UNIVERSITY OF TURKU

ABSTRACT

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Abstract

The purpose of this thesis is to evaluate the viability of railway transport in the transport of goods from China to Finland. In the past decades, China has experienced immense economic growth and in 2014, China surpassed the USA as the world's number one economy. The demand for transport from China has naturally exploded. Heavy investments in infrastructure have been made, yet congestion is still a problem. The One Belt, One Road initiative launched by the Chinese Government in 2013 aims to improve road and rail connections from China to its trading partners. As a result of investments made in Eurasian railway connections, the previously modest share of railway transport has begun to grow rapidly. Railway freight now provides a midway alternative to expensive air freight and sluggish ocean freight in terms of both cost and speed.

This thesis explores the costs and delivery times of railway freight and other transport modes when moving freight from China to Finland. This thesis was conducted as an assignment and it takes a single case approach. This thesis utilizes a single case approach by examining the costs and delivery times of transport modes in the context of a case company. Both qualitative and quantitative approaches are utilized in order to gain a holistic understanding of the individual case. The main sources of data used are requests for quotation, participant observation, archival records and discussions.

The main finding of this thesis is that railway freight is a viable alternative to ocean and air freight. Railway freight takes roughly half the time of ocean transport and the costs are not considerably larger than those of ocean freight. Air freight is indisputably the fastest and most reliable transport mode, but also evidently the most expensive. The second important finding is that with all transport modes, the freight costs per unit go down significantly when order quantity is increased. When only considering transport costs, it is advisable to order largest possible quantities. The third finding is that when transporting very small quantities, parcel services are always the best option.

Key words	Transport, railway, freight
Further information	

UNIVERSITY
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Economics

THE OPPORTUNITIES OF RAIL IN FREIGHT TRANSPORT FROM CHINA TO FINLAND

Case approach

Master´s Thesis
in Operations &
Supply Chain Management

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List of abbreviations

BRI	Belt & Road Initiative
ERP	Enterprise Resource Planning
EXW	Ex Works
FCL	Full Container Load
FDI	Foreign Direct Investment
FOB	Free on Board
GDP	Gross Domestic Product
JIT	Just-In-Time
KTZ	Kazakhstan’s national railway
LCL	Less-than Container Load
MNC	Multinational Corporation
OBOR	One Belt, One Road
RFQ	Request for Quotation
SME	Small and Medium-sized Enterprise
TEU	Twenty-foot Equivalent Unit
TKM	Tonne-kilometer
ULD	Unit Load Device

1 INTRODUCTION

1.1 Background

Since economic reform commenced in 1978, China has experienced remarkable economic growth. The Gross Domestic Product (GDP) growth rate averaged at 8,6 % over a thirty-year period from 1978 to 2007 (Ding & Knight 2011). Since 1994, China has also attracted foreign direct investments (FDIs) from multinational corporations (MNCs) from all over the world because of low manufacturing costs (Goh & Ling 2003). As a result of this rapid growth, China surpassed the USA as the world's number one economy in 2014. (Euromonitor International 2014).

According to a research published by Ta et al. in 1998, China's transport infrastructure had fallen seriously behind its economic growth at the time. It was estimated that the transport requirements would not be met until 2020 at earliest. The gap between the demand and the transport capacity generated serious bottlenecks at the time, which caused problems for foreign firms that were particularly dependent on freight movement (Ta et al. 1998). However, heavy investments in transport infrastructure have been made since the 1990s. Consecutively, connections both within China and between China and other countries have improved significantly (Qin 2016).

With the growth of e-commerce China's significance has further increased (Euromonitor International 2014) and the demand for transport continues to grow. From 1978 to 2009, the freight traffic volume per capita increased from 1030 tonne-kilometres (tkm) per year to 6038 tkm per year. This equals an annual growth rate of 5.9 %. (Ma et al. 2012.) Despite the recent investments in infrastructure, capacity problems still occur in transport networks. About 90 % of world trade travels through the world's seaports, which often causes problems even at the largest seaports in the world. Many seaports, including many Chinese and European ones, are very congested which leads to longer delivery times and additional costs. (Saeed et al. 2018.)

Shipping goods from Asia to Europe via sea is cheap but takes a long time, even more so with the congestion problem. In some cases, the shipping may take as long as 8 weeks. Unlike sea transport, air transport is a fast transport mode but poses limits to the size and weight of products. Air transport is also rather expensive in comparison to ocean shipping. Rail transport, however, is situated somewhere between air and sea transport in terms of both costs and lead times and may thus offer a solution. (Hilmola & Szekely 2006.)

Railway transport's share has for a long time been modest. However, as a result of the One Belt, One Road (OBOR) initiative started by the Chinese government in 2013, railway transport has become a competitive option for freight transport between Asia and

Europe. The aim of OBOR is to link China with Central and South Asia, Europe and Middle East. The initiative focuses on improving road and rail infrastructure that connects China to its trading partners, resulting in economic gain for all parties. (Freight Hub 2018a.)

As a result of investments and new routes being established, according to RailFreight (2018), the volumes on the Eurasian railway routes more than doubled during 2018. Furthermore, alternative routes grew in popularity and many new multimodal options became operative. According to RailFreight, these factors indicate that the massive growth is likely to continue in the coming years. However, there is also some uncertainty regarding the discontinuity of Chinese subsidies, which would presumably affect freight volumes.

Transport decisions are important decisions for companies for a number of reasons. Transport plays an important role in moving materials from supply sites to manufacturing facilities and moving finished goods to customers. (Stank 2010.) Transport is thus a crucial factor in the fluidity of production and customer satisfaction. Transport also accounts for a major part of total logistics costs. There are multiple levels of transport decision making, from long-term decisions to dock-level decisions. (Stank 2010.) This thesis, however, will focus on transport mode and carrier decisions.

Transport decisions are decisions that all companies face, and they have gradually become more and more complex during the past decades. Today, managers are faced with economic uncertainty, fuel price fluctuations, new regulations, increasing customer expectations, globalization, a changing transportation industry, new technologies and so forth. Managers are thus faced with an array of new challenges and opportunities. (Stank 2010.)

Transport mode and carrier decisions are no simple task and there are numerous factors that need to be considered. For example, delivery time, costs, safety, security, special handling requirements and reliability need to be taken into consideration when deciding between modes of transport. According to Stank (2010), the blurring of service capabilities among traditional transportation modes has resulted in options that in the past would not be considered feasible now emerging as the preferred choice.

There are some theoretical models for transport mode decision making but implementing them in practice is no easy task. The models are complex and often hard to comprehend. There are few hands-on researches about transport decision making apart from the brochures of transport companies, which is part of the motivation for this research.

1.2 Purpose of the research

This thesis is conducted as an assignment for a Finnish company that has transport needs from China to Finland. The main purpose of this thesis is to evaluate railway transport's viability as an option for Company X while also testing whether theory works in practice when observing a real case.

Even though extensive research on transport mode decision making has been conducted, there are few researches that take a practical, hands-on approach. Most research focuses on building theoretical models that are sometimes hard to comprehend. Theoretical models, however, provide a basis for understanding which factors are, or should be, taken into consideration when making transport mode decisions. The aim of this thesis is to evaluate how these theoretical approaches fit the actual context of a real company. In this thesis, the theoretical approaches provide a framework against which the results of this research are analyzed.

Furthermore, this thesis aims to provide Company X with information on the benefits, disadvantages, costs and delivery times of different transport modes to help with transport mode decision making. In addition to providing information for Company X, this thesis may help other companies struggling with similar transport needs.

The aim of this thesis is to answer the following questions:

- In the case of Company X, what are the costs and delivery times of railway transport compared to other transport modes?
- What preconditions are there to Company X utilizing railway transport?

This thesis utilizes a single case approach. The case company, Company X, produces geothermal products. Company X has a Chinese supplier that it orders welding parts from on a regular basis. So far, the company has utilized ocean shipping and air freight, depending on how urgent the delivery is. However, ocean shipping is seen as too slow and air freight as too expensive. Since these two transport methods are at opposite ends in many ways, questions about the possibility of rail transport have been raised. The case company will be thoroughly introduced in Chapter 4.2.

This thesis takes a mixed method approach by combining qualitative and quantitative approaches. Quantitative methods are needed to analyze the numerical data collected in this research, and qualitative methods are utilized in order to gain a broad understanding of the individual context of the research object. The methodological choices made in this thesis will be further discussed in Chapter 4.1.

The main sources of data in this research are **requests for quotation** (RFQs). The main data in this research is collected by sending out RFQs to potential transport service providers. Other sources of data include the case company's archival records and conversations with the company employees. Participant observation is also applicable since the researcher has accumulated insider knowledge of the case company while working there throughout several years. The data collection methods used in this research will be further observed in Chapter 4.3.

1.3 Research design

Figure 1 presents the research design in the form of a process chart. First, a literature review is conducted to acquire a theoretical basis for this research. The literature review consists of two chapters: the first chapter is on transport modes and transport decisions, and the second chapter examines Eurasian railway corridors in terms of their history, current significance and future prospects. The purpose of the literature review is to provide a framework for analyzing and discussing the results of this research.

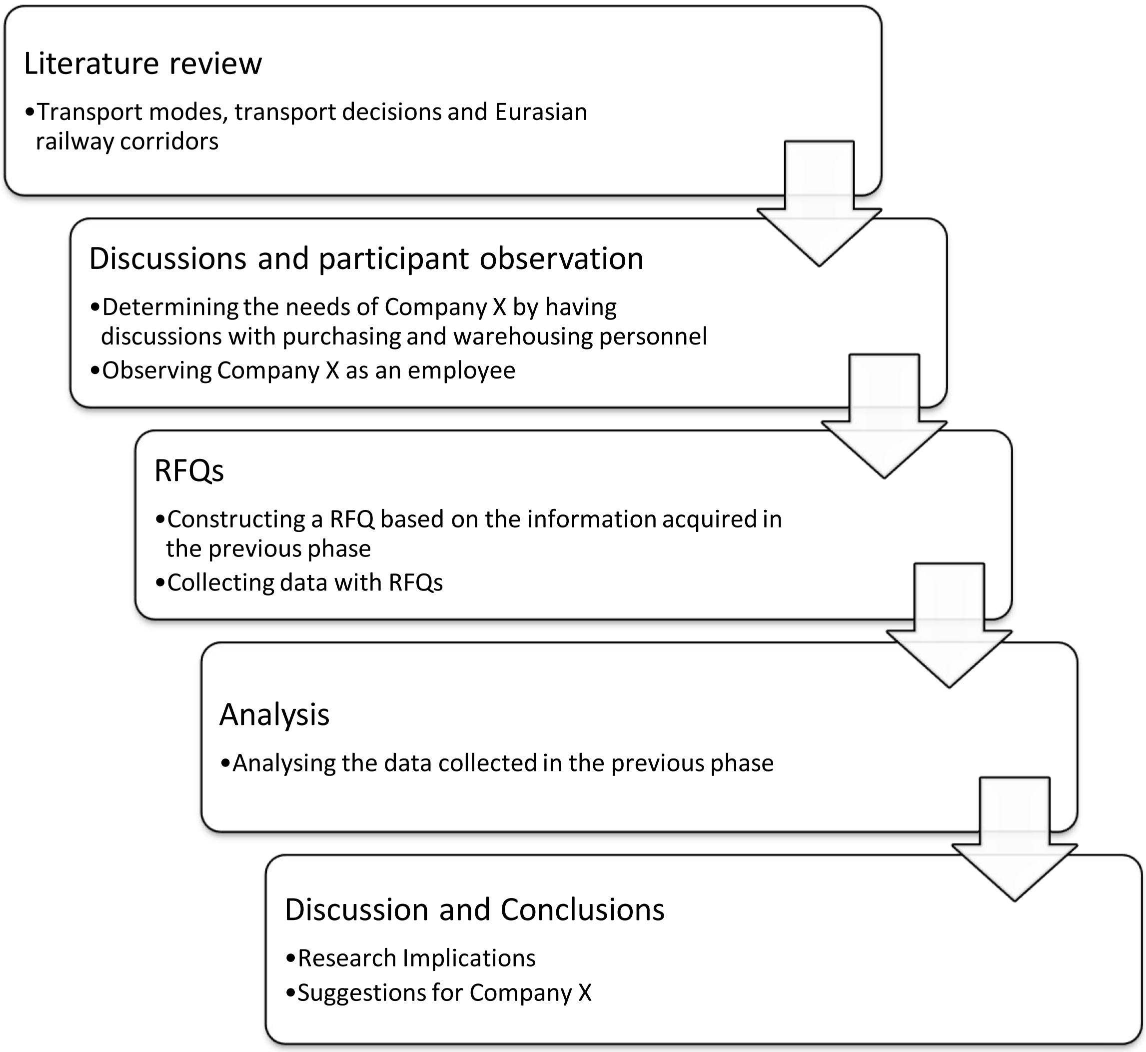

Figure 1 Research design

Second, information about Company X and its needs was collected by participant observation and multiple discussions. The researcher works at Company X and insider knowledge about Company X has been accumulated since 2013. These discussions are undocumented since they have been had daily throughout the years. In addition, numerous discussions were had throughout 2017 and 2018 with the Company X employees, namely the warehousing and purchasing personnel, about the company's issues and wishes in terms of freight from China to Finland. Additionally, the researcher had access to the company ERP, the data in which provided the researcher with an understanding of the current state of the company's affairs with the Chinese supplier. All of this information is used as a basis for analyzing the data collected in the next phase.

Third, based on the knowledge acquired through participant observation, archival records and multiple discussions, RFQs for air, rail and ocean transport were constructed and mailed to select transport companies. Overall 18 RFQs were sent but not necessarily to 18 different companies: for example, if a potential company offers both air and rail transport, RFQs were sent to that company for both air and rail transport separately. The data collection phase and the RFQs will be further observed in Chapter 4.3.

After the data collection phase, the data gathered is analyzed in Chapter 5. The methods for analysis will be discussed in Chapter 4.4. In the last phase, all information gathered throughout the research process will come together in the form of conclusions in Chapter 6. In Chapter 6, suggestions for Company X will also be provided as well as suggestions for future research.

1.4 Limitations

This thesis is conducted as an assignment for a company that is not involved in passenger transport. Because of this, observation of passenger transport has been left out and the term transport will be used to refer to the transport of goods.

This thesis concentrates on ocean, air and railway transport. Road transport will be briefly discussed in Chapter 2.2.1. for comparison, but further examination of road transport has been left out of this thesis as a non-viable option for such a lengthy transport distance. Other transport modes such as pipeline and inland waterway transport have been left out completely as insignificant for this case.

Because of limited resources and time, this thesis will concentrate on two aspects of transport mode decision making: costs and delivery time, even though other aspects, such as convenience, availability and dependability, will be taken into consideration as well.

Because of the amount of effort and time needed for a thorough case research, a single case approach was chosen. Even though broad generalizations cannot be made based on a single case approach, this thesis hopes to provide insights to other companies as well.

2 TRANSPORT MODES AND MODE SELECTION

This chapter will introduce the most relevant modes on transport for the purpose of this research as well as introduce the theoretical approach to transport mode selection. The aim of this chapter is to build an understanding of transport modes and freight transport processes as well as the decisions related to them. The literature review provides a theoretical framework against which the results of this research will be analyzed.

This chapter will begin with discussing the definition and significance of transport in general in Chapter 2.1. In Chapter 2.2. the most relevant modes of transport as well as their advantages and disadvantages will be discussed. Chapter 2.3. will introduce the concept of modal split. In Chapter 2.4. the concepts of multimodal and intermodal transport will be discussed. Chapter 2.5. will discuss the trends and challenges in the freight transport sector. Chapter 2.6. will introduce the factors that affect transport mode selection. Chapter 2.7. will introduce the theoretical approach to transport decision processes. This chapter will end with Chapter 2.8. that introduces Incoterms.

2.1 Definition and significance of transport

The Oxford dictionary defines transport as “a system or means of conveying people or goods from place to place” or “the action of transporting something or the state of being transported” (Oxford dictionary 2018). These definitions are widely accepted and established. In general, transport can be divided into three main ingredients: the means of transport, the infrastructure and the load. **The means of transport,** also referred to as **transport modes,** refer to trucks and other vehicles, trains, airplanes and vessels. These are often owned and operated by companies of various sizes. **Infrastructure** refers to roads, railways and other fixed facilities that are required in transport. **The load,** also referred to as **cargo** in this thesis, refers to the actual goods that are transported. Transport does not exist in its own right without a load. The load varies, so it can be said that a transport system comprises of two fixed components and one variable. (Blauwens et al. 2006.)

Transport can be classified in a few different ways. First, classifications can be made based on the type of load. Transport can be divided to passenger transport and freight transport. These two sometimes overlap: for example, airlines and ferries simultaneously transport both passengers and goods. Freight transport can be further divided to bulk cargo, general cargo and containers. (Blauwens et al. 2006.)

Transport can also be classified according to the mode of transport. This is the classification that has been chosen to be used in this thesis. Based on transport mode, transport can be divided into five categories: road transport, inland navigation, ocean transport, rail transport and air transport (Blauwens et al. 2006). In this thesis, observation of inland navigation has been left out as irrelevant for the case. In freight transport, the modal choice is generally made based on the type of goods and the distance over which the goods are transported. (Blauwens et al. 2006.) Sometimes pipeline transport is included in the list of modes of transport (Ghiani et al. 2013). However, since goods cannot be transported over a pipeline, further examination of pipeline transport has been left out. Transport modes are further examined in Chapter 2.2.

