).
	MRP master scheduling and WMS	The decision was based on their own needs (*company characteristics and operational characteristics*).
	JSDS	The decision was based on their own needs (*company characteristics and operational characteristics),* but the implementation of GPS was done in collaboration with PrimeLink (*external relationships*).
Supplier, Dubai	Oracle invoicing software, GPS, ERP (Oracle, soon)	The decision was based on their own needs (*company characteristics and operational characteristics*).
Transport Provider, Dubai	TMS, MS Excel	The decision was based on their own needs (*company characteristics and operational characteristics*)
	GPS	The decision was based on their own needs (*company characteristics and operational characteristics*), but the implementation of GPS was done in collaboration with Jotun (*external relationships*).
Customer, Dubai	EDI, ERP (Sage)	The decision was based on their own needs (*company characteristics and operational characteristics*).
Jotun Norway	EDI, ERP (IFS Matrix), Office 365, Jotun Operation System JOS, Join (Intranet)	A Jotun global decision (*internal relationships*).
	WMS, Workflow, KSD	The decision was based on their own needs (*company characteristics and operational characteristics*).
Supplier, Norway	EDI, ERP (SAP)	The decision was based on their own needs, and valid for all Emballator units (*internal relationships, company characteristics and operational characteristics*).
	VMI (soon)	Wish from the customers (*external relationships*).
Transport Provider, Norway	EDI, ERP (SAP), TMS, eSchneker, GPS	A Schenker global decision (*internal relationships*).
	API	Work with customers to develop this (*external relationships*).
Customer, Norway	EDI, ERP (Driw), WMS, Barcodes	The decision was purely based on their own needs (*company characteristics and operational characteristics*).

7. Reflections and Discussions of the Findings

Based on the research questions and objectives presented in Table 1, and the propositions presented in Chapter 3, the empirical findings from the interviews will now be discussed with regards to the theoretical fundament and the literature findings. The following reflections and discussions are based on my interpretation of what was said in the interviews. Both proposition 1 and 2 relate to the first research question (RQ1), while proposition 3 relates to the second research question (RQ2). They are hence discussed accordingly.

7.1 How do the Relations Between Supply Shain Relationships and Choice of ICT Systems Affect one Another? (RQ1)

7.1.1 The Effect of ICT on Supply Chain Relationship Intensity

To understand the relations between supply chain relationships and choice of ICT systems, it is important to understand how ICT systems affect supply chain relationships. In this section, findings related to the first proposition will be discussed.

Proposition 1: ICT increase supply chain relationship intensity

From the literature study, it is clear that the use of ICT is beneficial for companies, by reducing costs, increasing efficiency, improving visibility and strengthening supply chain relationships (Bartezzaghi and Ronchi, 2003, Majorique Léger et al., 2004, Cassivi et al., 2005, Saldanha et al., 2013, Vanpoucke et al., 2017, Alsaad et al., 2018). According to the Logistics and Distribution Manager at Jotun Norway, one of the main benefits of implementing ICT is the reduction of human errors. The use of ICT has also made communication and exchange of information easier, both within and between companies. Positively affecting the procurement processes, the internal production planning and coordination processes, and the sales processes, referring to the SRM, ICSM, and CRM in Figure 4.

Market characteristics affect the trust, uncertainties and the willingness to opportunistic behaviour between companies, highlighted by the General Manager at Mohd. Al Qama. Claiming that increased visibility in their supply chain would be challenging for them to manage due to the lack of trust between the suppliers and the customers, in their volatile Dubai-market. Regarding other supply chain actors than Jotun, Mohd. al Qama has a generally low intensity of supply chain relationships. These might for most cases, be characterised as open market negotiations, illustrated in Figure 5. On the other hand, the Key Account Manager of Emballator Ulricehamn states that they are positive towards greater visibility in their supply chain and wishes to implement VMI. Their market characteristics are more stable, and also their general intensity of supply chain relationships is higher, corresponding to somewhere in between cooperation and collaboration, illustrated in Figure 5.

As claimed by Hadaya et al. (2006), e-collaboration could be used as a safeguarding mechanism against opportunistic behaviour. Based on the interviews completed in this study, and, agreeing with (Spekman et al., 1998), a certain level of mutual trust is a fundament in a supply chain relationship. Without this fundament, e-collaboration will not be implemented. However, if trust already exists between two supply chain partners, this finding from Emballator Ulricehamn agrees with Hadaya et al. (2006) and Spekman et al. (1998), and shows that ICT could be beneficial and further increase the trust and supply chain intensity. Therefore, if companies first assure a certain level of relationship intensity, for example supply chain cooperation, then a more extensive implementation of internet-based, collaborative tools might be beneficial, to further increase the mutual supply chain partner connection and to increase the relationship intensity. Agreeing with proposition 1, implementation of ICT systems increases supply chain relationship intensity.

7.1.2 The Effect of Relationship Intensity on ICT Choices

To understand the relations between supply chain relationships and the choice of ICT, it also important to understand how the supply chain relationships affect the selection of ICT systems. In this section, findings related to the second proposition will be discussed.

Proposition 2: The intensity of the supply chain relationships influences the selection of ICT systems

In Jotun Group, the policy has been that different facilities select their own ICT systems. For most of the ICT systems in use, it is still like this. However, in 2004, the decision was made to invest in, and enrol the same ERP system in all facilities. This decision was made by the board of directors. It has been a long process, but soon all Jotun's facilities share the same ERP system. Giving them the possibility to access other facilities system, creating full visibility between one another. This allows, for example, some employees at Jotun Dubai to access the systems of other Jotun facilities in the MEIA region and borrow raw materials from them. Also, the enrolment of Office365 enables easier communication and coordination possibilities for Jotun employees all over the world. This decision was also made by Jotun's board of directors and applies to all Jotun's facilities. Also, the other large companies in this study with several facilities, Schenker and Emballator Ulricehamn, use the same ERP system to create internal visibility and standardisation.

Internally in these companies, trust is not an issue, since all facilities belongs to the same group. However, in external relationships, companies have the possibility to act opportunistic, then trust and uncertainties become a challenge. All the individual actors in a supply chain have the opportunity to act opportunistic. However, from a holistic supply chain view, this is not beneficial (Lambert et al., 1998; Slack et al., 2013; Chopra and Meindl, 2016). All companies interviewed in this study have high intensity relationships with Jotun already, and hence a high level of trust.

The companies interviewed in this project all have implemented several ICT systems. The most common ICT system used in the external relationships amongst the supply chain partners is EDI. However, this is an old system, with low potential for creating visibility across the supply chains, only generation of orders and confirmations. According to the Logistics and Operations Manager at Farveringen, a challenge of other ICT systems, is that very few actors use the same systems. This reduces the visibility-benefits and also increases the complexity of using the already implemented ICT systems. Agreeing with (Li et al., 2009) that the lack of ICT alignment often reduces the potential benefits of the implemented ICT solutions. Had the companies in a supply chain instead applied the same ERP systems, orders would go smoother, and the stress of sending order confirmations in the same succession as the order was sent diminishes. If collaborative planning systems had been implemented, it would allow for even better planning and possibilities

to reduce the bullwhip effect. The bullwhip effect occurs when there are uncertainties in the planning process, and every stage upstream produce or orders more goods then they actually need.

