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The impact of the Fehmarn Belt link on modal choice

An investigation of potential modal shift on Sweden's foreign trade

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Abstract

The construction of the Fehmarn Belt tunnel is a part of the European Union programme called TEN-T. A programme with the objective to connect the EU member-states in a comprehensive network consisting of road, rail, air and water infrastructure. The tunnel is expected to be operational in 2028, and the outcome will probably impact the freight flows. The objective of this study is to investigate whether a shift of current shares between the transportation modes road, rail and sea will occur once the Fehmarn Belt tunnel is operational and identify potential barriers in the surrounding infrastructure and cross-border traffic. The route between Sweden and European countries located south of the Fehmarn Belt link is the focus. The study is performed through a qualitative method with an explorative approach and interviews with persons in leading positions at Swedish freight forwarders and transport companies have been completed. A literature review is presented in the study as well. The study indicates that determining factors for modal choice is likely to be improved differently for each mode of transportation as a result of the Fehmarn Belt tunnel completion. It is suggested this will affect and contribute to a moderate shift of the current shares between the modes of transportation investigated. The main findings imply that the rail mode is likely to gain shares, the maritime mode is likely to lose shares while it is difficult to foresee changes for the road mode. There are however some uncertain factors that may affect the outcome of the tunnel, such as the user fee and future improvements in the surrounding rail infrastructure.

Key words: Cross-border barriers, Fehmarn Belt tunnel, Intermodality, Modal choice, TEN-T

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Glossary

Cross-border traffic = Transports that cross one or several national borders.

Fehmarn Belt fixed link = An 18-kilometre-long road and rail tunnel under construction between Lolland in Denmark and Fehmarn in Germany. Planned to be completed and operational in 2028.

Freight forwarder = Someone that organizes shipments for other companies, often by contracting carriers to move the goods.

Intermodality = An integrated transport system which allows at least two different modes of transportation to be used without any handling of the goods itself, for example by using a container or a trailer.

Rail operator = A business who carries out freight transports by rail.

Shipper = The consignor. The party who hands over the goods to a carrier.

Short sea shipping = A term for a maritime traffic on a relatively short distance. Opposed to Deep Sea Shipping which is intercontinental maritime traffic.

Tonne-kilometre = A freight transport measure unit. Represents one tonne of goods transported over a distance of one kilometre.

TEN-T = Trans-European Transport Network. A planned network initiated by the European Commission that coordinates improvements of roads, railways, waterways and airport infrastructure within the European Union.

TEU = Twenty-foot Equivalent Unit. A unit of measurement used to describe capacity for container transportation.

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1 Introduction

This chapter provides a general introduction to the thesis and the research area. It provides the reader with a basic understanding of the problem intended to be researched before introducing the purpose and research questions of the thesis.

Transportation systems are key to economic development and welfare for entire countries and regions. Efficient transportation systems provide multiple opportunities for firms and private citizens, it connects regions and facilitates trade as well as providing labour and work opportunities. Indirect positive effects can benefit entire regions connected to the systems. At the core of every transport system is the transport infrastructure and due to its impact on trading patterns and development, it is a widely discussed topic. (Rodrigue et al., 2013)

The Trans-European Transport Network (TEN-T), is a program from the European Commission with the objective to connect the EU member-states in a comprehensive network consisting of road, rail, air and water transport (European Commission, 2020a). Moreover, the European Commission is working towards a more sustainable future, thus several initiatives have been launched during the last 20 years with the ambition to reduce emissions from the transport sector, more specifically by incentivising a modal shift from road to rail and water transport (DG MOVE, 2019). Despite these initiatives from the European Commission, the distribution between the main modes of transportation within the EU has seen little change over the last decade where road accounts for approximately 75% of freight transports measured in tonne-kilometres (Eurostat, 2019).

One major infrastructure project under construction is the Fehmarn Belt fixed link which is an under-water tunnel that will connect Rödby in Denmark to Puttgarden in Germany. The 18-kilometre-long tunnel will have two electrified rail tracks and will allow motorists to travel at high speed in both directions on the four-lane motorway. The tunnel is intended to open in 2028 and the cost of the project is budgeted at DKK 52,6 billion (Femern A/S, 2020a). The Fehmarn Belt fixed link will be a part of the Scandinavian-Mediterranean corridor in TEN-T, which has long been considered a missing link. It will likely have an impact on existing freight flows and improve the possibility of freight transports between Scandinavian markets and the central parts of Europe (European Commission, 2020b). From a Swedish perspective, the tunnel will

significantly increase the transport options to one of its major trading partners, Germany (Green String Corridor, 2014). Other than Germany, several European countries located south of the Fehmarn Belt are important trading partners to Sweden both from an importing and exporting perspective as displayed in table 1 (SCB, 2020a; SCB 2020b). Once the tunnel is operational from year 2028 and onwards, it will likely have an impact on contemporary freight flows between Sweden and mainland Europe. However, the tunnel in isolation might not be enough to change current transportation patterns significantly as many other factors such as hinterland infrastructure and regulations are of massive importance too.

