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Identifying factors the Swedish forest industry considers important when selecting transportation mode

Master of Science Thesis
in the Supply Chain Management master´s Programme

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Cover: the picture illustrates trees which is the raw material and the basis for all forestry products.

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Gothenburg, May 2015 Adam Fredriksson and Niklas Granung

ABSTRACT

The world trade is becoming increasingly important and an enabling factor is transportation. The transportation industry is very competitive. For that reason, it is important to understand the shippers need to stay competitive.

This master thesis has been conducted for Seago Line as part of the program Supply Chain Management at Chalmers University of Technology. Seago Line is dedicated to intra-European trade and specialized in container shipping. Seago Line sees an opportunity to challenge other transportation modes and to increase their overall market share by converting transportations to container shipping. In order to accomplish this, Seago Line need to better understand what factors the shippers consider when selecting transportation mode, which is the purpose of this study. The main target for this study is Swedish exporters of forestry products such as paper, paper pulp and sawn timber, because it is where Seago Line sees great potential.

The first step of the study was to increase our knowledge and understanding of the shipping industry as well as the Swedish forest industry. Thereafter, a literature study was made to examine what factors research state as important for selecting transportation mode. Further, empirical data collection was conducted by having interviews with six companies within the Swedish forest industry. When all relevant data was collected, both theory and empirical data were analyzed. Later, three frameworks were developed in order to increase Seago Line's understanding of what the shippers consider important when choosing transportation mode. The frameworks consist of different components such as important factors, factors with future impact and influencers. The influencers are not factors by themselves but could influence factors included in the framework. The study has shown that several factors have an impact on the choice of transportation mode. There is seldom one ruling factor, instead there are many factors affecting the choice of transportation mode and those factors need to be weighed against each other. From our findings, the most important factors for all product categories are transportation cost, capacity and reliability.

Keywords: transportation choice, transportation mode, forest industry, paper, paper pulp, sawn timber, container, bulk, shipping.

GLOSSARY

Carrier	Any person or entity who, in a contract of carriage, undertakes to perform the transportation of goods by rail, road, sea, air or inland waterway.
Consignee	The person or company to whom goods are delivered to.
Deadweight tonnage	Measure of how much a vessel can carry. Is the sum of weights of cargo, fuel, fresh water, ballast water, provisions, passengers and crew.
IET	Abbreviation for "Intra-European Trade" which is all trade within Europe.
Intermodal transportation	A load carrier transported by more than one transportation mode, i.e. rail, road, ocean and air.
FEU	Abbreviation for "Forty–Foot Equivalent Units". Refers to container size standard of 40 feet.
Just In Time	An inventory strategy companies employ to increase efficiency and decrease waste by receiving goods only as goods are needed in the production process, thereby reducing inventory costs.
LOLO	Abbreviation for "Lift-On, Lift-Off". Cargo that must be lifted on and off vessels and other vehicles using handling equipment.
RORO	Abbreviation for "Roll-On-Roll-Off". Vessels that enable horizontal loading and unloading activities. The cargo are loaded on a rolling carrier such as cars, semi-trailers, trucks, cassettes, railway wagons etc., which are rolled on the vessel.
SECA	Abbreviation for "Sulphur Emission Controlled Area". From 1st January 2015, new EU environmental legislation will take effect which aims at ensuring a substantial reduction in marine Sulphur emissions in Northern Europe to the benefit of the environment.
Shipper	The person or company who is the supplier or owner of cargo shipped.
TEU	Abbreviation for "Twenty-Foot Equivalent Units". Refers to container size standard of 20 feet.

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1. INTRODUCTION

In this chapter, the background of the study, its purpose, research questions, delimitations and the structure of the report are presented.

1.1 Background

The world trade is becoming increasingly important, since 2005 the merchandize trade in the world has increased with over 80 percent. The World Trade Organization (2015) is publishing data of the world trade and from 2005, the value of the total merchandize trade has increased from about 10,5 trillion USD to about 18,9 trillion USD. As can be seen in *Figure 1.1*, the trade fell roughly 20 percent during the financial crises in 2008-2009, but since then, the trade has stabilized and increased year by year. An enabling factor to the increased trade is transportation. Transportations have enabled companies to have headquarters in one part of the world, production facilities in another, and sell its products all over the world (Jephson and Morgen, 2014).

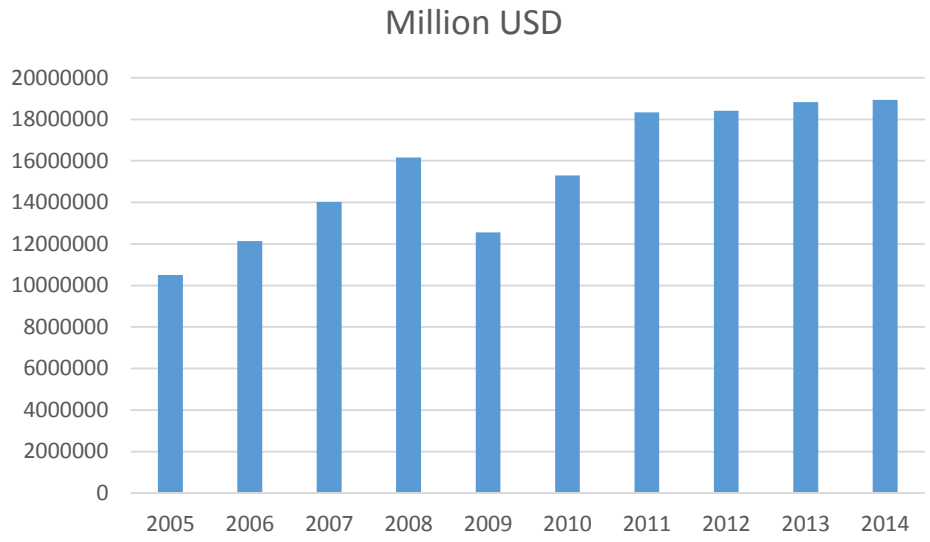

Figure 1.1 illustrates the merchandise trade in the world in millions USD during the past ten years.

The transportation industry is competitive (Badiyania et al., 2005). Seago Line is dedicated to intra-European trade (IET) and specialized in container shipping. IET is different from inter-continental trade. Not only are transit times shorter and tonnage used smaller, the competitive landscape is also different. Ocean-based transportations in this region does not only compete against each other, competition also occur with land-based transportation such as rail and truck. The shipping industry possess an overcapacity. It is a clear trend that carriers use larger vessels than required by trade volumes. Reasons are to not neglect any transportation assignments and to secure the resale value when demand for transport has increased after a few years (Lumsden, 2007). *Figure 1.2* illustrates how the capacity between different vessel types has changed over the past 10 years (UNCTAD, 2008, 2010, 2012, 2014). The data is presented in thousands of deadweight tonnage.

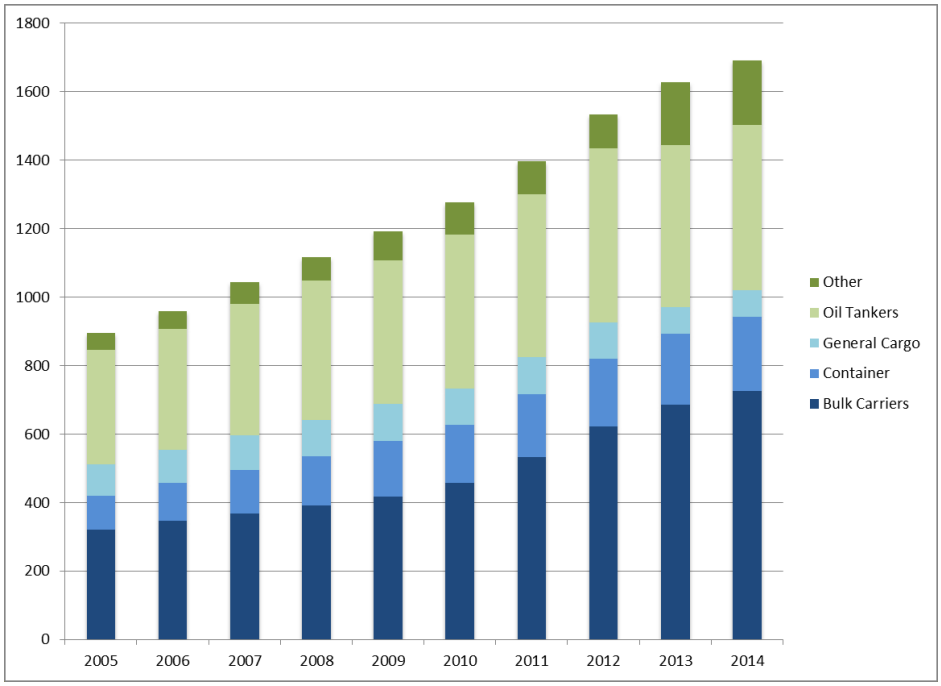

Figure 1.2 illustrate the capacity, in thousands of deadweight tonnage, development between different vessel types over the past 10 years.

In today´s global market, it is important for the shipper to reach high customer service level, cost savings and efficiency in the overall supply chain (Tuna and Silan, 2002). Consequently, it is challenging for carriers to compete if they lack understanding of what factors the shipper considers as important (Meixell and Norbis, 2008). The interest among carriers to understand this issue has increased (Tuna and Silan, 2002). Seago Line wants to improve the understanding of what the shipper considers important when selecting transportation mode. By understanding the shipper it is possible to convert transportation from one mode to another. Converting transportations from one mode to another can in many ways be more beneficial than taking market shares from a competitor. Moreover, taking market share from a competitor can result in lower margins. Literature suggests that there is an overlap between different types of vessels as can be seen in *Figure 1.3* (Lumsden, 2007). Cargo that is transported by bulk could for example be carried by a container vessel and vice versa.

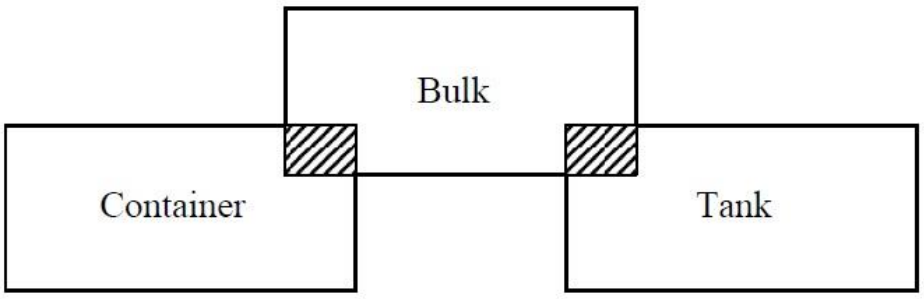

Figure 1.3 illustrating the crossover area between different types of vessels (Lumsden, 2007).

Seago Line sees an opportunity to challenge other transportation modes and increase their overall market share by exceeding the shipper's high demand on transportation through a better understanding of the shippers need. However, the nature, form, specifications and other criteria's

can make it difficult to convert some goods transported by other load carriers and modes to container shipping.

The main target for the study is the Swedish forest industry, because it is where Seago Line sees great potential. The forest industry is important because it is one of Sweden's primary industries and exported goods were valued at SEK 120 billion in 2013 (Skogsindustrierna, 2014). Typical forestry products are paper, paper pulp and sawn timber.

1.2 Purpose

The main purpose of this report is to improve Seago Line´s understanding of what factors the shippers consider important when selecting transportation mode. A framework will be developed for paper, paper pulp and sawn timber.

1.3 Research questions

To reach our purpose the following research questions are used:

1. What factors influence the shipper's choice of transportation mode?
2. Why do Swedish exporters of forestry products use different transportation modes to supply a single market?

The answer to the first question will enable Seago Line to better understand what factors the shippers consider important when selecting transportation mode. A framework will be developed to visualize the answer and help Seago Line distinguish between important factors. To enhance Seago Lines understanding further, they want to know why the forest companies use different type of transportation modes to supply a single market. This question is very specific to the Swedish forest industry and will therefore be answered in the empirical data section and later analyzed and discussed.

1.4 Delimitations

The thesis is done in collaboration with Seago Line Scandinavia in Gothenburg, Sweden. The thesis will not focus on products and raw materials that do not fit within the limitations of a container. Since, Seago Line operates within Europe and the Mediterranean Sea, see Appendix 1; the study will only focus on transportations made within this area. To limit the study, only the Swedish forest industry and products such as paper, paper pulp and sawn timber are examined. The consequences of the limitations could lead to a result which will not be applicable to other regions and industries.

1.5 Report structure

The report is divided in ten chapters. The first chapter introduces the study, a short background along with the purpose and limitations. The second chapter presents the theoretical framework. This part starts relatively wide to describe what a supply chain is, it is later narrowed down to different transportation modes and what factors previous research have found to influence the choice of transportation mode. The method is described in chapter three and are divided in two parts. The first part describes available options of what research designs are commonly used for this type of study and how reliability and validity can be ensured. The second part of the method describes our research strategy.

Chapter four and five constitute of a description of the companies included in this study along with industry background for the container industry and the Swedish forest industry. The empirical data is presented in chapter six. In chapter seven, results from the theoretical framework and the empirical data are analyzed. The next chapter contains three frameworks and an explanation of how to use them. In chapter nine, our result is discussed to evaluate how valid and reliable our findings are. The last chapter includes suggestions on further research topics.

2. THEORETICAL FRAMEWORK

In the theoretical framework, different concepts and models are explained, which are important for the study.

2.1 Supply chain

"A supply chain consist of all parties involved, directly and indirectly, in fulfilling a customer request" (Chopra and Meindl, 2013, p.13). The supply chain does not only include suppliers and manufacturers, it also includes warehouses, transporters, retailers and the customer itself. In other words, no firm can see its business as a solely autonomous- or isolated entity because every player is part of a larger network (Lambert and Cooper, 2000). As a result, competition has shifted from company versus company to supply chain versus supply chain. All firms are part of a supply chain, from raw material to end user and the integration of all key businesses processes within this chain is called supply chain management. "Supply chain management is a new way of managing the business and its relationships" (Lambert and Cooper, 2000, p.66).

A supply chain consists of a network of multiple actors and relationships. In today's competitive market, the success of a single business depends on the management's ability to integrate complex networks of relationships into the company. It is rare for a company to only participate in one supply chain and for the majority of all manufacturers, the supply chain will look more like an uprooted tree than a chain or pipeline. The tree's roots and branches represent the manufacturers, large network of customers and suppliers (Lambert and Cooper, 2000).

Stadtler and Kilger (2008) underline that the supply chain as a whole is responsible for being as competitive as possible; it should not be the objective for single actors. Total supply chain profitability is about taking a holistic approach to improve the entire supply chain profitability (Chopra and Meindl, 2012). Focusing on supply chain profitability rather than profitability for single actors in the supply chain will not only increase the profitability for all members, but also the competitiveness for the entire supply chain. The success of a single company is highly affected by the performance of other members in the supply chain. Chopra and Meindl (2012) argue that total supply chain profit will be reduced if single firms try to optimize their own profitability. Focusing on only one firm or parts of the supply chain could lead to sub-optimization and consequently unnecessary costs, extra work or waste. Therefore, the goal for every supply chain should be to maximize total supply chain profitability.

The physical flow of goods is a way to link different actors in the supply chain. The most important role of the physical flow is to ensure that supply of goods is accessible when needed (Gadde, Håkansson and Persson, 2010). In order to enable a physical flow of goods between actors in the supply chain, some kind transportation is needed, which will be described in the following section.

2.2 Transportation

Transportation can be regarded as a rather simple activity because it can be described as the movement of goods from one point to another. However, Enarsson (2006) argues that the transport business is rather complex because of relationships, dependencies and competition between and within different transportation modes. Five different types of transportation modes exist and these are categorized as road, rail, sea, pipeline and air transportation (Jonsson, 2008). Ismail (2008) states that most carriers available on the market utilize only one transportation mode. Moreover, this approach creates significant difficulties during, for example, intermodal transportations as different carriers need to be contracted. Other complexities can occur when transporting goods between countries. For example, the railway system is not standardized in Europe, both the power-systems and the gauges differ between countries. Consequently, implications can also occur between different transportation modes as some modes require specialized equipment and tools. This is explained further in section 2.2.2 and 2.2.3.

Another complexity in today's transportation is imbalances. Different imbalances occur depending on the situation, it can for example be in cases of imbalances in capacity from one region to another or due to the specialization of vessels. For example, some regions such as China, have experienced a boom in bulk import while the bulk export is low. A similar pattern can be found in container import and export where China exports lots of containers while the import of containers is low. It creates a global shortage of vessels, both to serve the import of bulk goods and to serve the export of containers. This is a reason for major shipping companies to increase their carrying capacity (Lun, Lai and Chang, 2010). Lun, Lai and Cheng (2010) continue to state that the growth of the shipping capacity for container vessels in relation to the growth of the shipping industry is about 1:10 compared to 1:20 for the bulk shipping, which indicates that there is a higher capacity requirement for container shipping. However, the reason is due to complex shipping operations. For instance, higher space requirement can be a result of the need for shipping empty containers from one area to another to manage the imbalance of trade between regions.

2.2.1 Sea transport

Shipping is together with ox-cart and horse one of the oldest modes of transport and it has been the basis for movement of goods for a long time (Enarsson, 2006). Enarsson (2006) describes that shipping can be categorized in five different segments; inland waterways, coastal shipping, ferries, feeder-services and world-wide shipping. Compared to land transportation, shipping differs a lot due to its international character. More than 80% of all trans-regional cargo is carried by sea transportation and in the foreseeable future; shipping will continue its important role in international trade (Ng, 2012). Shipping is an important part of the global transportation system because it is the only practical mode for transportation over long distances and between continents (Enarsson, 2006). Air transportation is of course a mode for long distance transportation but its market share is small.

Shipping is fundamental for the ongoing globalization and especially liner shipping has generated substantial economic benefits for globalization and enabled regional specialization. Developments through the years have led to a situation where there are various types of vessels that are constructed to carry different kind of goods (Enarsson, 2006). Different types of vessels could be divided into Container, RORO, Ferries and RoPax, Bulk, Tankers, Barges and General cargo vessels (Styhre, 2013). Since load-carriers as container and bulk were of highest importance for this study, these are described in more detail further on in this chapter.

According to Jonsson (2008), sea transport is the slowest mode of transport. However, it has a great flexibility because it is always possible to change transport route if an obstacle occurs and there is almost no need for infrastructure. Sea transportation has great loading capacity, which makes it the transportation mode with the lowest operating cost per ton-kilometer. However, it has a high tied up capital due to its great load capacity and the slow moving mode makes the delivery service quite low.

The shipping industry puts high demands on loading and unloading activities (Enarsson, 2006). Ports and terminals need to invest a lot of money in equipment in order to handle the goods. The need for certain equipment in ports and terminals has also led to specialization. Some terminals are specialized to handle container or bulk vessels to reach high efficiency in loading and unloading activities.

2.2.2 Container transportation

Container transportation has been developed after the Second World War and the container has several advantages compared to the conventional bulk such as less packaging, less damage and higher productivity (Hsu, 2013). The use of containers has increased rapidly in recent years (Bertazzi, Speranza and Nunen, 2009). Since the 1980s, the annual growth has been around 8% and the growth can be explained by increased international trade, outsourcing and the global

economic development (Ng, 2012). Moreover, the increased usage of containers can also be explained by the possibility to fit a large variety of products within the container (Lumsden, 2007).

The container construction is an ISO standard and can only be called a container if it fulfills the following criteria (Lumsden, 2007):

- It is a transportation unit with a durable construction and it can handle repetitive usage.
- It should facilitate fast, efficient handling and the ability to use different means of transportation without the requirement of reloading the goods. It should also be designed to make it easy to load and unload the goods within the unit.
- Has a volume of at least one cubic meter.

Containers exist in different sizes where the most common ones are twenty foot equivalent unit (TEU) and forty foot equivalent unit (FEU). A TEU and a FEU is about 6,1 and 12,2 meters long respectively. The width and height is about 2,4 meter. A trend today is to increase the height as it does not require as much standardization as the width and the length. However, longer containers up to 45, 49 and 53 feet have emerged lately to increase the transportation capacity even further (Lumsden, 2007). The maximum payload for a TEU and a FEU is roughly the same, about 30 tons. The container is made from different kinds of metals, but most commonly steel. The empty weight for a steel container is about 2 and 4 tons for the TEU- and FEU container (Maersk, nd). To make the handling of the containers easy, the containers are possible to lift from both the upper and lower corners. The container could also be locked to the transportation vehicle in the lower corners using unified grippers. For the longer containers (45, 49 and 53) the same gripper location as the FEU is used to fit established transportation systems (Lumsden, 2007).