The selection of transport mode and carrier is one of the key decisions in logistics management (Meixell & Norbis 2008) for two main reasons. Firstly, at manufacturing firms, transport costs account for 20 % of total production costs on average (Russell & Taylor 2003). Transport's share of total logistics costs is even greater: according to Ghiani et al. (2013), transport accounts for between one-third and two-thirds of logistics costs. Secondly, freight transport activities affect the service level provided to customers. Efficient and inexpensive freight transport systems increase the distance at which facilities can be economically founded. Efficient freight transport thus allows firms to take advantage of economies of scale. It also allows companies to feasibly supply markets that are geographically far away. (Ghiani et al. 2013.) The drivers for modal choice will be discussed in Chapter 2.4.

2.2 Transport modes

Transport modes are an essential component of transport systems since they are the means that support mobility. The modes can be grouped into three main categories based on what medium they exploit: land, water and air. All modes have their own special requirements and features. (Rodrigue et al. 2013.) The features of the most commonly used and relevant modes, in terms of this thesis, will be examined in this chapter.

Figure 2 presents the main freight modal options according to Rodrigue et al. (2013). Not all freight modes are suited for all types of cargo. From the figure it can be seen that, for example, ocean shipping is divided into multiple sub-categories. Different types of cargo require different types of vessels and services. In the following chapters, the most relevant freight modes for this particular research will be examined in more depth.

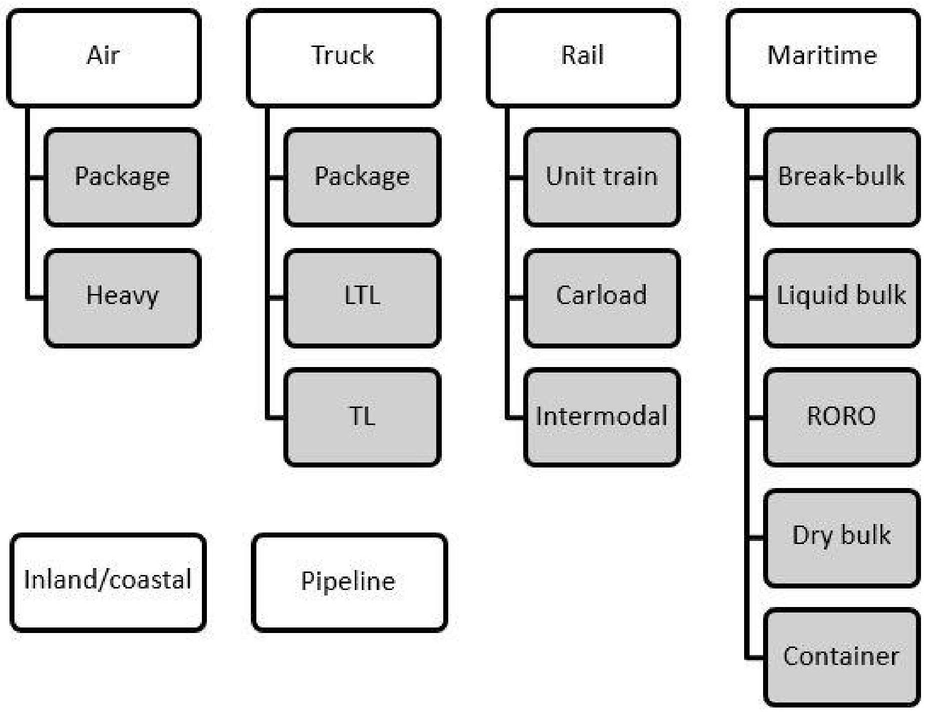

Figure 2 Main freight modal options (Adapted from Rodrigue et al. 2013)

Recently there has been a growing trend towards integrating multiple modes of transport (Rodrigue et al. 2013). This is called multimodal or intermodal transport. Multimodal and intermodal transport will be further examined in Chapter 2.4.

2.2.1 Road

Road transport is often chosen based on the door-to-door delivery possibility that it offers (Blauwens et al. 2006). Full truckloads (FTL) can be moved from their origins to their destinations in a single trip. Less-than-truckloads (LTL) need to be rearranged and moved onto other trucks along the way which results in LTL shipping being slower than FTL shipping. (Ghiani et al. 2013.) No pre-carriage or on-carriage is required. Pre-carriage refers to the transport from the shipper to the dispatch terminal, for example a seaport. On-carriage refers to the transport from the destination terminal to the customer.

Road transport is also very accessible and capable of adjusting to the just-in-time (JIT) principle (Blauwens et al. 2006) because it has the fewest physical constraints out of all transport modes (Rodrigue et al. 2013.) Road transport is often rather reasonably priced, and it is thus a potential transport mode for all kinds of goods. In the case of valuable goods, the price is not the main consideration since transport only contributes to a fraction of the total cost. Road haul is a preferred transport mode for perishable goods since it is rather flexible and fast. Road transport is thus suitable for all kinds of cargo. Generally, it is only not suitable for intercontinental transport. It is also noteworthy that road haulage is only fast on rather short transport distances. Furthermore, the ever-growing demand for transport has created a congestion problem on roads. This has led to alternative forms of transport being considered. (Blauwens et al. 2006.)

Even though road by itself is not a viable option for lengthy distances, it is noteworthy that road transport inevitably plays a part in long distance transport by the means of pre- and on-carriage. In order to achieve door-to-door connectivity, road transport needs to be utilized in transporting deliveries to and from seaports, airports, rail hubs and so forth. Road transport thus plays an important part in long distance transport even though it, by itself, is not enough. (Savy 2009; DSV 2018.)

2.2.2 Ocean

The notion of ocean transport rests on the existence of ocean routes. Ocean routes are hindered by, for example, strong winds and currents and other weather conditions. For example, the North Atlantic and the North Pacific are subject to heavy waves in the winter which causes ships to take longer routes when the weather conditions are bad. (Rodrigue et al. 2013.) This naturally affects the reliability of delivery times.

Ocean transport is the most effective mode when moving large quantities of cargo over long distances (Rodrigues et al. 2013). Preference is usually given to ocean transport when the cargo is non-valuable goods or bulk goods (Blauwens et al. 2006). Ocean transport is linked to heavy industries more than any other mode (Rodrigue et al. 2013). Since ocean transport is usually chosen for non-valuable goods, price is now an important factor in the decision making. When compared with road transport, the accessibility of ocean transport is significantly lower. This means that ocean transport in itself is not enough but needs to be combined with road transport. Because of this, ocean transport is rarely seen as an option for short distances. (Blauwens et al. 2006.)

When intercontinental flows are observed, ocean transport holds the dominant position. Ocean transport is mainly used for bulk materials such as petroleum and coal. In terms of weight, 99 % of international trade is transported by ocean. In terms of value, the share of ocean transport is 50 %. (Ghiani et al. 2013.)

2.2.3 Air

Air transport can simply be defined as the transportation of goods by aircraft (C. H. Robinson 2017). Air transport's constraints include the site, the climate, fog and aerial currents (Rodrigue et al. 2013). Despite these constraints, air freight has the lowest chance of impediment out of all the transport modes (C.H. Robinson 2017). Even though a plane needs roughly 3300 meters of runway to take off and land, air routes are practically unlimited (Rodrigue et al. 2013). It is, however, noteworthy that air transport requires pre- and on-carriage. Actual air transport thus only covers a part of the whole transport distance.

Speed is the most significant advantage of air transport over other modes and it has helped offset of its other limitations such as high operating costs, fuel consumption and limited carrying capacities. Air cargo is generally carried in unit load devices (ULD) either on freight planes or in the bellyhold of passenger flights. (Rodrigue et al. 2013.) Figure 3 illustrates an example of an ULD.

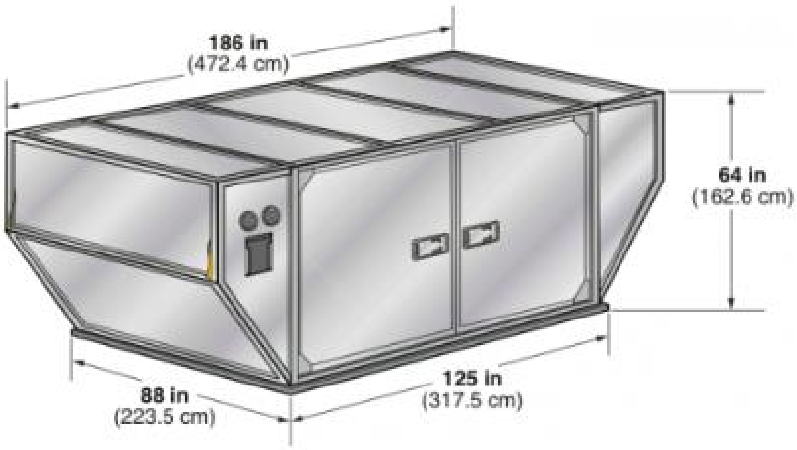

Figure 3 An example of an ULD (Searates LTD 2018)

Air transport is in principle very fast, but it is slowed down by freight handling at airports. Because of this, air transport is not competitive for short and medium-haul shipments. However, it is a very viable option for the transport of high-value goods over long distances: about 20 % of international trade in terms of value utilizes air transport. (Ghiani et al. 2013.)

According to Freight Hub, the main benefits of air freight are (Freight Hub 2018b):

- Quick transit
- Less handling of cargo
- Less documentation
- Reliable arrival and departures
- An enhanced level of security for the cargo

According to Boeing's World Cargo Forecast for 2016-2017, world air cargo is expected to grow 4,2 % annually as GDP grows. According to the World Cargo Forecast for 2018-2037, air cargo is expected to more than double over the next 20 years, and the freighter fleet will grow 75 %.

2.2.4 Rail

Rail transport is composed of traced paths on which vehicles are bound. Rail transport is often characterized by a high level of economic and territorial control since most rail companies operate in either a monopoly or an oligopoly. It is the transport mode with the most physiographical constraints. (Rodrigue et al. 2013.)

Railroad networks consist of three different main types of lines: penetration lines, regional networks and transcontinental lines. The main purpose of penetration lines is to connect port cities to areas with natural resources such as minerals and wood. Regional networks serve high density population areas with the goal to support large amounts of freight and passengers. Transcontinental lines are a link in the global transport system. As the name suggests, transcontinental lines travel across continents and connect them to each other. (Rodrigue et al. 2013.)

Figure 4 illustrates the stages of railway transport. It is noteworthy that the actual train carriage is only a portion of the whole transport. Because of the limited availability of railways and railway terminals, pre-carriage and on-carriage are required to achieve door-to-door delivery. Pre-carriage includes cargo pickup by truck, cross-docking when necessary, LCL (Less-than Container Load) consolidation, customs clearance and documentation. Only after these steps can the actual train carriage begin.

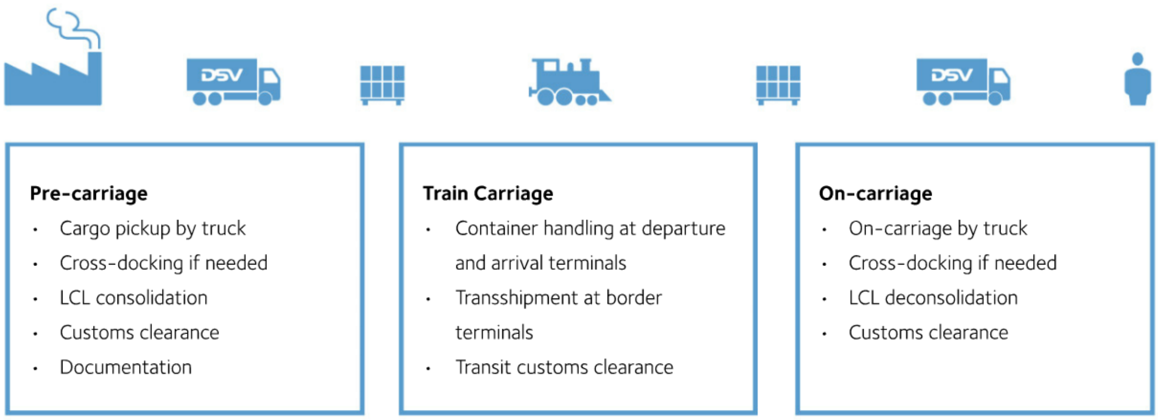

Figure 4 Stages of railway transport (modified from DSV 2018)

From Figure 4 it can be seen that train carriage includes container handling at terminals, transshipment at border terminals and transit customs clearance. When the train arrives at its destination and container handling is done, on-carriage begins. On-carriage includes delivery to the recipient by truck, cross-docking when necessary, LCL consolidation and customs clearance. It is noteworthy that even though the actual train carriage only takes roughly two weeks, the whole process takes significantly longer because of all the related arrangements. (DSV 2018.)

Rail transport is inexpensive especially over long distances. It is, however, rather unreliable and quite slow. There are three main reasons for this (Ghiani et al. 2013):

- freight trains have lower priority than passenger trains which means freight trains have to wait
- direct train connections are rare
- a convoy must consist of tens of cars in order to be worth operating

Because of these factors, rail transport is the preferred mode of transport for raw materials such as coal and chemicals, and low-value finished goods such as steel and paper (Ghiani et al. 2013).

According to the Association of American Railroads (2017), there are various benefits to utilizing railway transport. Using rail transport reduces highway gridlock and slows down wear and tear. Trains are, on average, 4 times more fuel efficient than trucks. As a result, trains produce up to 75 % less greenhouse gas emissions than trucks, which makes railway transport a more environmentally friendly choice. The capacity of a freight train is also significantly larger than that of a truck, and a single train can replace hundreds of trucks. (Association of American Railroads 2017.) However, comparing rail transport to road transport is rarely relevant because these two modes mostly compete over different kinds of deliveries in terms of delivery distance.

2.2.5 Comparison of transport modes

In the previous chapters, we have established that all transport modes have their benefits and their downsides. In this chapter, different modes will be compared to each other in order to gain understanding of the basis of transport decision-making and of the types of situations each mode is best suited for.

Figure 5 illustrates the transport times by mode from Asia to Europe. The delivery times differ quite a lot even within each mode. For example, the delivery time by ship, according to the figure, may be anything from 23 to 43 days depending on various factors such as origin, destination, the route used, weather conditions and so forth. It can also be seen that speed comes with a price: the fastest mode is also the most expensive and vice versa. It is noteworthy that the transit times presented in the figure are transit times without associated pre- and on-carriages. Thus, the transit times are not the same thing as door-to-door delivery times but rather the times that the goods spend in actual transit, for example, on the ship or train.

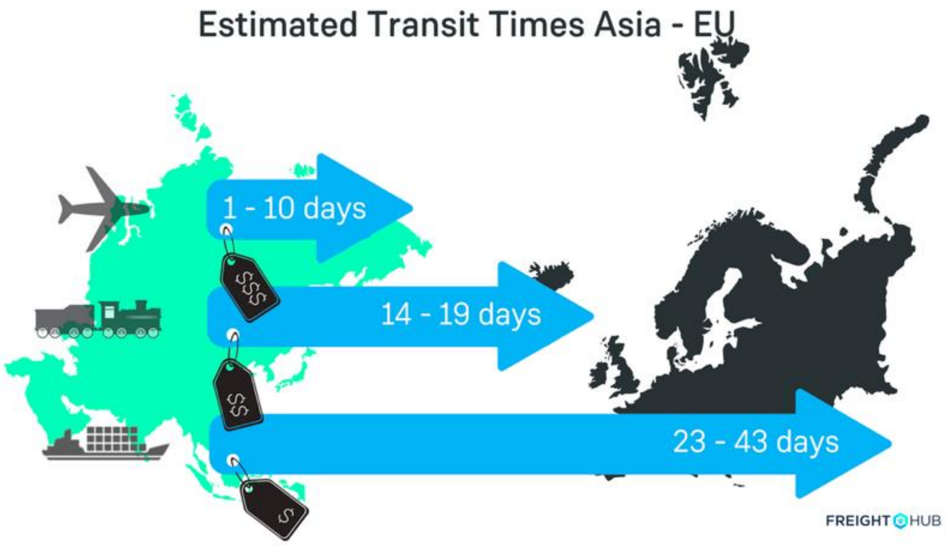

Figure 5 Transit times from Asia to EU by different transport modes (Freight Hub 2018b)

Table 1 presents the main advantages and disadvantages of different transport modes. From the table it can be seen that the main advantages of air are speed, reliability, safety and a high level of customer service. The main disadvantages are high costs, and limited availability, which is why pre and on-carriage are required.

The main advantages of ocean shipping are low costs, high capacity and safety while the main disadvantages are a slow speed and limited availability. Just like air transport, ocean transport requires pre and on-carriage.

The main advantages of rail are that it is ecological, and it has a relatively high transportation capacity. It is also safe. The main disadvantages are unreliability and limited availability. Railway transport requires pre and on-carriage, like other modes with limited availability.

The benefits of road include flexibility and high availability. Road transport requires no pre and on-carriage: rather, it is the mode of pre and on-carriage. The disadvantages include relatively high costs, low capacity and safety issues.

Table 1 The advantages and disadvantages of transport modes (Majerčák et al. 2015 after Šulgan et al. 2008)

Mode of transport	Advantages	Disadvantages
Air	Speed Reliability Safety High level of customer service	High costs Limited availability
Water	Low costs High transportation capacity Safety	Slow Limited availability
Rail	Ecological High transportation capacity Safety	Limited availability Relatively unreliable
Road	Flexibility High availability	Relatively high costs Low transportation capacity Safety issues

Table 2 presents the carrying capacities of different transport modes in twenty-foot equivalent units (TEU). One TEU equals one standard sized container that is 20 feet long (OECD 2002). There are containers of various sizes: 10-foot, 20-foot, 30-foot and 40-foot containers, half-height containers and so forth. However, twenty-foot containers are the ones most commonly used as a measurement unit when talking about transportation capacity. What this means in practice is that if a ship can carry 3000 TEU, it can carry 3000 20-foot long containers worth of goods.