Table 1. *Sweden's top fifteen trading partners in 2019 in terms of value. Presented as a percentage of total trade.*

EXPORT			IMPORT		
1	Germany	10,4%	1	Germany	18,1%
2	Norway	10,2%	2	The Netherlands	8,9%
3	USA	7,9%	3	Norway	8,4%
4	Finland	7,0%	4	Denmark	6,8%
5	Denmark	6,8%	5	China	5,4%
6	United Kingdom	5,6%	6	United Kingdom	5,0%
7	The Netherlands	5,5%	7	Finland	4,9%
8	Belgium	4,4%	8	Poland	4,3%
9	China	4,4%	9	Belgium	4,2%
10	France	4,3%	10	France	3,8%
11	Poland	3,5%	11	Italy	3,3%
12	Italy	3,0%	12	USA	2,6%
13	Spain	2,0%	13	Russia	2,4%
14	Japan	1,6%	14	Czech Republic	1,6%
15	Russia	1,2%	15	Spain	1,4%
	SUM	77,9%		SUM	81,2%

(Modified from source: SCB, 2020a; SCB, 2020b).

1.1 Problematisation

History confirms it is hard to predict the impact that infrastructure investments will have on traffic, especially regarding fixed links connecting different countries such as road and rail passages. The traffic forecasts have often been inaccurate where expert panels have overestimated the impacts of the fixed links, meaning that the traffic along the links have been less than expected (Flyvbjerg et al., 2005). One example when the demand forecasts were overestimated was in the case of the Channel Tunnel between UK and France, the forecasts for rail freight were off which ultimately forced the decision makers to lower the price for the rail operators (Winch, 2013). In the case of the Öresund Bridge which opened in 2000 and connects Denmark and Sweden, forecasts for lorry traffic were overestimated and passenger traffic underestimated during the first years of operation. The competing ferry routes between Sweden and Denmark were expected to lose significant volumes as the Öresund Bridge opened but the decline turned out to be nowhere near the estimated figures (Knowels & Matthiessen, 2009). The inaccurate traffic forecasts are generally a result of several factors in combination, where it is hard to ascertain the most significant ones, Knowels and Matthiessen (2009) express how the expert panels making forecasts usually lack relevant historical infrastructure projects to learn from. Further, they warn that forecasts might be too optimistic as they are usually conducted by individuals with an already positive inclination towards the infrastructure projects. Regardless of the reasons, the researchers conclude that it is hard to foresee detailed impacts that infrastructure projects will have on traffic.

With the introduction of the Fehmarn Belt fixed link, road and rail transports between Sweden and Germany will take less time. For example, the travel time for rail between Hamburg and Copenhagen will be reduced to 2.5-3 hours compared to today's 4.5 hours. A truck can drive through the tunnel in 10 minutes compared to today's ferry which takes 45 minutes plus waiting time, this would change the travel time between Hamburg and Copenhagen from approximately 4.5 hours to 3.5 hours (European Commission, 2020b; Tentacle, 2018a). With the decrease in transport time via rail and road between Sweden and Germany, it is likely going to change contemporary freight flows between Sweden and a majority of mainland Europe. However, it is not clear how the freight flows will be impacted between Sweden and European countries south of the Fehmarn Belt tunnel as the decision of transport mode rests upon many different factors. A shipper has several aspects to consider once deciding on which mode of transports to

use, Curty et al. (2011) lists several factors that needs to be taken in to consideration, for instance; time, cost, flexibility, capacity, frequency, emissions and noise to name some of the most important ones. These factors align with research conducted by Beuthe and Bouffioux (2008) in which they express the importance of time, frequency, reliability and cost to list a few. The value of the goods and the distance of the transport is also of importance when deciding upon which transport mode to use (Lumsden, 2012).

The introduction of the container has enabled goods to be transported in an efficient manner, providing the containerized goods the possibility of utilizing several different modes of transport during one journey. A standardized container can be transported via road, sea and rail, meaning that over certain distances, the different modes compete over the containerized goods. Intermodality is also made possible with another load carrier, namely the trailer which can be transported via road, rail and sea as well (Lumsden, 2012). In this case, the opening of the Fehmarn Belt link will increase the available options of transport modes and routes between Sweden and European countries located south of the Fehmarn Belt, thereby likely intensifying the competition between the different modes of transport.