Jonsson (2008) states that containers are most commonly used for medium-value goods. Lumsden (2007) gives some examples of different container types that exist to handle a large variety of goods; dry storage container, air containers, refrigerated container and containers with a built-in tank to handle fluids. The popularity of the container could be explained by the efficiency at loading and unloading operations as well as their protection of the goods (Lumsden, 2007). The container is sealed from the sender to the customer and is only opened for eventual inspections. It allows the goods inside to be protected from theft and other damages that can occur during transportation (Delaney, 2014). The standardized construction of the container enables easy handling and availability of equipment at the terminals. Time consuming activities like changing gripping appliance and other equipment can be avoided (Lumsden, 2007). The container has also enabled the possibility to easily combine different modes of transport (Jonsson, 2008). Other advantages mentioned by Jonsson (2008) are the ability to stack containers on top of each other as well as close to each other. The different modes of transport where containers are used are trucks, trains, airplanes and different types of vessels such as container, RORO and general cargo (Lumsden, 2007).

Sea ports and container terminals

Sea ports are the connection between ocean-based transportation and land-based transportation (Lumsden, 2007). At the sea port, it exist different kinds of terminals that can handle different types of cargo. The recent increase in global trade has made sea ports and especially container terminals increasingly important (Kim and Günter, 2007). Lumsden (2007) mentions that the containerized trade has changed the design of the sea ports. Parts of the storage area have moved away from the terminal itself. As can be seen in *Figure 2.1*, the function of the terminal is to consolidate shipments, after which transportation is performed in larger units between the terminals and then the goods are unloaded and spread out to the different receivers (Lumsden, 2007).

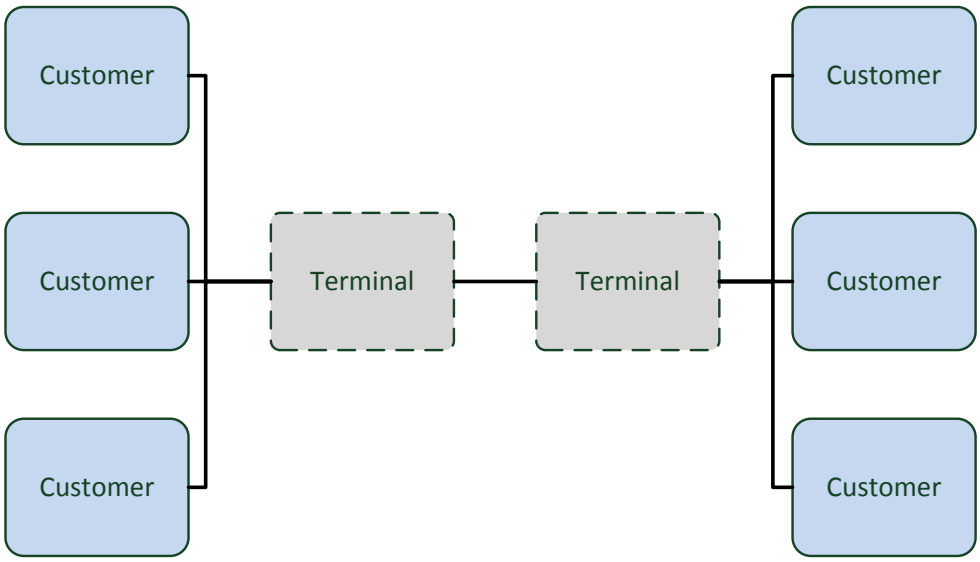

Figure 2.1 shows the function of terminals (Lumsden, 2007).

The newer, larger, container vessels have put an higher demand on sea ports and this have forced the flow of containers to focused areas since all ports do not have the ability and the equipment to handle the larger vessels (Ng, 2012). Instead, it has become more common with larger ports that are connected with smaller ports with the help of feeder activities. Kim and Günter (2007) state that the container terminal differs depending on what type of transportation and handling equipment that areused. The equipment that is required to load and unload the vessels is called quay cranes. Most container vessels are so called LOLO-vessels, which makes it relatively easy to load and unload the vessels with a gantry crane. Some ports do not have equipment to perform these activities and in these cases, a gantry crane can be placed on the vessels to perform loading and unloading activities (Lumsden, 2007). The following equipment, also called yard cranes, is used to handle the containers within the terminal area: rail-mounted gantry-, rubber-tired gantry-, straddle carrier-, reach stacker-, and chassis crane (Kim and Günter, 2007). Moreover, the different yard cranes are used depending on the size of the port. Kim and Günter (2007) further state that the rail-mounted gantry is a crane with the highest capacity and it is most suitable for fully automated container handling.

Container Vessels

The container has changed the nature and the structure of the whole shipping industry and it has enabled an increased customer-oriented focus to fit individual demands, increased flexibility and improved quality. Today, goods are supposed to be delivered within a short and appropriate period of time or so called Just In Time (Ng, 2012). Container vessels have great capacity utilization, as the containers can be stacked on top of each other as well as close to each other (Jonsson, 2008). Container vessels are usually designed as vertically-operating vessels, LOLO vessels, where cranes can easily lift of the containers located on the vessel's deck, (Lumsen, 2007) see *Figure 2.2*.

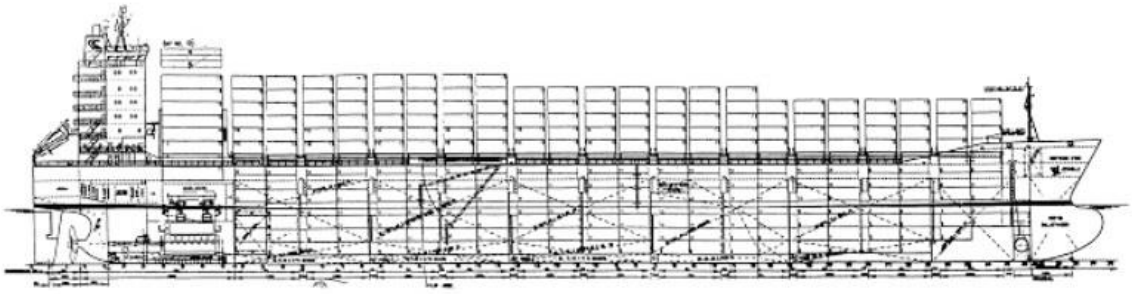

Figure 2.2 illustrates a typical design of a container vessel (Lumsden, 2007).

Vessels are designed to be optimized to carry containers and a recent trend has been to construct larger and larger container vessels (Lumsden, 2007). There has been a concern about the continuous growth in vessel size, some argue it is not sustainable. An argument is physical limitation at the port (Ng, 2012). The capacity of a container vessel is communicated in number of TEU´s. The average capacity of the vessels has increased dramatically in recent years. Twenty years ago, the average container-carrying capacity was about 4000 TEU´s among the 20 largest vessels (Ng, 2012). In 2014, Maersk line ordered 20 new models of their triple-E container vessel with a capacity of 18 000 TEU´s which shows the rapid growth (Maersk, 2014).

Roll-on-Roll-off

Horizontal transfer such as RORO is a very efficient way to transfer goods between different means of transportation. These vessels can transfer a large variety of goods that have been loaded on a rolling carrier such as cars, semi-trailers, trucks, cassettes and railway wagons. However, this technology leads to a lot of unutilized space onboard the vessel as the space between the decks cannot be completely utilized. Loading and unloading activities of this type of vessel can be in the stern or with side ports to connect the vessel with the quay (Lumsden, 2007).

General Cargo vessel

A large number of different kinds of vessels can be grouped into the category. It can be divided into vertically operating vessel such as LOLO-vessels and horizontally operating vessels such as RORO-vessels. LOLO-vessel means the goods are lifted on board the vessel and RORO-vessel means the goods are handled by trucks, wagons or some other type of rolling equipment. General Cargo vessels could be designed for pallets, containers or a combination of different load carriers (Lumsden, 2007).

Road

Road transport is a common way to transport goods both over short and long distances. It is the only transportation mode that can access all suppliers and customers on the same continent. It is possible to easily tailor transportations route depending on the individual consignment. Truck transportation is usually competing with air transportation for low volume and high value products and with rail for large volume and low value products (Jonsson, 2008). Trucks can handle different sizes of containers, which easily can be transshipped to different transportation modes such as sea- and rail transportation (Lumsden, 2007).

Rail

Railway transportation is a good alternative for transporting large quantities of high-volume and low value goods over medium and long distances. The rail wagons can carry a number of different load units and one of them is containers. The rail network is not as developed as the road network, which results in some flexibility issues compared to road transportation. Another downside with rail transportation in Europe is the lack of a uniform standard for electric power system, rail gauge and signaling system (Jonsson, 2008).

2.2.3 Bulk transportation

Bulk vessel can be classified as either dry- or liquid bulk (Lun, Lai and Cheng, 2010). Dry bulk cargos are usually mass goods of different kinds and some examples are: cement, grain, coal and ore (Lumsten, 2007). Liquid bulk is usually gas and liquids cargo (Lun, Lai and Cheng, 2010). The overall global economic development has influenced the supply and demand trend in the dry bulk cargo market (Schott and Lodewijks, 2007). The growth rate of dry bulk cargo transportation has been on average 4.5 % per year (Lumsden, 2007). Lun, Lai and Cheng (2010) state that bulk shipping transport is a practicable and cost-effective way of transporting large volumes of goods. In addition, the bulk vessels usually operate without a fixed route and schedule. Bulk goods have usually certain characteristics and some are its size, weight, moisture content, temperature etc. (Ray, 2008). It enables large batches to be transported long distances, which later can be divided in smaller batches from the terminal to the customer (Daganzo, 2005). Break bulk is described by Delaney (2014) as less-than-container-load and it allows smaller and low-volume exports. When using this method it is important to take extra care in the packaging. Common unit loads used to transport break bulk are: pallets, slipsheets and crates (Delaney, 2014). A large part of parcels transported by bulk does not require any packaging. However, bulk goods can also be transformed into unit loads using pallet collars, to ease the handling; in these cases it usually requires additional packaging materials like plastic foil or similar (Lumsden, 2007).

Terminals

The bulk terminals play an important role in connecting multimodal activities between transportations made inland and at sea (Yao and Hu, 2012). The increased amount of transportations made by bulk has increased the demand for handling capacity of bulk terminals (Schott and Lodewijks, 2007). Different equipment is needed depending on the characteristics of the goods and since a standardized package is not yet available for bulk cargo, it will require more equipment and handling than a container. Furthermore, Schott and Lodewijks (2007) mention some equipment that is used in the loading and unloading process of dry bulk cargos at the terminals and these are gantry cranes, mobile cranes and floating cranes. Grab unloader can be used together with the cranes and dry bulk cargo can be loaded and unloaded from the vessels. In addition, some other equipment that is used at the terminal to handle goods are: grab cranes, continuous vessel loaders, tipplers, belt conveyors, stackers, reclaimers, stacker-reclaimers and vessel loaders.

Bulk vessels

The size of the bulk vessel varies between 1 000 tons to about 300 000 tons, however the size of the vessels are continuously increasing (Lumsden, 2007). Lumsden (2007) classifies bulk vessels as either pure bulk vessel or a combination of different vessel types where the pure bulk vessel is designed to fit a certain type of cargo while a combination can handle for example both dry- and liquid bulk cargo, see *Figure 2.3*. Bulk transportation is commonly used for large volumes of goods, for example when the parcels are big enough to fill a whole vessel (Lun, Lai and Chang, 2010).

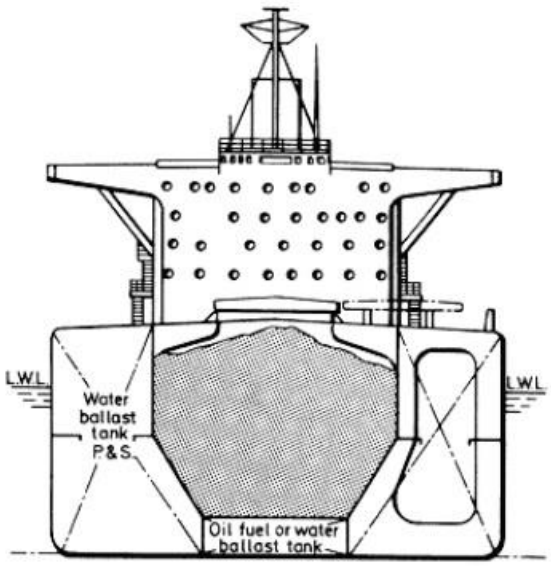

Figure 2.3 illustrate a combination bulk vessel that have separate room for ore and oil cargo (Lumsden, 2007).

Jonsson (2008) denotes that bulk vessels are used for low-value goods. Lumsden (2007) state that ungainly cargo and bulk cargo and especially forest products can be handled by flexible modern liners. However, specialized vessels that are designed for these products have been developed recently and the flexibility is given up for rationalization possibilities.

Rail

Rail transportation can handle different kinds of wagons that are specialized for the different types of goods. Examples are wagons specialized for palletized consignments, timber and other bulk transportation etc. (Jonsson, 2008). More information about rail transportation can be found in section 2.2.2.

Road

Almost any type of goods can be transported by road. Transportations by truck can easily be tailored for individual need, which is a strong reason why it is such a commonly used transportation mode (Jonsson, 2008). The trailer can be adapted depending on the goods transported. Bulk goods can for example fit within a semi-trailer or specialized trailers used for timber etc. More information about road transportation can be found in section 2.2.2.

2.2.4 Why do firms run their own fleet

Jeffs and Hills (1990) describe why firms run their own-account fleets and there are six main reasons for this. It enables the company to have total control over the transport service and provide flexibility. A company can also secure customer service and achieve cost advantages. However, running own fleets are rarely cheaper than buying transport services. Furthermore, Jeffs and Hills (1990) explains that local deliveries and convenience are other factors that influence why firms run their own fleet.

2.3 What factors influence the choice of transportation

The decision process for selecting transportation mode is a critical component of a firm's logistical strategy (Liberatore and Millier, 1995). Companies have to evaluate multiple attributes when taking the decision. Sometimes, a single mode could stand out alone as the best choice, but in many cases companies need to weight different factors against each other. The importance of individual factors can vary from company to company and between industries (McGinnis, 1989). For carriers, it is important to have an extensive understanding for existing and potential

customer's needs. If a carrier can satisfy the shipper, it is possible to attract freight traffic that otherwise would go to competitors (McGinnis, 1989). Moreover, Murphy and Hall (1995) explain that the relative importance of different factors for selecting transportation mode has shifted during the years and will continue to do.

Literature shows that different factors influence the decision of selecting transportation mode. In order to make it easier for the reader, factors are categorized in five different categories; costs, logistical aspects, product characteristics, cargo care and service and administration. A summarized model of different factors can be found in Appendix 2.

2.3.1 Costs

Cost is seen as an important aspect when selecting mode of transport as the transportation cost averages about 20 % of the total production cost for a manufacturing company (Meixwell and Norbis, 2008). Many articles mention transportation cost or freight rate as important factors to consider when selecting transportation mode (Evers and Johnson, 2000; McGinnis, 1990; Cullinane and Toy, 2000). For example, Reimann (1989) discusses that cost can be an instrument to achieve competitive advantage. Cullininane and Toy (2000) have made a content analysis of modal choice literature and a list of attributes that influence the freight modal choice. It was found that cost was the most important factor when selecting the transportation mode. Cost appeared in 98,7% of the articles. In Loetveit Pedersen and Gray´s (1998) article, transportation cost was concluded to the most important factor when selecting transportation mode for the Norwegian market. A reason for the cost sensitivity in Norway could be the high proportion of exports of commodities. Commodities are more likely to be sensitive to transport cost than other products (Loeteit Pedersen and Gray, 1998).

According to Liberatore and Millier (1995), cost can as a category, be divided in five major cost factors. The cost factors are common in many shipping scenarios and relevant in the case where finished goods or materials are shipped from one company location to another. The cost associated to transport the goods from A to B is in this case the freight cost. The first four cost factors are annual costs that will reappear as long as inventory exists in the transport chain. The fifth cost factor is a one-time cost because it is needed to initiate the transport chain. The cost factor two to five could be seen as cost of capital, because it represents the cost of having goods with value in inventory. Liberatore and Millier (1995, p.88) divide cost factors in the following way:

1. "Freight costs
2. The inventory carrying costs of inventory in the pipeline
3. The inventory carrying costs of cycle stock at the receiving location
4. The inventory carrying costs of required safety stock at the receiving location
5. The investment cost required to produce the inventory to fill the pipeline"

McGinnis (1989) have a similar approach as Liberatore and Millier. McGinnis (1989) discusses a model called Inventory-Theoretic model which is a cost function that is used to support the choice of transportation mode. This model is used to find the optimum transportation mode depending on cost. The cost factor, direct shipping cost, have previously been referred to as transportation cost or freight cost. The carrying costs and safety stock were previously explained by Liberatore and Millier (1995). This model also adds another cost which is the ordering cost. The model could be seen in the equation below:

$$Cost = direct\ shipping\ cost + carrying\ cost + ordering\ cost + recipient´s\ inventory\ carrying\ cost + safety\ stock$$

2.3.2 Logistical aspects

The choice of transportation mode will affect the effectiveness of the entire logistics function of a company. Selecting the right transportation mode and carrier is therefore an important business

decision (Loetveit Pedersen and Gray, 1998). Consequently it is important to evaluate how efficient or responsive the transportation function should be when selecting transportation mode. For example, Cullinane and Toy (2000) conclude that speed is the second most covered and dominant term in their literature review of modal choice. 94.7 % of the articles include speed as a relevant factor to consider. A reason why speed is important to study is because it will result in different inventory requirements in the supply chain (Kiesmüller, De Kok and Fransoo, 2005). Moreover, Kasilingam (1998) discusses that physical inventory such as in-transit inventory, inventories at source plant and inventories at consumption center also determine the choice of transportation mode. There should be a balance between speed and inventory, as faster transportation mode regularly cost more and slower transport requires more inventories. More inventories also cost money as explained earlier in section 2.3.1. Furthermore, it is also important to consider the value of the goods when selecting choice of transportation mode. Kiesmüller, De Kok and Fransoo (2005) further elaborate that the cost savings for selecting a slow, and cheaper, transportation mode for high value goods are low. However, the use of slow mode for low value goods can be economically beneficial. Especially since cost savings in inventory management are low and could not be out-weighted by costlier and faster transportation modes.

Lead time is a primary criterion to consider in the transportation mode selection process (Meixwell and Norbis, 2008; Jeff and Hills, 1990; Tuna and Silan, 2002). The international growth and global transportation systems have enabled sourcing from one country and consumption in another. This has increased transportation costs and made lead times longer (Meixwell and Norbis, 2008). It has also put an increased demand on adequate transportation, storage, getting items trough customer, delivering to foreign locations in a timely fashion at an acceptable cost.

Just in time is a popular tool that has a tendency to decrease the stock levels and require more frequent deliveries. However, it puts higher demand on the geographical location of the shipper and the receiver. Moreover, both Kasilingam (1998) and Cullinane and Toy (2000) mention that the distance between the shipper and the receiver and the frequency in transportations affect the choice of transportation mode. Some modes can be rolled out since certain transportation modes might not be feasible to use (Jeff and Hills, 1990; Bookbinder, 2013). For example, it is not yet possible to transport goods from Europe to America using road and rail transportation.

Cullinane and Toy (2000) mention transit time reliability, in their literature review, as the third most important factor that influences the choice of transportation mode and it is mentioned in 85,3 % of the articles in their literature review. In a study by McGinnis´s (1989) it is explained that reliability is the most important factor when selecting the transportation mode. Reliability was mentioned in all of the articles included in the literature review and it was declared to be more important than cost in ten out of eleven articles. Further, reliability is generally more important than speed of the transportation mode. Tuna and Silan (2002) also conclude that delivery reliability is an important factor to consider. Delivery reliability can be defined as the ability to deliver cargo exactly when promised (Lumsden, 2007). The importance of high delivery reliability has increased in recent years. High reliability can in many cases be more important than short lead times (Lumsden, 2007; Tuna and Silan, 2002). Jeff and Hills (1990) have a similar conclusion, but stress the importance of having control over dispatch as a crucial parameter. Control over dispatch is often the overriding criterion for selecting a certain transportation mode. Saldanha et al. (2009) concludes that shippers who select ocean carriers solely on cost and convenience are missing important opportunities to cut logistical cost if delivery reliability is not prioritized.