Table 2 Capacity by transport mode (Sources: Rodrigue et al. 2013; World Shipping Council 2018)

Vehicle	TEU
Semi-trailer truck	2,65
747-400F freight plane	6,625
41 car intermodal train	**82**
Panamax	3400
Post Panamax	4000
Panamax Plus	8000
New Panamax	12500
Triple E container ship	18000

It can be seen from the table that while a 41-car intermodal train can carry over 12 times more than a single aircraft, it can only carry 0,45 % of what the largest container ship today can carry. It is thus clear that while railway transport loses to ocean transport in terms of capacity, its capacity is still large compared to some other mods. The differences in capacity explain the advantages and disadvantages presented in Table 1 to an extent. The modes with the smallest capacities are also the ones with the highest costs. However, they make up for it with other advantages such as speed or flexibility.

Figure 6 presents the transport times and costs with different transport modes according to DB Schenker (2013). From the figure, it can be seen that the longer the transport time, the lower the cost. The freight rates presented in the figure are based on what transporting a single notebook would cost if a full container load, 3000 units, of notebooks were shipped. The transport time is based on how long it takes to transport the notebooks from Central China to the Netherlands. From the figure, it can be seen that railway transport in this case takes the same amount of time as a combination of ocean and air transport, also called Sea+Air. However, the costs of ocean and air are much higher those of railway transport.

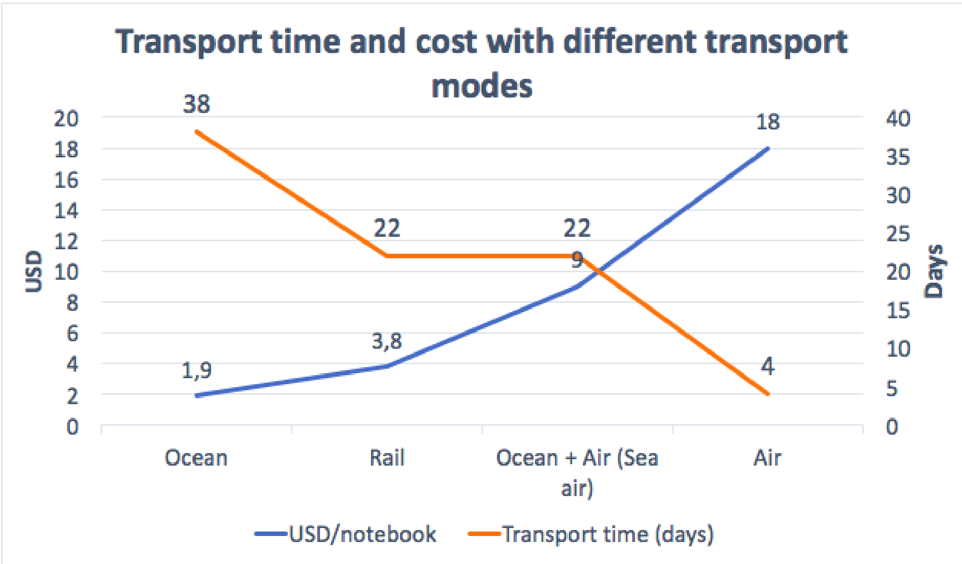

Figure 6 Transport time and cost with different transport modes (Modified from DB Schenker 2013)

The main idea is that transport costs vary in a linear way depending on the distance of haulage, but not proportionally. Transport costs also include a fixed cost that's not connected to the transport distance. Fixed costs consist of packaging, loading, unloading, preparation of vehicles, invoicing, transaction costs and so forth. These fixed costs vary between transport modes and shipment types. (Savy 2009.) For example, shipping a full truckload by road straight from place A to place B requires less hassle than rail transport with arrangements and pre- and post-road haulage. In this case, the fixed costs of the full truckload by road are naturally lower since there are fewer steps to take.

Different transport modes have very distinct characteristics regarding the commodity type, shipment sizes, transport distances and geographical coverage. Roads can serve basically all areas while ocean routes are limited to few axes. Rail tends to be limited to trunk lines. Each transport mode is thus focused on a specific market. This will be discussed further in Chapter 2.3.

2.3 Modal split

The modal split is defined as the way traffic is shared between transport modes and it is commonly considered to be the result of competition between several modes that the customers choose between according to their individual criteria. Different transport modes can also be seen as complementary. This approach emphasizes multimodal and intermodal transport chains by assuming that rather than competing with each other, modes complement each other. (Savy 2009.)

Both aforementioned approaches have their limits. Competition between modes is not as common as the first approach assumes: oftentimes there is only one mode available and because of that there is no competition. According to Savy (2009) it is noteworthy that road transport is often chosen even for long distances simply because it is the only mode available. In these cases, there is no alternative supplier and competition between modes simply does not exist. Road transport may thus be chosen for deliveries that would have been better suited for, for example, air transport, if it was available. Competition is thus often within modes rather than between modes. (Savy 2009.) Therefore, many cost-based decision-making models are somewhat unfit for reality from the start: they assume that modes are interchangeable when they often are not. Ocean and rail transport are also only accessible through terminals which means that transport from most locations will involve a road transport segment which changes the cost structure. (Rodrigue et al. 2013.)

The complementary approach stresses intermodal transport. However, integrating several modes into intermodal solutions is quite rare. On one hand, intermodal transport accounts for only a small portion of inland transport. On the other hand, intercontinental transport is by necessity multimodal, but rarely truly intermodal (Savy 2009.) Multimodal and intermodal transport will be further discussed in Chapter 2.4. According to Rodrigue et al. (2013), modes can compete or complement each other in terms of cost, speed, accessibility, safety, comfort and so forth. Rodrigue et al. (2013) state that there are three main conditions that ensure that transport modes complement each other:

- Different geographical markets
- Different transport markets
- Different levels of service

If different geographical markets are involved in transport, different modes will ensure continuity within the transport system. It needs to be possible to switch from one mode to another when borders between different geographical markets are crossed. Different transport markets refer to the nature of what is being transported. For example, road and rail transport can be complementary in the same market if one focuses on passenger transport and the other on freight. Different levels of service refer to the fact that when two modes operate in the same market and have equal accessibility, the modes can complement each other by offering a different level of service. According to Rodrigue et al., the most prevailing complementarity concerns cost versus time. This means that competition between modes exists when there is an overlap in one or more of the three areas listed above. (Rodrigue et al. 2013.)

Infrastructure plays a key role in modal split. Infrastructure is mainly provided by public authorities and building a network takes approximately two generations and large funds. The building of networks is further slowed down by their questionable profitability. (Savy 2009.) New networks are therefore slow to develop which means that new competing transport modes cannot enter markets on a whim. Facilitating competition between modes is a long-term policy issue. This is why road transport has monopoly in many areas and it is not likely to change in the short term. (Savy 2009.) For the purpose of this thesis, the most important network building initiative is the One Belt One Road initiative that will be further discussed in Chapter 3.4.

Table 3 presents the evolution of modal split in the EU. It can be seen that road dominates the European freight market. Road has increased its share from about 35 % in 1970 to about 50 % in 2015. Railway transport's share has dropped from 20 % to 12 % in the same timeframe. Waterway shipping's share, including inland waterways and short-sea shipping, has also declined but not as drastically. Air transport's share has not changed during 1970-2015 and a modest 0,1 % share of freight is carried by air in the EU. However, when observing Table 3, it needs to be taken into consideration that in this table, the market share is measured in weight. If it was measured in value, air freight's share could be higher since air transport tends to be chosen for high value commodities.

Table 3 Modal split evolution in the freight transport sector in the EU, by weight (Modified from European Comission Mobility and Transport statistics)

	Market share %					
	Road	Railway	Inland wa-terways	Pipelines	Short-sea shipping	Air
1970	34,7	20,0	7,3	4,5	33,5	-
1980	36,3	14,6	5,3	4,3	39,4	-
1990	41,9	10,9	4,6	3,0	39,6	-
1995	45,3	13,6	4,3	4,0	32,7	0,1
2000	46,5	12,5	4,1	3,9	32,9	0,1
2005	48,6	11,5	3,8	3,8	32,2	0,1
2010	49,4	11,4	4,5	3,5	31,2	0,1
2014	48,2	11,8	4,3	3,2	32,3	0,1
2015	49	11,9	4,2	3,3	31,6	0,1

Figure 7 compares modal splits intercontinentally in terms of tkm per mode. From the figure it can be seen that in China road is not at all dominant unlike in the EU. In China, railway's share is much bigger than in the EU, and ocean transport's share is bigger as well.

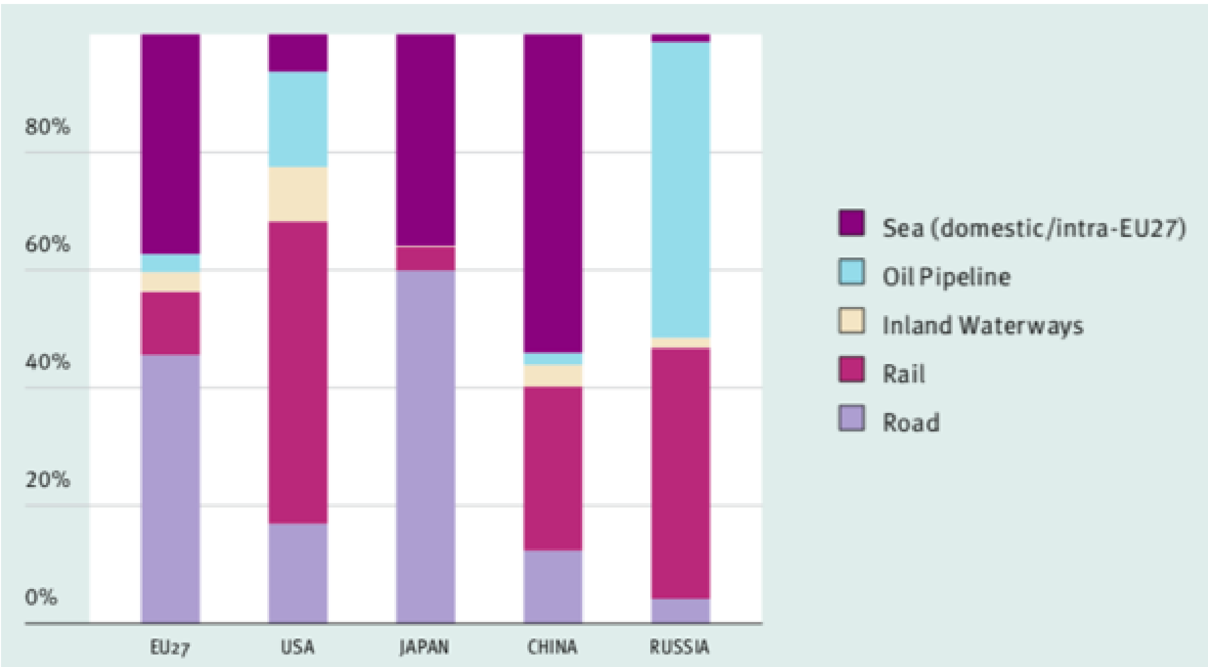

Figure 7 Modal split intercontinental comparisons in tkm (Savy 2009)

According to Rodrigue et al. (2013) China is a prime example of a country that has experienced a modal shift as a result of fast economic growth. It is the road and water transport modes that have gained the most. Even though road's share is still relatively small, it is twice the size of what it was in 1980. One of the most important Eurasian railway routes, the trans-Siberian railway, travels through Russia and it is thus noteworthy that in Russia railway's share is very large compared to road's share.

2.4 Multimodal and Intermodal transport

Intermodal transport refers to the movement of goods in one and the same loading unit or road vehicle, which uses successively two or more modes of transport without handling the goods themselves in changing modes (ECE 2001). Intermodal systems use various forms of transport to achieve a door-to-door delivery. The most common intermodal transport is a combination of road and rail. (Blauwens et al. 2006.) This is often referred to as piggyback transport (Ghiani et al. 2013.)

Figure 8 presents the transport chain in intermodal transport. Pre-carriage refers to the transport of goods by road to the dispatch terminal. At the terminal, the load is transferred from one mode of transport to another. Main transport refers to the moving of the load between the dispatch terminal and the destination terminal. At the destination terminal, the load is transferred again. On-carriage then refers to the moving of goods to the customer by road. (Blauwens et al. 2006.)

The transfer from one mode to another can happen in one of two ways: horizontally or vertically. When the goods are transferred vertically, the container, swapbody or semi-trailer is lifted onto the other mode with, for example, a forklift. When the goods are transferred horizontally, the container is driven onto the other mode. (Blauwens et al. 2006)

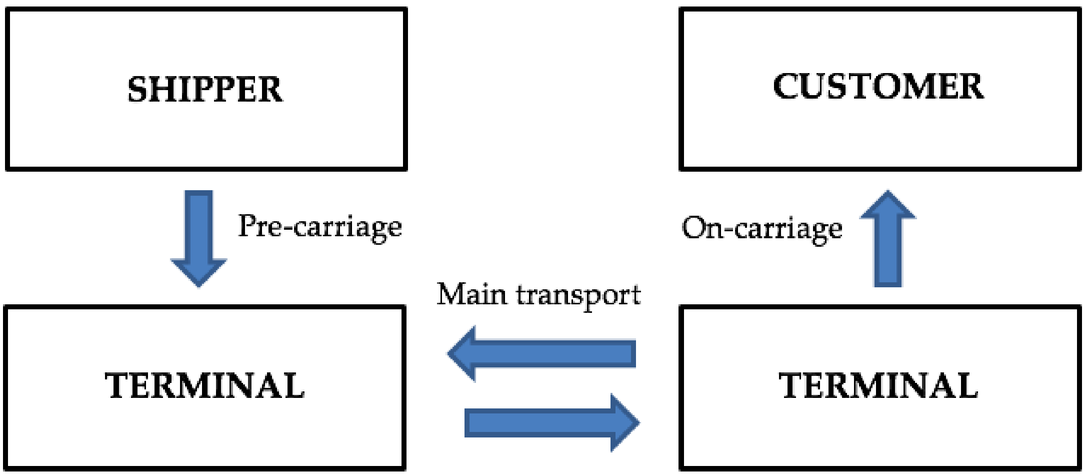

Figure 8 The simplified transport chain in intermodal transport (Blauwens et al. 2006)

Intermodal transport is quite rare, and only accounts for a small portion of inland transport. In the case of intercontinental transport, transport chains are by necessity multimodal but seldom intermodal. Currently, intermodal transport accounts for about 5 % of total freight in Europe, and 25 % of rail freight. (Savy 2009.) The reasons for the situation are not simple. Intermodal organizations are fragmented and consist of multiple autonomous actors, such as railway companies, railway operators, transshipment yard operators, shippers, consignees, intermodal transport operators and so forth, which makes them very complex and often inefficient. There are also other factors like gauge size changes, authorities, container renting companies, freight forwarders and real estate owners, which often results in poor interoperability. (Savy 2009.) Intermodal transport chains are thus simply not efficient and simple enough to be more popular. There are, however, newcomers that have set up integrated arrangements that organize intermodal transport chains under one agent's control (Savy 2009).

Multimodal transport refers to the use of multiple modes during one transport. Many deliveries are, like mentioned before, by necessity multimodal (Savy 2009): for example ocean and rail transport more often than not require pre-carriage and on-carriage, just like in intermodal transport. However, the difference between multimodal and intermodal transport is that in intermodal transport the goods travel in the one and same loading unit without any handling in between, while in multimodal transport the goods may be moved into another unit, re-packaged or otherwise handled during transport.

2.5 Trends and challenges in freight transport industry

During the past decades, a number of changes have taken place in logistics management that have brought about new challenges in the industry. On one hand, some new challenges originate from changed shipper requirements: for example, some shippers now require using RFID technology in transport. On the other hand, some challenges originate from carriers: for example, railroads and trucking companies have made decisions that have led to a capacity shortage in equipment and facilities. Furthermore, some challenges are caused by consumers. For example, the growing concern for environmental factors sets new expectations for both manufacturers and logistics companies. (Meixell & Norbis 2008.) Meixell and Norbis (2008) identify five main industry challenges in their literature review:

- Transport capacity shortage
- International growth
- Economics of scale and scope
- Security concerns
- Environmental and energy concerns

A capacity shortage has surfaced in all transport modes. Byrne (2004) points out that because of rising fuel prices, carriers have had to raise prices. Shippers have thus been left with higher prices without a subsequent raise in service levels. Tightened regulations, driver shortages and toll raises have also contributed to the capacity issue. In addition, according to Meixell and Norbis (2008), shippers are moving lesser quantities more frequently, which leads to trucks travelling only partially loaded. Railway capacity problems and a reduction in reliability can be attributed to inadequate investments (LaLonde 2004). According to LaLonde, airlines cut over one quarter of their seat capacity in response to the financial hardships in the 2000's. This naturally affected air freight capacity as well, since freight is carried on passenger planes.

However, the financial hardships of aviation are over, and according to Boeing's Commercial Market Outlook for 2018-2037, the aviation market is doing better than ever before. More people are flying than ever before and the industry has now recorded eight straight years of steady above-trend growth. (Boeing 2018b.) This means that the freight capacity on passenger planes is on the rise again. Boeing has also forecasted that the freighter fleet size will grow by 75 % worldwide over the next 20 years (Boeing 2018a).