According to the methodology of Lean thinking, waste reduction is central, focusing on limiting non-value adding processes (Alsaad et al., 2018). The 5S method is a familiar concept of Lean. In 5S, the concept of standardisation is one of the five S's (Gapp et al., 2008). According to the Logistics and Operations Manager at Farveringen, there is a lack of standardisation of technologies through the supply chain, which reduce the potential benefits of the technologies. Agreeing with (Harris et al., 2015) and the findings from Appendix 1, ICT applications are in need of standardisation.

One other important consideration is that none of the companies interviewed in this study are IT companies, i.e. they are not specialised in IT, and ICT system development. Therefore, the companies in this study buy their ICT systems from ICT development companies. The companies in this study send out ICT specifications on tenders, for the IT companies to tailor the most suitable ICT systems to the given specifications. Causing the majority of the companies to focus inwards, analysing their own needs, based on the company characteristics and operational characteristics.

The large companies, such as Jotun and Schenker have their own IT department responsible for development and upgrading of IT systems. For Schenker, their HQ and also their IT department are in Germany being less technology oriented than in Norway. Causing them to lack behind Norwegian operators in the same market. Regarding Jotun Dubai however, having their HQ in Norway might have increased their focus on technology, compared to other companies in Dubai. Giving them benefits from the technology level of Norway. Hence it might be that companies in emerging economies benefit from being a part of companies in developed economies.

In addition to running ICT tenders, the companies are contacted directly by IT companies. The IT companies deliver different systems and promote themselves to convince companies to invest in their systems. Some IT companies also arrange conferences where they invite their customers, the users of their ICT systems. Here, the IT company's customers get the possibility to meet each other and exchange information and lessons learned from the ICT systems. The Logistics and Operations

Manager at Farveringen claims that it is valuable to meet other companies that use the same system, to talk about challenges and to learn from each other.

The implementation of the common ERP system in Jotun, which has now lasted for 15 years, illustrates how comprehensive implementing a new ERP system could be for a large company such as Jotun. There are two main reasons for why this implementation have taken so much time. The first is that the ERP system needs to be customised to each facility. The second, is training of employees to use the system. Several of the managers from the other companies interviewed also highlight that training of employees is the largest challenge to implementing ICT systems, agreeing with (Chang et al., 2009; Gunasekaran et al., 2009; Zhao et al., 2016; Upadhyay et al., 2017). Creates incentives for the IT-companies to improve the user interface in their systems, which will reduce the amount of training needed.

For this particular case study, it turned out that internal relationships had a lot of influence on the types of ICT systems companies chose to implement and use. As shown in Table 12, there are also two other important factors affecting the ICT selection. The first are the company characteristics, regarding amongst other things, the type of company, industry and market the company operates in, and also the type of products, and the number of SKUs the company produce, buy or transport. The second are the operational characteristics, concerning the nature of the production, procurement or transportation. These are for example concerning the material and information flow, the customer order decoupling point (CODP) indicating whether the production is done by push or pull, and also the level of automatization, where increased automatization often leads to an increased demand for ICT systems.

External vertical collaboration-projects have resulted in several new innovations and joint improvements on many areas of business. However, external relationships had only limited effect on what types of technologies that were chosen to implement in the different case companies. There are two cases where the choice of a new ICT system was made in collaboration with supply chain partners. The first example is the GPS implementation done in collaboration by Jotun and PrimeLink. The second example was VMI projects, run by Emballator Ulricehamn and some of their customers. In the future, several joint ICT projects could be run, leading to the next research

question. With regards to proposition 2, it turned out that internal relationships, in addition to company characteristics and operational characteristics highly affected the type of ICT systems the companies implemented, while external relationships only to some extent affected the types of ICT systems implemented.

7.2 How Could the Relations Between Supply Chain Relationships and Choice of ICT Systems Affect one Another in the Future? (RQ2)

7.2.1 The Effect of Relationship Intensity on ICT alignment

The second research questions concern future possibilities on how high-intensity supply chain relationships could enhance ICT alignment. In this section, findings related to the third proposition will be discussed.

Proposition 3: High-intensity external supply chain relationships could enhance ICT alignment

The ultimate goal of many companies is to create a seamless interconnecting supply chain (Cassivi et al., 2005). However, despite the high intensity of their relationship, the companies in this study are far from having this seamless interconnected chain.

When a supply chain actor wants to tie a supply chain partner closer, the partners could invest in relation-specific assets, as explained in Subchapter 3.2. According to the TCT, investing in relation-specific assets will reduce the uncertainties between companies and hence reduce the transaction costs. According to the RV, investing in relation-specific assets will provide the partners doing the investment obtain collaborative advantages from the relational rent.

ICT system can be regarded as relation-specific assets (Gunasekaran et al., 2009). Based on information obtained during the interviews, suppliers and customers doing joint projects might obtain both reduced transaction costs and provide collaborative advantages. By using the same ICT system, orders could be sent and received seamlessly, and the visibility of the chain could also increase. The companies would hence be able to communicate and collaborate even better (Wang et al., 2011). One challenge is that companies have different wishes and needs for the ICT systems.

There exist also a number of different ICT systems which all have their strengths and weaknesses. The individual company need for tailored systems might therefore reduce the potential benefits.

As highlighted by (Spekman et al., 1998), not all supply chain relationships should be as close as collaboration. A company needs to make a strategic choice of whom to collaborate with. This could for example be a supplier of vital products. When it comes to customers, companies would usually like to tie them closer to themselves to reduce their own market uncertainties. This is also important to keep in mind when strategically selecting which companies to invest in relation-specific assets with. An important consideration is that tying closer bonds by relation-specific investments reduces the flexibility.

All the companies interviewed had experiences from joint projects with other members in their supply chain. Successful outcome of joint projects increases trust among the participants and often opens up for further collaborations (Schroeder et al., 2004). ICT-projects could also be done together, and some of the companies have already started doing this. However, the trust in the relationship have to be high, and the benefits of the system have to be clear and shared between the collaborating partners. Figure 7 illustrates the information flow of a supplier-customer dyad that first have different systems, then the dyad below uses the same system. The length of the information sharing arrows are the same length for both cases, but the second case saves time due to reduced compatibility issues, leading to reduced costs. Also, the companies tie closer bonds to one another, reducing uncertainties, enhancing trust and resulting in relational rents.

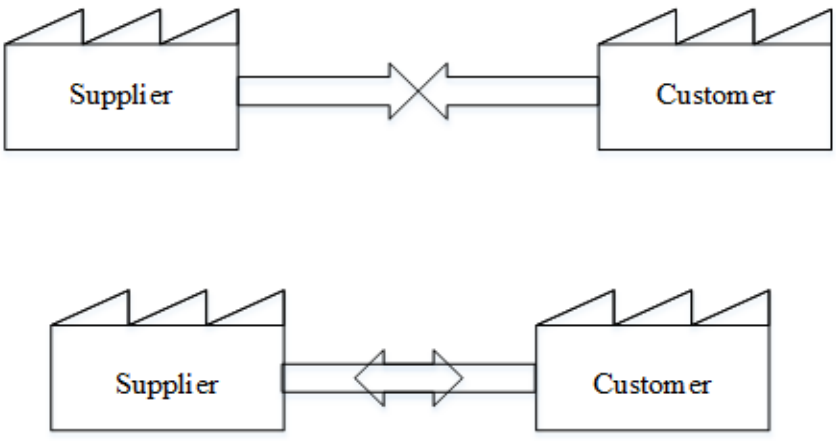

Figure 7 Illustration of the Supplier - Customer ICT Collaboration

The findings in this thesis might also be interesting for IT companies, who develop IT and ICT systems. They should increase the focus on user friendly systems, to reduce the time spend on training employees. This also creates a new market for IT systems that convert information from, for example, one ERP system to another, or from a TMS system to an ERP system and vice versa, making different systems compatible to interact with one another. This should be possible, since system interfaces between ERP and WMS systems for example already exists and are used by several of the companies in this study. When implementing these types of conversion or compatibility systems, two companies could share the expenses of the implementation and both draw the benefits of it. This type of system could therefore also be regarded as a relation-specific investment.