Capacity can be described as a form of flexibility as it enables the ability to accommodate variations in demand from customers (Meixwell and Norbis 2008). Lumsden (2007) mentions that all types of transportation modes have a limited capacity; it can be a specific amount of unit loads, volume or weight etc. Even terminals have a capacity limit, which can be related to for

example space or availability of equipment. Both Kasilingam (1998) and Liberatore and Millier (1995) mention capacity of the transportation mode as a factor of importance. Cullinane and Toy (2000) also mention capacity as a factor that influences the choice of transportation mode, however it is not a dominant theme in any of the articles reviewed in their study. A shortage of capacity can lead to challenges for shippers as described by Meixwell and Norbis (2008).

Flexibility is mentioned as a factor that should be studied when selecting transportation mode (Cullinane and Toy, 2000). Lumsden (2007) states that there is an increase demand for being able to adjust delivery services to the customers demand. Furthermore, flexibility is an important issue when it comes to competition. Matear and Grey (1993) mention that flexibility can be the ability to handle special requirements. However, flexibility is described as a rather vague term and it can be divided in several parts (Naim, Potter and Mason, 2006). Naim, Potter and Mason (2006) divide flexibility as either internal or external. Some aspects associated with internal flexibility are:

- The ability to accommodate different routes
- The ability to manage variations in capacity requirements or traffic demand
- The ability to adapt the transportation mode to manage different types of products

Moreover, external flexibility are divided according to:

- The range of and the ability to accommodate changes in transportation demand
- The range of and ability to change delivery dates

Meixell and Norbis (2008) have found that market changes and regulations influence the choice of transportation. Recent trends of a growing environmental concern among consumers have affected companies to strive to be greener in the eye of the consumers (Meixwell and Norbis, 2008). Rahman et al. (2013) discuss that both the environmental impact and the cost associated with transportations are important. Banister et al. (2011) states that modern transportation is dependent on oil and transportation itself stands for about 60 % of the total oil consumption. The result of transportation is emission of greenhouse gasses, such as carbon dioxide that affect the climate. Rahman et al. (2013) mentions that carbon dioxide stood for 57 % of the emitted greenhouse gasses globally in 2010. The current challenges for both the environment and the energy usage are not well covered in the transportation choice literature (Meixwell and Norbis, 2008). None of the 48 articles included in their research addressed environment or energy as a factor affecting the choice of transportation mode. However, Meixell and Norbis (2008) have identified the increased concern for both energy and the environment as an aspect affecting the shipper´s choice of transportation mode. The study by Rahman et al. (2013) argue that it exist a trade-off between the cost of the transportation and the environmental impact when choosing transportation mode.

Other aspects that affect the transportation choice and have been covered in the literature are both availability of infrastructure and equipment. Availability of infrastructure is covered by about half the articles in the research by Cullinane and Toy (2000) and some of them mentioned it as a dominant factor that affects the choice of transportation mode. Tuna and Silan (2002) concluded that the availability of handling equipment, and special equipment, can affect the choice of transportation mode. It can be apparent when transshipment will take place at a terminal if certain equipment is not available, special equipment can for example be a special container lifter (Lumsden, 2007).

2.3.3 Product characteristics

Previous research have showed that an important factor to consider when selecting transportation mode is characteristics of the goods. Cullinane and Toy (2000) state that characteristics of the goods are mentioned in 76,0 % of all litterateur covered in their study. It is seen as an essential factor that should influence the decision of transportation. Product characteristics could,

according to Jeffs and Hills (1990), be explained as value, volume to weight quotient, product type, handling requirements and perishability.

Lumsden (2007) describes that value of the goods determines what transportation mode to select. Low value goods are often transported by slow transportation modes, like ocean-based transportation, to keep transportation costs as low as possible. High- value goods usually mean that it is preferable to allow higher transportation costs to decrease total transportation time (Lumsden, 2007). For airfreight, the average goods value is noticeably higher than the relative figure for sea transportation. Another factor that could be of importance for choosing transportation mode is volume or sales per time period. Cullinane and Toy (2000) explain that sales per year are mentioned in 16,0 % of all previous research but it is not seen as a dominant factor. As stated in section 2.2.3, large volumes of goods can influence the decision of transportation because bulk transport can be seen as very sufficient if volumes are large enough to fill a whole vessel.

Jeffs and Hills (1990) state size of the goods as a factor that affects transportation mode selection. How efficient cargo can be transported is influenced by the size of the goods, in volume or weight (Lumsden, 2007). Different transportation modes and load carriers have restrictions and certain parameters that could determine whether a transport solution is suitable for a consignment or not. For example, the weight or size of a consignment could make it inadequate to be transported in a container. Moreover, handling requirements are important for selecting transportation mode (Kasilingam, 1998). The choice of material handling equipment will depend on the characteristic of the product. Sometimes characteristics are very unique and demand special equipment. Characteristics as such can be perishability, some perishable goods need special care and some require unique handling requirements. For example, a hospital who is going to transport a donated organ from one location to another may need to charter a whole airplane to secure a quick and dependable shipment (McGinnis, 1989).

2.3.4 Cargo care

When selecting transportation mode, research has showed that cargo care is a factor of importance. Several articles explain that the ability to provide a service that do not damage goods while in-transit influence the decision (Cascetta, 2009; Liberatore and Miller, 1995; Cullinane and Toy, 2000; Tuna and Silan, 2002). As much as 13 % of all goods that reach the shelf are damaged during supply chain activities, which could be reduced by a better understanding of activities involved (Mason, Bateman and Wood, 2004). According to Cullinane and Toy (2000), loss is also seen as a relevant factor. Loss and damage of goods are represented in 64,0 % of the studied literature, but it had no dominant theme. However, Tuna and Silan (2002) found that delivering the cargo without damage was of highest importance in their research about the shipper's selection criteria. In a survey made by Matear and Gray (1993), similar conclusions were drawn, avoidance of loss and damage were ranked high by the shippers.

Tuna and Silan (2002) mention that providing clean and undamaged equipment is vital for the selection of transportation mode. Security of goods during transportation (Kasilingam 1998; Jeff and Hills 1990) and possibility of theft (Cascetta, 2009) are other factors that are covered in the literature. Ekwall and Lantz (2013) describe that cargo theft represents a significant problem worldwide. To improve security of transportation, an efficient information system, such as a tracking and tracing systems, could be implemented to report divergence and reduce loss (Lumsden, 2007). Furthermore, Kasilingam (1998) explains that the ability to provide safety for goods also determines what transportation mode to select. One way to protect, store and handle goods during transport is by using product packaging. By always using a unit loads such as a container, a company can cut costs, increase productivity and reduce accidents and damage (Kasilingam, 1998).

2.3.5 Service and administration

In today's global economy the competition is high and it is no longer an added benefit to provide great customer service; it is a requirement. If the customers are not satisfied with how they are treated, they can easily take their business elsewhere (Evenson, 2005). Lumsden (2007) mentions, the level of customer service in logistics is usually defined using the following terms: delivery service, information exchange and logistics services that add value to the products or service in the different stages. Included in service is also the ability to quickly respond to problems and complaints, management of other urgent matters and co-operations or relationship between the shipper and the carrier (Loetveit Pedersen and Gray, 1998; Tuna and Silan, 2002).

Cullinane and Toy (2000) discuss that both service and previous experience influence the choice of transportation mode. Customers may come the first time for your product, but will return based on how well they are treated (Evenson, 2005). Lumsten (2007) discusses the importance of finding a balance between the service towards the customers and the cost of the service and product. The service level influences the customer´s decision process of what supplier to select. High customer service can be costly and should be reflected in the company´s revenue. Therefore, it is important to thoroughly analyze the customer´s needs to be able to facilitate proper level of service to stay competitive (Lumsden, 2007). Liberatore and Millier (1995) discuss that customer service can help to develop and facilitate long term partnership and relationship among shippers and the carrier. The shipper and carrier relationship were discussed in Loetveit Pedersen and Gray´s (1998) article to have an influence in the transportation selection process. Tuna and Silan (2002) state that the following factors also affect the choice of freight transport:

- Expert and knowledgeable personnel,
- Polite and respectful personnel,
- Informing about condition of the cargo,
- Giving arrival notice on time,
- Convenient working hours for contact.

Service is ranked among the top five attributes in Cullinane and Toy´s (2000) article about different attributes that affect the modal choice. 73,3 % of the articles included in their literature review mention service as important. On the other hand, when looking at what has been the dominant theme in the articles included in their study, service factors were ranked as number one. Whyte (1993) concludes that some service factors such as the carriers ability to meet requirements at short notice and the willingness to help were ranked higher than traditional factors such as cost and transportation reliability. Tuna and Silan (2002) describe willingness of the personnel to help and respond to enquiries promptly as aspects that affect the choice of transportation. Moreover, informing of whether goods will be transshipped and changes to schedule are other factors that have an impact on the decision.

Administrative tasks are important to perform correctly to minimize the amount of problems that can occur. Issuing accurate documentation and information about the shipment and costs are mentioned in the article by Tuna and Silan (2002) as aspects that affect the shipper's choice of transportation mode. The overall information about the shipment and cost have to be more than clear and correct, it is important that the price quotation is accurate as well to minimize the amount of surprises. Other factors that influence the choice of transport are invoicing and shipping information, which should be carried out quickly, accurate and on time.

In a study made by Mcginnis (1989), it is explained that issues regarding tracing, claims processing, loss and damage of goods where more important than freight rates in three out of eight instances. Tracking and tracing capabilities are factors that impact the decision of selecting transportation mode (Liberatore and Miller, 1995; Cullinane and Toy, 2000). In research carried out by Cullinane and Toy (2000), traceability and controllability were mentioned in 42,7 % of the reviewed literature, but it did not have any dominant theme. Tracking systems could be used to

follow goods during transportation and identify divergences in delivery time (Lumsden, 2007). Having the possibility to trace and control the goods during transportation are of major importance for many actors within the supply chain.

Customs clearance capabilities for international shipments are another factor that Liberatore and Miller (1995) present as important in the selection process. Little research has been conducted in the area of how the role of internet and emerging information technologies affect the selection of transportation mode (Meixell and Norbis, 2008). However, Liberatore and Miller (1995) state that Electronic Data Interchange (EDI) is a potential evaluation criteria for choosing transportation. To coordinate activities and enable supply chain integration, a well-functioning information system is needed. EDI makes the transmission of information between companies more efficient and enable shorter order cycles (Choudhary et al., 2011). EDI can be defined as "the interprocess communication of business information in a standardized format" (Choudhary et al., 2011, p.323). Provide advanced shipping information, invoicing and order processing are some features that makes EDI systems an important tool. Using the system in an effective way makes it possible to reduce costs by reducing paper work, delays due to data entry errors and mail expenses (Choudhary et al., 2011). For transportation, a well-functioning information system is desired to secure the quality of transportation and simplify administrative flows (Lumsden, 2007).

3. METHOD

In this chapter the methodology is described. First, method is elaborated and it is followed by an explanation about different research designs. Thereafter, reliability and validity is explained. The method chapter ends up with an explanation about our research strategy.

The method chapter is to give the reader a perspective of how the research is carried out and how the result is obtained. Cargill and O´Connor (2013) state a few models of how a research can be carried out. The hourglass shaped approach is arguably the most common structure to use for scientific research. This approach is focusing around the result, everything in the report should be connected to the data and the analysis presented in the result section. Reports using this approach usually start with a broad focus and is later narrowed down around the result and ends up with some broader issues to show how the report is important in the big picture (Cargill and O´Connor, 2013).

3.1 Data collection and research design

The method a researcher choose depends on whether the intent is to specify all the information to be collected in advance or if further information is allowed to be added during the progress. According to Creswell (2003), there are three approaches for research design and these are known as quantitative, qualitative and mixed methods approach. A definition and description of the three approaches will be presented in the following section.

3.1.1 Quantitative approach

A quantitative approach is one in which the investigator uses numbers as data (Braun and Clarke, 2013). It seeks to identify relationships between variables to explain data. In a quantitative approach the aim is to generalize the findings to a wider population. The study can be completed quite quickly and it requires a fixed method because it is hard to change focus when data collection has started. Furthermore, it generates shallow and broad data since lots of participants take part of the study, but each participant does not provide a lot of complex details. A cause and effect thinking, test of theories, experiments and surveys are expected in a quantitative approach to generate statistical data (Creswell, 2003).

3.1.2 Qualitative approach

A qualitative approach is one in which words, written and spoken are used as data (Braun and Clarke, 2013). It usually takes longer time because it is interpretative and there is no simple formula or way of execution. The method is less fixed and focus can shift within the same study. A qualitative approach also explores differences and divergence in data while personal involvement and partiality is expected. It is not many participants that take part in the project but every participant generates detailed and thick descriptions that are rich of data. The qualitative approach tries to understand and interpret more local meanings as it sometimes generates knowledge that could give a more general understanding. In the qualitative approach, it is also expected that the researcher collects open-ended and emerging data to be able to develop themes from the data (Creswell, 2003).

3.1.3 Mixed methods approach

A mixed methods approach is one in which at least one quantitative method is used to collect numbers and where at least one qualitative method is used to collect words in a single study. It is a type of research where the researcher combines elements of the qualitative and the quantitative approach (Creswell and Plano Clark, 2011). There are three ways to mix both approaches, to combine/merge them, by having one approach that build on the other or by embed one approach within the other. Moreover, a mixed methods approach combines viewpoints, analysis and data collection to be able to enhance breadth and depth of data at the same time and thereby give a better understanding.

3.1.4 Interviews

Interviews could be structured, semi-structured or unstructured. Structured interviews are predetermined set of questions (Lewis, Thornhill and Saunders 2007). Semi-structured interviews are among the most commonly used qualitative method (Longhurst, 2003). Semi-structured interviews could be used to enable a structured interview with the potential of adding additional questions during the interview, while unstructured interviews have not been prepared in advanced (Cohen & Crabtree, 2006). The semi-structured interview offers the participant an opportunity to explore issues that are important. This method allows a more open response to the questions asked, rather than yes or no answers (Longhurst, 2003). Answers from interviews could be secured by taking notes and/or doing a sound recording. To requite participants to interviews, cold calling could be used. Longhurst (2003) explains that cold calling is a method for calling people that could be of interest for participating in an interview.

3.1.5 Reliability and validity

Information is supposed to be informative as well as reliable and relevant (Badke, 2008). Sources should be critically evaluated to ensure reliability. In order to ensure reliability of the information gathered, three questions can be asked.

- "What are the qualifications of the author of this information?
- Who else believes in this?
- Has the information been subject to some kind of peer review or other form of gatekeeping?" (Badke, 2008, p 13).

A good research utilizes procedures to ensure validity of data, results and interpretation (Creswell and Plano Clark, 2011).Validity differs between qualitative and quantitative research. In a qualitative research, more focus should be put on validity than reliability. The main reason is to ensure that the researchers and the participants are accurate, can be trusted and credible (Creswell and Plano, 2011). In a qualitative research, such as semi-structured interviews, it can be hard to ensure validity since there might exist interpretations from both the researchers and the participants that are incorrect. Creswell and Plano Clark (2011) have a similar way to explain validity, the researcher´s personal view and characterizations can reflect the result. The quality of a quantitative research can be divided in the scores from the instruments and the conclusions drawn from the result. Creswell and Plano Clark (2011) state that the researcher need to design the studies to reduce possible threats, such as the results cannot be applied to the larger audience. Longhurst (2003) mentions that a general goal in a quantitative research is that the result is easier to reproduce compared to a qualitative research. To make sure that the qualitative and quantitative part of the research is valid, it is possible to consider if participants have a personal winning behind certain answers. This by using the questions "are there vested interest at stake?" and ”what are some good reasons for not believe in it?" (Badke, 2008, p 13).

3.2 Research strategy

To reach the purpose of this report, to create a framework for Seago Line to increase their understanding of what the shipper considers important when selecting transportation mode, several steps have been carried out. The first step was to study and increase our knowledge and understanding for the shipping industry as well as the Swedish forest industry. This was achieved by reading books, articles and other material about shipping, logistics and forestry products. Furthermore, internal documents and processes were studied in order to get an understanding of Seago Line´s position on the market and how they operate. Semi-structured interviews were held with sales executives at Seago Line, a representative from Port of Gothenburg and Bertling. These interviews were carried out to get input for our study and a better understanding for the shipping industry. We also visited the Port of Gothenburg to increase our understanding for stuffing activities of containers, using a so called LoadPlate.

In the second step, a theoretical framework was constructed. To find relevant literature, Chalmers library, Google Scholar and course literature were examined. The literature search was conducted using key words such as logistics, shipping, supply chain management, transportation mode selection, factors influencing modal choice, container and bulk. To ensure reliability of the information gathered, Badke´s (2008) three questions were used, see section 3.1.5. About 45 different sources have been used for writing the theoretical framework and these sources consist of mainly books and articles. Section 2.3, which is about what factors influence the choice of transportation, is the most comprehensive part of the report. This section has been the basis for the empirical data collection and many sources have been considered when constructing it. A summarized theoretical model for section 2.3 is presented in Appendix 2. The summarized theoretical model consists of 38 factors that the literature stress as important to consider when selecting transportation mode and these are categorized in five different aspects; costs, logistical aspects, product characteristics, cargo care and service and administration.

The third step of this study was to conduct the empirical data collection. Companies within the Swedish forest industry were first identified by looking at their size and exported products. Some actors were identified by Seago Line by looking at their customer base. However, other forest companies were also contacted to get a larger sample and thereby make data more reliable. In the process of recruiting participants, cold calling and email were used in order to find the right people. Seago Line did also contribute in the process of recruiting participants since some of the actors are current customers with known contact person. During the empirical data collection, five on site visits where carried out in order to perform face to face interviews and one phone interview was held. For more information about the interviews and companies involved see *Table 3.1*. The most important part of this step was to understand what factors the Swedish forest industry considers as most important when selecting transportation mode. Interviews were sound recorded, if anything appeared unclear it was possible to go back and listen again. Interviews were held semi-structured with the ability to add questions during the interview if something interesting came up. Questions were send in advance to let participants' prepare themselves. All participants had senior positions and had logistics as their main responsibility, see *Table 3.1*. The researchers did not have any personal winning in any of the findings. Both these aspects indicates validity of data. The companies name are presented as A, B, C, D, E and F to make it easier for the reader and more uniform throughout the report.

Table 3.1 illustrates the number of interviews and the title of the participants.

Company:	**A**	**B**	**C**	**D**	**E**	**F**
Number of Interviews	1	1	2	1	1	1
Face-to-Face Interviews		×	×	×	×	×
Phone interview	×					
Participants Title	Vice President Marketing and Business Development	Vice President Sea Service	Customer Logistic Manager & Director Logistics	Logistic Manager Ocean and Ports	Logistics Development & Purchaser	Logistic Manager

During the interviews, there was also a part included where the participants had to evaluate 13 factors on a scale from one to seven. One accounted for low impact, four to neutral and seven meant that the factor had a high impact. The interview questions could be found in Appendix 3. The 13 factors were all part of the 38 factors presented in the summarized theoretical model in Appendix 2. However, since it would have been difficult to let the companies evaluate 38 factors, the most relevant were chosen with help of representatives from Seago Line and Bertling, which have good industry insight. The result of the ranking is presented in section 6.2. Three diagrams were created, one for paper, paper pulp and sawn timber respectively, to clearly illustrate the profile for each company. When the result of the ranking was completed, feedback was given to all participants. The participants got the chance to update their answers if needed. Moreover, if there was a wide distribution between companies, it was also possible to discuss these and try to understand why this was the case. When trying to understand what the companies think is important when choosing transportation mode, both open questions and ranking of factors were used. It should also be noted that before factors were presented, the participants got the opportunity to explain what impacts their choice of transportation without any influence from the interviewer, since factors were unknown in advance. The 13 factors were shown and graded in order to understand what the participant think is most important. Furthermore, if participants came up with something during the interview they also got the chance to add this in the end when all questions where covered.

In the fourth step, both theory and empirical data were analyzed when all information were collected. The most relevant findings were analyzed along with parts, which were not expected. After all relevant aspects were covered, frameworks were developed to illustrate our result and to increase Seago Line's understanding for the shipper’s situation. A section including how Seago Line can benefit from this framework is also found in the chapter nine.

For this study, the hourglass shaped approach has been used since it starts with a rather broad focus. The focus is later narrowed down around the result of the study and ends up with some broader issues in the chapters, Frameworks for selection transportation mode and Further research. A mixed method approach has also been used in this study. Qualitative methods were used to generate knowledge that could give a deeper and more general understanding of different actors by adding additional questions during the interviews. Moreover, quantitative methods were used to generate statistical data to generalize the findings to a wider population in the Swedish forest industry. The quantitative method used made it easy to compare companies since factors were ranked during the interviews. The ranking made it possible to understand what factors the companies consider as most important.