The situation has changed for ocean shipping as well since Meixell and Norbis conducted their research 10 years ago. According to Tendereasy (2018), there are three main trends expected for 2019 in ocean shipping:

- Consolidation
- Governmental policy changes
- Container liner oversupply

Consolidations mean that smaller operators are being pushed out of the market by major global carriers. Tendereasy (2018) estimates that as of 2018, the 10 largest operators in the world already control 60 to 70 % of the global capacity, and that the trend is likely to continue. A major contributor to this is the development of alliances such as vessel sharing agreements between large carriers. (Tendereasy 2018.)

Governmental policy changes refer to the significant changes that global relations seem to be going through. No one knows for certain what will happen. It is unclear whether new tariffs are going to be imposed, what will happen with NAFTA, or how Brexit will affect the freight market. Companies need to continuously monitor the upcoming changes and devote significant resources to preparing for them. (Tendereasy 2018.)

Container liner oversupply is an issue that has been present in the industry for the last few years. Compared to 2008 (Meixell & Norbis 2008), the situation has changed drastically. In 2008, capacity shortage was a big issue, yet in 2018, there is an oversupply of container liners that is a result of fleet expansion. A stagnant growth rate is also to be expected in the coming years. (Tendereasy 2018.)

International growth and globalization have led to growing transport distances and transit times becoming longer. Transport costs are thus larger as well. International trade presents various challenges in terms of logistics: providing sufficient transport and storage, getting goods across borders and through customs and delivering to foreign locations on time and at a decent cost. (Meixell & Norbis 2008.)

Economies of scale and scope are often overlooked in carrier selection. Economies of scope in transport are related to the use of transport equipment after it is emptied. This is referred to as the "empty backhaul". (Meixell & Norbis 2008.) An example of this is that a lot of ship containers are shipped from the US and Europe back to Asia empty after the goods from Asia have been unloaded. This is a result of an imbalance in Asian imports and exports. Economies of scale are related to shipment size. For example, it is more profitable to ship in full truckloads than less than truckloads, and shipping cases is cheaper than shipping individual units. (Meixell & Norbis 2008.)

Security concerns have become increasingly important in logistics mainly because of the new security measures that have been put in place to prevent terrorist attacks. Logistics operators also need to be prepared to deal with the aftermath of a terrorist attack that affects their operations. (Meixell & Norbis 2008.) New security measures have led to an additional 151 billion dollars in costs annually. 65 billion dollars of those costs are caused by logistical changes. (Russell & Saldanha 2003.) Shippers can minimize the impacts of security threats by selecting security-conscious carriers and shipping ports, with secure packaging and by providing information on personnel. (Rinehart et al. 2004.)

Consumers have growing concerns for the environment. The concerns are complex and broad. According to a study by Harvey in 2007, over half of the people in UK would appreciate information about a product's carbon footprint when making buying decisions (Meixell & Norbis 2008 after Harvey 2007). Even after the study was conducted in 2007, environmental issues have been discussed daily. It can thus be assumed that environmental issues have become even more important during the past ten years as a result of increased awareness. The transport sector is a major contributor to all kinds of pollution; air pollution, acid rain, water quality problems and noise pollution. For example, as of 2006, transport accounted for 57 % of carbon monoxide emissions. (Coyle et al. 2006.) As of 2010, transport accounted for 14 % of all greenhouse gas emissions worldwide (EPA 2018).

As a conclusion, it can be said that the transportation sector is in constant turmoil. In the crossfire of customer expectations, environmental concerns, policy changes and an unstable political environment it is hard to say what is going to happen in the coming years. Therefore, constant attention is required from all parties associated with transport.

2.6 Mode selection drivers

Managers typically consider multiple factors when choosing a transport mode and a carrier. The focus is often on cost and transit time. However, the importance of different factors varies from industry to industry, from company to company and even from one facility to another. (Meixell & Norbis 2008.) With the careful selection of a carrier, competitive advantage can be achieved since the performance of the carrier affects the effectiveness of the entire logistics function. At the same time, however, mode and carrier selection has become increasingly complex. (Meixell & Norbis 2008; Reimann 1989.)

Historically, carrier selection was a two-step process. The mode of transport would be chosen first, then the carrier. Today, these choices are often made simultaneously. There is also the option of outsourcing to a third-party logistics operator. Some of the factors that have made the selection process more complex are the deregulation of the trucking and rail industries and innovative strategies such as JIT. More variables are now involved than before. Numerous different models and approaches have been developed to help with the carrier selection process. (Meixell & Norbis 2008; Murphy and Farris 1993.)

Mode choice and carrier selection are part of larger decision-making process in transport. The process includes identifying relevant transport performance variables, selecting the transport mode and carrier, negotiating freight rates and then evaluating carrier performance. (Monczka et al. 2005.) The transport mode selection process consists of various determinants. According to McGinnis (1990), the decision is typically affected by at least six different factors:

- Freight rates
- Reliability
- Transit times
- Over, short and damaged
- Shipper market considerations
- Carrier considerations

In addition to facts, modal choices are affected by the shipper perceptions of the transport modes and the services provided. The perceptions may or may not be realistic. For example, if a shipper believes that air freight is too expensive, he may dismiss the option without any further analysis. (Evers et al. 1996.)

According to Semeijn (1995), carrier selection in international shipping is very different from carrier selection in domestic shipping. There are three main differences:

- In international shipping, the choice of modes is more restricted
- In international shipping, other parties are involved, for example freight forwarders
- International shipments are more complex than domestic shipments because of the large amount of paperwork and insurance requirements

Table 4 presents the most common transport mode choices based on the value, perishability and fragility of the transported goods and the distance over which the goods are transported. It is noteworthy that the differences between modes of transport are so distinct that there is relatively little overlap. A single mode of transport tends to be best fit to serve each segment even though multiple modes may apply. (Savy 2009.)

Table 4 Subsystems in freight transport (Blauwens et al. 2006)

Commodity type	**Distance**		
	Continental transport		Intercontinental transport
	Short distance	Long distance	
Valuable goods Perishable goods Fragile goods	Road, Rail	Road, Rail	Sea, Air
Non-valuable goods	Road, Inland navigation, Rail	Inland navigation, Road, Rail, Sea	Sea

2.7 Transport decision process

The basic decision making process is commonly divided into seven steps. This is the very basic model for decision-making that's not limited to specific types of decisions. Figure 9 demonstrates the process.

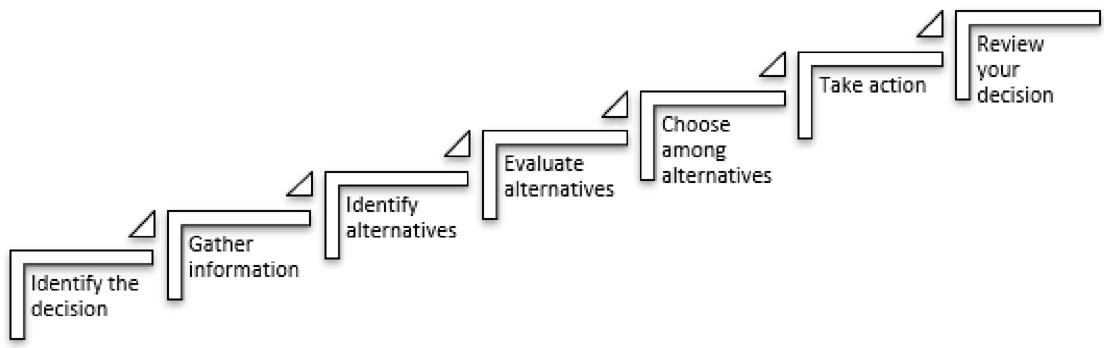

Figure 9 The seven steps of decision-making (Concordia University, St. Paul 2017)

In the first phase, the problem or opportunity that needs to be addressed is identified. In the second phase, data, facts and information about what needs to be taken into consideration is gathered. In the third base alternatives are identified based on the information gathered in the second phase. Alternatives are then evaluated and compared in the third phase. In the fourth phase, the best alternative is chosen based on the evaluation made conducted in the previous phase. In the sixth phase a plan for implementation is created. The last phase consists of looking back on the decision and reviewing it in terms of what went well and what could be improved the next time around. (Concordia University, St. Paul 2017.)

Steps 3 and 4 of the transport decision process are often carried out by sending out RFQs to the supplier alternatives identified in phase 2. Figure 10 illustrates the RFQ process. Companies send out RFQs to potential suppliers when they already know what they need, and only want the price for it (Deltabid 2018).

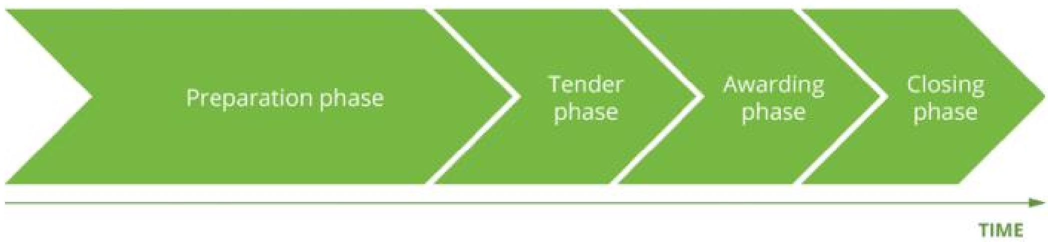

Figure 10 The RFQ process (Deltabid 2018)

The preparation phase is the most important part of the RFQ process. In the preparation phase, the documents and information that will be sent to bid participants is be prepared. The information should include, for example, all necessary background information about the company and the terms and conditions of the bid. In general, the documents should include all the information bidders need in order to submit a quotation. (Deltabid 2018.)

In the tender phase, the RFQ is underway. In this phase it is important to treat all bid participants equally and provide them all with the same information. No information about other bidders or the prices they have offered should be leaked to participants in order to ensure business ethics. This phase is also called the management phase. (Deltabid 2018.)

In this thesis, the RFQ process is limited to the preparation and tender phase. The awarding phase and closing phase are not included in the process in this thesis since no actual decisions will be made. The RFQ process in this thesis will be further discussed in Chapter 4.3.

According to Stank (2010), there are four key decision levels that need to be addressed in order to properly integrate transport into the supply chain. These levels are long-term decisions, lane operations, choice of mode or carrier, and dock level operations. (Stank 2010.)

Long-term decision making is about deciding, for example, which primary mode is best suited for each general flow, such as inbound and outbound. Attention needs to be paid to the availability and appropriateness of the transport modes for products and locations. (Stank 2010.)

Lane operation decisions are about daily operational freight transactions. Lane operation decisions have to do with ensuring that the right products in the right quantities arrive where they are needed, in time and at the lowest costs possible. In practice, lane operation decisions often manifest themselves as consolidation of vehicles and carriers. For example, assigning larger volumes to just a few carriers should result in lower per-unit transport costs and higher priority. (Stank 2010.)

The next level, choice of mode and carrier, is about making mode and carrier decisions for individual shipments. At this level, a particular shipment is evaluated in terms of the service criteria that must be met and a suitable mode and carrier is then chosen based on that criteria. (Stank 2010.)

On the last level, dock level operations, decisions about load planning, routing and scheduling are made. Dock level decisions are the manifestation of long-term planning on an operational level. (Stank 2010.)

According to McGinnis (1989), there are four transport decision model types:

- Classic economic models: identifying the distance breakpoint between truck and rail shipments
- Inventory-theoretic models: identifying the best mode based on total transport, ordering and inventory costs
- Trade-off models: identifying the best mode based on the sum of transport and non-transport costs
- Constrained optimization models: identifying the best mode by minimizing transport costs subject to non-transport cost constraints

The transport decision models are theoretical models that are rarely used on a day-to-day basis in companies. They, however, provide a basis for understanding what decision-making is, or should be, based on.

2.8 Incoterms

When making transport decisions, Incoterms also need to be negotiated with the suppliers. Incoterms are internationally known trade terms that explain the division of costs and risks between the parties of the contract. There are 11 incoterms, 4 of which are only suitable for ocean shipping: FAS, FOB, CFR and CIF. All other incoterms are suitable for all transport modes. (ICC 2010.) The Incoterms are (ICC 2010; TNT 2018):

- **EXW: Ex Works.** Places minimum responsibility on the seller. The seller only takes care of the goods being available.

- **FCA: Free Carrier.** The seller is responsible for the costs and risk of delivering the goods to the buyer's carrier at an agreed location. Seller also clears goods for export. After the carrier has received the goods, risk transfers to buyer.
- **CPT: Carriage Paid To.** Same as FCA, but the seller is responsible for all delivery costs.
- **CIP: Carriage and Insurance Paid To.** Same as CPT, but the seller also pays for insuring the goods.
- **DAT: Delivered at Terminal.** The seller is responsible for the costs and risk of delivering the goods to an agreed terminal. The seller organizes export customs clearance and unloads the goods at the terminal. The customer is responsible after the goods are at the terminal.
- **DAP: Delivered at Place.** The seller is responsible for the costs and risk of transporting goods to an agreed address. Import and export responsibilities are the same as in DAT.
- **DDP: Delivered Duty Paid.** The seller takes almost all the responsibility and covers all costs and risk of transporting the goods to an agreed address. The seller also makes sure goods are ready for unloading and pays all duties and takes care of export and import.
- **FAS: Free Alongside Ship.** The seller is responsible until the goods are delivered next to the ship. Buyer takes care of import and export clearances.
- **FOB: Free on Board.** The seller takes care of costs and risk until the goods are onboard. The seller also sorts out export clearance.
- **CFR: Cost and Freight.** Same as FOB, but the seller also pays for bringing the goods to the port.
- **CIF: Cost, Insurance and Freight.** Same as CRF but the seller also covers insurance costs.

Naturally, the incoterm has an effect on the costs that have to be paid by the buyer. From the viewpoint of the buyer, negotiating a term that imposes as much of the costs and risks as possible on the seller is beneficial. However, depending on the position of negotiation, this may not be possible. Respectively, it is in the best interest of the seller to negotiate a term that imposes as many of the costs and risks as possible on the buyer.

3 EURASIAN RAIL FREIGHT

This chapter will take a look at the history, current significance and future prospects of Eurasian rail freight. Additionally, the most important railway routes for freight transport from China to Finland will be observed in depth. This chapter will begin with the history and development of Eurasian railway freight in Chapter 3.1. and move onto its current significance and future prospects in chapter 3.2. Chapter 3.3. will take a look at the most relevant Eurasian railway corridors in terms of this research. Chapter 3.4. will introduce the One Belt, One Road initiative that has the potential to change Eurasian railway freight dramatically in the coming years.

The purpose of this chapter is to provide an understanding of the development and opportunities of railway freight in Eurasian freight transport. These insights will be beneficial in analyzing and discussing the opportunities of rail for Finnish companies, now and in the future.

3.1 The history and development of Eurasian railway freight

According to a study conducted by Ta et al. in 1998, rail transport was perceived as the least satisfactory transport mode by the respondent firms. It was thus concluded that it is advised to avoid the use of rail unless it is absolutely necessary. (Ta et al. 1998.) Figure 11 presents the modes of transport used by foreign firms in China in 1998. Things have, however, changed since then because of the modernization and development of the railway network.

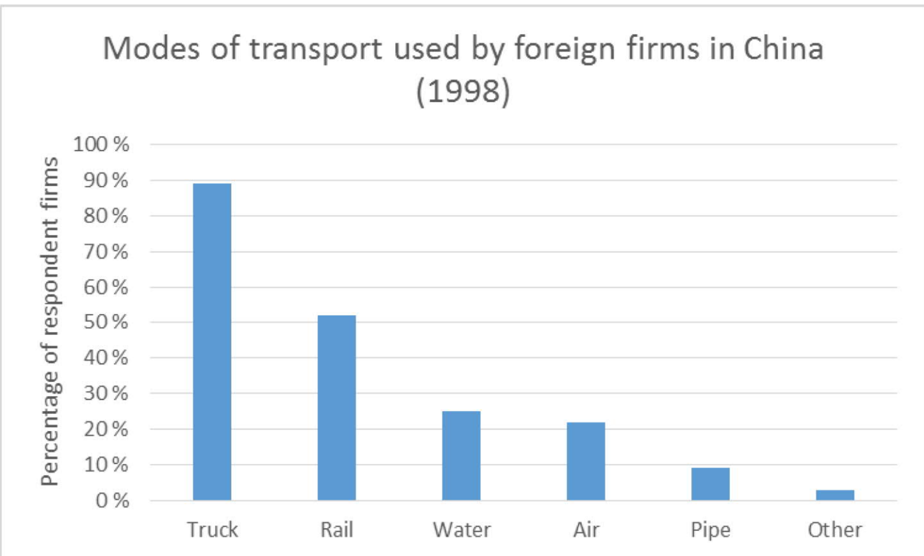

Figure 11 Modes of transport used by foreign firms in China in 1998 (Ta et al. 1998)

New railway services between China and Europe have emerged very rapidly. Ten years ago, the concept of regular direct freight service from China to Europe did not exist. (CSIS 2018). The first direct train connection from China to Europe was launched in 2006. This train traveled from Xiangtan in Hunan province to Hamburg. This connection was a ground-breaking innovation but at the time the service was too slow and inconsistent to gain any significant ground. It took 17 days from the departure date for the train to arrive in Hamburg. The inconsistence was mainly due to the departure depending on the freight volume. If there was not enough volume, the train operator would wait a few days to get the train full. There was hence no certainty when the train would actually depart. This did not change until the year 2013 when a train route from Chengdu to Lodz opened. On this route, trains would depart according to a published schedule and it also traveled much faster than the Xiangtan-Hamburg train because of a direct line. (Shepard 2016.)