Other than the generic factors, like time, cost and frequency, that a shipper considers when deciding on transport routes and modes, there are usually case-specific factors in place as well. In a stakeholder analysis conducted by Tentacle (2018), worries are expressed on hinterland railway connections on the German and Danish side of the Fehmarn Belt tunnel. If the hinterland railway connections are insufficient, shippers might be reluctant to switch from road to rail or from sea to rail. Even if railway infrastructure were to improve on the Danish and German side of the tunnel, the Swedish railway system is experiencing capacity constraints (Vierth et al., 2019) which will further complicate the assessment of the tunnel's impact on freight flows. Another barrier for railway traffic is legal factors, according to the Swedish railway operator Green Cargo (2018), the documentation requirements for rail freight is more complex and comprehensive compared to the requirements for road transport. Adding to the complexity, a train driver must master the language in the country he or she operates the train in (Green Cargo, 2018), meaning that a driver cannot operate a train between Sweden and Germany unless they speak Swedish, Danish and German. In terms of road transports, one interviewed stakeholder emphasized the need for truck drivers to rest during long-haul transports, and the existing ferry services between Rödby and Puttgarden serves as a good time

to do so (Tentacle, 2018b). So, if a truck driver crosses the Danish-German border via the Fehmarn Belt fixed link, the time gained in comparison to the ferry service might be lost at a later stage when the driver needs to rest.

According to the port of Hamburg (2019), which is a major port located in the northwest of Germany, Sweden were their fourth biggest trading partner in terms of seaborne container traffic during 2018, with 333,540 Twenty Foot Equivalent Units (TEUs) being shipped between Hamburg and Sweden. The transport of containers between Hamburg and Sweden is a good example of short sea shipping where freight are being transported shorter distances by feeder traffic before being loaded on bigger deep-sea vessels. Usually short sea shipping is in direct competition with land-based transports like road and rail (Stopford, 2009).

Once the Fehmarn Belt tunnel is operational, it is not unlikely to think that some of the current container volumes that are being transported via short sea shipping between Hamburg and Sweden will shift towards a land-based mode, namely road or rail. It will contribute to the Trans-European Transport Network in making the EU states well connected and competitive, but it might also have a negative impact on the European Commission's objectives to decrease the transport sector's impact on the environment (DG MOVE, 2019).

1.2 Fehmarn Belt fixed link

The straight between the Danish island of Lolland and the German island of Fehmarn is currently operated by a RoRo ferry service by Scandlines. Around 45-55 ferries are crossing the passage per day in each direction, between the cities of Rödby and Puttgarden (Aigner & Weber, 2017). Hence, there is in general a departure every 30 minutes, and the crossing time is 45 minutes. There is also a need for trucks to check in at least 15 minutes before departure, meaning the total crossing time is at least one hour. Except the regular traffic, Scandlines operates one specialized ferry transport of hazardous goods on the route as well (Scandlines, 2018a). The ferry traffic between Rödby and Puttgarden has seen a growth in number of trucks in recent years. In 2018, approximately 551 000 trucks used the ferry services in total, compared to 370 000 in 2008, while freight trains are currently not believed to use the ferry services on the route at all (Scandlines, 2018b).

Discussions on a fixed link between the islands have been held for many years. The time schedule has been revised several times and because of challenges in obtaining approval from authorities, the project has been delayed by at least seven years (Femern A/S, 2012). In 2008, a state treaty between Denmark and Germany on the Fehmarn Belt fixed link was signed, and the project was ratified in the Danish parliament in 2009 where Denmark will be the sole owner and operator of the tunnel. Discussions whether it should be a bridge or a tunnel were apparent but, in the end, an immersed 18 kilometre tunnel was the preferred choice (Femern A/S, 2020b). The now proposed project of the tunnel was approved by the Danish parliament in 2015. However, an approval from the German authorities had to wait until 2019, which delayed the project's time schedule further. Thus, advanced preparation activities for the construction of the tunnel is underway since 2019 and the tunnel is currently set to be finished in 2028 (Femern A/S, 2020c).