4. COMPANY DESCRIPTION AND INDUSTRY BACKGROUND

In the following chapter, the case company, Seago Line will be described. Furthermore, an industry background with developments and market changes will also be presented.

4.1 Company description

The Maersk Group was founded in 1904 and has roughly 89 000 employees in more than 130 countries. The group´s revenue in 2014 was about 47 billion US dollars generated from the group's five core business areas which include Maersk Line, APM Terminals, Maersk Oil, Maersk Drilling and APM Shipping Services. Maersk Line is the world's largest container shipping company, known for reliable, flexible and eco-efficient services. The company has a fleet of about three million TEU´s and over 600 vessels, which sail every major trade lane on the globe.

The Maersk Liner business also includes Seago Line, Safmarine and MCC. Seago Line was established in 2011 to handle Intra-European container activities on behalf of the Maersk Liner Business with the aim of becoming the trade specialist in the region. To reach the aim, Seago Line offer client valued propositions tailored for the European short sea market. This includes fast documentation and quoting to enable agile operation and strong local client interactions. Seago line has access to the Maersk Group´s equipment pool, main hub ports, industry knowledge, unmatched vessel fleet, extensive network and local focus, which put them in a unique positon to achieve flexible and reliable services towards their customers.

The new container shipping company was created to simplify Maersk Line's organization and simultaneously develop an existing business opportunity. The initiative supports the European Union's efforts to create a transport system with low environmental impact and reduced carbon footprint, by moving road-based traffic to sea-based transport systems (Jephson and Morgen, 2014). Seago Line provides regular, reliable, frequent container capabilities and short transport times to retailers and manufacturers that use near-market sourcing.

Seago Line serves about 40 countries in the markets of Scandinavia, Russia and the Baltic countries, Northern Europe, the Mediterranean, North Africa and the Black Sea. The area of operation can be seen in Appendix 1. Seago Line is an independent entity within the Maersk Liner Business with own offices in 23 countries throughout the region. In 2013, Seago line had about 300 employees and operated some 50 vessels with a combined capacity of around 90,000 TEUs, this makes Seago Line one of the largest short-sea operators in Europe and well positioned to create value for their clients. Of all IET that is containerized, Seago Line has an estimated market share of 15%.

Seago Line´s head quarter for the Scandinavian market is located in Gothenburg, Sweden. In Gothenburg, about 15 employees are working and departments are customer service, sales and trade and marketing. In the same office Maersk Line, Safmarine and Damco are present. Some functions are shared between the companies' such as finance and operation.

4.2 Industry background and containerization

In this section, industry developments and market changes will be described. This section gives an indication of how fast changes can occur and what implication it can have. The book "Creating Global Opportunities: Maersk Line in Containerisation 1973-2013" by Chris Jephson and Henning Morgen has been used for writing the industry background.

"Today's trade is global. A company can choose to have its headquarters in one part of the world, its production facilities in another, and sell its brand in all markets" (Jephson and Morgen, 2014, p.1). As C. C. Tung, CEO of Orient Overseas Container Line (OOCL), commented in 1997, "Without the container the global village would still be a concept, not a reality, because manufacturing would still be a local process (Jephson and Morgen, 2014, p.1). A basis for global trade has been the containerized door-to-door solution, an intermodal transport concept.

The shipping industry has been one of the main facilitators of the globalization of trade, especially since the first sea-borne container transport took place in 1956. Malcom McLean, founder of Sea-Land in 1960, organized the first seaborne container transport in 1956 between Newark and Huston, USA. The container and innovations in the shipping industry associated with it has rightly been called a revolution. At first, it was a rather slow revolution, but when Maersk Line joined in 1973 it had picked up considerable speed. When Maersk took the decision to join the container revolution, they did the single largest investment the company ever made. The container has since its introduction had an extensive impact on the development of global trade, global commerce and shipping industry. As Adolf Adrion, CEO of Hapag Lloyd, stated in 2006, "The box became both the driving force behind, and the beneficiary of globalization as an ongoing process. Scarcely has any other industry achieved such high and continuous growth over a period of 40 years" (Jephson and Morgen, 2014, p.3).

How companies buy, build and sell its products has changed drastically over the last 50 years. Changes in production, distribution and supply chain management have been necessary to meet the demands of the globalizing consumer. To facilitate these developments, the container shipping industry has needed to adapt and reinvented itself. A prerequisite for international trade is the availability of fast and reliable transport. There are four main factors that have supported developments in the shipping industry and these are presented in the following bullet list:

- The steam engine, vessels were not dependent on wind anymore.
- Iron hulls, enabled larger vessels to be built and protected cargo in a better way.
- Screw propellers, made merchant vessels more seaworthy.
- The deep-sea cable network, allowed communication across the world between traders and shipping companies.

Steamships enabled more reliable services, which in 1912 was improved further through the introduction of ocean-going motor vessels. Shipping companies started to specialize their vessels for liner business as international trade grew and shippers became more dependent on reliable services.

The container revolution started with the ISO container, although Malcom McLean should be credited for introducing the first seaborne container transport in 1956. The first container vessels were converted Second World War tankers and later vessel owners designed specialized vessels to carry their containers. In 1961, US authorities decided upon a standard container with the measures 8 x 8 x 10, 20, 30 or 40 feet. The International Standards Organization (ISO) was about to establish international standards and the American dimensions were agreed upon in 1964. From now on, vessel owners could start designing vessels specialized for standard containers. It is explained that these vessels could transport goods five times more efficient than conventional break-bulk cargo vessels. The containerization was taken to another level and became truly international in 1966 when U. S. Lines shipped the first ISO-standard 20-foot container from USA to Europe. The political climate and war created the basis for faster development as with many other inventions. Base cargo, which is the shippers' guarantee for a certain quantity of cargo on regular basis, was essential for the establishment of liner shipping. In 1966, container shipping was emerging but the container was still seen as special cargo. Ports did not have any special cranes or special trucks for inter-terminal transportation of containers. With its individual trades, the shipping industry might have been global but it did not serve a global economy. At the time, only a few of the world's most prominent shipping companies had the courage and vision to take substantial steps into containerization.

In early 1970s, containerization was growing rapidly but it had not reached all parts of the world. Ports were still not equipped to receive container vessels as we know them today. Vessels had their own cranes that could handle a variety of cargo such as goods in bulk, general cargo in unit loads and standard containers. In 1973, the containerization question had become critical for some

companies. It was a case of either being in or not participating at all. If Maersk Line had not decided to replace conventional break-bulk service with a containerized service it would rapidly been forced out of the liner business. Ib Kruse, a former A. P. Möller Maersk employee, should have said, "I would say that the decision took itself… There was no other way than going in to the container business" (Jephson and Morgen, 2014, p.76). In 1973, the shipping industry could not foresee the dramatic annual growth rates, about 20 per cent, that would be reality in container shipping during the next decade.

In 1970, the world container vessel capacity was in total 195 362 TEU and this number had passed two million in 1985. World merchandise exports doubled between 1975 and 1980 and reached $3,753 billion. In late 1970s, the container revolution grew slowly around the world. Significant improvements in cargo handling were made even though tools may seem simple. By mid 1980s, new developments and innovations were introduced within Maersk. The most important was into information technologies with the ability to provide online tariffs, booking systems, sailing schedule system, cargo tracking system and automated customs documentation.

The 1990s was a period of transition. Globalization had accelerated in the 1980s and started to take off during the 1990s. Markets as Russia and East Europe were opened up and China unlocked its door to foreign investments and free enterprise. Moreover, information and communication technologies were further developed and improved. During the time, it was an increased awareness for environmental considerations and the global economy was further unified. In 1997, the containerization was growing but the container liner industry was heading for the rocks. The levels of scrappage had no appreciable pick-up, freight rates lower than it was for 10-20 years ago while trading volumes increased 8 per cent per year.

During the 2000s, Asia and particularly China remained a strong growth area. The need for highly efficient and quality port infrastructure became more and more obvious. The containerization was basically a commoditized industry, which mean that scale was all-important and consolidation would continue. In the container shipping industry, a lot of mergers and acquisitions have been made during the years. Maersk's acquisition of Sea-Land in 1999 is one of the bigger. In 2009, market conditions were tough with falling freight rates and volumes. During this period, many shipping companies struggled with declining revenues and Maersk Group made its first loss ever, after 104 years in the business.

The container has made it possible to transport goods in a safe, reliable, environmentally sustainable and low-cost way. In order to reach this point, massive investments in infrastructure, terminals and vessels have been made. In the 2010s, a key challenge for the industry is how to make profits at lower levels of utilization. Slow steaming and cooperative operational agreements between actors are some innovative decisions that have been introduced. Last but not least, *Figure 4.1* illustrates developments in the container shipping industry during the last decades.

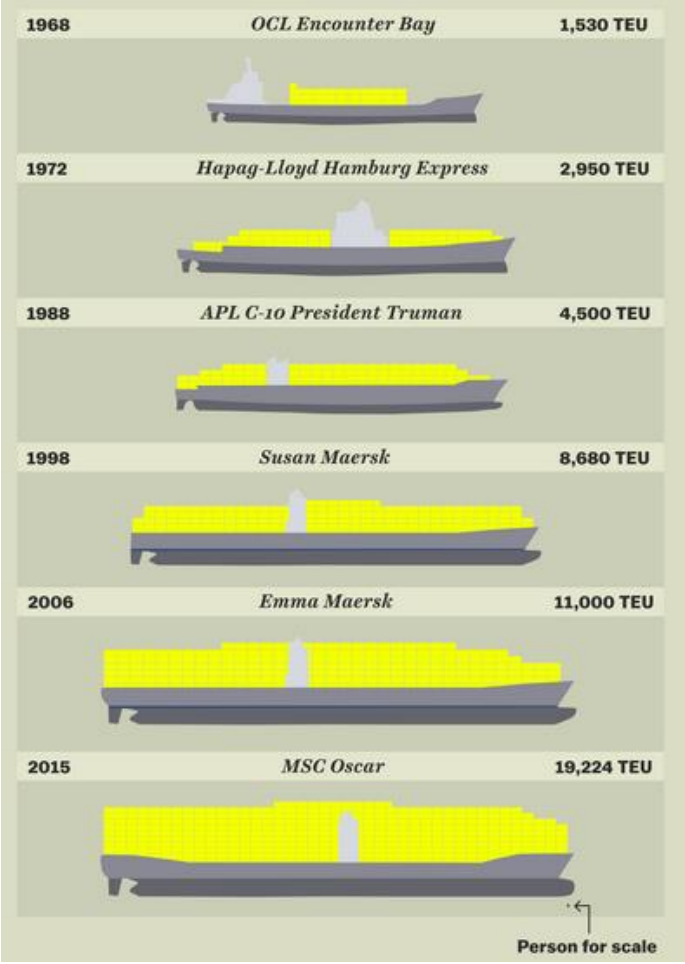

Figure 4.1 illustrates the largest container vessels per decade (Stromberg, 2015).

5. THE SWEDISH FOREST INDUSTRY

In this chapter, the Swedish forest industry will be described, along with an explanation of the forestry products and a short introduction of the six forest companies included in this study.

5.1 Background information about the Swedish forest industry

The Swedish forest industry employs about 60 000 people and exported goods were valued at SEK 120 billion in 2013. The forest industry is an important part of the Swedish economy and accounts for between nine to twelve per cent of the Swedish industry´s total employment, export, sales and refinement value. Since the Swedish forest industry is based on renewable resources, it plays a vital role in the development towards a sustainable, bio-based society. Included in the forest industry are companies within the paper and pulp industry, sawmill industry, wood board industry, production of packaging from wood, paper and board, carpentry industry as well as the manufacture of refined wood fuel. Products from the forest industry can replace fossil based materials in for example packaging. Wood products, paper, packaging materials and hygiene paper are traditional products within the Swedish forest industry, however the forest industry is also the leading producer and user of biofuels (Skogsindustrierna, 2014).

According to Skogsindustrierna (2014), the industry is heavily export oriented because imports of forest industry products are small and raw material is mainly domestic. About 90 per cent of all paper and pulp production and 75 per cent of sawn wood are exported, which contributes to Sweden's trade balance. In the world, Sweden is the third largest exporter of paper, pulp and sawn wood products, only Canada and USA exports more. Europe is the Swedish forest industries main market. As stated before, the industry has direct employment of about 60 000 people in Sweden, but with its subcontractors it creates about 200 000 jobs. The industry is know-how and technology intensive with many high-tech processes. Environment and energy-related investments represent a large proportion of all investments in the Swedish forest industry. Investments in the business are made in order to stimulate research and development, increase forest growth and making manufacturing more efficient (Skogsindustrierna, 2014).

Paper pulp is a raw material that consists of cellulose fibers and it is made from wood, see *Figure 5.1* (Park and Allaby, 2013). In 2013, 3,3 million tons of paper pulp where exported from Sweden (Skogsindustrierna, 2013). Globally, deliveries of paper pulp is increasing (Sveaskog, 2015) and the market is expected to grow about two percent per year (SCA, 2014). Park and Allaby (2013) state that paper is a thin sheet of material, which is made of paper pulp. Paper has many areas of usage and it is made by processing paper pulp into flexible leaves or rolls, see *Figure 5.2*. Paper could be used for writing, printing, wrapping, drawing and covering walls. 9,7 million tons of paper where exported from Sweden in 2013 (Skogsindustrierna, 2013). The paper and printing industry in Europe have been struggling with lower volumes and declining demand (Stora Enso, 2015; BillerudKorsnäs, 2014; Holmen, 2015 and SCA, 2014). The reasons are consequences of lower readership of printed media and more competition from electronic media (SCA, 2014). Park and Allaby (2013) state that timber is a general term for forests or other clusters of trees. Sawn timber could be seen in *Figure 5.3* and *5.4*. It is explained that exports of sawn timber were 11,6 million m^3 in 2013 (Skogsindustrierna, 2013). The price of wood as a raw material has taken a dip over the past three years. The price is influenced by the output from the paper pulp industry in the Nordic countries, the demand for sawn timber and wood as a combustion material especially for the biofuel industry (Stora Enso, 2015). Within the Swedish forest industry, there are several big players that control a large part of the market. Some of these companies are part of the empirical data and will now be described. In *Table 5.1*, the most important information about the companies are summarized.

Figure 5.1 illustrates packages of paper pulp (Lomo Wood Fibre, nd).

Figure 5.2 illustrate paper rolls (Stockholm University, 2011).

Figure 5.3 illustrates a sawn timber package (APP TIMBER, 2013).

Figure 5.4 illustrates a quarter package of sawn timber.

5.2 Company A

Company A is a leading global hygiene and forest products company. The group develops and manufactures sustainable personal care, tissue and forest products. Company A conducts sales in over 100 countries and products are sold under many strong brands. With 2,6 million hectares of forest, the company is the largest private forest owner in Europe. The company conducts manufacturing activities in 18 sites and offers paper, packaging paper, paper pulp, renewable energy and solid-wood products. As part of their integration strategy, Company A operates parts of their own logistics. The company has loading and unloading terminals in Sweden and abroad as well having their own vessels.

5.3 Company B

Company B is a leading provider of renewable solutions in packaging, biomaterials, wood, paper pulp and paper on global markets. The company wants to provide their customers with products that are a climate friendly alternative to none-renewable materials. This is made by developing their expertise in renewable materials. The company states that their logistics services are carried out by contracted suppliers, for example road hauliers, rail and shipping companies as well as terminals and port operators. In late 90's, Company B evaluated the opportunity to improve efficiency between the mills and the port of Gothenburg. A new loading unit was developed and the container measures 3.6 x 4.3 x 13.80 meters, which is larger than a standardized container and it is designed to maximize carrying capacity on a train (Miljönytta, 2009). Their customized transport solution has led to a need for specialized vessels that can carry this special container. Moreover it has also led to a decrease in flexibility and compatibility, but it has helped the company to achieve improved efficiency and reduced emissions (Miljönytta, 2009).

5.4 Company C

Company C is an economic association and has over 50 000 members. The members' own more than half of all privately owned forest in the southern part of Sweden. The forest is everything since it provides the company with raw materials for their operations. It produces sawn and planed timber goods, interior products, paper pulp and biofuel. The company also produces electricity and it produces even more than it consumes. Products are delivered to customers all over the world by vessels, trucks, and rail transportation. The company uses long-term chartered vessels and contracted vessels for sea transportation.

5.5 Company D

Company D has eight production units and sales offices in ten countries. They describe themselves as a world leading manufacturer of fiber-based packaging material, working with more than 1500 customers in over 100 countries. The company has a strong focus on customer benefit, innovation and sustainability. Company D develop renewable materials and packaging solutions that support a sustainable development together with its customers. Packaging paper,

consumer board and containerboard are three business areas that the company has. The business area packaging paper contains paper pulp, kraft paper and sack paper. Consumer board includes liquid packaging board and carton board. Moreover, the business area containerboard includes fluting and liner.

5.6 Company E

Company E is a forest industry group that produces printing paper, paperboard and sawn timber. The company runs forestry and energy production operations. Its high proportion of energy production and the company's large forest holdings are strategically important resources for the company's future growth. The company embraces about 1,3 million hectares of land of which one million are used for forestry. The group has five production sites in Sweden and 90% of all sales are within the European market via its own sales companies.

5.7 Company F

Company F operates four paper mills and two paper pulp mills within Sweden and Norway. The company have been producing paper since the late 19th century for a wide range of applications. The knowledge of paper manufacturing have been passed down through generations. Only renewable forestry resources are used in the manufacturing process and everything is done with great consideration for the environment. Products can be placed in two main groups, which are kraft paper and greaseproof paper. Kraft paper is made of Scandinavian fibre and it is used for bags and packaging solutions. Moreover, greaseproof paper improves hygiene levels and is used in cooking and baking worldwide. Their paper can replace or reduce plastic and aluminum in a number of products.

Table 5.1 summarizes all vital information of the company description.

Company:	A	B	C	D	E	F
Paper	×	×		×	×	×
Paper pulp	×	×	×	×		
Sawn timber	×	×	×			
Own logistic system	×	×	×	×	×	
Own load carrier		×				

6. EMPIRICAL DATA

The chapter empirical data contains information from the interviews with forest companies. Everything, which is presented in here, is directly taken from the interviews. This chapter is divided in seven parts, where the first section mentions what factors the companies consider important when selecting transportation mode. In the second part, the outcome of the ranking of factors could be seen. The third part explains why single markets are supplied with more than one transportation mode. Followed by a description of how the sales people and consignee influence the choice of transportation mode. At last, market changes and regulation along with logistical trends in the forest industry are explained. To give the reader a better understanding and basic knowledge for logistics in the forest industry an introducing part could be seen below.

Six large companies from the Swedish forest industry have been interviewed. The size of the companies included in the study differs, but all of them export a majority of their products in the European market. The exported amount varies from around one million tons per year to roughly 20 million tons and the modes used to transport the goods are mainly truck, rail and ocean transportation. It is common that intermodal transportations are used i.e. the same load carrier is transported by more than one transportation mode. Different vessel types are used for ocean transportations for example RORO, bulk and container vessels. It was also explained that many forest companies trade timber with each other to make transportation more efficient by reducing transportation distances to mills.

All companies export a large amount of what is produced. Most of the companies have divided up the exporting market. Generally, Europe is seen as one market and outside Europe, as the oversea market. But even though North Africa is part of another continent it is in some cases included in the European market as it belongs to the Mediterranean Sea. A similar example could be seen for the countries Greece and Turkey as these are part of the oversea market in some cases. Some companies have divided the responsibility of the different markets between managers. Depending on what market goods are transported to, different options of transportation modes are available.

The companies in this study export different types of products and the different products segments included in this study are paper, paper pulp and sawn timber. It is not only the product characteristics that differ between the different products mentioned. In most cases are for example both paper pulp and sawn timber produced to stock while paper is in most cases produced to customer order. Some of the companies had other product segments outside our scope and these were excluded in this study. As could be seen in *Table 5.1*, company A, B, D, E and F export paper, company A, B, C, D paper pulp and company A, B and C sawn timber. The companies have a somewhat similar logistical setup where company A to E owns their own logistical system. Some are co-owners in a train setup while others own and operate their own vessels. One actor has developed their own load carrier, which is used in their logistical system.

6.1 Factors influencing the choice of transportation mode for the Swedish forest industry

The answers in this section are divided between the forest companies to demonstrate what each company thinks is important when selecting transportation mode. Answers are based on the question “What do you consider as important when selecting transportation mode for these products in this region?” covered in all interviews, see Appendix 3. This section will answer our first research question, but the data will also be analyzed in chapter seven and summarized in chapter eight.