3.2 Current significance and future prospects

As of today, around 35 Chinese and 34 European cities are connected by trans-continental direct trains (CSIS 2018). For example, Suzhou is connected to Warsaw, Yiwu to Madrid, Lianyugang to Rotterdam, and Zhengzhou to Hamburg. These trains travel along one of two main routes: along the Trans-Siberian railway (the Northern Corridor) or across Kazakhstan (the Middle Corridor). A third, very ambitious, main route is on the development stage: this route goes from the Yunnan province to Hamburg through Myanmar, Bangladesh, India, Pakistan, Iran and Turkey (The Southern Corridor). The Southern Corridor is more of an extension of the Middle Corridor as can be seen from Figure 12 below. (Shepard 2016; CSIS 2018.) It can thus be said that all trans-continental China-Europe trains can be divided into two three groups based on which main rail route they travel along, depending on whether the southern route is taken into consideration. The vast majority of trains make use of the North and Middle corridors since the Southern corridor is still unfinished. The different trans-continental train routes will be discussed further in Chapter 3.3.

Figure 12 China-Europe Main Rail Routes (Source: CSIS 2018)

According to DHL's Konrad Godlewski, nearly every province of China will have at least one train route to Europe if the current trend continues. Chinese cities are interested in Europe-bound train routes because these trains have become criteria of evaluation for the well-connectedness of cities. Well-connectedness is an important factor when investors look for places to invest in and is thus crucial in terms of luring investments and business. (Shepard 2016.) The largest and most active rail freight hubs in China are located inland. The closer the origin and destination are to the ocean, the more alluring ocean shipping is. (CSIS 2018.)

Because of the improvements made during the last decade, rail cargo has become a viable option for shippers and the market for the trans-continental trains is growing fast. Previously, there were only two formidable options because of the flawed rail freight system: the slow and cheap ocean freight and the fast and expensive air freight. Now there is a third option that is a middle ground solution in terms of both speed and cost. (Shepard 2016.) In 2006, rail freight was not only more expensive than ocean shipping but also slower (CSIS 2018). In the light of this it is easy to understand why transcontinental rail cargo was not a thing until the launch of the direct trains. In 2006, shipping a container from Shanghai to Hamburg via rail took 36 days. Today, the same journey takes 16 days. (CSIS 2018.) The travel time has thus been cut by more than half. In contrast, ocean shipping has become slower as a result of "slow steaming", an effort to cut fuel costs by reducing speed (CSIS 2018). Today, most China-Europe direct trains make the journey in less than two weeks each way. Shipping from China to Europe by train now takes about a quarter of the time shipping by sea takes. (Shepard 2016.) The cost of railway shipping has also been reduced but not as dramatically as transit time (CSIS 2018).

Improvements have also been made in customs and other “soft” infrastructure aspects. A decade ago, shippers had to coordinate arrangements with each country that the train passed through which meant a lot of paperwork and additive costs such as tariffs and various permits and inspections. As a result, railway routes were understandably barely used. As of today, rail cargo still requires more paperwork than ocean shipping, but some requirements have been lifted and logistics experts are skilled in navigating the remaining barriers. (CSIS 2018.)

According to Kouvola Innovation (2018), the rail freight volumes between China and Europe are rising fast. In the first half of 2017, the value of rail transports rose by 144 % compared to the same period in 2016. In 2016, KTZ (Kazakhstan’s national railway) estimated they would achieve 42 000 containers between China and Europe. In 2011 the number of containers transported was about 2 000. (Shepard 2016.) A major development is that some operators are now offering the option to ship less-than-container loads, which is attracting smaller shippers in addition to large customers (CSIS 2018). Previously, you could only ship full containers.

Modernization of the existing railway routes between China and Europe could produce enough capacity to carry 3 million containers a year. (Kouvola Innovation 2018.) According to CSIS (2018), China-Europe rail services could potentially double their share of trade in terms of volume over the next decade.

Kazakhstan has spent over 3 billion US dollars since 2011 on upgrading its railway lines and rolling stock. 250 million US dollars have been spent on building the Khorgos Gateway, a dry port where containers can be lifted from Chinese trains onto Kazakh ones to overcome the problem caused by different gauge sizes. (Kouvola Innovation 2018.) The containers can be transferred from one train to another in just 47 minutes at this dry port (Shepard 2016).

There are some constraints to dramatic growth in the rail freight volumes. Taking on much larger volumes requires overcoming multiple economic and technical constraints. First of all, there is a chronic trade imbalance between Europe and China, which means that there is more demand for eastbound services than westbound services. Stakeholders have estimated that about 60 to 70 % of railway shipments are westbound. Empty containers need to be transported back to China from Europe which creates additional costs. It is, however, noteworthy that this is not a new problem or one that only applies to rail. For example, the ocean shipping giant Maersk estimates that it spends a billion dollars on repositioning containers each year. (CSIS 2018.)

The main challenge that shippers face is the constrained availability of data. Information about the train frequency, cargo volume, freight rates and other basic information remains hard to find. There is little reliable and centralized information for shippers despite the attention these new railway routes receive. This is mostly due to the newness of these routes but there are also incentives for keeping this information from the public.

These Eurasian trains also serve a political agenda; some services have only run once solely for promotional purposes. China has used constantly announcing new routes as evidence that their Belt and Road initiative is succeeding, regardless of the economic merits of those routes. (CSIS 2018.) It is thus questionable whether the sole number of transcontinental routes can be used as evidence of well-connectedness and whether certain routes are viable or lucrative in reality. Large government-provided subsidies also make the economic viability of the routes hard to assess. (CSIS 2018.)

The enduring strengths of ocean shipping also pose a challenge to the future growth of rail freight: trains are never going to be able to compete with container ships in terms of cost and capacity. Even with the government-provided subsidies discussed earlier in this chapter, the cost of rail is about three times higher than that of ocean shipping. Because of this, trains are mostly a viable option for companies that source high-value, time-sensitive products or inputs. Contradictory to this, the International Union of Railways estimated that rail's growth will take away more from ocean shipping than air. (CSIS 2018.) This would suggest that the most high-value and time-sensitive products will continue to be transported by air which is the fastest, but also the most expensive, alternative. There are, however, many contradictory opinions and studies regarding whether rail is a bigger threat to ocean or air. It is also possible that rail will not take away from either one but rather hinder their future growth (CSIS 2018). The evidence remains inconclusive.

New airports are constantly being built in China because of the growing aviation industry. China is estimated to overtake the United States as the world's number one aviation market around the year 2024. The expansion of aviation infrastructure will make air freight more accessible even to those that did not consider air an option before. Ocean shipping also has new options opening up because Arctic sea routes are open for longer each year as a result of rising temperatures. (CSIS 2018.) The Arctic route is significantly shorter than the southern route when travelling to certain destinations. It remains to be seen how these developments will affect rail freight's competitiveness in the coming years. (CSIS 2018.)

There are certain bottlenecks along the transcontinental routes. Chinese and European railways have the standard gauge size of 1,435 mm but Russia, Kazakhstan and other former Soviet Union states employ a 1,524 mm gauge. No train can thus travel the whole way without a gauge change or the containers being transferred onto another train. Bottlenecks can occur at points where the gauge size changes. There are also capacity challenges within the European railway network. The European railways are much older than the Chinese ones. Modernizations and investments are currently being made but the changes will take time. Bottlenecks create delays which is not ideal since rail transport's main selling point is speed. In 2017 delays of as many as six days were reported. (CSIS 2018.)

3.3 Eurasian rail transport corridors

Transport corridor refers to a specified route for moving people and goods across international borders. Transport corridors connect key points in different countries and are ideally intermodal and thus combine various modes, for example roads, railways, inland waterways and sea routes. (Regmi & Hanaoka 2012.) The following chapters will present the most relevant railway routes in terms of transporting goods from China to Finland by rail.

3.3.1 Trans-Siberian railway route

The Trans-Siberian railway connects western and eastern Russia by connecting Moscow and Vladivostok. The Trans-Siberian connects to the Trans-Manchurian and the Trans-Mongolian railways that are sometimes considered a part of the Trans-Siberian railway. The Trans-Mongolian railway travels through Mongolia and the Trans-Manchurian railway directly connects Russia and China. The Trans-Siberian railway is approximately 9600 kilometers long and it is one of the longest railway routes in the world (Kilroy 2018). Figure 13 illustrates the Trans-Siberian railway route.

Figure 13 Trans-Siberian railway route (Modified from The Independent 27.9.2014)

In the east, the Trans-Siberian provides access to the railway networks of North Korea, China and Mongolia via the border stations in Khasan, Grodekovo, Zabaykalsk and Naushki. In the west, it has access to European countries via Russian ports and border crossings at the former republics of the Soviet Union. (Russian Railways 2018)

The Trans-Siberian Main Line has been included as a priority route between Europe and Asia in projects of international organisations such as the United Nations Economic Commission for Europe (UNECE), the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP) and the Organisation for Co-operation between Railways (OSJD) (Russian Railways 2018). According to Russian Railways (2018), the transport of a container from China to Finland via the Trans-Siberian takes 10 days.

3.3.2 Xi'an – Kouvola and Hefei – Helsinki

The roughly 8000-kilometer railway connection between Xi'an and Kouvola was introduced in 2017. Figure 14 illustrates the railway connection. The first departure on the route took place on the 10th of November in 2017 when the train departed from Kouvola. It arrived back in Kouvola for the first time on the 12th of December 2017. Four railway operators are involved in the traffic: VR-Transpoint (Finland), RZD (Russia), KTZ-Express (Kazakhstan) and China Railway. The route takes ten to twelve days: 3 days in China, 4 days in Kazakhstan, 2 days in Russia and one day in Finland. The gauge size is the same for most of the route but in China, however, the gauge size is different. (Kouvola Initiative 2018.) According to Kouvola Initiative, the Kouvola – X'an route is the shortest route to China in terms of both geography and time. The current annual rail freight volume is about 350 000 TEU, and it is expected to be 1 million TEU by 2020. (Kouvola Innovation 2018.)

Figure 14 Xi'an - Kouvola and Hefei - Helsinki railway routes (Varova 2018)

Back in February 2018, news was published about German and Dutch as well as other Nordic companies being interested in the new rail connection. Back then, the 800-meter long freight train departed every other week. (Yle 20.2.2018.) In April 2018, the freight train operated on a weekly basis and news outlets reported that the demand was so great that occasionally some of the containers needed to wait for the next departure. (Yle 9.4.2018.) Unfortunately, problems soon occurred and the Kouvola – Xi'an railway route has not turned out to be as successful as hoped. In June 2018, news about companies abandoning the route surfaced. In the spring of 2018, trains from Xi'an had continuously been up to three weeks late. Because of the unreliability, many companies have switched to the route travelling through Poland. According to Kouvola Cargo Handling, the reason for the delays is terminal congestion in Xi'an. Trains from Kouvola have departed without problems. (Kouvolan Sanomat 19.6.2018.)

Another new railway route connecting China and Finland, from Hefei to Helsinki, has recently been opened. This route connects Helsinki harbor to Hefei which is the capital of Anhui Province. The first departure took place on the 8^{th} of November 2018. The journey takes approximately 2 weeks. According to current plans there will be weekly departures, and it remains to be seen how the route succeeds. (Nurminen Logistics 2018.) The Hefei-Helsinki route is also illustrated in Figure 14.

3.4 The "One Belt, One Road" initiative

The "One Belt, One Road (OBOR)" initiative is a development plan through which China aims to boost trade and growth across Asia (Kouvola Innovation 2018). The initiative also goes by, for example, the names "Belt and Road Initiative (BRI)" and "Silk Road Economic Belt". The purpose of the initiative is to promote regional economic development though the creation of win-win cooperation and mutual prosperity. The initiative aims to increase trust, communication and strengthen friendship and understanding between all the countries included. (Huang 2016.) The core of the initiative is building infrastructure that connects China to countries all across the globe. China aims to transfer 25 % of European transports to land because of overly congested sea harbors. The budget of the initiative is estimated to be 900 billion US dollars. (Kouvola Innovation 2018.) It is noteworthy that OBOR is not international aid by the Chinese government but an initiative that needs to make commercial sense as well (Huang 2016).

Investments will not be made solely in Asia. Figure 15 illustrates the planned investments in Europe related to OBOR. The plans include investments in terminals, logistics centers connections. PwC (2018) estimates that the transport corridor between Europe and China will grow rapidly over the next few years as a result of the initiative. Such developments will lead to lower transport costs and enable creation of new services.

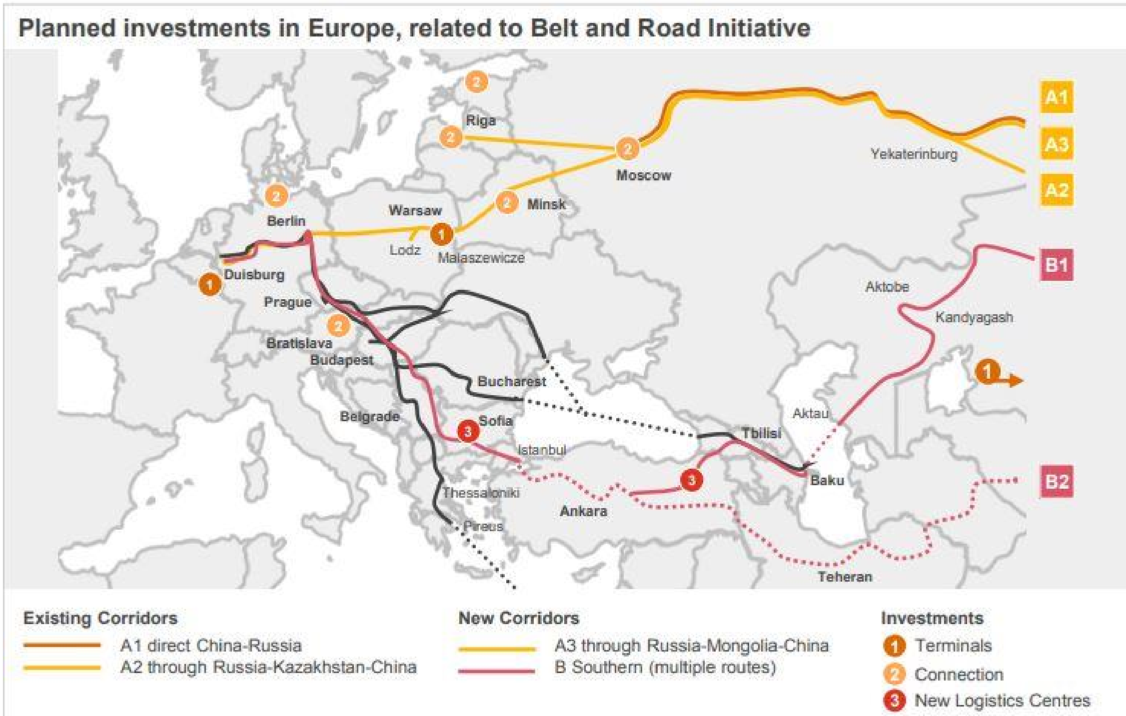

Figure 15 Planned investments in Europe, related to OBOR initiative (PwC 2018)

Huang (2016) presents four main arguments regarding the intentions and consequences of the OBOR initiative:

1. **The OBOR initiative is an attempt by China to sustain its economic growth.** China's economy developed very fast during the first three decades of economic reform as a result of foreign direct investment and the dramatic expansion of exports. However, the growth has now moderated and the development pattern seems to have reached a bottleneck. OBOR could open up new economic opportunities in the west and support future growth.
2. **Through OBOR, China aims to achieve greater international influence and contribute to the international economic architecture.** China has shown willingness to take on greater responsibilities in economic governance on an international level. It has yet to achieve its goal since the reform of international organizations is slow and difficult. The OBOR initiative is a step towards achieving a greater role in reshaping the economy since China's experience of the importance of infrastructure development could be a useful lesson for other developing economies.
3. **Infrastructure development is an important part of OBOR but OBOR also covers policy dialogue, infrastructure connectivity, unimpeded trade, financial support and people-to-people exchange.** Even though, given China's own experience, infrastructure development is in the center of the initiative, other as-

pects need to be considered as well. The initiative covers, for example, the following: promoting political trust, deepening shared interests, achieving convergence of technical standards, promoting low-carbon green economy, providing solutions for eliminating trade barriers and working on a wide range of cross-border financial agendas. The initiative is thus about much more than just infrastructure and logistics.

4. **OBOR provides important opportunities but also contains significant risks and uncertainties.** These risks include, for example, geopolitical risks, unpredictable international policy coordination and the questionable financial sustainability of cross-country projects. Caution should be taken even though China's efforts to assist economic development are welcome.

The OBOR initiative is arguably the most important Chinese international policy initiative in history. Until now China has rarely played any international economic roles outside its own borders. China's new-found willingness to participate and take on a greater role internationally is triggered by three main factors: the desire to maintain economic growth, the constant pressure from the international community to take on more responsibilities, and the need to make changes to the existing economic system that is no longer compatible with the reality of the "new world". (Huang 2016.)

If the OBOR initiative is successful, it has the potential to create new opportunities for the world economy and positively affect the lives and increase the living standards of the 64 % of the world's population residing in the affected region. It is noteworthy that China's aim is not to build a parallel economic system to the one lead by the US. China has been the main beneficiary of globalization in the past decades and it has every incentive to continue supporting that international system. It is, however, necessary to reform the existing system to better reflect the new role of emerging economies. (Huang 2016.)