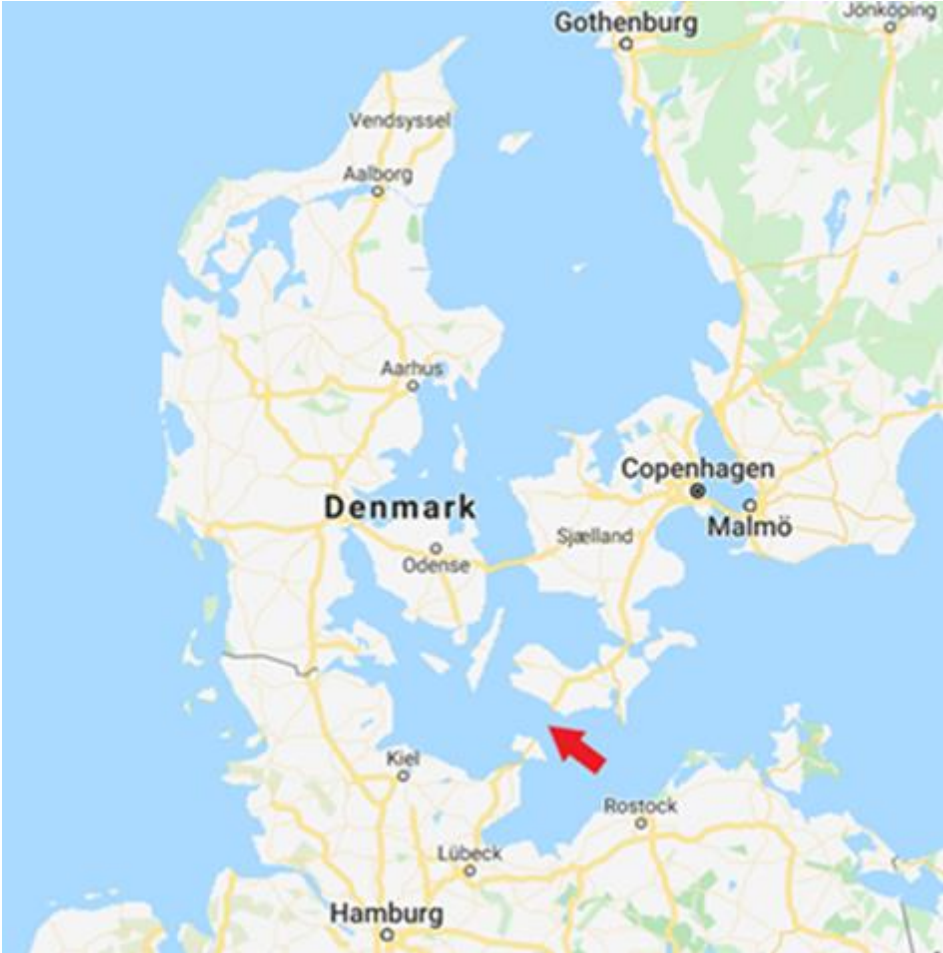


Figure 1. *The geographical position of the new Fehmarn Belt tunnel.* (Modified from source: Google Maps, 2020).

The company Femern A/S, a subsidiary of Sund & Bælt Holding A/S which is owned by the Danish Ministry of Transport, is responsible for planning and in the future operating the tunnel (Aigner & Weber, 2017). The tunnel will consist of a four-lane motorway and two electrified rail tracks. It is expected that the journey between the islands in the new tunnel will take approximately 7 minutes by train and 10 minutes by car, compared to 45 minutes plus waiting time with the existing ferry today (Femern A/S, 2020c). In total, it is believed that the tunnel will save around one hour of travel time through the passage compared to today (Aigner & Weber, 2017; Femern A/S, 2020c). However, in terms of rail transports, the freight trains from Scandinavia towards central Europe are today mainly passing through Funen and Jutland or by train ferries between Sweden and Germany (Femern A/S, 2020c; Tentacle, 2017). The new tunnel will enable freight trains taking a new route and passing through the Fehmarn Belt link instead, hence, distance is shortened by 160 kilometres and the total travel time between the Scandinavia/Copenhagen area and Hamburg is estimated to be reduced by approximately up to 2 hours (European Commission, 2020b). According to the planning and operating company Femern A/S, rail links to and from the tunnel are going to be upgraded. Denmark is making rail links to and from the tunnel ready for trains in a speed of 200 km/h, while the upgraded rail links on the German side will be ready for trains in a speed of 160 km/h (Femern A/S, 2020c).

The construction budget of DKK 52.6 billion is co-financed by EU as part of the TEN-T network but will also be financed by user fees. The Danish parliament is to decide the price for passing through the tunnel. However, in forecasts and financial calculations the price for a lorry to go through the tunnel is set to approximately EUR 267, which is quite similar to the current ferry prices. The charges for rail operators to pass through the tunnel is also to be determined by the Danish Minister for Transport and Building. However, no approximation is made yet, but it is said it will be based upon the value of savings made by rail operators from using the Fehmarn Belt fixed link rather than the route via Funen and Jutland. (Femern A/S, 2016)

1.3 Purpose

The purpose of this study is to investigate if the Fehmarn Belt fixed link will impact current distribution of freight flows between Sweden and European countries located south of the Fehmarn Belt link. The objective is to investigate whether a shift in current distribution between

the three main modes of transport, namely road, rail and sea, will occur once the Fehmarn Belt tunnel is operational. The study will identify which possibilities and negative impacts the tunnel will entail for each mode of transport by interviewing stakeholders from the transport industry. Another objective with the interviews is to identify potential barriers in the surrounding transport systems which may restrict the possible advantages the tunnel could offer. The ambition is to use the collected information from the literature review and stakeholder interviews to predict the nature of a potential modal shift in container and trailer transports between Sweden and European countries south of the tunnel.