6.1.1 Company A

Several factors affect the modal choice. Transportation cost is one important factor company A consider. The volume will make some transportation modes be more favorable than others. For example, big volumes of goods will in most cases be transported on the ocean using bulk vessels

and smaller volumes in containers. Some products require high transportation quality because it needs to arrive in excellent condition. Sensitive products such as paper requires clean environment and needs to be handled with care. Printable paper are never transport in bulk vessels because the risk of damage is large. Other factors that have become increasingly important in recent years are the delivery precision and lead time. However, the delivery precision is more important than lead time as long as the lead time in not too long. At last, it is also important that the goods arrive with the right documentation.

6.1.2 Company B

The first factors Company B investigates in the process of selecting transportation mode are feasibility in combination with cost. Transportation cost is an important factor, which in many situations are the ruling factor. Included in transportation cost are handling costs, cost for hubs and transportation cost to and from the terminal. A trend in recent years has been to reduce the amount of hubs, as these are costly. According to company B, if the hubs are removed it becomes increasingly important to have transportation modes that can manage direct transportations to the end customer.

Before Company B select a specific transportation mode, it is essential to look into what providers are available on the market. The following factors are investigated for each transportation provider, delivery reliability, frequency and that the provider can manage orders electronically. Company B demands to receive shipping instructions and other information electronically to be able to follow up the performance of each provider. The demand for high delivery reliability from their customers have increased dramatically in recent years as companies are optimizing their processes and stock levels which makes time very important. Another important factor is financial stability of the transportation provider. This might not be a current problem, but during the financial crisis in 2008-2009 there were many carriers that were close to bankruptcy. Company B is exporting big volumes and if one of their providers would go bankrupt they would be in serious problems.

Sustainability is another factor that the company consider when selecting transportation mode. Company B have recently joined Clean Shipping Network. Together they are analyzing all suppliers to make sure that none are breaking Company B´s values. However, it is a tricky situation according to Company B since the largest carriers in the world are used. If any of the providers would be identified as unsustainable, the company would face problems in finding substitutes because of the volumes managed are large. The goal in working with sustainability is to influence and work together with their suppliers and customers to become more sustainable.

6.1.3 Company C

Different products and products characteristics affect the choice of transportation mode. Some aspects are more important for paper pulp than sawn timber products and vice versa. For example, it is more important that the paper pulp is not exposed to certain environments or damaged during the transportation. Therefore, it is important that load carriers are clean and undamaged. In a similar fashion, it can be difficult to load paper pulp products in some load carriers as specialized forklifts are required. Transportation cost is another factor that affect the modal choice. Included in transportation cost are the transport cost itself and all the costs associated with handling and terminal fees.

In general are paper pulp customers keener on sustainability. On the other hand, it is important that the more environmentally friendly transportation option does not have an additional cost. Company C are always focusing on reaching high fill rates in their transports since it enables them to achieve good transport economy as well as lower the environmental impact. Quarter package, see *Figure 5.4*, lowers the utilization in transportation since different wood lengths occupying space. The low utilization requires transportation cost to be low.

For both paper pulp and sawn timber it is important that the transportation mode is reliable, flexible and has the capacity required. Both personal relationship and previous experience are factors that influence, what provider and transportation mode to use. There is always a risk when changing transport provider. Company C work with several actors in the transportation industry to be able to manage their large volumes and to secure capacity. Small volumes are given to all new transportation providers to evaluate the performance. If everything works well the carrier can receive bigger orders.

Geographical limitations are a factor that also influences what transportation mode that will be used. These limitations could be logistical prerequisites in the receiving location and it could also be affected by the volumes which will be transported. For example, Company C state that their logistical setup looks a bit different depending on if bulk or container transportations are used. Containers are usually shipped directly to the customer while bulk goods need a terminal with storage, from which goods are distributed to the end customer. Having their own long term chartered vessels enables the company to navigate their own fleet and make adjustments with short notice.

6.1.4 Company D

Selecting transportation mode is a complex task; there are many factors that affect the choice of transportation mode. When Company D are in the process to design a new setup to a customer, they always start by the customer and optimize the distribution from there. Since the company possess their own logistical system, considerations of the system need to be taken when designing the logistical setup. If something would happen that would require a change in the logistical setup, the company need to look at the entire solution to know if this change could affect another setup. These changes can be both internally and externally. Consequently, changes can affect the cost structure, which could make other options more beneficial. For that reason, it is most of the time easier to design a new setup compared to editing an existing one. Company D are co-owners in a train setup with four other actors, where Company E is one of them. This train setup is the largest logistical system in Sweden. If changes occur within this setup it will have implications on the transportation mode selection. According to Company D, these kind of ownerships have many fixed and variable costs associated to them. In their logistical system about 50 terminals exist in Europe and these needs to be taken into consideration when selecting transportation mode.

The factors reflected upon when optimizing the logistical flow are transportation cost and quality. Company D always considers the total cost when selecting the transportation mode. In some cases, a specific solution could be cheaper for a plant or a destination, but it is important to study the entire distribution to find the best option. In some cases, this is difficult as the local logistic manager at each plant are measured on cost and if the manager is required to select a transportation mode that is more expensive for them, but favorable for the company, it will still reflect negatively on their numbers. Quality is specified as goods arrive clean and undamaged. The amount of handling differs between transportation modes and it is usually in the handling process that the goods get damaged. Quality is seen as important and will affect the choice of transportation mode. On some destinations the company has changed logistics set up from bulk to container because of quality issues.

Previous experience with the carrier can affect the selection process of what transportation mode to choose. The customer, where it is located, and the infrastructure at the receiving location need to be considered as well. Some modes might be more preferable to some locations. For example, some markets are not used to manage containers. Company D´s plants are designed to load goods in a specific way. Depending on how goods are loaded it can affect the transportation mode later in the chain. All their plants are designed to handle train, the transportation cost using a rail solution will affect if goods are transported to a harbor, terminal or directly to end customer.

The volume of the order can also affect the choice of transportation mode. Some modes are not designed to manage big volumes. In some cases, the customer requires goods to be transported using a specific transportation mode as some activities like documentation and administrative tasks can differ. The customer is in some cases requiring a specific volume and refuse to decrease them to have more frequent deliveries. As big volumes are more appropriate with some transportation modes the customer has an impact in what transportation mode is selected. Company D mentions that the reason is that the capacity of certain mode differs. Big volumes result according to them also to a bigger risk. Big volumes are tough and the company are trying to minimize these as it is hard to allocate the right capacity if the demand is fluctuating. Problems that Company D has faced are availability of containers and capacity issues regarding rail transportations.

The product characteristics and profitability are affecting the modal choice too. Some products are impossible to ship in certain modes e.g. big paper rolls might not fit in a container. The value and the profitability of the product can in some cases have an impact on the choice of transportation mode and especially the service level towards the customer. For example, it is more likely that a fast transportation mode is used for products with high profitability, as the extra cost for the faster mode will not be as noticeable on the total cost, than it would be for products with low profitability.

6.1.5 Company E

It is a combination of factors and not only one factor that influence the choice of transportation mode. Transportation cost and capacity was mentioned as top factors. The capacity is key for them and this is a reason why Company E have their own fleet and a train setup with Company D. The number of actors that can handle Company E´s volume and number of destinations are few, which can affect the choice of transportation provider and mode. When comparing transport providers, it is important that goods can be delivered to the specific destination. The company do not care about the number of transshipments, as long as the lead time is met. Large volumes are exported company E could affect the trade imbalance in the region if changes in the logistical setup are made. A reason why the company has their own fixed logistical system is to secure capacity. If volumes are big, some transportation modes are more preferable than others and vice versa. Trucks are used as backup for their logistical system. However, if the transportation distance is far, intermodal transportations are used to minimize the environmental impact. During certain periods it can be hard to allocate the right capacity, especially truck transportations during holidays. If the customer has specific requirements Company E listen to them and adapt the logistics service. Different customers have different requirements when it comes to lead time and flexibility. Therefore, customer requirements can also affect the choice of transportation mode.

6.1.6 Company F

For company F transportation cost, reliability, lead time and that the goods arrive without damage are important factors when selecting the transportation mode. Tenders are sent out every year and the transportation provider is selected solely on cost as long as the provider can guarantee the desired quality in the tender. Moreover, Company F are trying to take advantage of the trade imbalance in Norway as many trucks are driving empty on their way back to the European continent, which enables Company F to receive competitive prices. The geographical location of the customer will also affect the choice of transportation mode as the location of the customer makes it more or less impossible to use some transportation modes. The company have spoiled their customers with short lead times, which now has become a demand since customers are trying to lower their inventories. Environmental issues are considered but if transportation cost or lead time are affected it will be given lower priority. Their customers are seldom willing to pay for more environmentally friendly options.

6.2 Ranking of factors

During the interviews, the participants ranked different factors that research state as important when selecting transportation mode. Literature suggests 38 factors, see Appendix 2, which have an influence on the modal choice. 13 of these 38 factors were ranked during interviews with the forest companies. The 13 factors have been carefully selected from the 38 factors with help of people with good industry insight. In the following sections, the result from the ranking of factors is presented. The figures illustrates how important the factors are when selecting transportation mode for the different products paper, paper pulp and sawn timber.

6.2.1 Paper

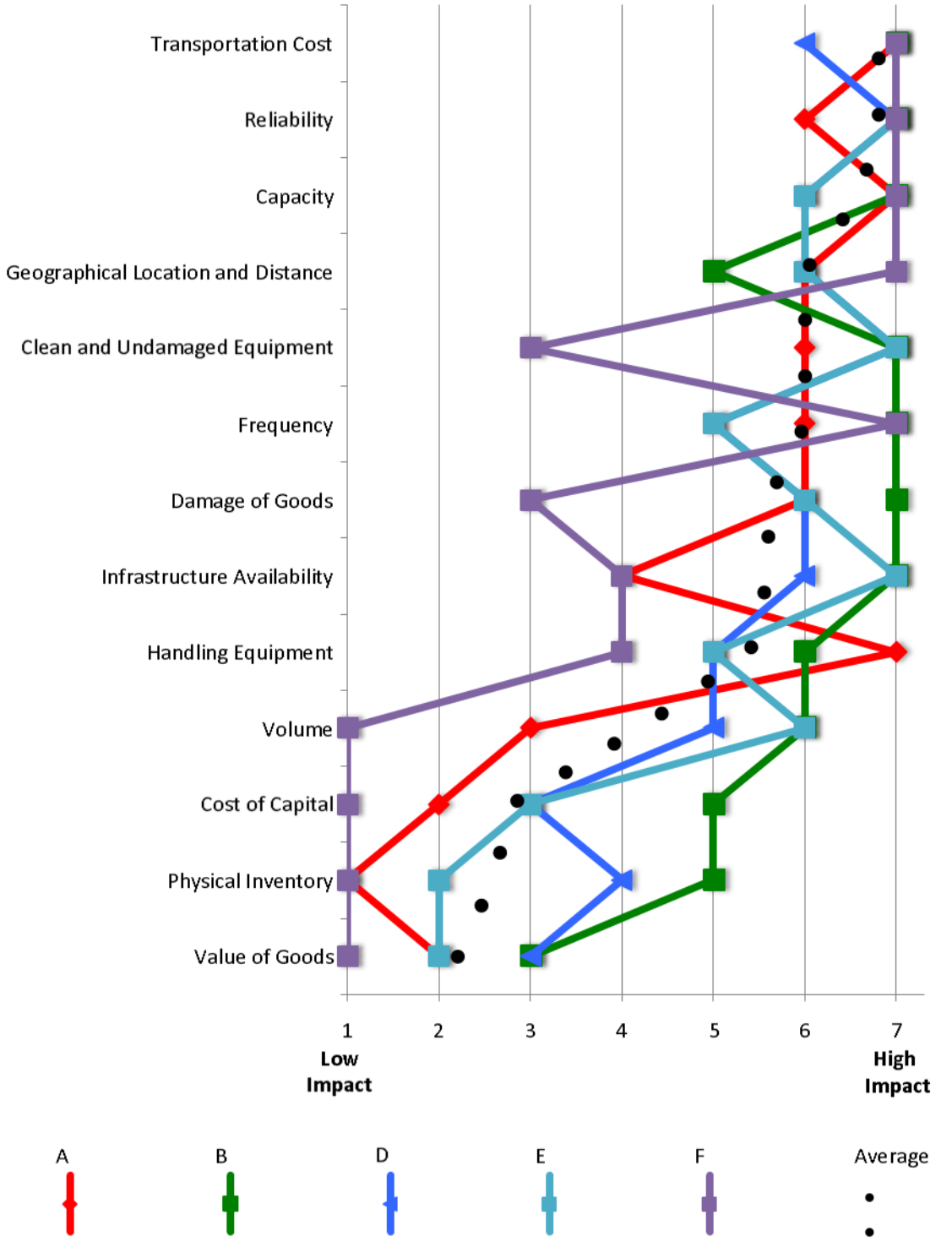

Figure 6.1 illustrates the outcome of ranking for paper

6.2.2 Paper pulp

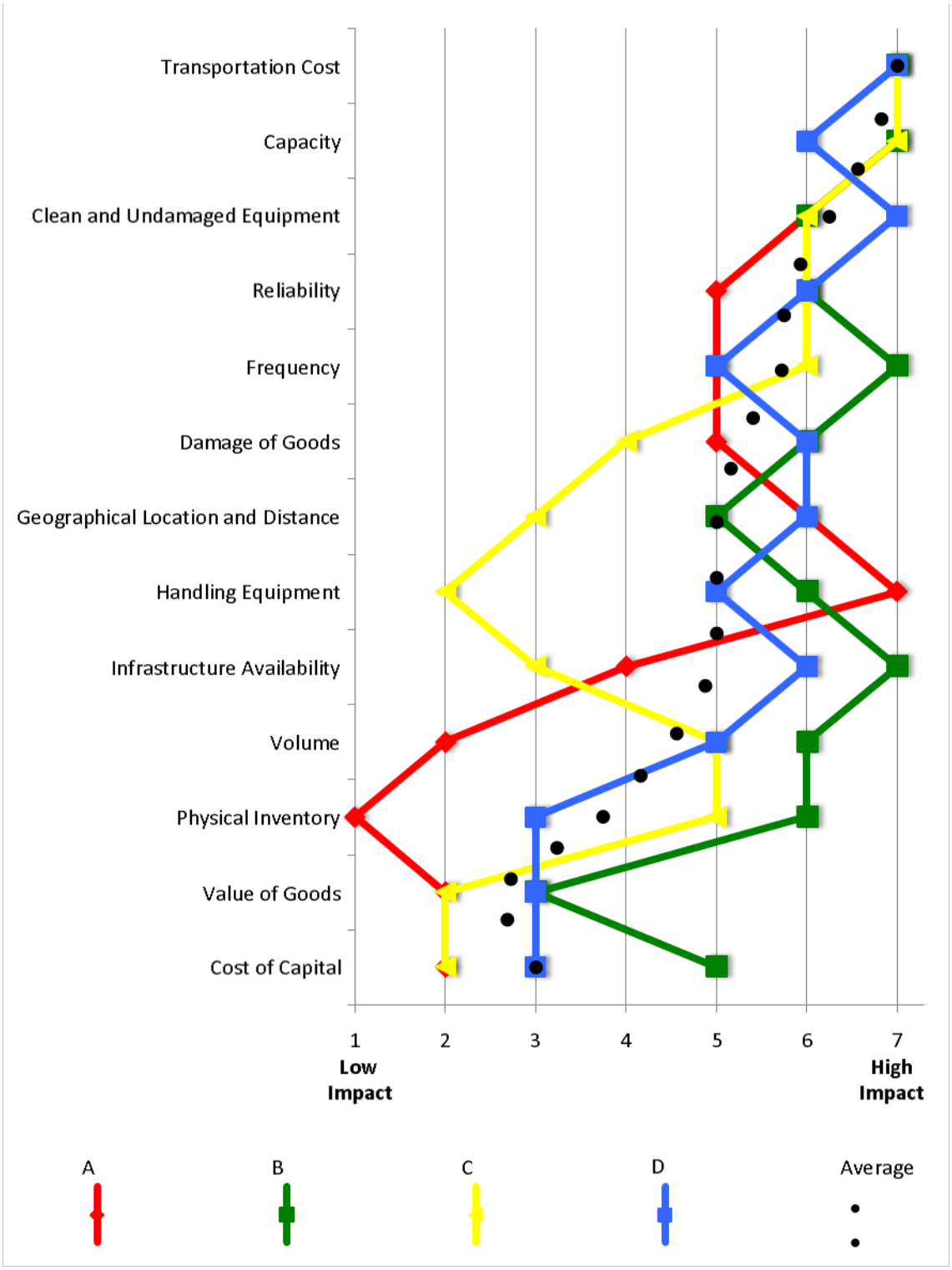

Figure 6.2 illustrates the outcome of ranking for paper pulp

6.2.3 Sawn timber

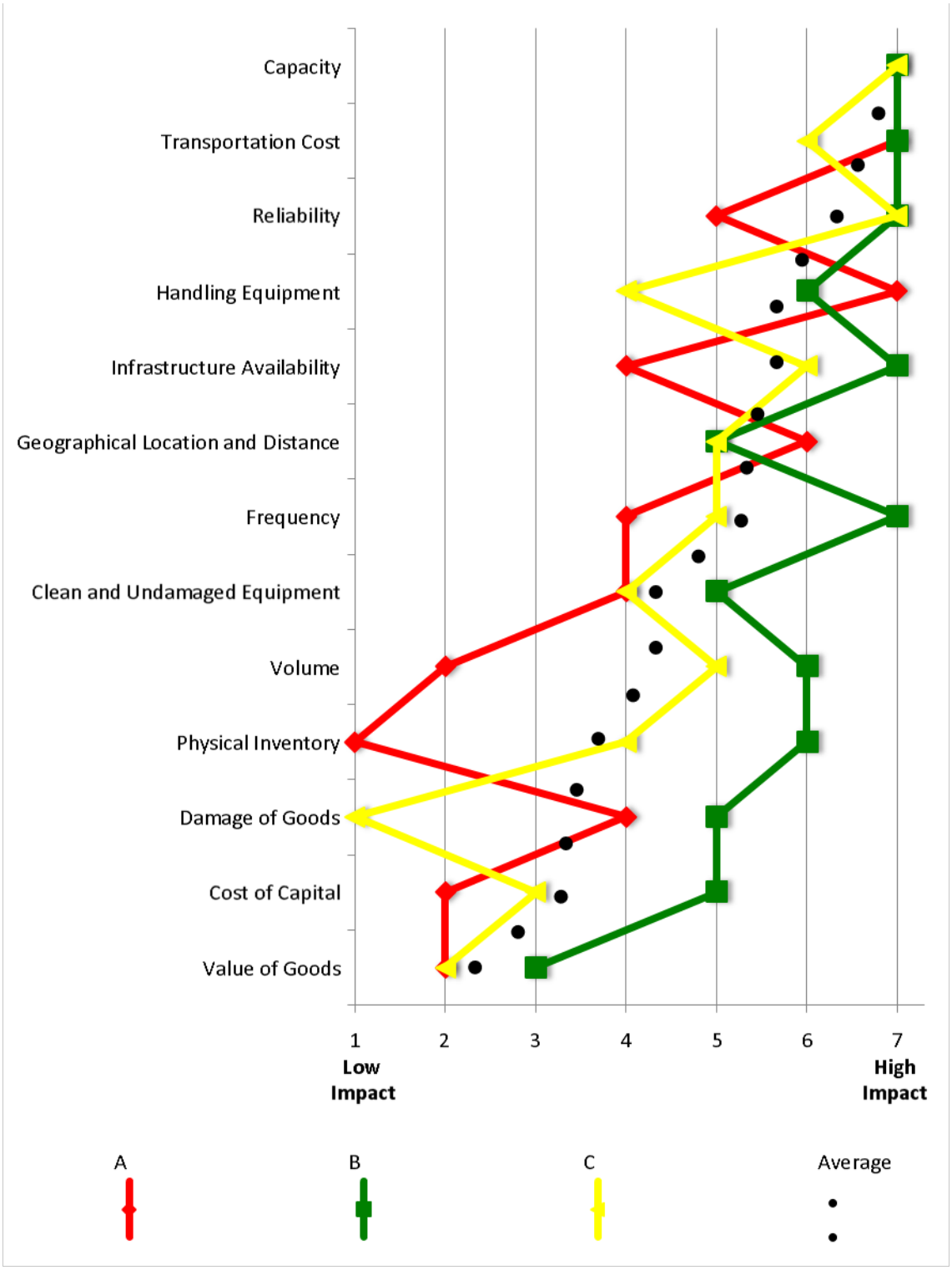

Figure 6.3 illustrates the outcome of ranking for sawn timber

6.2.4 Complimenting comments on the ranked factors

During the ranking of factors, several interesting comments appeared that are vital for this study. In the following section, some short and interesting comments on different factors are represented.