Not all companies are recommended to invest in new systems and force all their partners to do the same. But this thesis encourages companies to be more open-minded and also take into account their closest partners, and their suggestions. Keeping in mind that using the same system could increase visibility in the chain and also work as a relation-specific asset to tie suppliers or customers closer.

The companies interviewed are not yet using any of the more advanced digitalisation technologies. When deciding which ICT systems, or emerging digitalisation technologies to implement, companies could research which systems other strategic actors in their supply chain use, and benefit from implementing the same or a compatible system. Figure 8 summarises the four focus areas a company should have when implementing new technological solutions.

Internal Relaitonships	Company Characteristics	Operational Characteristics	External Relaitonships
What is done by other facilities or departments? Makes sure the ICT system is aligned inside the compeny	How can the ICT system best fit the needs of the company? Makes sure the ICT system is suitable for the company characteristics	How can the ICT system best fit the operational needs? Makes sure the ICT system is suitable for the operational characteristics	What is done by strategic supply chain partners? Makes sure the ICT system is compatible with strategic partners, and aligned through the supply chain

Figure 8 Decision Areas for ICT Selection

8. Conclusions, Limitations and Further Work

8.1 Conclusions

In this project, eight companies from two different supply chains, one in an emerging economy and one in a developed economy, have been studied with regards to their internal and external supply chain relationship intensity and their implemented ICT systems.

How do the relations between supply chain relationships and choice of ICT systems affect one another? (RQ1)

According to both literature findings and findings from the interviews, ICT systems contribute to strengthen supply chain relationships. The ICT systems provides better visibility, and easier communication channels, in addition to reduce the cost of transactions. Hence it is concluded that for these cases, ICT systems improves supply chain relationships.

High-intensity internal relationships highly affect the choice and use of ICT systems. This is clear from the large companies interviewed in this study: Jotun, Schenker and Emballator. These companies have invested a lot of resources into unifying the ICT systems implemented in each of their facilities. The intensity of external relationships does to some degree affect the choice and use of ICT systems. However, other factors are currently more important. These are the companies' characteristics, and the operational characteristics in addition to the internal relationships. Therefore, the intensity of supply chain relationships influences to some extent the selection of ICT.

How could the relations between supply chain relationships and choice of ICT affect one another in the future? (RQ2)

Regarding future investments in ICT systems and emerging computer technologies, it might be beneficial for companies to collaborate on the choice and implementation. This might save implementation costs due to economies of scale. Additionally, it might further increase visibility, tie the companies closer to one another and provide collaborative advantages.

Using ICT as a relation-specific asset could be beneficial for companies, reducing transaction costs, according to TCT, and provide collaborative advantages according to the RV. However,

mutual trust must exist between the actors to achieve these benefits. Therefore, when investing in relation-specific assets, the company needs to be strategic with which partners to do this. To reduce uncertainties, companies should focus on implementing relation-specific assets towards strategic actors. Hence, it is concluded that high-intensity external supply chain relationships could enhance ICT alignment.

There is no doubt that ICT systems have had and will continue to have a high positive impact on supply chain relationships. When choosing ICT systems, or emerging technological systems, companies should focus on internal relationships, company characteristics, operational characteristics and external relationships to be able to gain the most possible benefits of the systems implemented.

8.2 Limitations

Generally, case studies are not generalisable, and generalisation is not an aim or intension in this project. However, the use of multiple-cases can to some extent increase the level of generalisation.

When using case studies in research, reliability can be threatened. The semi-structured interviews conducted/used in this study were performed both in Norway and in Dubai. Both cultural and second-language-challenges might have influenced the answers.

All the interviewed objects were managers with different responsibilities, as shown in Table 6. Thus, their answers are based on their own perception, insight and knowledge. If other respondents in the companies had been interviewed, perhaps other answers had been given. Also, observer bias must be accounted for.

The companies interviewed have all close relationship to Jotun Dubai and Jotun Norway, and the interviews were all organised by Jotun employees. Except for two interviews, Jotun representatives were present during the interviews. This can have influenced the answers given. To help the transcription and reflection on the interviews afterwards a tape recorder was used. The respondents were informed of this. Knowing this, they can have been influenced when answering.

8.3 Further Research

While this thesis has identified that companies should increase the focus on external relationships when selecting ICT systems, the opportunities and potential benefits of ICT collaboration projects should be investigated. To do this, empirical studies of pilot projects where two supply chain partners engage in joint ICT implementation could be conducted. This could reveal the long-term effects of the relations between external supply chain relationships and ICT.

Depending on the outcomes of further research on this topic, it would be interesting to investigate how future technologies should accommodate the aspect of external collaboration in supply chains. To find out of it is beneficial with unification of ICT systems across actors, or if the ICT development should focus on compatibility between different systems. This development of future ICT solutions is dependent on to what degree the supply chain actors recognise the benefits of investing in ICT collaboration with external partners. Increased supply chain visibility could compromise the trust between actors, and research on how trust can be assured for supply chain actors in transparent supply chains should be a focus in further research.

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Appendix 1 – Paper Based on Specialisation Project

Decision Variables for Inbound Transportation Redesign in a Chemical Manufacturing Supply Chain

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Abstract: With respect to process manufacturing industries, there has been limited research on inbound transportation management in the literature. While some of the methods and strategies developed in the discrete manufacturing industry are easily applicable in the process industries, increasing changes in business environment through emerging technologies and a push for increasing sustainability performance motivates the need for research that addresses the needs of process manufacturers. The purpose of this paper is therefore to provide an overview of current research on key variables to consider when deciding inbound transportation strategy. Those factors are then discussed by looking at the opportunities and challenges they present in the process manufacturing supply chain context, via a case study of a paints and chemicals manufacturing company. Data from the case study was collected during a workshop at the main factory location, and several follow-up interviews. The main opportunities identified are improved sustainability and visibility, while main challenges are increased complexity, and increase in coordination requirements with more collaboration.

Keywords: supply chain management, inbound transportation; logistics in manufacturing, process manufacturing

1. INTRODUCTION

Traditionally, all actors in a supply chain are responsible for their own outbound distribution of goods. In many cases, this result in vehicles arriving with raw materials and leaving empty, while at the same time, empty vehicles arrive to pick up the finished goods. This lack of collaboration and visibility between inbound and outbound transportation leads to lost opportunities in taking advantage of the empty vehicles. Empty vehicles are non-value-adding sources to greenhouse gas (GHG) emissions, cost, and driver-time. Montreuil (2011) address this problem, by referring to McKinnon (2007), stating that 27% of truck-kilometres was travelled empty in the UK in 2004. Furthermore, customers are increasingly demanding supply chains that consider environmental issues as well as economic. According to European Commission (2016), in 2014, the transportation sector was responsible for almost 25% of all GHG emissions in Europe, and road transport contributes with over 70% of this. Their goal is to reduce road transport by 60% from 1990 to 2030.