1.4 Research questions

- *Will the distribution between road, rail and sea transport of containers and trailers between Sweden and European countries located south of the Fehmarn Belt link change once the fixed link is opened?*
- *If a modal shift in container and trailer transports will occur along the investigated routes as a result of the Fehmarn Belt tunnel, which transport modes will likely gain market shares and which will likely lose?*

1.5 Delimitations

The thesis is focused on container and trailer transports carried out via rail, road or sea. In terms of geographic scope, the focus is on Swedish transport flows of containers and trailers to and from the majority of Europe, where the eastern parts of the continent and countries located north of the Fehmarn Belt will not be covered in detail. It is hard to define a strict geographic scope as strong economies and big trading partners to Sweden, such as Germany, will naturally be covered more in detail.

2 Literature review

The purpose of this chapter is to introduce the readers to literature findings that is relevant for the topic of this thesis. It provides scientific findings which will be used to analyze and compare the results from interviews.

2.1 Intermodality and world trade

Containers are standardized load carriers which are compatible with several different modes of transport such as trains, ships and trucks. The main benefit with standardized containers is how it can be transferred from one mode to another in a smooth way. With its strong and durable design, it protects the goods inside and allows for vertical stacking which saves space. There are mainly two different sizes of containers used, the 20-foot containers, often referred to as TEUs, and 40-foot containers. TEU has developed into a measurement unit for ships and ports et cetera, meaning that a 15000 TEU-ship could hold 7500 40-foot containers. The most common size used of the two is the bigger, 40-foot container, which is the main type used in sea transports. Containers have set the standard for entire open transport systems worldwide where trucks, ships, trains, ports and lifting equipment are all designed to be compatible with the measurements and functions that a container provides. (Lumsden, 2012)

The introduction of the container during the 1960's had a massive impact on world trade. The process of unloading ships with general cargo prior to the containerization was a time consuming and labour-intensive task. Ships would spend days loading and unloading in ports and the labour-intensive nature of the process made shipping expensive. Since the container was introduced and gradually accepted throughout transport systems over the world, the utilization rates of ships have increased massively, and the price of shipping has decreased. The introduction of the container also allowed for bigger ships and intermodality throughout transport systems all over the world. (Bernhofen et al., 2016)

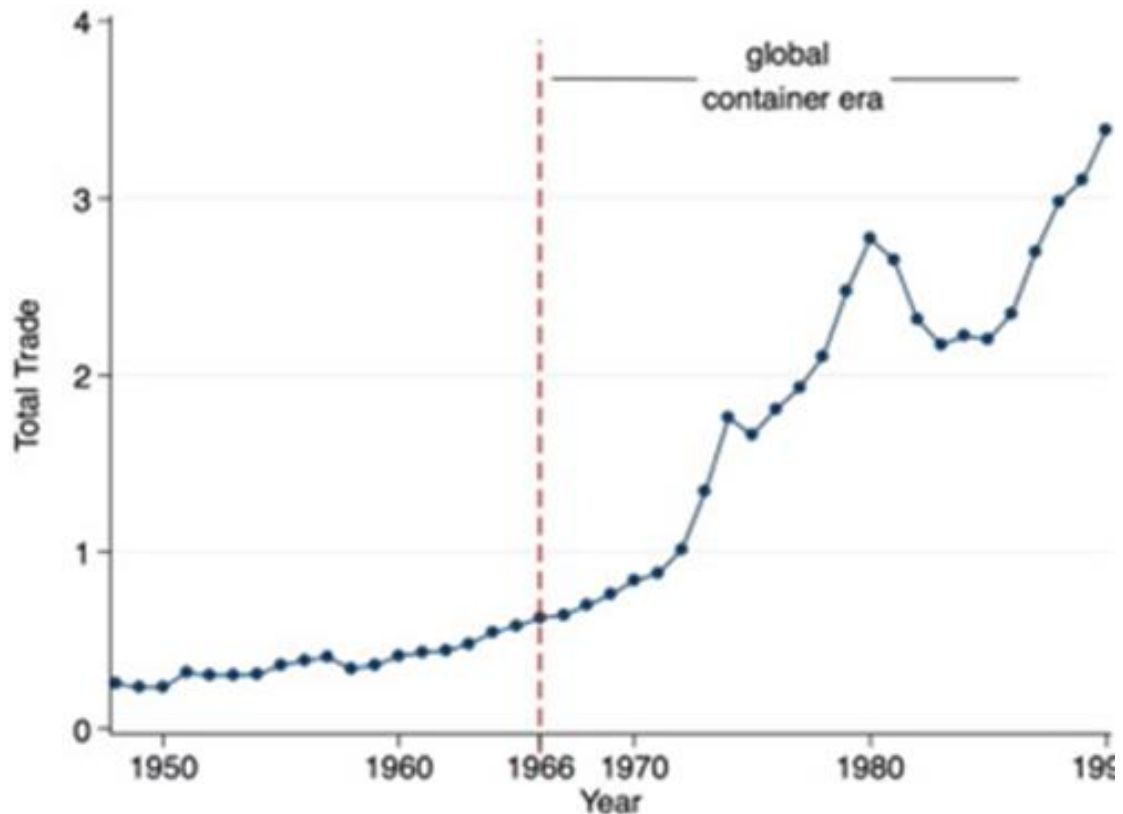


Figure 2. *The growth of world trade (deflated): 1948–1990.* (Bernhofen et al., 2016).