4 METHODS

4.1 Approach and research method

4.1.1 Mixed method research

This chapter will introduce and explain the methods chosen for this thesis. Figure 16 illustrates the research strategies commonly used in research.

Figure 16 Research Strategies (Jyväskylän Yliopisto 2018a)

Qualitative approaches are concerned with interpretation and understanding rather than explanation and statistical analysis. Qualitative approaches aim at a holistic understanding of a subject since they are more sensitive to context than quantitative approaches. Qualitative research tends to be exploratory and flexible due to unstructured problems. There are many qualitative research approaches, such as case study, action research, discursive research and grounded theory research. (Eriksson & Kovalainen 2008.)

Quantitative research is a broad area of scientific methods that enable describing and interpreting the research object statistically by numbers. It focuses on classification, causality, comparison and explanations of phenomena through numbers. Qualitative and quantitative research form a methodological pair and they are often used side by side in research. (Jyväskylän Yliopisto 2018a.)

This thesis combines qualitative and quantitative research. Quantitative methods are used when analyzing the numerical data acquired via the RFQs. Qualitative methods are needed when analyzing and discussing the non-numerical data. Data collection will be further discussed in Chapter 4.3. Both qualitative and quantitative methods are used when combining the numerical and non-numerical data in the discussion phase. Neither quantitative nor qualitative methods by themselves can answer the research questions because this thesis combines statistical data with non-numerical data. The methods complement each other and provide a richer and more comprehensive understanding of the research object. This thesis can thus be called a mixed method research (Lund 2012). According to Lund (2012), there are four main benefits to mixed method research designs:

- Mixed methods research is more able to answer certain complex research questions than qualitative or quantitative research in isolation.
- Qualitative and quantitative results may relate to different objects or phenomena, but may be complementary to each other in mixed methods research.
- Mixed methods research could provide more valid inferences.
- In mixed methods research, qualitative and quantitative results may be divergent or contradictory. This can lead to extra reflection, revised hypothesis, and further research.

4.1.2 Case study approach

This thesis is conducted as an assignment for Company X. This research mainly utilizes the case study approach, even though it has elements of other research approaches as well. The case study approach aims to gain an in-depth understanding of a single case or a small number of cases set in their real context. Case studies thus aim at new learning about real world behaviors. (Yin 2012.) This thesis aims to test whether theory applies to a real-life case and its individual context. Therefore, a single case approach was chosen.

A case is generally a bound entity such as an organization, a person or an event. In business economics, cases are often companies or parts of companies, which is also the case in this research. In the case approach, it is assumed that the context of the case is vital for truly understanding the case. (Yin 2012.) In this thesis, the case is a single company. The case, also called the research object, will be introduced in Chapter 4.2.

The case study method is the suggested research approach in especially three cases (Yin 2012):

- When the research questions are explanatory or descriptive: “*what*” or “*how*”

- The case approach favors data collection in a natural setting instead of relying on derived data
- The case approach is useful for conducting evaluations

A single case was selected for this thesis because the aim of this research is to gain a deeper understanding of the conditions affecting the modal choice in a single firm. This research aims to explore individual context and including multiple cases would have blurred that context. The case study approach provides richer descriptions and more insightful explanations than other research methods that are mode concentrated on generalizations than deeply understanding individual context. A holistic approach was taken: there is a single unit of analysis that's analyzed in its natural context.

4.2 Research object

The case company, Company X, is located in Turku area in Southwest Finland. It is an SME with roughly 20 employees. The company is a part of an international group with multiple manufacturing sites in Europe. The headquarters are located in Sweden.

Company X manufactures and distributes geothermal energy products. This thesis has been conducted as an assignment for company X, at which the researcher also works. For this reason, the organization is very familiar to the researcher. The researcher had access to the archives and the ERP (Enterprise Resource Planning) system where cost information, invoices and freight documents are stored. These archives were used as a basis for understanding the current state of the case company in terms of the research subject. Insights were also provided by other employees at Company X, most importantly the group chief buyer and the warehousing personnel.

Company X buys plastic pipe couplers and welding parts from a Chinese company located in Jiaohe City, Jilin Province. This company will be called Supplier X in this thesis. Supplier X manufactures the parts for Company X after order, which means that the parts are not kept in stock. The delivery time thus consists of manufacturing time and transport time. The distance between Supplier X and Company X is roughly 6600 kilometers, as the crow flies, which poses limitations.

Company X orders from Supplier X approximately 8 to 10 times a year. The shipments are relatively small: they range from one box to roughly one pallet of boxes. All shipments are thus LCL. So far, the orders have been shipped by ocean or air, depending on how urgently the goods are needed. Sometimes the order quantity has been split and a smaller quantity has been shipped by air and the larger quantity by ocean. The orders that have been shipped by ocean have travelled through Dalian port. Figure 17 shows the locations of Dalian port and Supplier X in Jiaohe City. The distance between the two is approximately 900 kilometers. Supplier X has taken care of shipping arrangements and bookings, although all costs have been charged from Company X.

Figure 17 Chinese seaports and Supplier X location (Modified from China Performance Group 2013)

This research was conducted because Company X wants to explore its shipping options. Ocean shipping is often seen as too slow: a few weeks of manufacturing time and 7-8 weeks of transport time equals a delivery time of up to two months. When ocean shipping has not been an option because of how slow it is, Company X has turned to air transport. However, air transport is rather expensive given that the parts Company X orders from Supplier X are very inexpensive. Company X has been pondering whether railway transport would be a viable midway solution to their transport problem.

Before starting to request offers, an incoterm needed to be decided on. Incoterms were introduced in Chapter 2.8. Since the incoterm chosen affects freight costs, a choice was made to utilize the same incoterm for all modes of transport. This ruled out the incoterms that are only suitable for ocean transport. For clarity and comparability, a choice was made to assume that all transport arrangements would be handled, and all costs paid by Company X. This choice led to EXW being chosen.

4.3 Data collection

In this chapter, the data collection phase of this research will be introduced. The process of constructing and sending the RFQs will be explained in depth and other sources of data will be disclosed.
There are six common sources of data in case approaches (Yin 2003):

- Direct observation: *e.g. human actions or physical environment*
- Interviews: *e.g. conversations with key participants*
- Archival records: *e.g. financial archives, statistics*
- Documents: *e.g. e-mails, letters*
- Participant observation:
- Physical or cultural artifacts

It is typical for the case approach that data is collected using more than one method. The data collected in this research was collected via participant observation, archival records and e-mail quotations. The quotations were the primary source of data. Figure 18 demonstrates the data collection process in this thesis. The data collection phase follows the basic structure of the transport decision process model presented in Chapter 2.7. The process in this thesis is, however, limited to steps 1 to 4 in the process chart illustrated in Figure 9 since no definitive decisions will be made in this research.

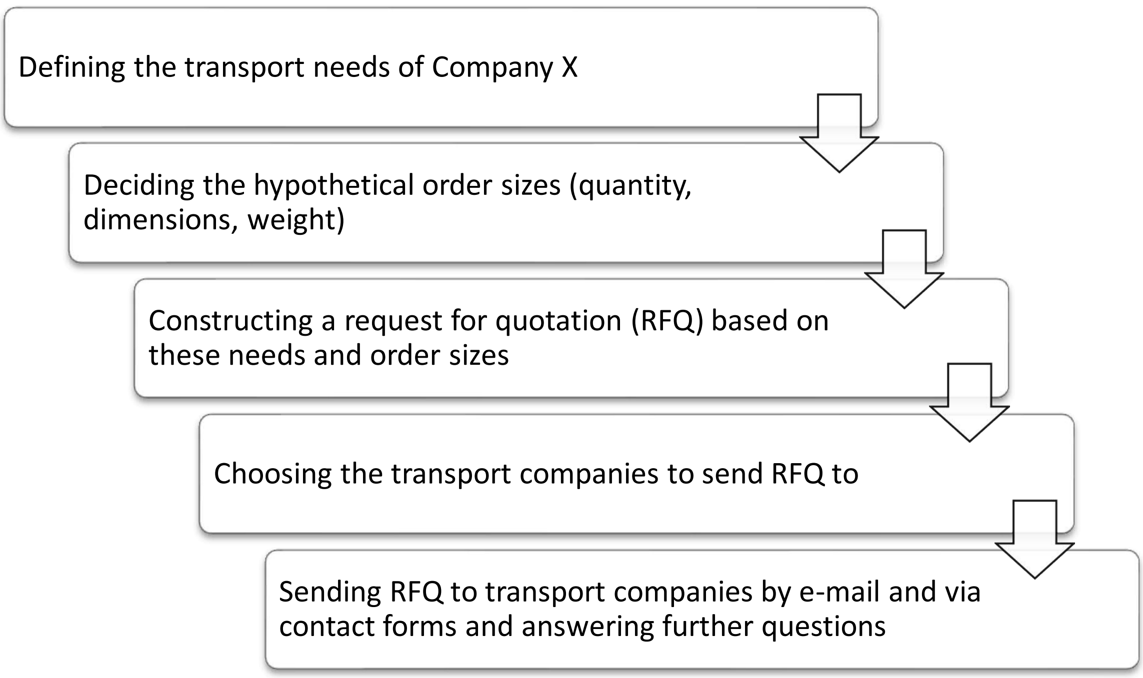

Figure 18 Data collection process

The first step of the data collection process was to gain insight on what kind of transport needs Company X has. The researcher has worked at Company X since 2013 and as a result has a thorough understanding of how the company operates. In addition, multiple discussions were had with the company purchasing and warehousing employees about typical and potential order quantities, delivery dimensions, delivery weights and incoterms throughout 2017 and 2018. These discussions were had for the purpose of gathering information that the researcher could base the request for quotation on. Because this thesis was conducted as an assignment for Company X, it was important that the data collected is useful for the company.

During the first phase, it was discovered that all the parts that Company X orders from their supplier in China are close in weight and size. All items are also packed into standard sized boxes that always contain roughly the same number of items. It was thus decided that all items would be weighed, and an average item weight and package size would be used to calculate shipment dimensions.

In the second phase, all individual items from Supplier X were then put on a scale one by one. All weights and package sizes were gathered into a table. Based on this table, average item weight and package size were calculated. These weights and sizes were utilized in calculating the dimensions and weights for three hypothetical order quantities.

The researcher was then provided with three potential order quantities by the company chief buyer based on which the following three shipment sizes were calculated:

- 1 standard sized box (42x34x42 centimeters), 16 kilograms
- 27 standard sized boxes, 420 kilograms, one pallet
- 81 standard sized boxes, 1260 kilograms, three pallets

The first quantity is the minimum order quantity based on past orders, the second is an average sized order, and the third is a large order that could be placed if the case company ordered on behalf of the whole group. These potential order quantities were thought over and provided by the chief buyer of the case company and the researcher did not affect the choice. These three hypothetical order quantities were used in requesting approximated freight rates from transport companies.

The case company has previously shipped orders from China by ocean and air. The initial plan was to utilize archived invoices in determining ocean freight and air freight rates for the deliveries and to only send RFQs for rail freight. However, the cost data of past deliveries was poorly documented and a decision to ask for new quotations for air and ocean freight as well was then made to ensure comparability and reliability.

Based on all the decisions made in the previous phases, a RFQ was constructed. The RFQs included the following information:

- Pick-up: Supplier X address
- Delivery: Company X address
- Shipment contents: Welding parts and pipe couplers
- Shipment dimensions and weights
- Incoterm: EXW

After constructing a request for quotation that included all the information deemed necessary, the RFQ was sent to one transport company as a test run. The RFQ was then edited to include the additional information the transport company asked for in their response. The RFQ was then sent by e-mail or contact form to multiple companies that offer rail, ocean and air transport. These companies were selected by choosing the viable options from search engine results. Companies that were not able to offer viable solutions for whatever reason were thus ruled out. These reasons included, for example, the service not being available in the area.

The researcher then provided further information for companies that asked for it in their response. All companies were, however, provided with the same information to make sure that the results are comparable. The offered prices for the different transport modes and shipment sizes were then put into a chart form. Not all companies were able to come forth with offers for all shipment sizes.

In addition to using RFQs as a data collection method, participant observation also comes to question in the sense that the researcher is also an employee at the case company and is thus a participant in the case that is being studied. According to Kawulich (2005), "participant observation is the process enabling researchers to learn about the activities of the people under study in the natural setting through observing and participating in those activities."

The transport companies were not informed that their offers would be used in this thesis in order to avoid distortion. This decision was made because of the risk that this information could hinder the companies' willingness to reply to the RFQ. It also improves the reliability of this thesis: the transport companies were not tempted to distort the results. However, to ensure the ethicalness of this research, the transport companies will be referred to as Company A, Company B and so forth in order to prevent identification and ensure research ethicalness.

4.4 Analysis methods

In this chapter, the data analysis methods used in this thesis will be introduced and explained. Figure 19 illustrates the fields of data analysis methods. Data analysis methods are generally divided to quantitative and qualitative analysis based on whether the methods are used in quantitative or qualitative approaches.

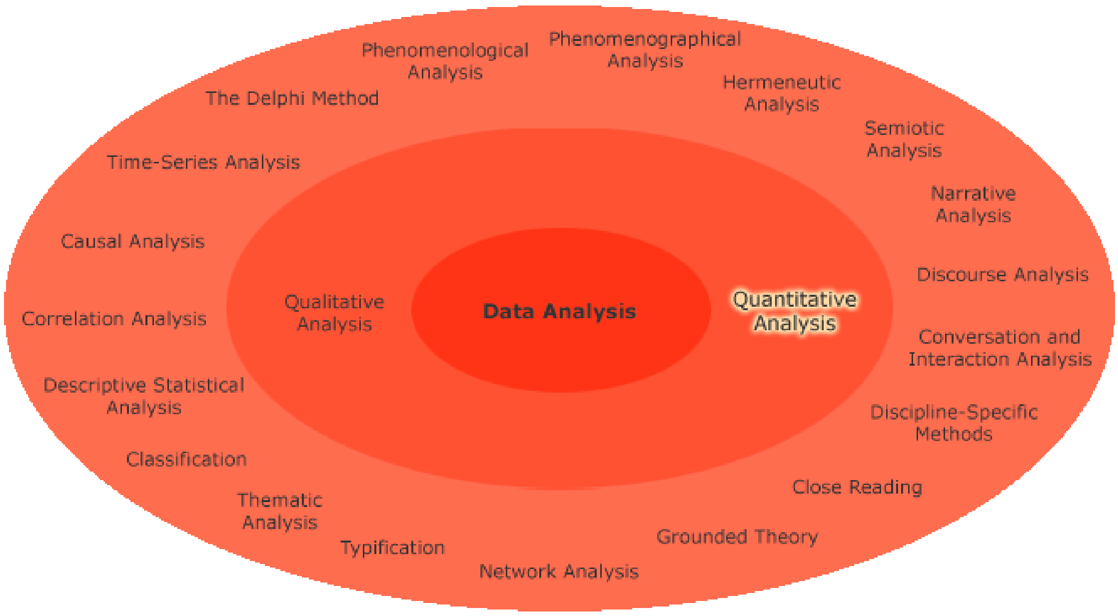

Figure 19 Analysis methods (Jyväskylän Yliopisto 2018b)

Since this thesis is a combination of qualitative and quantitative research, both quantitative and qualitative analysis methods are naturally used. On one hand, quantitative analysis focused on describing and analyzing research objects statistically with numbers. On the other hand, qualitative analysis aims to increase the overall understanding of the characteristics and meanings of the research object. Qualitative and quantitative data analysis methods form a methodological pair and the two different methods complement each other, enabling a broader understanding. (Jyväskylän Yliopisto 2018b.)

In this research, quantitative analysis methods are used when analyzing the numerical data acquired by sending the RFQs. Quantitative methods are used when qualitative data such as the information acquired via participant observation is combined with the data from the RFQs to draw conclusions.

4.5 Limitations of the research

Various criteria can be applied when evaluating qualitative research. According to Silverman (2009), validity and reliability are particularly important. On one hand, validity refers to truthfulness and measures the extent to which an account accurately represents the phenomena it refers to. Reliability, on the other hand, refers to the degree of consistency. (Silverman 2009.)

It could be said that the single case approach of this thesis hinders the validity of the thesis. However, the single case method allows for deeper understanding of individual circumstances that affect the choice of a transport mode. If there were multiple cases, time constraints would have emerged, and the context would have been blurred. Triangulation, the use of multiple data collection methods, improves validity. Multiple data collection methods were used in this thesis, which can be seen as a merit as well as the fact that this research is based on a real-life scenario, not just hypothetical context. The grounds for all decisions made are provided to the reader which improves validity.

It needs to be taken into consideration that all qualitative research is to some extent interpretation and interpretations can differ between individuals. All qualitative research thus portrays the researcher's individual interpretations to some degree. (Silverman 2009.) However, the analysis in this research is based on all gathered data and the data has not been filtered or altered by the researcher.

When evaluating the reliability of this thesis, is it needs to be considered that all the data gathered is based on approximations and furthermore, the conditions on which these approximations were based on differ from company to company and from day to day. All these variables could not be taken into consideration which is why a single case approach was chosen. The data gathered thus is not applicable to different companies or when time goes by. This means that reliable generalizations cannot be made on the basis of this research. However, this thesis can be used as a signpost for further research and as a starting point for similar companies when evaluating their transport mode options. It can also contribute to research by testing out whether the findings of existing literature are truthful and applicable at an SME.