An industry associated with a considerable amount of global transportation is the chemical process industry. The actors are usually positioned in the middle of wider supply chains with many suppliers and customers scattered worldwide (Barbosa-Póvoa, 2012, Shah, 2005). Currently, competition in the chemical process industry has increased and several researchers address the fact that there is a need to reduce both costs, inventories and the time to market. (Shah, 2005, Papageorgiou, 2009, Barbosa-Póvoa, 2012, Liu and Papageorgiou, 2013). Hence, there is a need for both improved efficiency and responsiveness in the supply chains. Since the chemical industry is such a global industry, the transportation of chemicals corresponds to a large amount of the total transportation of goods world-wide (Erera et al., 2005).

One approach to address this need is the introduction of the factory gate pricing (FGP), a strategy that has had a great success in other industries e.g., in the UK grocery distribution sector. One of UKs largest fashion retailers implemented FGP in the 1970's and have improved their profitability by doing so. Potter et al. (2007) have found that introducing FGP for other sectors of the retail industry as well, with a focus on the grocery sector, could lead to an improved market position. Also, the automotive industry has experienced reduced lead times in the delivery of parts to manufacturers. The FGP strategy concerns the issue where the buyer is in control of the transportation from the supplier. Inspired by the retail industry and the FGP strategy, this research is motivated by the hypothesis that this strategy would benefit also companies in the chemical process industry. The large amount of global transportation in the chemical industry makes this a desirable industry to research.

Therefore, this paper seeks to evaluate the benefit of taking control of the inbound transportation in the chemical process manufacturing industry. The objective of the research is to

establish a body of knowledge to what decision-making areas to consider when changing the inbound transportation strategy. Thereafter, the different areas are assessed and discussed during a workshop by managers at a chemical and paints manufacturing company, to assess possibilities and challenges. There exists, to the authors knowledge, only a limited amount of literature on inbound transportation strategies, and hence, this is the knowledge gap intended to fill. To fulfil this objective, the following research question is addressed: *what opportunities and challenges are expected when planning and control of the inbound transportation shifts from input suppliers to a focal company in the chemical process industry?*

The scope of the study is limited to discussing what different decisions to make, and the possible outcomes of these decisions, when taking over the planning and coordination of inbound transportation, and not to research how a new strategy could be implemented. With this aim, the companies do not necessarily own the vehicle transporting inbound materials themselves. They could choose to hire a carrier or a third-party logistics provider (3PL) to take care of the transport itself, but the important difference is which company that makes this decision. Based on reflections around the findings from the literature study, and findings from the case study, the strategic transportation management decisions are evaluated.

2. RESEARCH METHODOLOGY

The methodology consists of both a systematic literature study and a case study. To study existing literature on the field, a keyword search was done in the databases of Emerald Insight, Science Direct and Web of Science. The articles were limited to the last 20 years, and no articles older than 1998 were included in the study. The articles were sorted by the following criterion: (a) trucking transportation in a supply chain; and (b) the shippers' point of view + not only concerning distribution. This resulted in 42 articles being selected for the study, to identify the key decision-making areas to consider when changing inbound transportation strategy.

In addition, empirical data was collected from a chemical manufacturing company with a large supply network, to figure out if what we found in the literature was relevant in the industry as well. The empirical data was gathered by a workshop, a factory tour and semi-structured interviews with managers in the case company to address their impression of possibilities and challenges with changing the inbound transportation strategy.

3. FINDINGS FROM THE LITERATURE

From the literature study, seven key decision-making areas were identified. These are presented in the following sub-sections.

3.1 Internal Collaboration and Factory Gate Pricing (FGP)

Internal collaboration refers to the collaboration internally in a company. Stank and Goldsby (2000) focus on internal collaboration in transportation management, and the corporate transportation function in a changing environment. They claim that a supply chain is no stronger than its weakest element, and that transportation planning managed independently of other value-adding activities, in many cases exemplifies a very weak element. They also state that internal collaboration between inbound and outbound transportation will result in possibilities to combine freight, and milk-runs, as well as better deals with carriers, due to both higher priorities at the carrier and also lower per-unit transportation costs, because of increased shipping volume, giving economies of scale.

It is not new for a manufacturer to take control of and responsibility for the planning and coordination for its inbound transportation. The retail industry and the automotive industry are two examples. The strategy has been presented in the literature under the name of *factory gate pricing* (FGP) strategy. By using the FGP strategy, the inbound transportation becomes a part of the company's supply chain and internal collaboration and coordination between inbound and outbound transportation is possible. (Potter et al., 2007)

Mason et al. (2007) incorporate a case study on the FGP strategy in their paper on freight transport management when combining horizontal and vertical collaboration. From the case, they conclude that introducing the FGP strategy could improve both customer efficiency, asset utilization and customer response. However, work needs to be done before the full potential of this and of collaboration can be achieved. For example, they claim that a holistic viewpoint and a change from a functionally-oriented mentality to a process-oriented mentality is needed.

3.2 Environmental Sustainability

Traditionally, the main focus of operations research (OR) has been to obtain a supply chain economic surplus. In recent years, the environment and social part of the supply chain has gained more attention due to the huge environmental issues the world now faces. It has therefore been a shift of the focus of OR, particularly to include the trade-off between economic and environmental sustainability. Environmental issues are one of the greatest challenges of our world today, and no easy answer yet exists to this complex problem. To improve environmental sustainability of transportation, the most important factors are the load factor, the speed, the transportation network and the transportation mode (Dey et al., 2011; Demir et al., 2014; Mallidis et al., 2014; Christopher et al., 2015). The next sections contain other ways of improving environmental sustainability.

3.3 Transportation Modes

The topic of transportation modes has been highly covered in the literature. The reason for the high focus of changing the mode of transportation is because different modes of transportation emits different amounts of greenhouse gases (GHG), also highlighted by Dey et al. (2011) and Christopher et al. (2015) in the last section. Macharis and Bontekoning (2004) provides a thorough review of the existing operations models used in intermodal transportation. Intermodal transportation concerns transportation of goods by different modes. The goods however, are at all times kept in the same unit and are not treated along the way. This is a subcategory of

multimodal transportation, which is defined as the transportation of goods in a sequence of at least two different modes. Their conclusion is that the decision-making process for multimodal transportation is complex and many actors and stakeholders are involved.

A thorough review of the strategic, tactic and operational levels of multimodal transportation planning is provided by SteadieSeifi et al. (2014). The conclusion is that there is a huge gap in multi-objective transportation planning and the incorporation of backward flows into the planning of forward flows. Harris et al. (2015) review 33 EU framework program projects and conclude that "One of the major constraints is the lack of effective and efficient information connectivity among and between various modes (water, air, road and rail)". They claim to be the first to combine the technological trends and barriers to technology adaption with multimodal operations.

3.4 Vertical Collaboration

Outsourcing of transportation activities to a third-party logistics provider (3PL) is common. Outsourcing allows companies to focus on the activities they perform well, and paying others, with other specialties to perform other activities in the supply chain (Chopra and Meindl, 2016). When activities have been outsourced, the company also need to determine how close to collaborate with each other.