Transportation cost

Company C state that transport cost is essential for choosing transport since the goods are low value products. Company E also explained that logistic costs have a direct impact on the result and profit for each customer order.

Physical inventory

Company C ranked physical inventory as neutral because it depends on if the customer can manage direct deliveries or if a terminal is required. Company D states that their paper mills do not have the capability to manage inventories. Inventory space is rent from subcontractors that operate terminals. All paper is produced to customer order, but paper pulp is produced to stock. Therefore, the company has more inventory possibilities at the paper pulp mills.

Cost of capital

Company A and B state that cost of capital is something they should consider more when selecting transportation mode in the future. Company C, D and E describe cost of capital as very important for production and distribution set up but not for choosing transportation mode. For example, cash flow is measured on the different terminals etc. but not on transportation modes. Company F also states that cost of capital has no impact on the choice of transportation mode.

Reliability

Company D expresses that reliability is the most important aspect among their customers. Reliability as a factor affects the whole distribution set up and how it is designed. Reliability issues have created a need for using terminals. Slot times are different between customers, some want deliveries a specific week while others on a particular day. Moreover, company E expresses reliability as vital for direct deliveries, if goods are transported to a terminal reliability is less important.

Frequency

Company B explains that weekly service are needed, otherwise there is a risk that finished goods inventory and hubs get full. Company C states that frequency is very important for lorry transport but not as important with sea transport, since the company have to plan months in advance. Company D explained that if a customer want high frequency, bulk transportation is not an option. Company E could select a more frequent transportation mode if the customer pays for it.

Capacity

Company A describes capacity and cost as something which is related. If you do not have the needed capacity, it is expensive to buy additional capacity compared to if you would have possess the needed capacity from the beginning. Company C states that capacity is a big challenge, both in harbors and on vessels. Also, it could be hard to get enough trucks after holidays because it is positioned wrong depending on the driver's home location.

Geographical location and distance

Company C explains that geographical location and distance have an impact on the choice of transport. The mills location determines which customers will be supplied. A mill close to a harbor means a good location for export and a mill inland is often used for supplying the domestic market. The company uses all transportation modes from their paper pulp mills, but the receiving location could in some cases make it impossible to use certain modes.

Infrastructure availability

Company E states that congestion starts to be an issue on infrastructure. Congestion in harbors and on roads can make it tough to meet required slot- and lead times. Company A mentioned that the usage of rail transportation has decreased. The reason is due to inflexibility of the mode. If something unforeseeable happens it could take time to solve the problem. The company is located on the east coast of Sweden, next to harbors, which makes sea transportation preferable.

Volume

Company D expresses volume as a factor that has an impact on the choice of transportation mode. Large volumes make rail and sea transportation more appropriate. If the volumes are very large, bulk could be the only option since it might be hard to get enough containers and wagons.

Value of goods

Company C do not consider value of goods when selecting transportation mode since all goods exported are of low valued.

Handling equipment

Handling equipment is not an issue for company E. Company F sees handling equipment as a prerequisite. However, when designing the transportation system, Company E needs to look at what the customer has or does not have, which can influence the choice of transportation mode.

Damage of goods

Company C states that damage of goods appear during handling activities and not during transportation for sawn wood products. Therefore, it is not a factor of importance for choosing transportation for sawn wood products. Company E and F explained that damages have caused them to change transportation mode.

Clean and undamaged equipment

Company C, E and F see clean and undamaged equipment as a prerequisite.

6.3 Why do Swedish exporters of forestry products use different transportation modes to supply a single market?

Using more than one transportation mode to supply a single market is common among the investigated companies. Information stated in this section will answer our second research question. However, it will also be analyzed in chapter seven and covered in chapter nine. Frequently used reasons why the companies' use more than one transportation mode to supply a single market are; transportation cost, volume, products characteristics, customer demand, capacity, frequency and lead time requirements.

Company A has a logistical system that they always prefer to use but exceptions occur. Their logistical system has a fixed route and when goods are transported outside this area it is adapted to the customer order. Factors that influence the transportation mode are volume and product characteristics. For example, if the order is small container transportation is preferred while bulk transportation is beneficial for large orders. However, the products characteristics are affecting the choice of transportation mode as some products require more care and protection than others. Company E adapt what transportation mode will be used depending on customer demand. Furthermore, trucks are used as backup to support their fixed system and to handle variations. Company E mentions that having a fixed logistical system costs a lot of money but at the same time it enables them to secure a certain capacity which is important for them.

Transportation cost and customer demand are reasons why Company B has used different transportation modes to supply a single market. Some customers might only be able to handle cargo in a specific way while others prefer it in a different way. Company B gave an example where both customer demand and transportation cost affect what transportation mode is used.

Some customers require frequent deliveries as they might not have an option to have inventory in the production facility. In these circumstances, Company B transports large volumes of goods to hubs from where frequent deliveries can be made to the customer. It would have been uneconomical to transport large volumes by truck to the hub, instead ocean based transportations are used. Company B adapts transportations to the customer, which leads to different transportation solutions to various customers.

Company F adapt their logistics to customer demand. In some cases, customer demand short lead time for the transportation process which can result in a change from a planned ocean based transportation to a truck transportation. Company D has similar arguments why different transportation modes are used to supply single markets. Reasons are, customer demand and lead time. If the customer wants the goods delivered in a certain way Company D try their best in fulfilling the customers need. When the customer demand short lead times it becomes a challenge to deliver the goods using ocean transportation even if the goods will be transported to an oversea market where mainly ocean transportation is used. Ocean transportation is selected as the preferred mode as it is a cheaper alternative, but a faster mode can be selected if the customer pays for it. In those situations Company D can use trucks so the customer receives the goods as faster.

Reasons for Company C to use different transportation modes to supply a single market are to secure capacity and to meet customer demands on short lead time. As transportation modes have capacity limitations, different transportation modes are needed to make sure that the right capacity is possessed to transport the goods to the customer. The lead time can also affect what transportation mode to used, as the customer can require faster transportation. If it is a big volume, Company C needs to make sure that the receiving location has storage capacity available. Otherwise the company needs to evaluate what transportation mode to use for specific shipments.

6.4 Sales peoples influence on the choice of transportation mode

All companies' agreed that the sales people have some kind of influence when selecting transportation mode, whether it is direct or indirect through the customer. The sales people's job is to sell in the company's products and decide terms of delivery with the customer. Terms of delivery could include how a shipment should be delivered and at what time etc. The logistic department has responsibilities for choosing transportation mode and distributes products according to what is agreed with the customer. The logistic department designs a logistical setup with input from other departments to find an appropriate solution. The sales team does not have any direct impact on the design, but it is through the sales department demands from the customers are made apparent.

Company A, C and E made it clear that they try to educate and improve the sales people's logistic knowledge. The reason is that these companies want to make logistics to a competitive advantage. Transportation cost represents a relatively large part of total cost, small adjustments could have major impact on profits. The sales and logistic department try to have an ongoing dialog to find a good logistic solution for their customers. An aspect that Company C tries to optimize is for example sales volume in order to reach high fill rates in their transports. When backtracking orders, company E explained that it is possible to see if a transport has been driving full or not, only looking at profits.

Company A states that the sales people have an impact for choosing transportation mode. However, the sales people do not use their power as much as they could. In the near future, company A explains that this may change. The sales people will be required to have more knowledge in the area of logistics as it is a big part of total costs and it could help them to gain more from their sales. Traditionally, forestry companies have possessed big logistical systems, which are rather fixed. For that reason, the sales people have had little impact. However, exports have become more globalized and are not as concentrated to the European market as before.

Therefore, the logistical system has changed and sales people need to take a larger responsibility. Company A and E also explain that sales people could be resistant to change logistical set up in some cases. In the printable paper industry where volumes are getting smaller, it is sensitive to make changes because it could result in lost customers. According to Company E, changing processes under pressure can be tough.

6.5 The consignees influence on the choice of transportation mode

The interviews showed that the consignee has an impact on the selection of transportation mode. A customer can have certain demands and requirements, which can have impacts for choosing a specific transportation mode. Some want direct deliveries; others want to pick up the goods in the harbor or from a hub. Another issue could be that the consignee does not handle containers and want to receive the goods with a certain load carrier. Company C explained that the consignee does not choose transportation mode even though they can have preferences. It is vital to adjust to customer needs; otherwise they might look for another supplier.

Before, company E accepted everything the customer said in order to not disappoint them. Now it is more of a conversation and alternatives are presented if it suites the company and their customers better. Company C, D and E are trying to influence their customers to make logistical changes if it could bring benefits for both parties. Company C mentioned that there are ongoing conversations between logistics, sales and their customers to optimize delivery days, in order for the carriers to find return loads and level out transportations. Company D has also noticed some resistance to change logistical set up. If everything works well, it can be hard to motivate a change for the consignee.

Company B explains that the consignee has had little influence on the choice of transportation mode. Previously, the company has not listened enough to the customers demand and needs. Today, the logistical department is part of sales meetings to reach great service to key clients. The goal is to always find the best possible solution for the consignee. Company B has a strategy to make logistics and supply chain activities to a competitive advantage in the sales process.

6.6 Market changes and regulation

Market changes and regulations can have an impact for sales volumes to certain markets. Company C describes North Africa as a market that fluctuates depending on business cycle and political situation. Company B and E state that an ongoing trend is that the market for printable paper is decreasing and will continue to do so. There is still an overproduction of printable paper even though it is starting to stabilize and become better. However, the market for packaging materials is increasing and has a promising future.

Company E has had a hard time competing against competitors on the European continent when volumes for printable paper are decreasing. The reasons are geographical location and distance. Company E experiences longer lead times and higher costs for transportation if compared to their competitors. For solving the extra lead time that occurs, hubs are needed which increase logistical costs. Not only has the market for printable paper decreased, it has also shifted and become more global. Before, Company E wrote long agreements and were more loyal to their transport providers. Due to the competitive situation, it is a challenge for Company E to sell their products unless transportation is carried out efficiently. In the printable paper industry, all actors are selling their paper with the hope of getting higher margins in the future.

Company A and E explain that the SECA directive has affected transportation costs for the Swedish industry. Many actors have been required to revise their logistic system and move some transports to land transportation. The SECA directive is bad for the Swedish industry since it becomes harder to compete against actors that are not affected. Many companies have not noticed this extra cost yet because the oil price has been low during the recent year.

6.7 Logistical trends in the forest industry

Company A stated that the process of containerization is continuing both in short sea and oversea markets. Moreover, Company D has faced issues regarding containerization. New cost factors occurred that the consignee did not have before. The company needed to decide how different costs should be divided between actors. The goods, which were containerized, had been transported using bulk vessels before. The main driver for the change from bulk to container was due to damages. According to Company D, the risk of damages during a bulk transportation is higher since it requires more handling. Traditional bulk markets, as Greece and Turkey are now containerized while North Africa is in transformation. Both company A and D agree that North Africa is not used to containers.

Company C and E discussed that their own logistical system has decreased over the years. Today, fewer vessels are operated in their fixed logistical system. Variations in demand have led to fluctuations in transported volumes. Company C has let the carriers take up this variation, which has caused problems with capacity constraints. The company thinks it would be good to level out transportation and create a more even flow. Much effort has been put on internal processes to optimizing production while distribution has been disregarded. Company C experiences low inventory turnover, which is something they want to improve. If company C can understand their customers' volume, it is possible to make operations planning well and thereby increase inventory turnover and become more efficient.

Company A, C and E believe that logistics will be an essential factor that could give them a competitive advantage against competitors in the future. Company C has already noticed new sales because of their well-functioning logistics. Company A, B and F stated that the demand for delivery precision has increased during recent years. Moreover, company C and E stressed that slot times for delivery have changed from weeks to days and even minutes in some cases. Another logistical strategy that company B has is to reduce stock levels and the amount of hubs to decrease tied up capital. By having direct shipments, it is possible to save money since transshipments and inventory in hubs can be reduced according to Company B.

Company C believes that long term relations will become more important in the future. The number of carriers will probably be reduced since long term partnerships with selected carriers will be established.

7. ANALYSIS

In this chapter, material gathered from literature is analyzed together with the empirical data. The chapter analyses factors affecting the shipper's choice of transportation mode. It is divided up using the same structure as the theoretical model, see Appendix 2, with one supplement of an analysis of the research question, why Swedish exporters of forestry products use different transportation modes to supply a single market.

The world trade is becoming increasingly important and more global. As stated in the background, world merchandize trade has increased with over 80 percent during the last ten years. An enabling factor to the increased trade is transportation.

IET where Seago Line is active is different from inter-continental trade because several transportation modes are possible. In the IET region, ocean-based transportation is not only competing with each other, Seago Line are also competing directly with land-based transportation. Different vessel types exist within the shipping industry and as shown in *Figure 1.3* literature have found an overlap between different vessel types, which means that some goods that are transported by one mean could also be transported by another. During the last decades, the container has experienced a significant journey as described in the industry background. The container revolution has been an important factor of the increased world trade and the container will probably be as important in the future.

There are several transportation modes to choose from and the choice will affect the effectiveness of the entire logistics function of a company, as stated in section 2.3.4. Many of the interviewed companies try to make logistics to a competitive advantage. Theory and empirical data have shown that there are a lot of different factors that influence the choice of transportation mode. Consequently, Company D and E explained that selecting transportation is a complex decision because there is seldom one ruling factor. Factors have to be weighted against each other before a choice of transportation mode can be made. Looking at factors such as price or capacity is one part, but a transport has to be practically possible.

What is important for choosing transportation mode has changed during the years and will continue to do according to the literature. An example is reliability, which has become more and more important in recent years. Market changes, regulations, developments and innovations can make some transportation modes more or less favorable. This means that a factor, which is currently considered as critical, could have less impact in the future.

7.1 Cost

Transportation cost was ranked as the most important factor in two out of the three categories. For sawn timber cost was ranked as the second most important factor. Summarizing the ranking of all the categories would make transportation cost the most important factor for the companies in this study. A reason could be because transportation costs stands for a relative large part of total cost for the forest companies. The products paper, paper pulp and sawn timber are considered as low value goods. Loeteit, Pedersen and Gray (1998) mention that commodities are more sensitive to transportation cost than other products which is clear in this case. In Cullinane and Toy´s (2000) literature content analysis, transportation cost is mentioned in 98,7% of the articles which shows that other literature have stressed the importance of transportation cost as well.

All companies in this study except one have their own logistical system, see *Table 5.1*, a strong reason is to secure needed capacity. Possessing a fixed logistical system is associated with a cost and it is rarely cheaper than buying transport services as stated in section 2.2.4. Looking at the diagrams in *Figure 6.1, 6.2* and *6.3* where the result of the interviews were illustrated shows that transportation cost was ranked higher than capacity in two out of three circumstances which in a way is contradictory to the above. Company B considers all costs associated to the transportation when comparing different modes. Included in all costs to them are handling costs, costs for the

hubs and transportation to and from the terminal. All the other companies had a comparable way to describe transportation cost but all did not possess hubs. The literature described transportation costs in a similar fashion but put more emphasis on cost of capital. The companies in this study consider cost of capital in many of their operations such as, production, finished goods inventory and hubs but not when selecting transportation mode, which could be seen in the ranking in *Figure 6.1, 6.2* and *6.3*. In all three categories, cost of capital is among the last three factors. However, Company A and B state that cost of capital is something they should consider more in the future.

7.2 Logistical Aspects

The companies included in this study, are exporting large volumes of goods especially from Scandinavia. All companies, except Company F, have their own logistical system as just mentioned. The logistical system consist in this case of a rail solution and/or vessels. The theory and the empirical data did have a somewhat similar approach to describe why companies choose to have their own logistical system. Company C expressed themselves as having their own vessels enables them to navigate the vessels as they please, which is a sort of flexibility and a way to have control. This reasoning was supported by the literature. Having your own logistical system could also be a strategy to secure customer service. However, the empirical data showed clearly that the strongest reason was to secure capacity, despite this was not stressed by the literature. However, Meixwell and Norbis (2008) declare that capacity can become challenge if there is a capacity shortage. Capacity was found to be among the top three most important factors in all the product categories that were investigated. The companies export large volumes and have all experienced capacity shortage.

Even though most companies in this study possess a fixed logistical systems they need to purchase logistical services from other transportation providers. According to Company E, a reason is that the market for the forestry products has changed. It has gone from being concentrated to a specific region to become more globalized. Goods are now transported all over the world and not only to the markets close by. The need for a fixed logistical system has decreased, both company C and E have reduced their fixed system in recent years. Consequently, the amount of vessels, especially bulk and container vessels have increased on the market, and the capacity of the vessels has also gone up as could be seen in *Figure 1.2*. Securing capacity is a challenge for the companies in this study. The companies can affect the trade imbalance in the region where they operate. The trade imbalance is a strong reason to why carriers increase their carrying capacity (Lun, Lai and Chang, 2010). Company F´s strategy is to take advantage of the trade imbalance in Scandinavia and especially from Norway. Many trucks are heading to Norway and many of them are empty on its way back to the European continent.

To minimize the risk of not having capacity, Company B is evaluating all their transport providers' financial situation. Company B do not want to be without capacity if a financial crisis or any other situation would occur that could put their transport provider out of business. During the most recent financial crisis in 2008-2009, the volume in the transport industry went down as could be seen in *Figure 1.1*. Hence many carriers were close to bankruptcy. The financial situation of the transportation provider was not found in the literature study but was made apperent during the empirical data collection. Cullinane and Toy (2000) have included capacity as a factor that could influence the choice of transportation mode but it is not seen in any of the articles as a dominant factor that affects the choice of transportation mode. From the empirical data, it was obvious that capacity has a large impact in the modal choice in the forest industry.

The forest industry is quite traditional, if something has worked well, few actors are willing to change. However, a trend in recent years is that actors have started to optimize their logistics and inventories. Limited inventory at the production sites has increased the demand for higher delivery reliability and more frequent deliveries. This is more noticeable in the paper industry compared to the paper pulp and sawn timber as could be seen in *Figure 6.1, 6.2* and *6.3*. To be able to manage frequent deliveries, hubs are used. However, these hubs cost money and ties up

capital. Company B has a clear goal to try to reduce the amount of hubs and by doing so reduce their cost of capital and other fixed costs. Reducing the amount of hubs will require more frequent and direct deliveries to the customers. Not going through the hubs and deliver directly to the customer will in most cases result in longer lead times. Since some customers require frequent deliveries, this can be a challenge. Comparing load carriers and transportation modes, see section 2.2 and 4.2, it is obvious that some load carriers and transportation modes are more favorable than others. The load carriers and transportation modes that can manage door-to-door solutions will have an advantage in this transformation.

Company A discussed that delivery reliability is more important than lead time, as long as the lead time is not too long. Delivery reliability was ranked high in all product categories among all companies. Company A and B mentioned that the reliability has become increasingly important in recent years. Some literature is supporting the statement and delivery reliability is more important than both speed of the transportation mode and lead time (Lumsden, 2007; Tuna and Silan, 2002), while other value speed and short lead time as the most important (Cullinane and Toy, 2000). Moreover, it is important to find a balance between transportation speed and inventory levels as faster modes require lower inventory and vice versa. The use of slow modes can be economically beneficial if the value of the goods is low. The potential savings in inventory costs could be outweighed by the costlier and faster transportation modes.

Flexibility was something that the literature mentioned as a factor to consider when selecting transportation mode. Flexibility can be rather vague and it can be applicable in many different situations. The factor flexibility was not included among the thirteen factors that the participants ranked. However, flexibility was something, which came up during the interviews as factor that the companies consider important. Having a logistical setup that can handle variations in volume and capacity requirements is a form of flexibility. Many of the companies have their own fixed logistical system for a large part of their volumes and purchase additional transportation services from other carriers to manage the variations and to be flexible. Company C has their own vessels and expressed that it enables them to be flexible because adjustments can be made with short notice. Furthermore, the customer can also require flexibility. In some cases, the customer can require products in a short period of time. Thereby, Company C needs to use a fast transportation mode to be able to meet required lead time.