5 ANALYSIS

In this section of this thesis the results of the research will be analyzed in depth. In the data collection phase, identical RFQs were sent to various freight companies. Offers were requested for three different quantities:

- Quantity 1: 1 standard sized box (42x34x42 centimeters), 16 kilograms. Minimum order.
- Quantity 2: 27 standard sized boxes, 420 kilograms. Average order.
- Quantity 3: 81 standard sized boxes, 1260 kilograms. Large order for the whole group.

Overall 18 RFQs were sent: 6 for ocean freight, 7 for air freight and 5 for railway freight. This, however, does not mean that RFQs were sent to 18 companies. For example, if a company offers both air and ocean freight, RFQs were sent to the company for both air and ocean freight separately. This means that if all recipients of the RFQ were able to make offers for all quantities, 54 individual prices should have been provided. However, not all companies were able to provide prices for all quantities, the reasons for which will be explained in the following chapters. Additionally, the average prices of parcel services were investigated as well.

All offers received were a little different in terms of what they included and what additional costs needed to be added to come to a total cost. Because all amounts need to be comparable for the analysis, all offers were gone through carefully. For example, one of the offers was in USD which meant that the amounts needed to be converted to euros. Some offers were all-in prices, some were broken down so that all the individual costs needed to be added to receive an approximated total price. After all offers had been gone through and made comparable, the offers were then compiled into Table 5.

In Table 5, all amounts are in euros and include all costs door-to-door apart from taxes and duties. All prices are Ex Works, meaning that the buyer carries all costs and risk. Incoterms were introduced in Chapter 2.8. Grayed out cells mean that the freight company could not or would not provide a price for said quantity. Reasons for this included:

- The quantity is too small
- The quantity is too large
- The company only offers transport for FCL (Full Container Load)
- The company representative did not feel it was advisable to choose a certain mode for a certain quantity and would not provide a price

It is noteworthy that many transport companies provide transport by multiple modes. This means that, for example, Ocean 3 may be the same company as Air 2. When looking at the table it can also be noted that there are less offers for railway transport than air and ocean transport. When looking for companies to send RFQs to, it became apparent that far fewer companies offer railway transport than air and ocean transport. Because of this, the number of offers for railway transport is slightly smaller than for the other two modes. Many more offers could have been requested for ocean and air freight, but it was decided against because it was deemed reasonable to include roughly the same amount for offers for each mode.

Table 5 Offers received (door-to-door, EXW)

		EUR Price (approx. total without taxes and duties)		
	Delivery time	Quantity 1	Quantity 2	Quantity 3
Ocean freight				
Ocean 1	7-8 weeks		632	1042
Ocean 2	7-8 weeks	901	920	1095
Ocean 3	7 weeks		852	1305
Ocean 4	8 weeks		692	1001
Ocean 5	9 weeks	611	742	1360
Ocean 6	7-8 weeks	441	713	1224
Air freight				
Air 1	1,5 weeks		2979	
Air 2	1 week	900	1925	4250
Air 3	1 week	580	2720	6770
Air 4	1-2 weeks	727	1983	4686
Air 5	1 week	507	1716	4204
Air 6	1-2 weeks		1733	4491
Air 7	1-2 weeks	749	1911	4881
Railway freight				
Rail 1	4 weeks		980	1753
Rail 2	3-4 weeks	758	785	1475
Rail 3	3-4 weeks			
Rail 4	3,5 weeks			1455
Rail 5	3-4 weeks	709	780	1450
Parcel services				
Approx. average	1 week	250		

When looking at the table it can be concluded that the least offers were provided for the smallest quantity. When going through the offers, it became apparent that many transport companies would not calculate a price for such a small quantity but recommended an express parcel service instead. The cost of the parcel was estimated to be around 250 euros, which is significantly lower than any of the offers received for the smallest quantity.

In the following chapters the offers by transport mode will be analyzed in depth. After going through individual modes, a comparison chapter will follow. In this chapter, transport costs by mode will be compared and analyzed.

5.1 Ocean

Based on the offers and e-mails from the transport companies, the estimated delivery time by ocean is anywhere from 7 to 9 weeks. Some possible reasons for the varying delivery times include the routes used, port congestion, delays in pick-up and weather conditions. Only half of the ocean transport companies were willing or able to provide a price for the smallest quantity. However, all companies provided prices for the middle and largest quantities. This suggests that standard ocean transport is not well suited for quantities as small as quantity 1.

When looking at the offers it can easily be seen that the freight rates increase when shipment size increases, but not proportionally. For example, quantity 3 (q3) is three times the size of quantity 2 (q2). However, the average costs for q3 are only 1,5 times the costs of q2. Then again, q2 is 27 times the size of quantity 1 (q1) but the average price difference between the two quantities is only 16,5 %. Figure 20 presents the ocean freight rates in relation to shipment size.

Figure 20 Ocean freight rates in relation to shipment size

Based on the information above, it can be concluded that a large part of the costs is made up of fixed costs that remain the same even though the shipment size changes. When analyzing the offers, examples of these fixed costs include:

- Terminal costs in both the origin and destination country

- Customs charges in both the origin and destination country
- Handling costs
- Release documents
- Various service and office fees

Not all of the costs are, in theory, fixed, but in reality, they are not completely varied either. For example, if terminal costs are 0,1 USD per kilogram but there is a minimum charge of 30 USD, the terminal costs are the same for shipments of 10 and 300 kilograms despite the difference in shipment weight. For this reason, many of these costs were the same for q1 and q2, which partly explains why the prices are not drastically different for the two quantities even though q2 is 27 times the size of q1.

Figure 21 presents the freight costs per unit for all three shipment sizes. It can be seen that for q1, the costs are drastically larger than for the other two quantities. The costs per unit decrease when moving from q2 to q3 but not as dramatically.

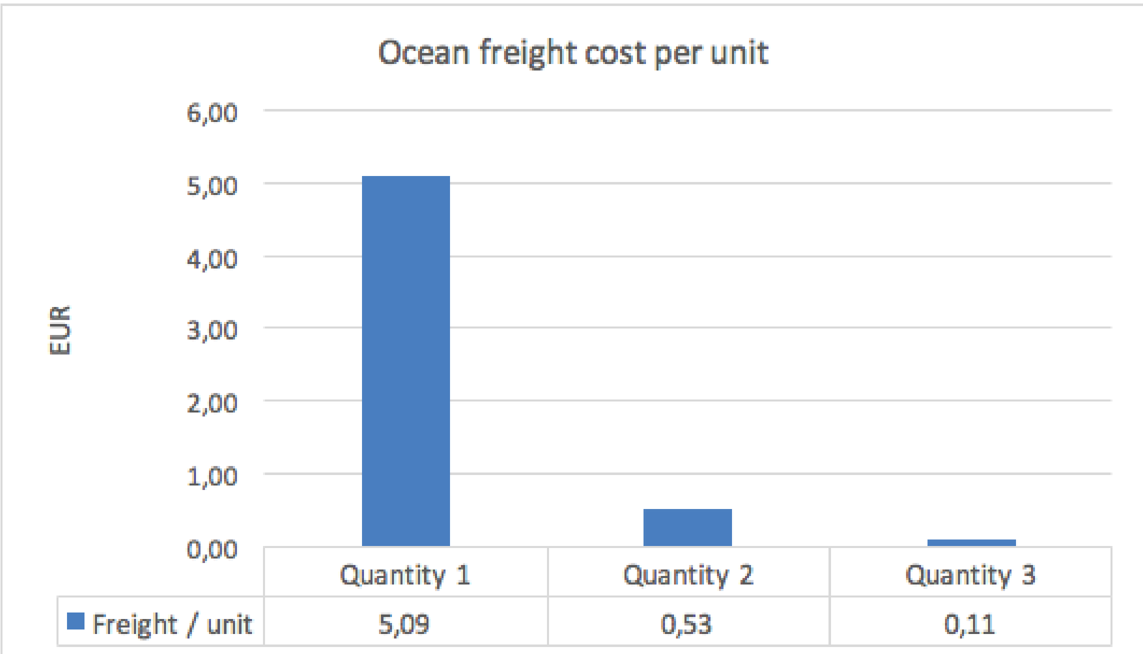

Figure 21 Ocean freight cost per unit

Based on this information it can be said that when only freight costs are considered, ordering large quantities at once is the most cost-effective solution. Very low freight costs per unit can be reached when shipping by ocean. This, too, suggests that the majority of ocean freight's costs are fixed costs that do not change when shipment size changes.

5.2 Air

Air transport from China to Finland takes approximately 1-1,5 weeks. Delivery times vary for various reasons: Airport congestion and pick-up delays mean longer delivery times. The route used naturally affects the delivery time as well, and whether passenger planes or freight planes are used makes a difference. Generally speaking, Finnair is the only airline that flies straight from China to Finland. Using any other airline thus means at least one connecting flight, which also increases the amount of cargo handling required.

Most companies were able to provide prices for all three order quantities. Only one of the air transport companies deemed q3 too large for air transport. One of the companies was only able to make an offer for the middle quantity. This suggests that air transport is best suited for rather small quantities even though larger quantities can be transported as well.

Figure 22 presents air freight rates in relation to shipment size. It can be seen right away that the price increases when the shipment size is increased. When increasing the shipment size from q1 to q2, the shipment size gets 27-fold while the price only gets 3-fold. When going from q2 to q3, the shipment size gets 3-fold and the price 2,3-fold.

Figure 22 Air freight rates in relation to shipment size

Based on this it can be said that freight rates do not increase proportionally with shipment size. This suggests that ordering a large quantity at once is the most cost-effective solution when utilizing air transport. However, these results do not provide information on whether this is true when shipment size is increased further or whether there is a point after which this principle changes. It is also noteworthy that because of limited capacity, especially on passenger planes, transporting very large quantities of freight by air may not be possible.

Figure 23 presents air freight costs per unit by shipment size. The costs per unit decrease dramatically when the order quantity is increased from q1 to q2. The costs per unit also decrease when going from q2 to q3 but not nearly as drastically.

Figure 23 Air freight cost per unit

This suggests that the freight rates are, for a large part, composed of fixed costs that do not change or change only slightly as shipment size changes. It is noteworthy that even though air freight is generally seen as expensive, rather low costs per unit can be reached when shipment size is large enough.

5.3 Railway

Railway transport from China to Finland takes 3-4 weeks including pre-carriage and on-carriage. There are various factors that affect delivery time. Some railway connections are operated on a weekly basis, some only operate every two weeks or wait until the train is full. Because of this, shipments sometimes have to wait multiple days for departure. When a train is sold out, some shipments may have to wait for the next departure. This causes delays. The route used also affects the delivery time: it is not insignificant whether the train is unloaded in Warsaw or Kouvola. However, regardless of the route, the lengths of the journeys do not vary more than a few days. Rather, it is a question of how long the on-carriage distance is. Other factors affecting transport time are, for example, handling times and delays in shipment pick-up.

Out of the five railway freight providing companies that were contacted, one was not able to offer LCL transport at all. Two of the companies were able to provide offers for all three quantities and two companies were not able to provide offers for the smallest quantity. This suggests that railway freight is best suited for medium and large quantities, not very small quantities.

Figure 24 illustrates railway freight rates in relation to shipment size. From the figure it can be seen that freight rates increase when shipment size is increased. However, the freight rates for q1 and q2 are quite similar even though q2 is 27 times larger than q1. Especially with Rail 2, the price difference between q1 and q2 is minimal. When moving from q2 to q3, the shipment size gets 3-fold, but the price only gets 1,8-fold. It can thus be concluded that freight rates increase when shipment size increases, but not proportionally.

Figure 24 Railway freight rates in relation to shipment size

The same conclusion can also be drawn from Figure 25 that illustrates freight costs per unit for all three quantities. It can be seen that freight costs per unit decrease dramatically when order quantity is increased, especially from q1 to q2. When increasing the quantity from q1 to q2, freight costs per unit are decreased by 89,7 %. This suggests that in terms of freight costs only, it would be beneficial to order largest quantities possible.

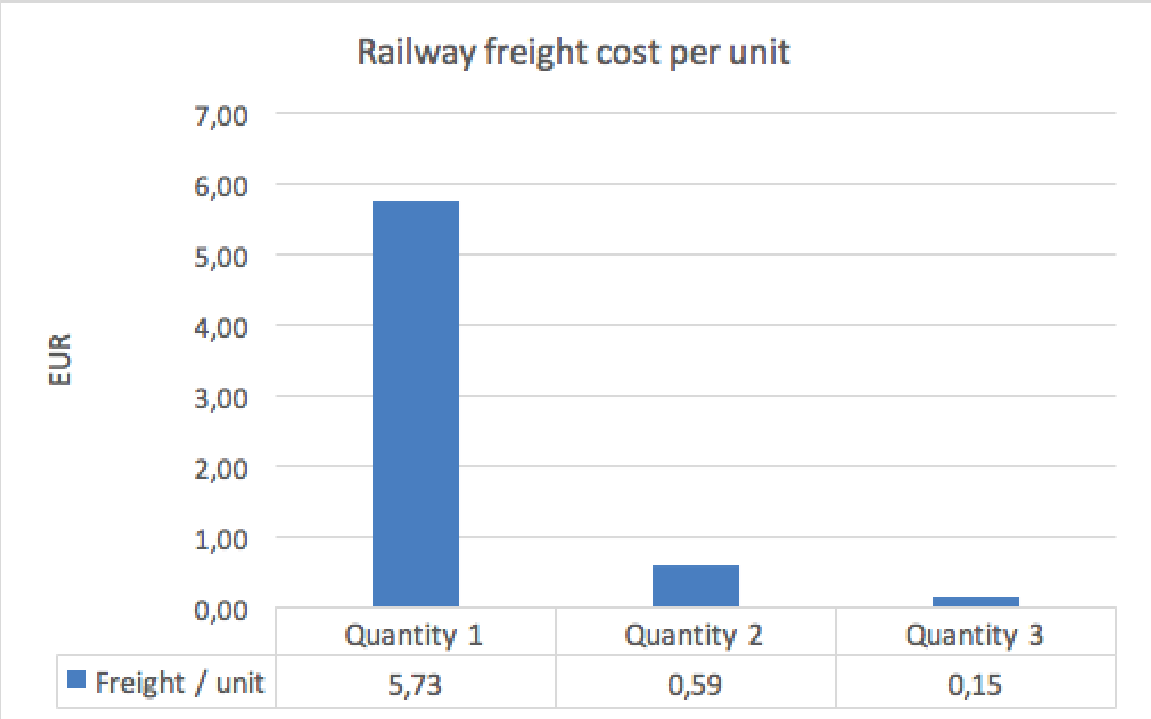

Figure 25 Railway freight cost per unit

5.4 Comparison of results by transport mode

In the previous chapters, the findings by modes of transport were analyzed. In this chapter, the costs and delivery times of modes will be compared with each other.

Figure 26 illustrates the delivery times and average costs by shipment size and mode. When looking at the delivery times, it can be seen that air transport is the fastest mode by far, which was predictable. Air transport takes roughly one third of the time that railway transport takes and roughly one sixth of the time ocean transport takes. Railway transport is roughly twice as fast as ocean transport; in other words, ocean transport takes twice as long as railway transport.

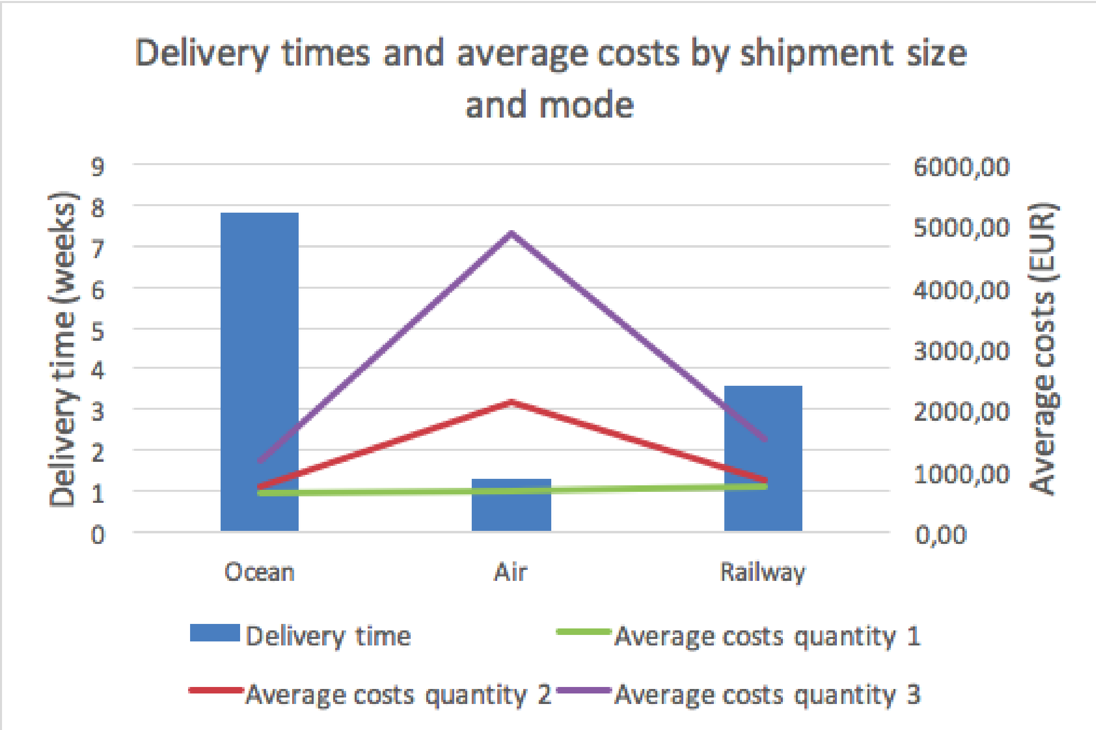

Figure 26 Delivery times and average costs by shipment size and transport mode

When looking at the average costs for different quantities in Figure 26, it can be concluded that for q1, the price is roughly the same for all three modes. Price differences start emerging when moving to q2. For q2, the prices for ocean and railway transport are very similar, but air transport is significantly more expensive. When moving to q3, the price difference between ocean and railway becomes visible. For q3, ocean transport is noticeably cheaper than railway transport.