Mason et al. (2007) highlights combining vertical and horizontal transportation, when being in charge of all transportation management in the logistics flow in addition to focusing on the FGP strategy. They find that when using the FGP strategy, new and innovative technological solutions could improve collaboration, both horizontal and vertical. Roorda et al. (2010) focus on outsourcing of logistics services. They present a framework for modelling the diversity and interactions of actors in an outsourced supply chain. Their findings states supply chains should increase the focus on long-term alliances between suppliers, manufacturers, retailers, carriers and 3PLs to become successful.

3.5 Horizontal Collaboration

A more explored area of research is the collaboration between companies on the same level of the supply chain. This collaboration between competitors is called horizontal collaboration. The main focus of the primary literature on horizontal collaboration has been different approaches on how to allocate the costs between the collaborating shippers (Ozener and Ergun, 2008, Frisk et al., 2010, Yilmaz and Savasaneril, 2012, Lozano et al., 2013).

Defryn and Sörensen (2018) aim to capture the individual partner interests in the logistics optimisation model. They found that the collaboration can be beneficial, even when partners have conflicting objectives. Palmer et al. (2018) quantify environmental and economic benefits of collaboration in the fast-moving consumer goods (FMCG) sector. From their study of collaboration amongst ten FMCG companies, they found 23% cost reduction, with 58% fewer road kilometres travelled and a reduction of CO_2 emissions by 46%. However, the results represented the theoretical maximum, and might not be equally large in the practice.

3.6 Fourth Party Logistics Providers (4PLs)

The main challenge of both vertical and horizontal collaboration is trust between the different collaborating companies. An emerging business originated by the consulting company Accenture is fourth party logistics providers (4PL). The idea behind 4PLs is that they operate as a neutral service provider, implementing data from both the primary client, their partners and their 3PLs to optimise the total supply chain and gain a sustainable end-to-end supply chain, without any of the collaborating companies risking information sharing with one another (Christopher, 2016).

Hingley et al. (2011) research benefits and barriers of 4PLs in horizontal collaboration. Through their research, they found that "managers believed 4PLs could provide key potential benefits, but that it would negatively influence the grocery retailer-supplier dynamics". Mehmann and Teuteberg (2016) research how a 4PL could be implemented in the transportation planning process. Their findings are that implementing a 4PL could lead to up to 38% cost savings and also the reduction of environmental pollutions.

3.7 Information and Communication Technologies

Some authors also have implemented and analysed the use of information and communication technology (ICT) solutions into transportation management. Only two papers from the literature search had main focus on ICT solutions, being Evans et al. (2015) and Harris et al. (2015). But, many of the other authors mention that emerging track-and-trace technologies and ICT solutions could contribute to improve transportation management even though this is not their primary focus (Stank and Goldsby, 2000; Macharis and Bontekoning, 2004; Wijngaard et al., 2005; Mason et al., 2007; Potter et al., 2007; Norbis and Meixell, 2008; Roorda et al., 2010; Dey et al., 2011; SteadieSeifi et al., 2014; Mehmann and Teuteberg, 2016).

The use of ICT has a directly positive impact on the reduction of CO_2 emissions in road freight transport. However, to be able to utilise the full potential of reducing CO_2 emissions there is a need for collaboration with other companies as well (Evans et al., 2015). The role of ICT in multimodal transportation is key enabler, but the uptake on provisions in Europe and un the UK has been slow (Harris et al., 2015). Wijngaard et al. (2005) claim that the use om real-time information has been implemented in the planning, to improve schedules and routes of transportation. Also, the implementation of the FGP strategy is highly dependent on the use of ICT solutions (Potter et al., 2007). Mason et al. (2007) claims that developments in ICT is one of the main catalysts to improve vertical and horizontal collaboration as well.

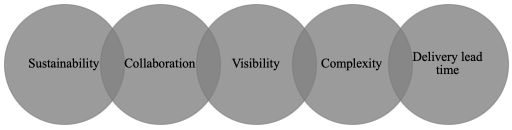

Fig. 1. Key Challenges of Transportation Management

4. DISCUSSION AND CASE INSIGHTS

Even though the core goal of a supply chain is to maximise the company surplus, every supply chain is different, tailor made for its needs. This is what makes supply chain management such an interesting field of study. In recent years, the main focus, and also the core goal has not only been to maximize the surplus, but also to obtain environmental and social sustainability. Also, due to changing customer demands, increased globalisation and emerging technological solutions, supply chains are in constant need of changing. In the literature several potentials have been suggested to obtain successful supply chains.

In Fig. 1. an illustration of the five key challenges of transportation is presented. These five areas are found to be what makes transportation management challenging, and also where there are room for improvements. As illustrated, all the challenges slightly overlap and affect one another. They are based on findings in the literature and the case company, and they all underlie the choices of transportation strategy.

4.1 Factory Gate Pricing (FGP) and Internal Collaboration

Findings from the literature shows that the lack of visibility in supply chains is a challenge. A lack of visibility and mutual trust are the main reasons for why many companies have trouble with collaboration. It is increasingly important to have a good relationship and collaboration with suppliers if a company wish to implement the FGP strategy, because the planning of inbound transportation creates the need for better collaboration on pick up times. In different ways, collaboration is the core element in all papers used in this study. However, the papers often conclude that collaboration have the potential for successful implementation.

Findings from the case company, states that it is usually the complexity of the collaboration that makes it difficult. The case company, whose customers are seven big wholesalers, have a close customer collaboration. While, they find it much more difficult to collaborate close with all of their many suppliers.

4.2 Sustainability

From the literature findings, the load factor has been claimed to be a large contributor when improving the sustainability of the transportation. Findings from the company is that, when ordering raw materials, they do not care about the load factor of their orders, mainly due to a lack of raw material storage space, resulting in a desire to make the orders as small as possible. They order only exactly what they need, and the transportation cost of the order is not visible to the case company. This is one major drawback of the current strategy. It is especially apparent that once the cost of transportation is visible, as it is for outbound transportation, they are keen to fill full containers. On outbound transportation it is also important to reduce transportation costs, since the customers at all times have control of these costs. This is also due to the fact that the customers are large wholesalers that transport the finished goods to their own storage spaces, and it is assumed that a lack of space is not as big an issue. The load factor therefore becomes a trade-off between economic and environmental sustainability. This affects the sustainability and the visibility challenge in Fig. 1.

4.3 Transportation Modes

Of the key challenges in Fig. 1, the transportation mode covers the trade-off between the sustainability and the delivery time. Norbis and Meixell (2008) highlight the lack of research on security issues and international issues of the different transportation modes, leading to uncertainties in the security and international part of the decisions. Have in mind that a transportation route not necessarily only include one mode of transportation. Multimodal, intermodal and synchromodal transportation are possibilities, but this further increase the complexity of the transportation planning.

For the case company, they have no control of the current inbound transportation modes. This creates possibilities of affecting the choices of transportation mode if they manage the transportation. However, the suitable mode used might not differ at all from the current situation, because, probably the most suitable mode is used already. At least for the short-distance shipments.

4.4 Vertical Collaboration

If the supplier, customer and carrier were to share more of their information with each other, this could contribute to reduce uncertainties. This factor highlights the collaboration and visibility challenge from Fig. 1. It also emphasises a trade-off between collaboration and competitiveness. Increased vertical collaboration leads to increased information sharing between the actors, which again lead to increased visibility in the supply chain. But increased visibility could again result in a lack of negotiation opportunities between the actors. Stank and Goldsby (2000) argues well for why companies should seek to increase collaboration. Their findings match the findings from the case study, where managers also agree that the increased collaboration would benefit flexibility and visuality, cut inventory levels, creating a more seamless supply chain operation and also, reduce uncertainties. Here the issue of complexity is found again. It will be hard to create and obtain a close collaboration in a complex supply network.