Trailer is another type of load carrier. Trailers are most commonly transported by trucks and the general length is 16.5 metres. A trailer can however be decoupled from the truck which means it is compatible for intermodality. Except for road transports, trailers are often used in short sea shipping and on RoRo ferries. It can be used for rail transports as well, but the trailer has to be extra strong in order to meet the safety requirements for rail transports. Another load carrier is swap body which is quite similar to trailers and containers. It is possible to move between trucks and trains and it can stand alone as well. This makes it compatible for intermodal transports. However, compared to the containers, trailers and swap bodies cannot be stacked. (Lumsden, 2012)

2.2 Road freight in EU

Road is an essential transportation mode and has been strengthened as the dominant mode both nationally and internationally during the last decade (Alises & Vassallo, 2015; Johnstone &

Ratanavaraha, 2017). However, in a road transport market research, lack of cooperation between the European countries contributes to obstacles for cross-border road transports (M2 Presswire, 2018). Divergence in regulations and standards such as differences in weight and length of trucks is one of the main barriers for international road transport in Europe and leads to increased transit times and costs. In Sweden, the maximum length of a lorry is set to 25.25 meters whereas in the EU the maximum length is generally 18.75 meters (Lumsden, 2012).

Road transportation contributes to negative impacts in terms of emissions and congestion, while social working conditions for drivers has been on the radar in EU during several years (Frémont & Franc, 2010; Goel, 2018; M2 Presswire, 2018). The environmental factor is rising in importance among both shippers and carriers as well as governments. Plans and aims to reduce emissions from road transport have been adopted by the European Commission, especially on transports exceeding 300 kilometres where rail and maritime services would be preferable through the development of transport corridors (M2 Presswire, 2018). However, if further harmonisation of road transport regulations between European countries is accomplished, it may increase cross-border road transports within Europe. Road is generally associated with a lot of externalities and is in most cases responsible for more emissions per transported tonne than combined transports like rail and sea (Alises & Vassallo, 2015; Frémont & Franc, 2010). Emissions and congestion are essential concerns for companies in the transport sector. Port owners and other port stakeholders have keen interests in integrating hinterland connections as they experience increased road congestion around the port areas as a growing problem which increase the transit time and decrease the reliability of the maritime services (Frémont & Franc, 2010; Notteboom, 2004). Today, most port hinterland services are committed to road transport, but port stakeholders have interests in shifting the hinterland modes from road to combined transports.

Optimizing road freight transports are generally based on vehicle routing schedules where cost-minimizing routes are set. However, there are constraints in the form of several legal requirements in the road transport sector that impact schedules and routes (Goel, 2018; Toth & Vigo, 2014). Social legislation imposed by corporate agreements and governments exist in order to ensure driver's working conditions and road safety. According to EU regulation, a driver may not run a lorry for more than 4,5 hours without taking a break of 45 minutes, and after 9 hours of driving a rest period of 11 hours is required (Goel, 2018).

Cost is a critical factor when deciding on which transport mode to use, and road transports have advantages over combined transports when the geographically concentrated flows of goods are small (Frémont & Franc, 2010). When higher flows of goods exist, economies of scale can more easily be achieved by combined transports. However, combined transports must have the ability to massify goods in order to be competitive, but infrastructure restrictions in Europe decrease the possibility of achieving this. For example, the largest block trains in EU generally have a capacity of only 80-95 TEUs and factors in maritime transports such as imbalance in traffic complicates this (Alises & Vassallo, 2015).

2.3 Rail freight in EU

In a case study by Zunder et al. (2012), the possibility of inter-European rail freight transports from private operators are investigated. The researchers interviewed actors from the Retrack-pilot, which was a two-year long project where private operators perform commercial rail freight transports between the Netherlands and Romania, passing through and stopping at Germany, Austria and Hungary. The project was partly sponsored by the EU to help identify possible barriers in their continuous work to create a modal shift from road transports to more sustainable options. The project proved to be successful as it worked and the operation made a profit, but some barriers were identified and it was concluded that cross-border rail freight needs improvements on many levels to further shift goods from road to rail.