All companies agreed that the sales people have influence when selecting transportation mode. The sales people was not identified by the literature as a factor influencing the choice of transportation mode. The sales people forward the customers preferences but they can also sell in for example the terms of delivery. A clear trend among some of the companies in this study is to change the company's commercial strategy to increase the logistical knowledge of the sales people. The sales people possess more power than what they use. In that sense, the commercial strategy of the company could influence what factors affecting the choice of transportation. For example, the sales people can contract a specific volume or frequency that makes some modes more preferable than others. The customers of the forest companies were also identified from the empirical data as an actor that could influence factors. The customers could have different preferences and requirements that the shipper and carrier are required to meet. For example, some customers require frequent deliveries as they do not possess any storage capabilities in the production facility, while other demand low frequency and large volumes to minimize the handling occasions and some administrative costs. The customer can also demand certain modes, as their production facility is designed to handle goods in a specific way.

Transportations can be seen as a rather simple activity but Enarsson (2006) explain that it can be rather complex. Different relationships, dependencies and competition within different modes make it even more complex. Something that came up during the interviews which was not part of the theoretical model was if the company had an already established logistical setup or if it was a new setup. Editing an existing setup can be complex as dependencies and many other aspects are

influencing what mode that will be used. Making changes in one part of the supply chain can affect other parts. For that reason, it is usually easier to design a new setup.

Companies C, D and F stated that geographical location can make some modes more feasible than others. In general, it is possible to transport goods long distances with truck and rail. But, ocean transportations usually become more beneficial the longer the transport is. Especially when considering the costs. The ranking also showed that geographical location and distance is something the forest companies consider when selecting transportation mode. Both Kasilingam (1998), Cullinane and Toy (2000) state that the geographical location and the distance affect the transportation mode. Long distances can make it more difficult to manage frequent deliveries to the customer.

Different modes require different amount of infrastructure (Jonsson, 2008). Company A, D and E mention that it affects their choice of transportation mode. Company E states that the congestion on roads and harbors make it tough for them to manage lead times. Company A is using less rail transportation due to inflexibility in the transportation mode, while more sea transportations are used since their mills are located next to harbors. Both the geographical location in combination with the infrastructure availability affect the choice of transportation mode. Both road and rail transportation require more infrastructure than ocean transportation, but ocean transportation becomes more dependent on the harbors instead.

The environment is a factor that was included in the theoretical model and mentioned during the interviews. Meixwell and Norbis (2008) state that a recent trend among companies has been to strive to become greener in the eye of the customer. Little research have been carried out in the area of how the environment and the energy usage is affecting the choice of transportation. In general, all companies did care for the environment but it was never a ruling factor when selecting transportation mode. Company B was the only company that stated the environment as one of the aspect they always consider when selecting transportation mode. Many companies stress that it is often a trade-off between transportation cost and the environmental impact when selecting transportation mode, which is similar to what Rahman et al. (2013) discussed in section 2.3.2. A reason why the companies in this study are not considering environment as a ruling factor when selecting different transportation mode could be related to the statement from Meixell and Norbis (2008). None of these companies are a consumer brand and for that reason, it is their customer or the customer's customer that might be striving harder to be greener in eye of the consumer instead.

Market changes and regulations can affect the choice of transportation (Meixwell and Norbis, 2008). An examples is the new SECA agreement, in the Baltic Sea, Kattegat and Skagerrak, which in the future can affect the choice of transportation mode. This agreement was introduced the first of January 2015 and many actors have not understood the impact it will have on transportation costs. Especially since the oil prices have gone down during the period when it has been active. Another example is that the market situation in Northern Africa can influence the modal choice. Company C notes that the volumes in that region fluctuates depending on the business cycle and the political situation.

7.3 Products Characteristics

The size of the products affect the choice of transportation mode. Some products are too big and do not fit in some load carriers. Company D mention large volumes as a risk and to minimize the risk, the company tries to level out production and distribution. Reducing the amount of fluctuations makes it easier to secure capacity, as the need for capacity will be leveled out. Company D prefers to split large orders in smaller volumes to be able to have a more even flow through their production and distribution. Both volume and capacity is related. Since all the companies manage large volumes, securing capacity is important. Company A, D and E described that some modes are more applicable to use if large volumes are to be transported and vice versa. The literature mention for example that if the volumes are big enough to fill a whole vessel then

bulk is the most appropriate alternative. As mentioned in section 6.7 and analyzed in section 7.2 reducing the amount of hubs are contradicting to the previous statement. Reducing the amount of hubs puts a high demand on door-to-door solutions, smaller volumes and more frequent deliveries. For example, in the analyzed situation, containers would be more favorable than bulk. Cullinane and Toy (2000) mention that volume can affect the choice of transportation mode but none of the articles included in their study had volume as a dominant theme. During interviews, volume was ranked among the factors with the lowest influence in all product categories, while capacity was ranked high. However, the answers were quite scattered, some answered a six while other answered a one, which shows a big difference among companies in the same product category.

Products with lower value can benefit from slower transportation modes (Kiesmüller, De Kok and Fransoo, 2005). Low value products are more sensitive to transport costs, especially since transport costs could be a substantial part of the total product cost. Jonsson (2008) states that container transportations are appropriate for medium value goods while bulk transportations are suitable for low value goods. The empirical data showed that transportation cost was ranked as the most important factor. This implies that the transportation provider need to provide low transportation cost for the Swedish forest industry to be attractive. The value of the products included in this study is quite low and for that reason, the value has a very little influence in what transportation mode that is selected. Value was ranked among the lowest factors in all categories. However, profitability of the product can in some cases influence the choice of transportation mode according to Company D. It is more likely to use a faster transportation mode to products with higher profitability.

Some parts of the paper industry, especially printable paper, is competitive where the volumes decrease and the profitability is low. In these situations, many actors are unwilling to change. Company E mentions that potential improvements and changes to a different transportation setup are challenging to communicate in tough situations. In section 2.1, it is stated that it is important to look over the entire supply chain and its performance. Stadtler and Kilger (2008) elaborate that it is the actors in the supply chain that are responsible for being as competitive as possible. Moreover, to make the supply chain as competitive as possible it is important that processes are not sub-optimized for a single actor, instead it should be optimized for the entire supply chain. Increasing the profitability for the entire supply chain will not only make all the players in the supply chain more profitable, it will also make the supply chain more competitive (Chopra and Meindl, (2012). Taking this into consideration, it is important to have a dialog with members in the supply chain to increase the total profitability and competitiveness.

7.4 Cargo Care

The literature stated that a relatively high percentage of products that reaches the shelf are damaged during supply chain activities. The companies ranked the factors damage of goods as well as clean and undamaged equipment high for especially two of the product categories. For both paper and paper pulp, the two factors were ranked among the top factors in comparison with sawn timber where these factors were among the lowest. Company D has changed transportation mode due to damages. Both Tuna and Silan (2002) and Matear and Gray (1993) state that delivering cargo without damage is a factor that the shipper considers important when selecting transportation mode. Tuna and Silan (2002) also mention that providing clean and undamaged equipment is important in the selection of transportation mode. All companies mention that having clean and undamaged equipment is a requirement when selecting transportation mode. Even though company F ranked damaged of goods and clean and undamaged equipment as a three, while others a six or seven, they still believed it is important. Company F has chosen other transportation providers due to damages and they consider clean and undamaged equipment as a prerequisite. This also shows that companies within the same product category value specific factors more than others. Both damage of goods and clean and undamaged equipment are somewhat related, as clean and undamaged equipment could prevent the amount of damages, as some products will get damaged if exposed to certain environments. Security was mention as

important to consider in the literature but none of the interviewed companies mentioned security of the goods as a factor that affect the modal choice. A reason could be that the products have a low value and are not attractive in that sense. Another reason could be that many of the products are not consumer products and therefore it could be difficult to find any usage outside its main purpose.

7.5 Service and Administration

According to Company C and D, previous experience is a factor that in many ways can influence the choice of transportation mode. Company C also states that personal relationships can influence the choice of carrier and indirectly also the transportation mode. Their goal is to reduce the amount of transportation suppliers in the future and have closer partnerships with a few selected suppliers. The literature has a similar approach when describing how previous experience and relationships can influence the choice of transportation mode. For example, Liberatore and Millier (1995) suggest that delivering high customer service is a strategy to develop and facilitate long term relationship and partnership. Lumsden (2007) discusses the importance of finding a balance between the cost of the product and the service level towards the customers. High customer service is costly and should be reflected on the revenue. Comparing this to what Company D mentioned about profitability of the product, more profitable products are more likely to be transported in a faster transportation mode.

To minimize the amount of problems, it is important that documentation and other information are correct. Both Company A and D agreed that it is important that the documentation is correct. Tuna and Silan (2002) argue that clear and correct documentation and invoicing can reduce the amount of surprises. Company B stressed the importance of having carriers that deliver information and invoices electronically though EDI. Using EDI can improve efficiency and reduce the amount of errors, which will make the documentation and invoices more accurate.

7.6 Why do Swedish exporters of forestry products use different transportation modes to supply a single market?

Referring to what Ismail (2008) stated in section 2.2, carriers usually utilize one transportation mode. If shippers want to use more than one transportation mode, they usually need to contract several companies. One of the research questions in this study was why Swedish exporters of forestry products use different transportation modes to supply single markets, which was answered during the interviews. Strong reasons why the companies are using different modes are transportation cost, volume, product characteristics, customer demand, capacity and lead time. All factors have been analyzed as factors that affect the choice of transportation mode earlier except customer demand. Customer demand or preferences have not been identified as a factor, from the theory, that affect what transportation mode that is selected. However, during the interviews it was obvious that the customer demand is influencing what transportation mode that is selected. In the future, the demand for several transportation mode might decrease, since a potential trend is that companies are building long term partnerships with fewer transport carriers which was analyzed in section 7.5. Fewer transport carriers can also result in fewer transportation modes as different carriers usually are specialized in single modes. But due to the large volumes several transportation modes might be required to secure the capacity.

8. FRAMEWORK FOR SELECTING TRANSPORTATION MODE

In this chapter, three different frameworks will be presented, one for paper, paper pulp and sawn timber respectively.

The frameworks could be seen in *Figure 8.1, 8.2* and *8.3* and components included in the frameworks are described in the following sections. The Frameworks have been developed with the help of our theoretical model, see Appendix 2, together with inputs from interviews with six different companies within the Swedish forest industry. Our frameworks contribute to the academia by presenting factors which are important for selecting transportation mode among Swedish exporters of forestry products. The frameworks are a result of a literature study and an empirical data collection, using both qualitative and quantitative methods.

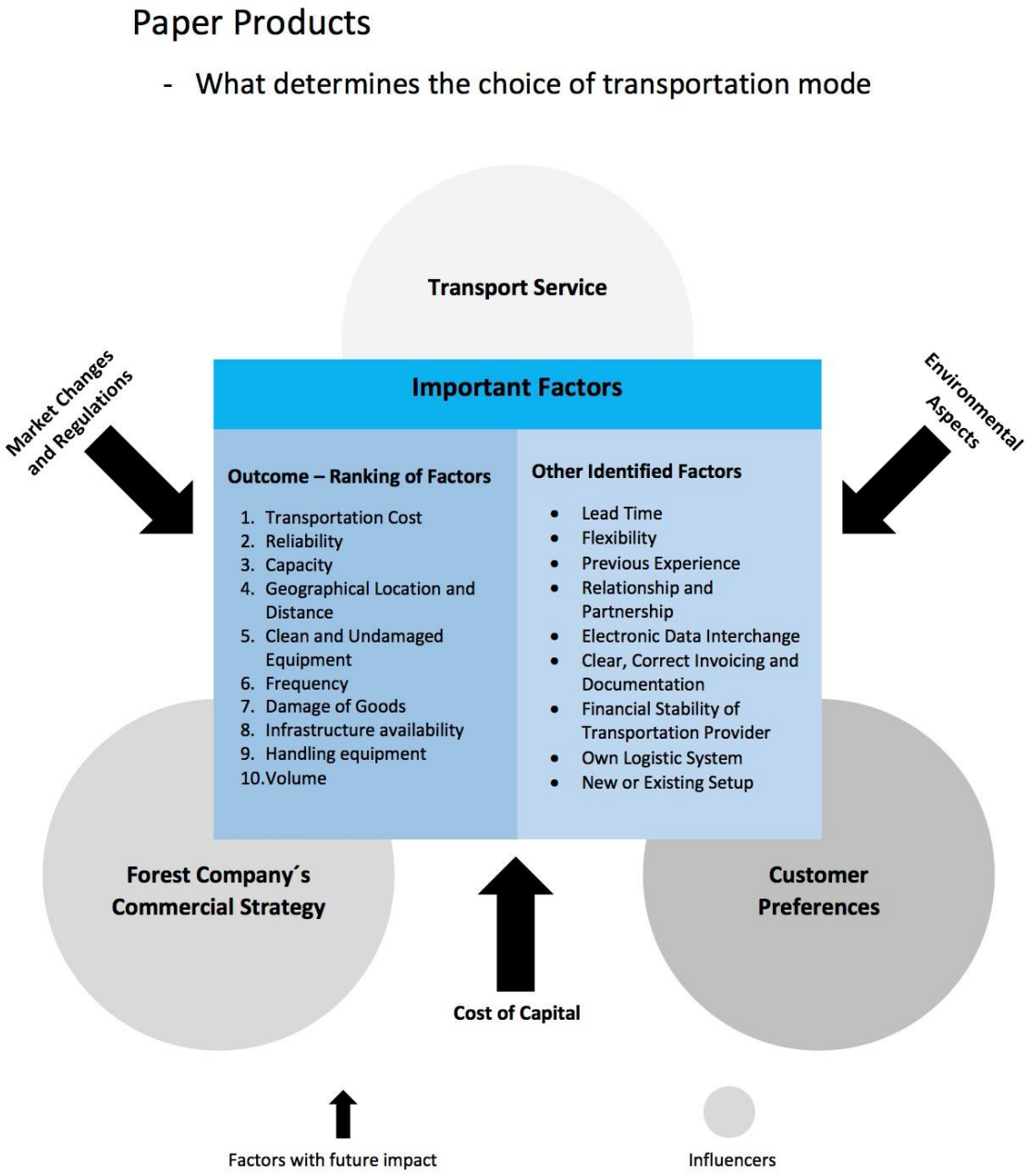

Figure 8.1 illustrates what determines the choice of transportation mode for paper products.

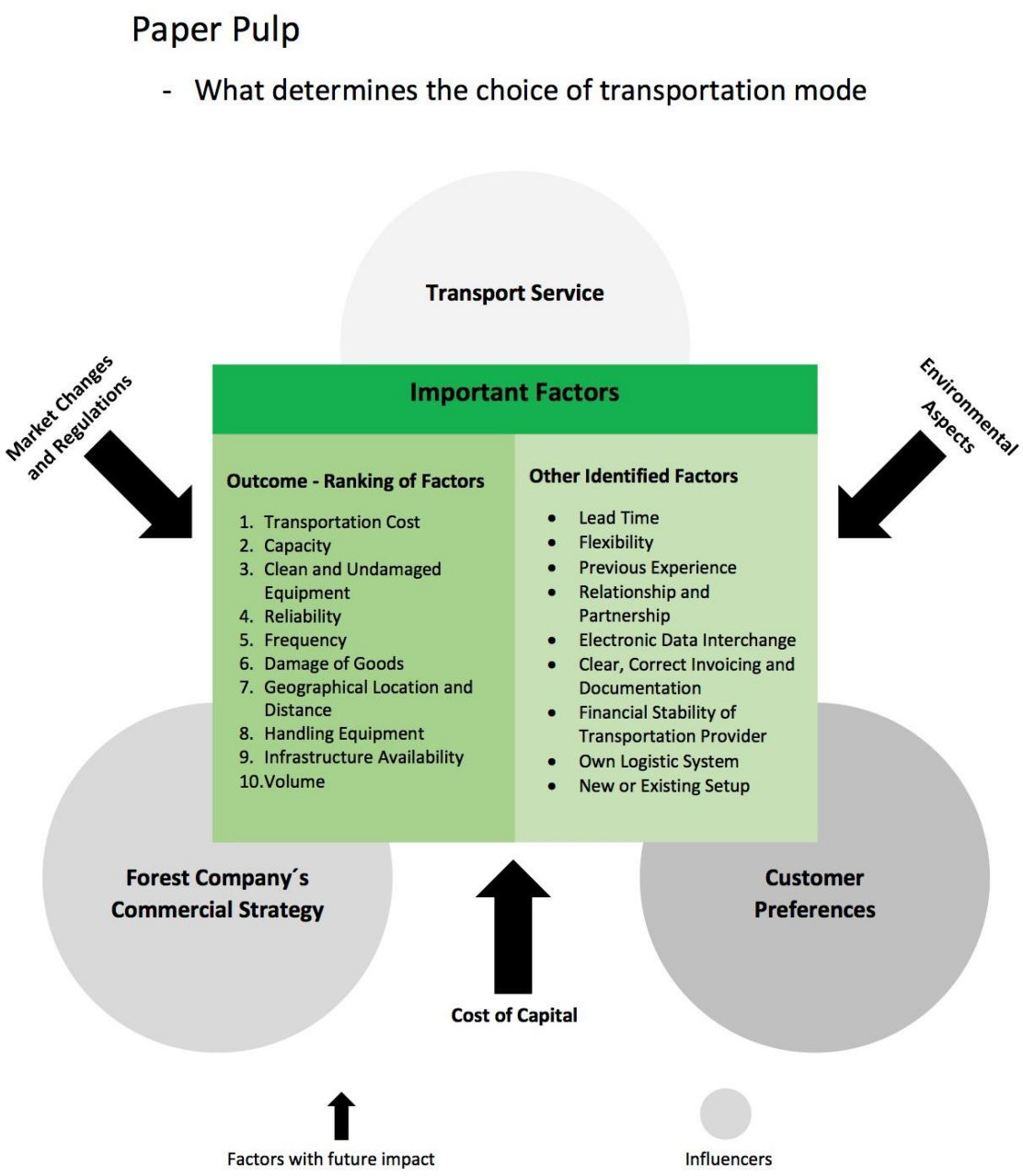

Figure 8.2 illustrates what determines the choice of transportation mode for paper pulp.

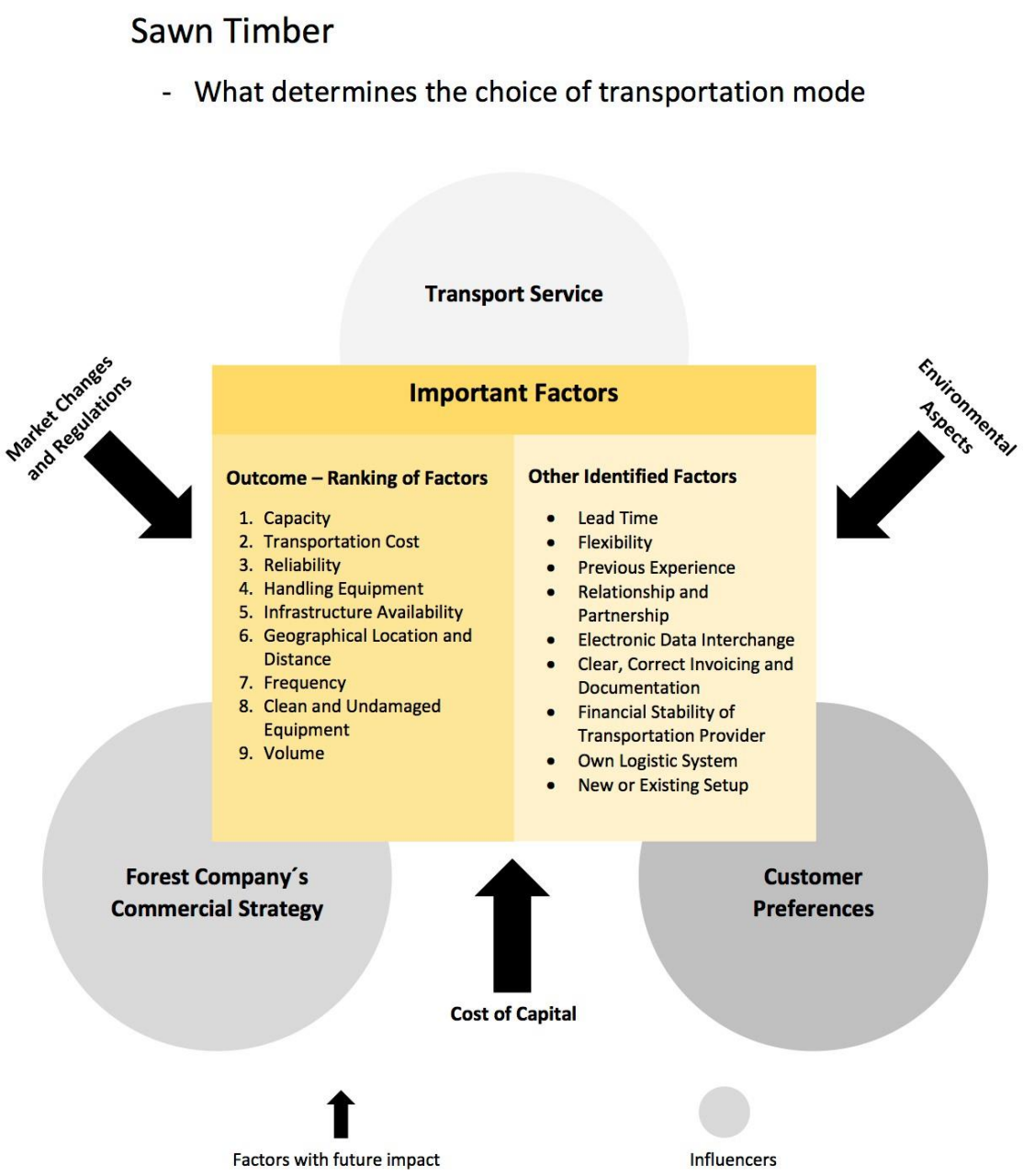

Figure 8.3 illustrates what determines the choice of transportation mode for sawn timber.