4.5 Horizontal Collaboration

Research has shown both economic and environmental saving potentials, increased capacity utilization and increased service level of horizontal collaboration. However, several issues follow this alternative. First and foremost is the issue of privacy being highly relevant for this area. Also, what the majority of researchers in this field have researched, how to distribute joints benefits and costs of this solution in a stable and sustainable way is not an easy task. Ozener and Ergun (2008) highlights that the synergy of the lane network is very relevant and has impact on the collaboration. Suitable companies with synergetic lane networks would have to be

found before deciding to establish this type of collaboration. This appears very challenging, since companies seems unlikely to share supplier and customer locations with each other.

Another important aspect is the legal ramifications of the collaboration, highlighted by Frisk et al. (2010), the collaborating companies must not form cartels, and the coalition must be trustworthy for all collaborating companies. Yilmaz and Savasaneril (2012) states that the collaboration might not be as beneficial for large companies with large amount of transportation. While Lozano et al. (2013) points to the limited number of partners that can form the coalition because of complexity and transaction costs. With all these constraints, it might be hard to find suitable companies to collaborate horizontally with. Time and effort must be spent on collaborating and negotiating with the alternative companies. It is also very hard to estimate the possible gains of this alternative, which would make it hard to convince companies to collaborate horizontally.

4.6 Fourth Party Logistics Providers

A 4PL could incorporate information from suppliers, manufacturers, carriers and customers into one system, and thus be able to plan the supply network more efficiently. Providing all the benefits while at the same time bias the challenges of information sharing and trust of horizontal and vertical collaboration. However, their services would most likely be expensive. The cost of hiring a 4PL versus the cost savings of improved efficiency, less coordination and planning in the company has to be deliberated. The managers of the case company did not believe a 4PL to be favourable for their company. The case company already has a planning department and because of the complexity of the planning and coordination, the 4PL would have to be deeply into the organisation. They would also rather keep this competence inside the company than outsource it. This agrees with Hingley et al. (2011), who found that retailers also lack the willingness to collaborate with a 4PL.

4.7 Technologies

Even though ICT solutions have been on the market for quite some time now, it is still constantly need for developments. Many companies still struggle with how to best utilize advantages of the technological trends. Evans et al. (2015) concludes that ICT solutions directly impact the CO_2 emissions positively, however to obtain even further improvements, collaboration and information sharing is needed. When it comes to the visibility, ICT solutions could come in handy. The ICT solutions hence address both visibility and sustainability challenge of Fig. 1. One issue of ICT solutions is that they usually are expensive and comprehensive to implement. However, tracking technologies are becoming cheaper and easier to implement with time.

The authors impression is that ICT has potential in logistics and transportation management. It could help improve visibility and collaboration and reduce complexities. However, the technologies are relatively new and emerging and evolving on almost a daily basis. The large amount of potentials makes this a very exiting area for further research.

Table 1. Opportunities and challenges in key decision areas

	Opportunities	**Challenge**
Change Strategy in general	Improved visibility	Increased complexity Unforeseen uncertainties
Environmental Sustainability	Improved environmental sustainability	Economic sustainability
Transportation Mode	Improved environmental sustainability	Increased complexity Delivery lead time
Vertical Collaboration	Improved visibility Improved environmental sustainability	Collaboration
Horizontal Collaboration	Improved environmental sustainability	Collaboration
Fourth Party Logistics Provider	Less complexity Improved environmental sustainability	Collaboration
Technologies	Better Visibility Improved environmental sustainability	Privacy-issues Complexity of implementation

5. CONCLUSION

In this paper, different decision areas concerning inbound transportation management when changing inbound transportation strategy are covered. The findings show that there are several possible advantages of changing inbound transportation strategy to manage the inbound transportation. The general challenges of transportation management, shown in Fig. 1. are possible areas for improvement when changing strategy. Table 1 illustrates which decision-making area could experience which of these improvements. The clearest improvement was of environmental and economic sustainability, as well as improved visibility. The clearest challenge was that of increased complexity and establishing good collaboration with other actors. The collaboration is increasingly difficult with increasingly complex systems. Good collaboration could further improve sustainability and visibility. In sum, this study provides insight to critical possibilities and challenges of inbound transportation management.

The main limitation of this research is that the study is based on only one case study, and the findings are explorative. The assumption of improved environmental sustainability is only based on findings from the literature and are not empirically tested. It has not been possible to estimate, because the characteristics of the current inbound transportation is unknown, due to the fact that suppliers currently are

responsible for this part of the supply chain. Better visibility in the chain is crucial to be able to measure the entire environmental impact of the changes. If the implementation of the new strategy will result in sub-optimising for the case company and their part of the supply chain, but not the entire chain as a whole is also unknown. There is no measure of how these decisions affects other actors in the supply chain. Closer vertical collaboration would however contribute more information in this area.

The topic is rich with opportunities for further research. The empirical implementation of the new strategy should be conducted. Also, the use of multiple cases would improve the credibility of the research. Emerging technologies and digitalisation in the evolution of Industry 4.0 makes it interesting to look into opportunities for the use of track and trace technologies as well as ICT to further improve planning and coordination. Vehicle routing problems occurring when coordinating the trucks and deliveries could be analysed, even if these findings will be case-dependent and non-generalizable.

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Appendix 2 – Literature Study

Journal	# Papers
Asia Pacific Journal of Marketing and Logistics (APJML)	3
Baltic Journal of Management (BJM)	1
Benchmarking: An International Journal (BIIJ)	7
British Food Journal (BFJ)	5
Business Horizons (BH)	1
Business Process Management Journal (BPMJ)	4
CIRP Annals (CIRPA)	1
CIRP Journal of Manufacturing Science and Technology (CIRPJMST)	1
Computers & Industrial Engineering (CIE)	8
Computers & Operations Research (COR)	2
Computers in Industry (CI)	7
Decision Support Systems (DSS)	1
Electronic Commerce Research and Applications (ECRA)	1
EuroMed Journal of Business (EJB)	1
European Journal of Innovation Management (EJIM)	2
European Journal of Operational Research (EJOR)	7
Expert Systems with Applications (ESA)	4
Foresight	1
Global Environmental Change (GEC)	1
IIMB Management Review (IIMBMR)	1
Industrial Management & Data Systems (IMDS)	22
Industrial Marketing Management (IMM)	3
Information & Management (IM)	2
Integrated Manufacturing Systems (IMS)	1
Interactive Technology and Smart Education (ITSE)	1
International Business Review (IBR)	2
International Journal of Information Management (IJIM)	4
The International Journal of Logistics Management (IJLM)	17
International Journal of Operations & Production Management (IJOPM)	17
International Journal of Physical Distribution & Logistics Management (IJPDL)	14
International Journal of Production Economics (IJPE)	22
International Journal of Productivity and Performance Management (IJPPM)	3
International Journal of Retail & Distribution Management (IJRDM)	1
Internet Research (IR)	2
Journal of Accounting Literature (JAL)	1
Journal of Advances in Management Research (JAMR)	1
Journal of Business & Industrial Marketing (JBIM)	7
Journal of Business Research (JBR)	2
Journal of Cleaner Production (JCP)	4
Journal of Enterprise Information Management (JEIM)	1
Journal of Environmental Management (JEM)	1
Journal of Fashion Marketing and Management: An International Journal (JFMM)	1
Journal of Knowledge Management (JKM)	2
Journal of Management Development (JMD)	2
Journal of Manufacturing Systems (JMS)	2