Some of the most important issues identified from the Retrack stakeholder interviews were structural inequalities. Despite EU-regulation intended to create liberalization and fair competition, stakeholders experienced discrimination in terms of access to infrastructure and problems accessing shunting services. Terminal access was also more challenging for the private operator compared to incumbent national railway operators which were often prioritized. Personnel was another major barrier for the service, and other than the existing shortage of drivers and qualified personnel in Europe, the fact that the Retrack service operated across borders made it even more complicated. In Europe, there is no mutual driver's license, and the driver would have to master the language of the country in which the train is operating at the time. This requires a single driver to have multiple driver's licenses issued in the countries of operations as well as managing the different languages. (Zunder et al., 2012)

Other issues that the train operator faced when crossing borders were documentation related. The requirements in terms of paperwork were substantial and differed between the countries along the route. Security checks, safety checks and different rules regarding train length and weight further complicated the border crossing and was very time consuming. Further, different power supplies along the corridor also served as a barrier and had to be solved by changing locomotives at the national borders. (Mortimer et al., 2012)

One general problem for rail bound freight transport in Europe is the co-existing passenger traffic. In most countries, passenger traffic is using most of the available railways whilst also being prioritized ahead of the freight traffic. (Eom et al., 2012)

2.4 Short sea shipping in EU

Short sea shipping is lacking a clear and official definition. But some authors' interpretations align, for instance the definition that short sea shipping is waterborne transport that does not cross an ocean (Bjornland, 1993; US Department of Transportation, 2008). According to Douet and Cappuccilli (2011), other common words or phrases used to define short sea shipping are inter-regional, feeder traffic, coastline traffic and small ships. According to Stopford (2009), short sea shipping is carried out between smaller ports and regional hubs such as the port of Rotterdam, Hong Kong and Singapore. As the ships performing deep-sea trades have grown in size and decreased the number of port calls, short sea shipping carried out by smaller vessels have increased in importance. Short sea shipping is in competition with rail transports (Stopford, 2009) and road transports (Henesey & Yonge, 2005). Assuming the three modes of transports are available, the competition between them are more intense over certain distances of transportation. According to Rodrigue et al. (2013), road, rail and seaborne freight transport are all viable options at distances between 500 to 750 kilometres.

Despite several initiatives from the European Commission to incentivise a modal shift away from road transports to sea and rail transports, the former still prevails. Some of the initiatives are The EU White Papers and the Marco Polo programmes. Short sea shipping is suffering from EU inconsistencies, programs intended to create modal shifts are running in parallel with EU-financed road constructions under the TEN-T programme, which is likely going to increase

road transports further. The administrative work required for shippers are more complex in maritime transport compared to road transports which serves as a barrier, especially for smaller shippers. In order to achieve a modal shift, the EU should strive to improve the short sea shipping options and also work actively to reduce the competitiveness of road transports. The latter has been done in Spain and Italy through taxation with positive results. (Marie & Cappuccilli, 2011)

One technical barrier for maritime freight transports between Sweden and mainland Europe is the Sulphur Emission Controlled Area (SECA) in north western Europe. Since 2015, vessels that operate in the Northern Sea, Baltic Sea and English Channel must use marine fuels with a sulphur content of 0.1% or lower. Low sulphur fuel is more costly and may require technical updates of the vessels such as scrubber installation. Since January 1st, 2020, global sulphur limits are lowered to 0.5 % from previous 3.5% (Kuehne Nagel, 2020) which will mitigate the difference in costs between areas (Trafikanalys, 2018).

2.5 Modal choice

A lot of research and literature within the field of modal choice exists. Attributes and factors that determine the choice of transport mode have been analysed by several researchers. The modal choice is driven by the desire to serve customers effectively and to a low cost in order to be competitive (Ribbink et al., 2005). However, the critical factors are not only determined upon the characteristics of the transportation mode but also depended on the characteristics of the goods, the transportation distance and the access to infrastructure (Beuthe & Bouffieux, 2008; Bolis & Maggi, 2003; de Jong & Ben-Akiva, 2007; Feo et al., 2011; Fowkes, 2007; Wang et al., 2013). According to a manifest content analysis by Cullinane and Toy (2000), cost/price/rates is the most considered factor in decision making regarding freight routes and modal choice followed by speed, transit time reliability, characteristics of the goods and service.

Cost is considered in an extensive mass of research as one of the most determining factors in modal choice (Bolis & Maggi, 2003; Curty et al., 2011; García Menéndez et al., 2004; Ribbink et al., 2005). Each mode of transportation bears private costs and external costs. Private costs are transport costs and additional costs such as transshipment, storage, pre- and post-transport

and costs of service including quality losses while external costs are externalities such as pollution and congestion which are harder to calculate (Van Ierland et al., 2000). There is an idea, but not fully implemented, that the transportation costs should include all true costs to environment and society such as noise, emission and accidents (Ribbink et al., 2005). According to Beuthe & Bouffioux (2008), cost is the most important factor in the modal choice and therefore competitive pricing and production efficiency should be of concern for all carriers and transport service providers.