8.1 Important factors

The study has shown that several factors have an impact on the choice of transportation mode and these factors have to be weighted against each other to find the best option. Factors of importance are presented in the subheadings, outcome of ranking and other identified factors.

8.1.1 Outcome of ranking

Out of the 13 factors, which were ranked during the interviews, nine to ten factors were shown as important for selecting transportation mode. Three to four factors were ranked lower than four, which implies that the factor have little impact when choosing transportation mode. Only the factors, which were ranked higher than four in average are part of the framework for selecting transportation mode. Factors within outcome of ranking are presented in numerical order to demonstrate what the companies thought was most important. Number one was shown as most

important, while number ten was less important. In *Figure 6.1*, *6.2* and *6.3* diagrams are illustrating the ranking of factors. The ranking of factors had different outcome depending on which kind of product that was ranked. Therefore, the outcome of ranking differs depending on the product categories, paper, paper pulp and sawn timber. All the factors, which were part of the ranking, are also part of the theoretical model presented in Appendix 2.

8.1.2 Other identified factors

In addition to the factors presented in outcome of factors, nine other factors were identified as important for selecting transportation mode. Six out of these factors were part of the theoretical model and were also shown to be important in the empirical data. The last three factors, financial stability of transportation provider, own logistic system and new or existing setup, were not part of the theoretical model but was shown to have a major impact from the interviews. The nine factors were not ranked during the interviews which makes it difficult to have a similar grading as in outcome of factors. The factors are presented in bullet points to indicate their importance without stating which one is more important than the other.

8.2 Factors with future impact

Three factors that were part of the theoretical model and mentioned during the interviews are presented as factors with future impact. These factors could not be regarded as important factors, but will certainly have an impact on the choice transportation mode in the future. Companies in this study do not consider cost of capital when selecting transportation mode, even though it is an important factor for production and inventory management. The empirical study showed that environmental aspects are something the companies consider, but there are other factors that are more important. Therefore, environmental aspects are not part of the important factors but it could be in the future. Market changes and regulations are other factors which are part of factors with future impact. It could for example be new regulations such as the SECA agreement or fluctuations in the business cycles in certain regions.

8.3 Influencers

Influencers were identified during the empirical data collection. Influencers were made apparent during the interviews and are represented as transport service, forest companies commercial strategy and customer preferences. The influencers were not part of the theoretical model, but have an indirect impact on the selection of transportation mode. The reason is that they influence factors in the framework. For example, the customer can have preferences when it comes to delivery frequency and volume.

8.4 How can Seago Line benefit from these frameworks

The frameworks have been developed to increase Seago Lines knowledge of what the shippers consider when selecting transportation mode. The shippers are in this case more specifically Swedish exporters of forestry products. The forestry products focused on are paper-, paper pulp- and sawn timber products.

The frameworks are intended to be used by sales people and other market oriented positions that could benefit from having a good knowledge about what the shipper value depending on what type of products they are about to transport. The outcome of the ranking clearly indicates what is important for each product category. Having this knowledge can enable Seago Line to better understand and support their existing and future customers. According to the theory, it is crucial to have a good understanding of current and future customer's needs, otherwise it is a big risk that volumes are lost to competitors. It is important to understand that selecting transportation mode is a complex task and it is seldom one factor that influences the choice.

These frameworks are created to illustrate what factors the shipper takes into consideration when selecting transportation mode. Other identified factors are not ranked, which is important to take into consideration. Therefore, how much impact these factors have could not be obtained from

this study. However, the study has showed that the factors have an impact on the choice of transportation mode. The factors with future impact have low impact today, but will probably be more important in the future. It is vital to have these factors in mind to act proactive in the selling process. It is also important to know that companies are different, which are illustrated in the *Figure 6.1, 6.2* and *6.3*. Moreover, the influencers can have different levels of impact on important factors depending on companies involved and transportation occasion.

It can be a challenge to be the best possible transportation supplier when it comes to all factors mentioned in the framework. For that reason, it is important to carefully select what factors Seago Line can be most competitive with during the negotiation processes. Usually, some modes are more favorable than others depending on what factors the shipper value the most. The carrier's goal must be to first understand these factors and thereafter sell in their transportation solution in the best possible way, by looking at what factors they can satisfy the most in each negotiation process. For example, if Seago Line could provide the shipper with a satisfactory transportation cost or possess the capacity to meet large volumes and fluctuations in demand it is vital that it is reflected in their sales approach. Therefore, in every negotiation process, it is crucial to evaluate what the carrier can provide to exceed the shippers high demand on transportation.

Using these frameworks could lead to an increased market share for Seago Line and the container industry. The shaded area in *Figure 1.3* illustrates a potential for the container industry. This framework could be a great asset for Seago Line to explore the potential and capture market shares. This framework could be used for all types of carriers and it is not only intended for the shipping industry. However, it is specific for the Swedish exporters of forestry products.

9. DISCUSSION

In this chapter, our results, selected methods and the quality of our study is discussed.

Our first research question has been covered in many parts of this report. First, a literature study was made about the topic and empirical data was collected. The research question was covered in the analysis in chapter seven and later frameworks were developed to visualize the results, which are presented in chapter eight. Our second research question is very specific for the forest industry and little research was found in the area. Answers to this question are based on empirical data presented in chapter six, but the question was also covered in the analysis in chapter seven. It was obvious that companies in the forest industry use several transportation modes to supply single markets. Reasons why the companies use more than one transportation mode to supply a single market are; transportation cost, volume, products characteristics, customer demand, capacity, frequency and lead time requirements.

The empirical study showed that transportation cost was considered most important. According to the literature study, transportation cost is very important and it was therefore not a surprise that it was ranked high in our study. Products are of low value and therefore transportation cost represents a relatively large part of total costs. Capacity was identified as the second most important factor among the interviewed companies. None of the studied articles mentioned capacity as a ruling factor, even though theory mentioned that capacity could be a challenge if there is a shortage. However, the Swedish forest industry exports large volumes and all companies have experienced problems with securing capacity. For us, it was a surprise that capacity was ranked as the second most important factor. The reason is that we did not really understand the volumes these companies export. Moreover, reliability was ranked as the third most important factor. The literature suggests reliability as important and the companies expressed that the demand for reliability has increased in recent years. The impotence of high delivery reliability was expected, which is supported by literature and empirical data.

Several methods have been used to achieve the results and generate findings of our research. A mixed method approach has been used. The qualitative data collection was carried out by asking open questions where the participants had the opportunity to explain their views. The qualitative data collection was more open for interpretations by the researchers. The researcher´s personal opinion can have influenced the result of the qualitative research. However, the researchers' of this study have not had any personal winning for writing the report, which makes the result more valid. Moreover, all data collection have been obtained by two researchers, which have reduced issues regarding interpretations mistakes. Participants for this study were carefully selected to ensure that people involved had the desired knowledge. It is our view that all participants in this study are accurate, could be trusted and credible, which ensure the validity of collected data and result.

The result of a quantitative research is easier to reproduce since no personal interpretations can affect the result. The participants ranked 13 factors without any influence by the researchers. The participants were also contacted after the interviews to get the opportunity to update their answers, if needed. Having the opportunity to adjust the answers makes the result more reliable. One company used this occasion to update their answers. A drawback in the quantitative data collection has been that all factors from the theoretical model were not ranked during interviews. It would have been difficult to let the participants rank 38 factors for two reasons. There was limited amount of time and we did not want to affect the quality of the qualitative data collection. Although a survey could have been used to rank the 38 factors we wanted to ensure the quality of the data collection and a good underlying understanding of the factors. We wanted to receive the participant's direct comments and enable a discussion about factors. However, we believe that for further research a survey would be a good way to validate and complement our result since it is a way to reach out to a wider population.

Since varying data collection methods have been used together with relevant theories, it has been possible to highlight the studied area from different angles, which increases the results reliability and validity. The researchers' of this study have also remained objective during the interview and when processing the data. All information in the report has been critically evaluated to ensure that it is reliable and relevant. All interviews have been voice recorded in order to have the possibility to go back and check details or listen again, if anything was unclear. By using the mixed method approach, it was possible to understand what factors the forest companies think are important when selecting transportation modes. The quality of the empirical data collection has been ensured by first asking the participants what they consider important when choosing transportation mode. Secondly, 13 factors were discussed and ranked. Finally, the participants got the opportunity to add additional factors in the end, if new ideas appeared.

We have conducted seven interviews with six large exporters of forestry products. Five of these companies export paper, four paper pulp and three export sawn timber. Therefore, one could argue that the information gathered about paper is more reliable compared to sawn timber, since the sample is larger. However, a mixed method approach have been used to get a deep understanding of what the shipper consider important when selecting transportation mode. We believe that we have had enough information to draw the conclusions and create three frameworks where our findings are presented. We have been able to secure the quality of the study by finding participants with senior positions and great knowledge in logistics and transportation for the Swedish forest industry.

10. FURTHER RESEARCH

In this chapter follows our recommendation for further research in the studied area.

During our study, several factors have been identified as important when selecting transportation mode. Most of the factors could be found in the theoretical model, see Appendix 2, while a few were identified during the empirical data collection. Some of these factors have been ranked, which clearly indicate how important the factors are for the selected product category. Since all factors are not ranked, it could be difficult to know how important some of the factors are in relation to the ranked factors. Three factors did not belong among the important factors, these were classified as factors with future potential. Two of them are market changes and regulations as well as cost of capital. Company B mentioned during the interview that it would be a great master thesis for some students to conduct a study of how cost of capital could impact the choice of transportation mode. Environment was the third factor with future potential and it was mentioned in the literature as a factor, which is not well covered in the transportation choice literature. Three influencers were also found in this research. However, it is still unknown how much the influencers affect the factors and if there are some specific factors they affect more than others. Hence, recommended further research would be to complete the frameworks so that all factors are ranked, also to study what factors the influencers affect and in what way. Further, how the environment and cost of capital affects the choice of transportation mode.

It would also be interesting to find out if the ranking would differ depending on the size of the company. Some factors might be more relevant for larger companies while others might be more important for smaller or medium sized firms. Moreover, from both the theory and the empirical data collection it was clear that the transportation mode selection process is a complex task. There are several factors influencing the choice of transportation. Further research in this topic could evaluate if there are any factors that are linked together i.e. that relationships could be found between some factors. For example if a company value a specific factor then the probability that the same company also value other factors is high or low.

This framework is developed for the Swedish forest industry and especially for paper, paper pulp and sawn timber products. These products are seen as low value goods. Therefore, it would be interesting to find out the framework is applicable in other industries and for products with higher value for example the Swedish steel industry.

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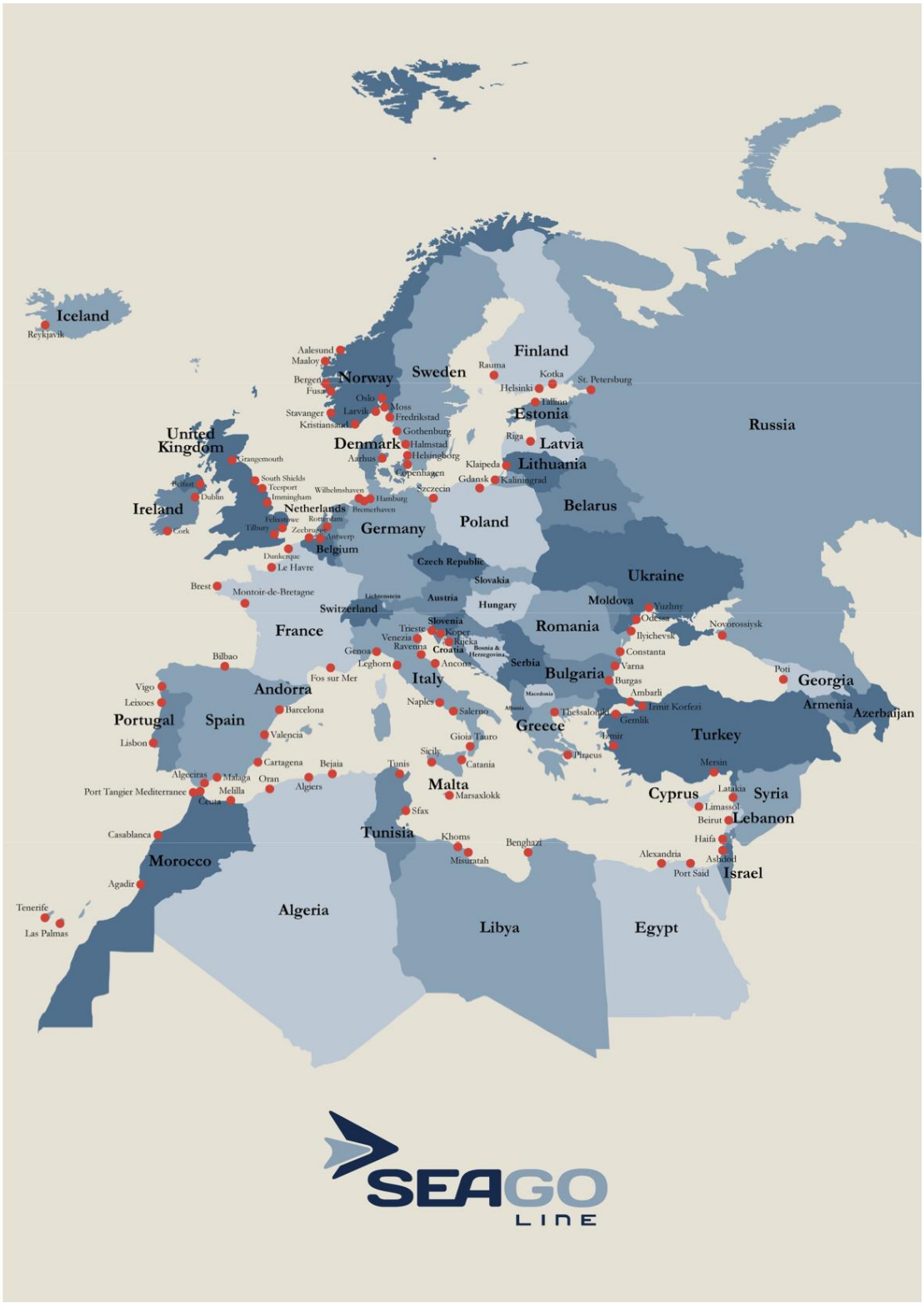
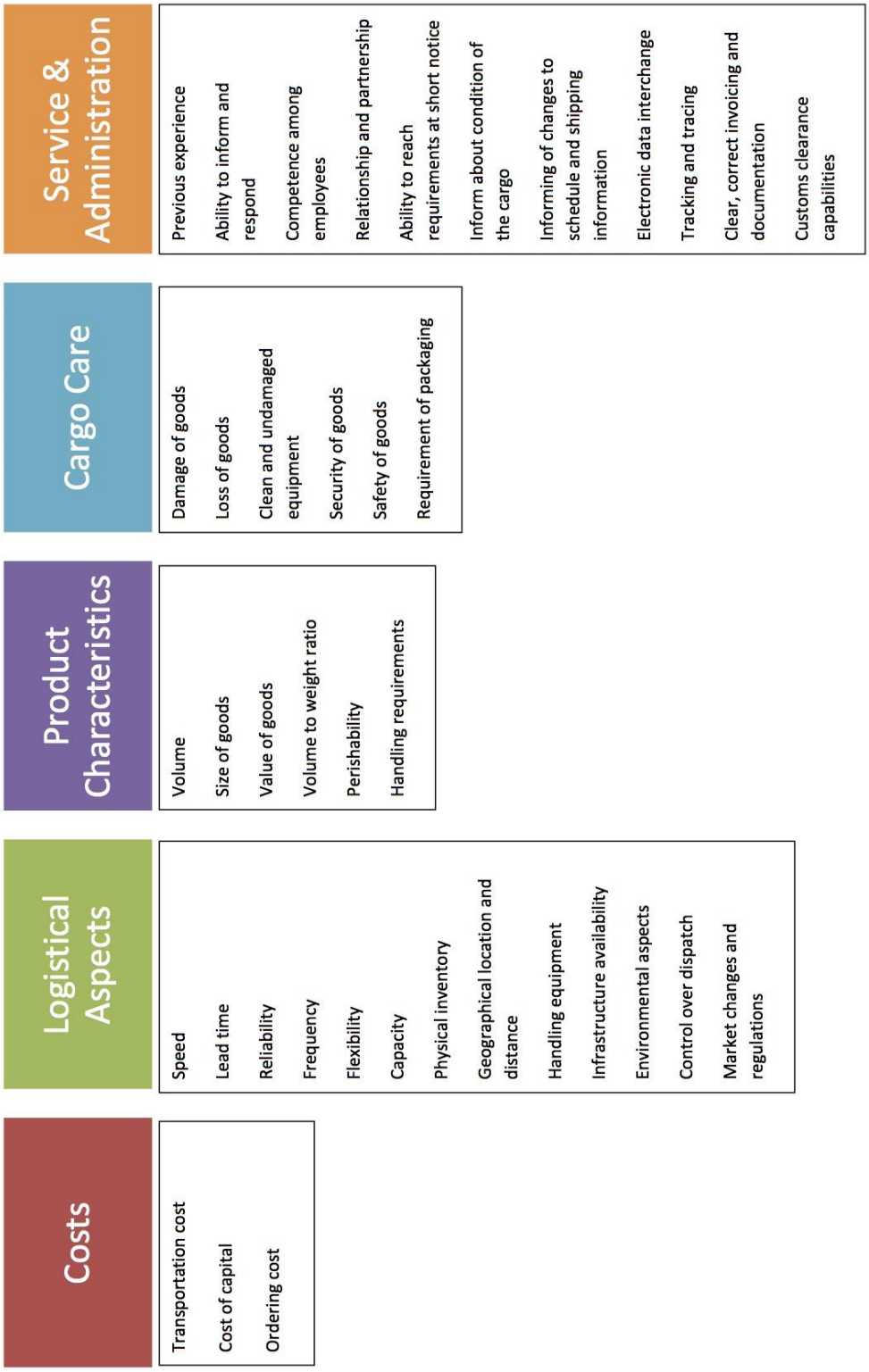
APPENDICES

Appendix 1: Countries where Seago Line operates.



Appendix 2: Theoretical model of factors that influence the choice of transportation mode.



Appendix 3: Interview questions.

- **What type of products do you export?**
- **Where do you export your products?**
- **Which transportation mode do you use for your products, in the region of Mediterranean Sea (including North Africa and Middle East)?**
- **Do you supply single markets using different transportation modes? If yes, why?**
- **What do you consider as important when selecting transportation mode for these products in this region?**

The following questions will be evaluated on a scale from 1-7. 1 accounts for low impact, 4 equals to neutral and 7 means that the factor has a high impact on the choice of transportation mode.

The factors below are stressed by the literature as important when selecting transportation mode, on a scale from 1-7, how important are these factors for you and your organization?

1. ***Transport cost***
2. ***Physical inventory***
3. ***Cost of capital***
4. ***Reliability***
5. ***Frequency***
6. ***Capacity***
7. ***Geographical location and distance***
8. ***Infrastructure availability***
9. ***Volume***
10. ***Value of goods***
11. ***Handling equipment***
12. ***Damage of goods***
13. ***Clean and undamaged equipment***

- **Do your sales people have any impact in the choice of transportation mode?**
- **Does the consignee have an influence on what transportation mode to select?**
- **Do you consider any other factors as important that we have not covered?**