Journal of Manufacturing Technology Management (JMTM)	8
Journal of Operations Management (JOM)	8
Journal of Purchasing and Supply Management (JPSM)	4
Journal of Strategy and Management (JSM)	1
Management Decision (MD)	4
Management of Environmental Quality: An International Journal (MEQIJ)	2
Management Research Review (MRR)	1
Marketing Intelligence & Planning (MIP)	1
Omega	1
Research Policy (RP)	1
Strategic HR Review (SHRR)	1
Strategic Outsourcing: An International Journal (SOIJ)	1
Strategy & Leadership (SL)	5
Supply Chain Management: An International Journal (SCMIJ)	29
The TQM Journal (TQM)	1
Vine: The Journal of Information and Knowledge Management Systems (VINE)	2
Total	**264**

Author (year)	Focus Area	Relevant Findings	Highlighted further research
Bartezzaghi and Ronchi (2003)	Which factors are driving the internet-based tools adoption in supplier-customer relationships	E-procurement reduce transaction costs, improve procurement efficiency, and increase collaboration.	Include upstream and downstream actors
Cagliano et al. (2003)	The adoption of internet technologies in supply chain processes	There exists a close link between the use of internet tools and the level of integration with suppliers and customers.	Analyse which types of relationships suitable for the different e-business strategies.
Majorique Léger et al. (2004)	How e-collaboration impacts a company's performance	E-collaboration has higher efficiency towards suppliers than customers	Performance is hard to measure Only one supply chain is included
Schroeder et al. (2004)	How the internet will affect supplier-manufacturer relationships	Suppliers fear increased visibility in the supply chain. Manufacturers should focus on stablishing trust in their relationship	n/a
Cassivi et al. (2005)	The impact of e-commerce on collaboration	The benefit of e-commerce is end-to-end visibility	Analyse this in the context of e-marketplaces
Cassivi (2006)	How e-collaboration affect different supply chain actors	Visibility of information is crucial for supply chain efficiency	Look out the later stages, not only the initiating stage.
Hadaya et al. (2006)	E-collaboration as a safeguarding mechanism	E-collaboration reduce opportunistic behaviours	Enlarge the supply network studied
Sheu et al. (2006)	The use of technology to have successful supplier-retailer collaboration	Successful collaboration needs to be supported by technical factors. A lack of trust prevents IT-improvements.	Research several of the supply chain actors
Mason et al. (2007)	Collaboration for optimising transport.	ICT provides possibilities for reduced costs, reduce inefficiencies and increase the service.	n/a
Potter et al. (2007)	Evaluate electronic logistic marketplaces (ELM)	ELMs have a huge potential for optimising supply networks.	How ELMs could impact the society and the environment.
Russell and Whipple (2007)	Examine collaborative relationships	A suite of technologies is needed to support collaborative initiatives, as opposed to one single solution. There are a lot of compatibility issues of technology platforms.	Increase the number of organisations and industries studied.
Sanders (2007)	How e-business technologies impact organizational collaboration and performance.	E-business technologies impact performance of both internal and external collaboration.	A broader range of companies should be included

Bergeron and Raymond (2008)	Performance outcomes of the alignment between e-business capabilities and business strategy for small and medium sized enterprises (SME).	E-business alignment provides improved growth, productivity and financial performance for SME manufacturers.	In this study they used Miles and Snow typology, highlighting that the same research should be done by using other typologies, such as Porter.
Lalwani et al. (2008)	How supply chain integration can improve supply chain performance	The use of ICT (MRP, MRPII, ERP, EDI and WBI) alone does not provide improved performance. Only when these hard variables are combined with soft variables, such as collaboration, performance benefits occur.	Follow-up case studies is needed
Chang et al. (2009)	Discovering implications and success factors of B2B collaborative information systems	Some of the key factors were; support and understanding from the entire team, standard process development and total support from top management	Apply the model to other industries
Chong et al. (2009)	Factors affecting e-collaboration adoption.	The factor with the highest impact the adoption e-collaboration is trust. Followed by product complexity, product volume and frequency.	Research in other countries. In-depth case studies examining implementation of e-collaboration
Cullen and Taylor (2009)	Find success factors influencing B2B e-commerce	Information quality, system quality and trust are the most important success factors	Use in-depth case-study methods
Gunasekaran et al. (2009)	E-commerce adoption in SMEs	Current status, perceived benefits, perceived barriers, critical success factors and organisational performance of e-commerce adoption.	Include global supply chains
Nakano (2009)	Examine how internal and external use of collaborative planning and forecasting (CPF) affect logistics and production performance	Finds a positive relationship between internal and external CPF. Confirms a positive effect from internal CPF on relative logistics and production performance, but this effect is not confirmed from external CPF.	There is no focus on how firms can achieve the improvement of forecasting and planning process, these process improvements should be highlighted in future research.
Rosenzweig (2009)	How e-collaboration affect operational performance.	E-collaboration is related to better operational and business performance.	Incorporate both downstream and upstream linkages between manufacturers and suppliers.
Plomp and Batenburg (2010)	Measure external collaboration through ICT	Companies could improve their level of supply chain digitalisation by comparing their ICT and organisational initiatives and finding similarities in their chain characteristics.	Apply the research to larger companies and other industries.

Iyer (2011)	Enhance understanding of IT-collaboration relationship.	Collaboration improves operational performance. Technological turbulence enhances the relationship between IT capability and collaboration.	Investigate specific IT technologies' impact on collaboration. A more longitudinal research could be conducted.
Wang et al. (2011)	Collaborative ELMs	Having a common system across supply chains reduces the complexity of communication and provides a number of benefits.	Only a single case study is used Look at more long-term impact. Examine the in-depth relationships between actors in the SC.
Chan et al. (2012)	E-collaboration diffusion in SMEs.	SMEs should focus on improving performance and effort expectancy of e-collaboration tools.	This study focusses on an emerging country. Data from a developed country should be used to do a cross-country comparison.
Saldanha et al. (2013)	How volatile demand conditions could be affected by information systems (IS)	When manufacturing plants are faced with volatile demands, they experience improved labour productivity and inventory turnover when using IS for collaboration with suppliers and customers. Plants employing IS for transacting do not experience the same benefits.	Motivates further research in the intersection between IS and OM.
Iyer (2014)	Understanding the nature of supply chain relationships under a technology context.	Collaboration positively impact operational performance. Technological turbulence strengthens collaboration but diminishes the resource specificity when it comes to predicting the operational performance.	Studying all three partnerships in the SC will increase the understanding of SC partnerships.
Jean et al. (2014)	Outcomes of e-collaboration on internal customer-supplier relationships.	E-collaboration positively influence relationship performance.	Examine other dimensions of inter organisational systems (IOS). Examine other cross-cultural differences.
Kim et al. (2015)	The relationships between strategic sourcing, e-procurement and company performance	e-procurement has a positive effect on company performance	Include other industries, and other countries
Migdadi et al. (2016)	Antecedents of e-business implementation	Organisational factors influence the implementation of e-business.	Include environmental and technological factors
Mirkovski et al. (2016)	Understand how external relationships influence ICT-enabled supply chain interactions in SMEs in an emerging versus developed economy	Environmental uncertainty has substantial influence on ICT use by SMEs.	Extend the cross-country comparison