However, looking at delivery time and freight cost separately is an unrealistic viewpoint. In order to make sound decisions about transport modes these factors, along with many more, need to be considered together. These limitations and their effects will be further discussed in Chapter 6.

Figure 27 illustrates a conclusion that has already been established in the previous chapters: with all three transport modes, the freight costs per unit decrease when shipment size is increased. This is consistent with the general rule of scale economy. However, it needs to be taken into consideration that there is a possibility that there is a point at which freight costs per unit start increasing when shipment size is increased. This could happen if, for example, the quantity was so large that multiple aircrafts were needed for transportation.

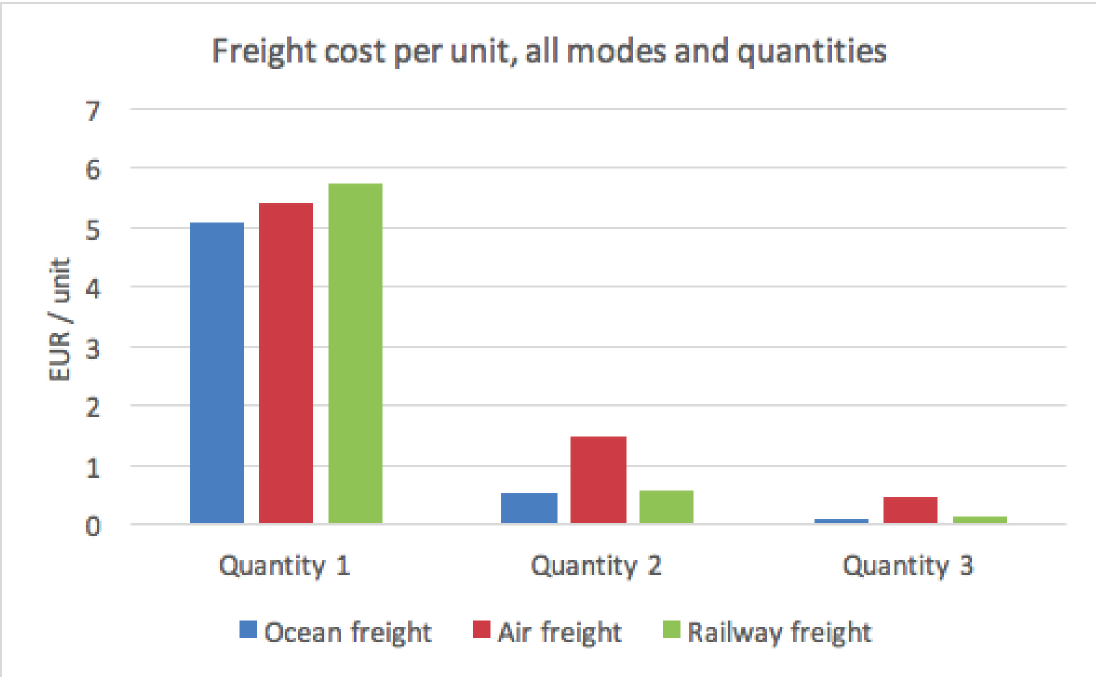

Figure 27 Freight cost per unit, all modes and quantities

It also needs to be noted that freight costs are not the only costs affecting total logistics costs. Ordering large quantities could potentially increase other logistics related costs such as warehousing costs. This could potentially undermine the cost savings gained in freight costs. This will be further discussed in Chapter 6.

6 DISCUSSION

In the previous chapter, the findings of this thesis were analyzed. In this chapter, the results will be discussed. The results of this research will be examined in the light of the theory base presented in the first chapters.

Company X has up until this point utilized air and ocean freight in transporting goods from their Chinese supplier to their own premises in Southwestern Finland. Company X is, however, frustrated with the long delivery times by ocean. Air transport has its problems as well: it is fast, but rather expensive. The goods that Company X buys from the supplier are very inexpensive and when utilizing air transport, transport costs are sometimes larger than what the value of the goods is. Company X has been pondering whether railway transportation could be a midway solution to these problems.

The literature review conducted in the first chapters of this thesis provided a basis for the research and also hinted at what the results were going to be like. However, the findings of this thesis turned out not to be fully compatible with the theory presented in the literature review. According to DSV (2018), the general rule of thumb is that transporting a container from door to door by rail is twice the price of ocean freight and a quarter the price of sending the goods by air. This general rule does not seem to fully apply to the case studied in this thesis. In this case, rail seems to be 1,13-1,31 times the price of ocean freight depending on shipment size, and 1,06-0,31 times the price of air. Thus, the rule seems to be rather accurate in terms of the air and rail price ratio, apart from q1, in which case air is actually cheaper than rail. However, the ocean and rail price difference is not as steep as the general rule suggests.

There are multiple possible reasons for this. Firstly, the rule of thumb talks about FCLs. In this case, however, no full containers are transported but LCL transport applies instead. In principle, LCL requires more handling than FCL which naturally affects the freight costs. Secondly, the general rule is not able to address seasonal variation. Third, the rule being true for some locations does not necessarily mean that it is true for other locations. Fourth, the costs vary between incoterms. The freight rates thus depend on the incoterm that has been agreed upon. Thus, it can only be said that the general rule of thumb does not seem to apply to this specific case at this specific time. It is also noteworthy that it is only a general rule, not something that can be, or is supposed to be, completely solid.

This thesis has investigated the costs and delivery times of three different transport modes when transporting goods from Northeast China to Southwest Finland. However, freight costs are not the only costs that contribute to total logistics costs. This provides some limitations to this research: the freight mode deemed the most inexpensive in this research may not be the best option in terms of total logistics costs. For example: ordering a very large quantity and transporting it by ocean is the cheapest alternative in terms of transport costs. However, keeping that large a quantity in stock may lead to high warehousing costs and actually lead to higher total logistics costs. This problem is illustrated in Figure 28.

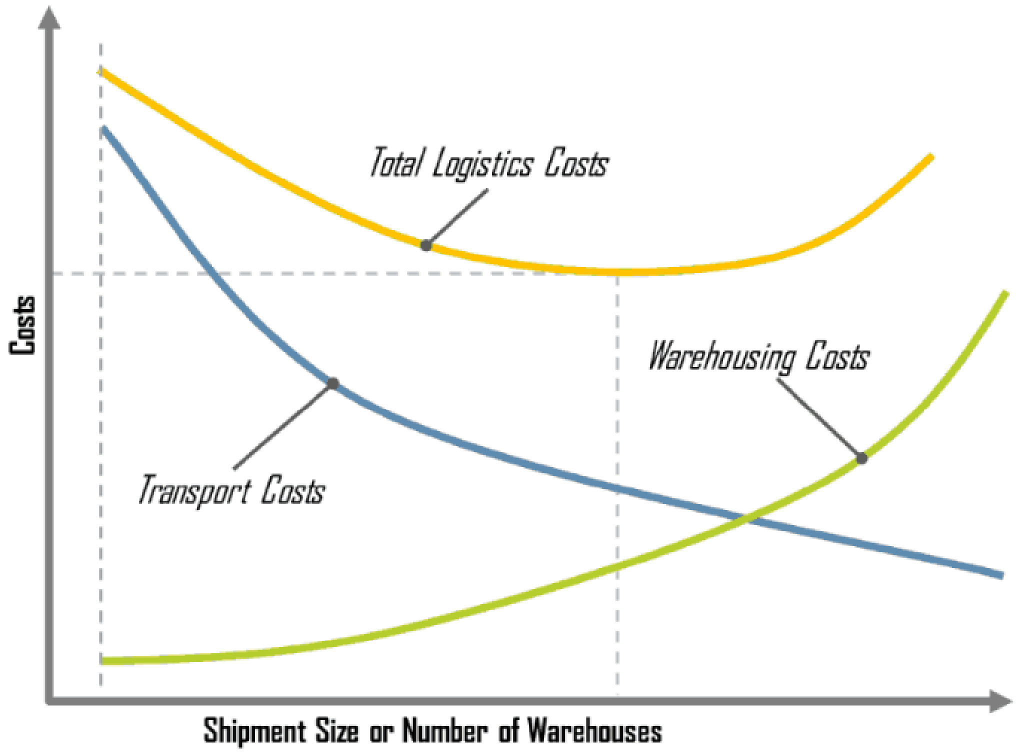

Figure 28 Total logistics costs tradeoff (Rodrigue 2017)

Furthermore, as discussed in Chapter 2.6., costs in general are not the only criteria when making transport decisions. For example, reliability, speed and quality of service may justify a higher price. This has often been the case in Company X as well: air transport has been utilized because of its speed, despite its high costs.

When talking about reliability, the problems that ocean transport and railway transport are facing need to be acknowledged. World trade is constantly growing, which means more demand for transport. Many of the world's, and China's, seaports are very congested, which may lead to delays and thus increased unreliability. There have also been reports of problems in railway transport as discussed in Chapter 3.3.2. For example, in the spring of 2018, trains from Xi'an to Kouvola had continuously been up to three weeks late. Delays of that magnitude may cause railway transport to be just as slow as ocean transport. Air transport is the most reliable transport mode.

Because of the investments made in the Eurasian railway network in the recent years, railway transport has become truly a viable option. Development of the rail transport network is going to continue in the coming years, and it is likely that railway transport will continue to grow its share and popularity. During the past few years, the rail freight transport rates have decreased, and this trend is likely to continue. As of 2018, railway transport does not seem to be drastically more expensive than ocean freight at the time this research was conducted. If the rates for rail freight keep on decreasing, the prices of rail and ocean transport may soon be very similar, though rail transport is twice as fast.

However, as discussed in Chapter 2.5., the transport sector is in constant turmoil. No one knows for certain what will happen in the coming years in the crossfire of environmental concerns, customer expectations, government regulations, natural disasters and unstable political environment. We can only make predictions, however accurate or inaccurate they may prove to be in the future. At this point in time railway transport seems to be on its way to becoming a worthy opponent for ocean transport. However, there are still many obstacles to overcome. If the railway transport sector is not able to resolve its issues regarding reliability, the promising growth could soon be hindered.

At this point in time, railway transport seems to be a viable option for Company X. However, there are some preconditions for this. Company X has continuously utilized air transport because they have urgently needed the parts from Supplier X because of not being able to forecast the consumption. This is a problem caused by poor planning that railway transport cannot solve: if the goods are needed as soon as possible, air transport is the only choice. This means that in order for railway transport to be a real choice, forecasting needs to be improved. Orders need to be placed at least 6 weeks in advance of when the parts are needed at site. The production for these products is anywhere from 1-2 weeks and the delivery time by rail approximately 3-4 weeks. This means that when in a hurry, rail transport will not do, even though it is significantly faster than ocean transport. This problem with poor forecasting could potentially be avoided by keeping a safety stock.

Another precondition is that the shipment sizes are large enough for railway transportation. Railway transport companies were not able to provide price offers for the smallest quantity of one box. In principle, it is said that railway transport is suitable for shipments of one cubic meter and up. Furthermore, transporting very small shipments by anything but an express parcel service seems to be simply unwise in terms of both cost and delivery time. First, express parcel services are in principle very fast and apart from air freight, no mode of transport can compete with them in speed. Many express parcel services even offer next-day deliveries, for an additional cost, of course. Second, no conventional freight mode can compete with the low costs of a parcel service when the order size is very small.

7 CONCLUSIONS

This thesis was conducted as an assignment for Finnish Company X that has transport needs from China to Finland. So far, the company had utilized ocean shipping and air freight, depending on the urgency of the delivery. However, ocean shipping was seen as too slow and air freight as too expensive. Since these two transport methods are at opposite ends in many ways, questions about the possibility of rail transport have been raised.

The main purpose of this thesis was to evaluate railway transport as an option for Company X while also examining whether theory works in practice when observing a real case. Even though extensive research on transport modes and transport mode decision making has been conducted, there are few researches that take a practical, hands-on approach. Most research focuses on building theoretical models that are often hard to comprehend and harder to implement. This thesis aimed to fill a gap in research by examining the costs and delivery times of different transport modes in a real-life context.

This thesis took a mixed method approach by combining qualitative and quantitative approaches. Quantitative methods were needed to analyze the numerical data collected in this research, and qualitative methods were utilized in order to gain a broad understanding of the individual context of the research object. The main sources of data in this research were **requests for quotation** (RFQs) and participant observation.

The aim of this thesis was to answer the following questions:

- In the case of Company X, what are the costs and delivery times of railway transport compared to other transport modes?
- What preconditions are there to Company X utilizing railway transport?

7.1 General conclusions

In terms of costs and delivery time, railway freight seems to be a viable option for Company X. Railway connections from China to Europe have gone through major improvements during the past years, and the costs of railway freight are nowadays very reasonable, and this trend is likely to continue. Railway freight, at this point in time, is only a little more expensive than ocean, though it is about twice as fast. This suggests that railway freight may be the preferred choice when speed as well as costs matter.

In general, air freight is significantly more expensive than railway freight. However, when the order quantity is particularly small, such as only one box, the costs of air freight are very similar to those of rail or ocean transport. The price difference becomes significant when order quantity is increased.

There are, however, some preconditions to Company X utilizing railway freight. Railway freight is not suited for very small deliveries, and neither are ocean or air transport.

When the order quantity is particularly small, it is advisable to utilize parcel services. The first precondition is thus that Company X orders enough parts at once.

The second precondition is that Company X can predict their needs multiple weeks in advance. Railway freight is not an option for deliveries that are needed at site as soon as possible. However, if the delivery is not needed within a few weeks, but the 6-8 weeks by ocean is too long, railway freight provides a middle ground solution, provided that trains run on time.

No matter the transport mode, the principle is that freight costs per unit go down when order quantity is increased. This suggests, that in terms on freight costs, grouping as many orders together and ordering large quantities at once is the best option. However, it needs to be taken into consideration that large quantities in stock mean increased warehousing costs. It is advisable to examine total logistics costs instead of transport costs only in order to achieve lowest costs possible.

7.2 Suggestions for Company X

This thesis is not able to provide indisputable solutions for Company X. It is, however, able to offer useful insights based on which some suggestions will be made. These suggestions may be helpful for other companies struggling with the same type of transport problems as well.

This thesis has provided Company X information on the costs of railway freight at one point in time. However, there is seasonality in the transport sector and prices may change on a daily basis. It is thus advisable to always check the price of the day when booking transport. At the time this research was conducted, railway freight was more expensive than ocean, but not by much. Considering railway freight only takes about half the time that ocean freight takes, railway freight seems like a strong alternative for the previously used ocean freight that has been deemed too slow by Company X.

The problem at Company X in the past has been that the company has not been able to place orders at Supplier X early enough. Company X has thus been forced to utilize air freight even though it is expensive, because no other transport mode can deliver the order fast enough. It is advisable that Company X acts to improve their demand forecasting to be able to cut down transport costs. Alternatively, Company X could consider keeping a safety stock on hand. This could cut down the need for emergency deliveries by air.

It is advisable that Company X tries to combine orders into larger orders since transport costs per unit go down when order size is increased. Since the parts that Company X orders from Supplier X are very inexpensive to begin with, large transportation costs are not justified. If, however, Company X must order very small quantities, it is advisable to utilize parcel services for these shipments. No conventional mode of transport can compete with the costs and delivery time of parcel services when the shipment size is very small, such as a box or two.

Another thing to take into consideration is the incoterm used. In this thesis, EXW was used because of clarity and comparability. Transport costs are, however, to some extent dependent on the incoterm used. If Company X can negotiate incoterms with Supplier X, transport costs may decrease significantly. FOB is commonly used when shipping from China to Europe, though it is only suitable for ocean freight.

Quantity 3 was an order that could be placed at once if Company X were to serve as a group central warehouse for Supplier X parts. Ordering a large quantity such as Quantity 3 is lucrative in terms of transport costs, no matter the transport mode. However, when considering this, it needs to be taken into consideration that there will be additional transport costs when the parts are shipped from Company X to other locations. Without knowing how much those additional transport costs would be, it is impossible to say whether this sort of arrangement would be beneficial. However, Company X already ships items to other manufacturing sites on a weekly basis. Supplier X part deliveries could be combined with these deliveries to minimize additional transport costs.

7.3 Implications for future research

Based on this research it seems that much of the literature associated with transport modes and transport mode decision making is outdated. Comparison of the costs and delivery times of different transport modes has not been a topic of interest in research in recent years, which manifested itself in the difficulty of finding recent research. Many of the most significant researches comparing transport modes have been conducted decades ago.

However, the transport sector has changed tremendously in the past few decades. Many of the assumptions that emerged during the literature review phase of this research did not seem to fit this case seamlessly. Most importantly: the information on the costs and other features of different transport modes seemed to be outdated in many sources. It is unclear whether this is case of individual context clashing with generalizations or whether the literature needs to be reviewed and updated. This could be a point of interest in future research.

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