Zhao et al. (2016)	How HR and MP-IT influence the internal and the supplier integration capabilities.	Both HR and MP-IT has a positive impact on integration in a SC, but HR has a much larger impact than MP-IT.	Use data from only one developing country. Should investigate more MP-IT systems and networks. Should measure the alignment between HR and MP-IT.
Vanpoucke et al. (2017)	Interrelationships among operational integration, performance, informational exchange, and the use of IT.	ICT increases the aped and accuracy of external supply chains, but not necessarily the agility of the process.	Future studies should examine a broader set of operational benefits, and distinguish between different types of IT.
Afshan et al. (2018)	How information sharing, information quality, trust and commitment impact SCC.	Information sharing and information quality has shown significant positive impact on SCC. Trust positively impact commitment, which positively impact SCC which positively impact financial performance.	n/a
Alsaad et al. (2018)	How e-collaboration could lead to competitive priorities and value creation	Collaboration is the key to gain value from IT in a supply chain.	Focus only on value creation, further research could also include other competitive priorities, such as quality and innovations.
Shee et al. (2018)	How Cloud-based technologies affect SCI and SC performance	Cloud-based technologies improves SCI, and cloud-based SCI has a positive effect on SC performance and sustainability of the SC.	Extend the scope to include other parts of the SC as well, not only retailers. Extend methodology.
Upadhyay et al. (2017)	Key influencers for ICT usage in India	The attitude of the employees and the peer-usage have direct effects on the ICT use	How sales technology could be more user friendly
Yang et al. (2018)	Study antecedents and effects of operational collaboration between a buyer and its key suppliers	IT capabilities and SRM are positively associated with operational collaboration, improving process efficiency	Include orientation-related factors.

CPF – Collaborative Planning and Forecasting; SCC – Supply Chain Collaboraiton SPFR – Collaborative Planning, Forecasting and Replenishment; ELM – Electronic Logistic Marketplace; HR – Human Resources; IOS – Interorganisational Systems; IS – Information Systems; IT = Information Technologies; MP-IT = Manufacturing Plant Information Technologies; SC – Supply Chain; SCI – Supply Chain Integration; SME – Small and Medium sized Enterprises;

Appendix 3 – Interview guide: "A Study of How Collaboration Affects Digitalisation in a Global Supply Chain"

Comment: *This interview guide was used when interviewing the suppliers. When interviewing the transport providers and customers, other company characteristics was asked for. When interviewing Jotun employees, internal relationships was also asked about in the same manner as the external relationships. Also, Jotun's company characteristics was asked bout. All the other questions remained the same during all interviews. Additional follow-up questions, being a natural part of the semi-structured interview format have also been asked about.*

Date: xx.xx.2019

Thank you so much for participating in this research project. Your expert input is highly appreciated and valuable for my research. [The first 5-10 minutes will be used for a brief introduction to the study and to make sure key data on the interviewee are collected]

1 Short introduction to the study:

The research questions will be elaborated, and the propositions are shaped based on the literature study. By the research questions, the objective is to investigate how collaboration within, and between actors will improve the benefits of implementing technological solutions for transportation management in supply chains. The research questions are:

> *RQ1: How does collaboration influence the choice and the usage of planning systems and track & trace technologies for transportation management in a global supply chain?*
>
> *RQ2: In what ways will the outcomes of RQ1 be different for an emerging country compared a developed country?*

Collaboration is defined as the case where two or more actors in a supply chain work closely together to achieve a mutual goal. Planning systems are in the form of ERP systems and/or other transportation planning systems that you use. Track & trace technologies are in the form of GPS, and/or RFID and/or Barcodes, and if you use any other form of technologies to communicate with suppliers/customers.

2 Important information and interview plan

- Thank you for participating
- Purpose of the study
- Confidentiality
- Use of tape recorder, transcription and possibility to review
- Format: Semi-structured interview – please feel free to talk freely
    - I will present open ended questions which the interviewees are asked to elaborate on
- Agenda (ca 50 minutes)
    - Introduction (ca 5 min)
    - Questions to characterise the company and your relationship with Jotun (ca 10 min)
    - Key research question in this study (ca 30 min)
    - Detailed discussion on the collaboration and digitalisation
    - Wrap up (ca 5 min)

3 Interviewee data:

Name:

E-mail address:

Position:

Education:

Years in the Company:

Any other important information:

Company Characteristics

Which category describes your company?

- Process manufacturing
- Discrete manufacturing

How many production plants do you have?

Do you manufacture in house or do you outsource some/all manufacturing?

What type of markets do you operate in?

- B2B
- B2C

Approximately how many individual suppliers do you have?

Approximately how many individual customers do you have?

How is the inbound transportation of raw materials to your company organised?

Who is responsible for ordering the freight?

Who is responsible for executing the freight?

How is the outbound transportation of finished goods from your company organised?

Who is responsible for ordering the freight?

Who is responsible for executing the freight?

How many employees do you have?

What is the volume of your business?

Your yearly revenue or Production volume (for 2018)

What is your personal responsibility and work tasks?

Your Relationship with Jotun

How large is Jotun as a customer to you?

- Which percentage of your finished goods are sold to Jotun?
- Do you deliver one or more type of products to Jotun?

To how many Jotun factories do you deliver your finished goods?

Do you communicate with individual Jotun factories or through a central procurement office?

Do you receive orders from each factory or from a procurement office?

Questions About Collaboration

How do you collaborate with the suppliers?

- How do you learn from each other?
  - For example; do you have formal meetings?
  - Do you regularly keep in touch to give and get updates?
  - Do you have joint pilot projects?
- What do you learn from each other?

What are the key challenges of your collaboration with the suppliers?

How do you collaborate with the customers?

- How do you learn from each other?
  - For example; do you have formal meetings?
  - Do you regularly keep in touch to give and get updates?
  - Do you have joint pilot projects?
- What do you learn from each other?

What are the key challenges of your collaboration with the customers?

How do you collaborate with the transporters?

- How do you learn from each other?
  - For example; do you have formal meetings?
  - Do you regularly keep in touch to give and get updates?
  - Do you have joint pilot projects?
- What do you learn from each other?

What are the key challenges of your collaboration with the transporters?

Questions About Technology

What types of planning systems and track and trace technologies are used for external and internal collaboration?

Does the planning systems and track & trace technologies applied by suppliers, transporters and customers affect the types of planning systems and track & trace technologies you apply? And vice versa.

Has there been cases where you had to, or chose to, select a technology because your suppliers, customers, or transporters were using the same or a similar technology?

If yes, did you make the choice because you expected to be able to benefit from the experience of that partner?

Was it easier for the company to deploy the technology because you had a partner you could talk to for help?

What are the key challenges of choosing and using this technology?

What are the key benefits of choosing and using this technology?

If not: How did/do you select what types of planning systems and track and trace technologies, you use for collaboration with suppliers?

What factors were/would be important for this decision?

Wrap up

- Any other information you think could be of value for this project?
- Further process: I will transcribe the interview, and send you what
    - Please give feedback if I have misunderstood anything in the transcription.
    - Then the audio file will then be deleted for good.

Thank you again for your time!

Best regards,
Ninni Kristina Andreassen
Master student at NTNU