Ribbink et al., (2005) identifies costs as one of two main factors that determine mode of transportation. According to their paper, the cost differences between the mode is to a certain extent determined by the price of taxes and fuel and hence, the energy efficiency of the transport vehicle used. The modes are sensitive to costs changes, and just a small change in price could be decisive and turn into a change of mode (Tentacle, 2017). In a study by García Menéndez et al. (2004) on modal choice in Spain, maritime transport has been found sensitive to changes in road transport prices. That means a shift from road transport towards maritime transport is expected if the road transport prices increase while maritime transport prices remain the same. That is confirmed in another study by Feo et al. (2011) where it appears cost policies have a significant impact of the choice between road transport and maritime transport. An increase in road transport costs have a slightly greater effect on the probability of choosing the maritime mode than a decrease of transport costs in the maritime mode itself.

A modal change investigation based on economic and environmental aspects was made by van Ierland (2000) on the Betuwe line, a new rail infrastructure in the Netherlands, that was going to be built. The focus was on container traffic and three transportation modes; road, rail and maritime, and the ultimate modal choice was based upon three factors; cost, capacity and emission levels. For this infrastructure project, the Dutch parliament had not yet decided the user fees for the new infrastructure, and that brought uncertainty. Hence, to monitor the total economic cost of using the infrastructure, and thus forecasting the preferred transportation mode, the fee of using the infrastructure is a vital factor.

Transit time is another attribute that is critical to the modal choice according to several researchers. Transit time is the time needed to travel plus loading and unloading time, and it differs between transportation modes. It is often determined by capacity limitations of the infrastructure but also by distance (Ribbink et al., 2005). There is often a trade-off between

quality and price in the choice of transport mode and there are clear signs that the quality of service factors such as transit time have significant roles in the choice of mode (Bolis & Maggi, 2003; García Menéndez et al., 2004; Moschovou & Giannaopoulos, 2012). Transit time is the second main factor identified to determine the mode of transportation of containers in the study by Ribbink et al., (2005). In European container hinterland transports, three-digit Euro cost disadvantages per container are considered by some logistics service providers and shippers, just to gain some days of transit time (Tentacle, 2017). It is explained that could be one of the reasons why road transports still play a decisive role on long-distance transportations, even when rail and maritime services exist on the same route. According to Fowkes (2007), long transit times, especially road transports, are associated with extra costs. The extra costs are caused because of increased wage costs, vehicle related costs, deteriorated or diminished value of the goods transported and extra costs due to earlier departure or later arrival, i.e. loading and unloading costs. But here, it is stated that time is not always necessarily the most critical factor but a trade-off with price. Some slack and buffer time are often present in road transport driver's schedules. An example is given; a lorry with two options, either a congested and free road or a quicker and tolled road, the driver may choose the congested and free road because he or she may not have incentives to shorten the transit time and arrive earlier and pay that road toll.

The modal choice is also affected by the distance the goods are supposed to be transported (García Menéndez et al., 2004; Ribbink et al., 2005). According to Beuthe and Bouffioux (2008), the total cost, including carrying, loading, unloading and transferring costs, are in focus for shippers on distances less than 300 kilometres while the transit time attribute appears rather unimportant over that range. These shorter distances are natural markets for trucks. For distances between 300-700 kilometres, service quality such as transit time, reliability, flexibility, and frequency in the transport service appear to have an advantage over costs, especially on shipments of middle-value goods. On this distance, competition between the modes of road, rail and sea are generally strong and changes in regulation, policies, costs or service quality in the different sectors may impact modal shares significantly. On distances longer than 700 kilometres, again the total cost appears to be more important while transit time and reliability appear to be less important. Longer transportation distances often affect the transport price in favour of intermodal transport solutions, such as the rail and sea modes (Macharis et al., 2016).

Availability and accessibility to infrastructure is a prerequisite for using a specific mode. Proximity to quay docking facilities for a sending firm increase the likelihood of choosing maritime transports, and access to industrial rail tracks for a sending firm increase the likelihood of choosing rail transports (de Jong & Ben-Akiva, 2007). The distance between the port where the goods are unloaded and the final point of the shipment's destination (port-to-door distance) is found significant for modal choice (Feo et al., 2011). A port-to-door distance less than 150 kilometres increases the likeliness to use maritime intermodal solutions while port-to-door distance more than 150 km is less likely to use maritime intermodal solutions.

Infrastructure capacity limitations affect the transit time (Ribbink et al., 2005). In terms of road, Pan-European corridors were encouraged by the European Commission in order to improve transit times but has often been cancelled out by increased traffic and further congestion. Another limitation in transit time for road traffic is the passages across waterways and mountains. The railway system in Europe has been reduced over the last decades by 10 percent. At the same time, the traffic on key lines has increased substantially and often the freight and passenger traffic must share the infrastructure. This has created bottlenecks, and together with other bottlenecks in the network such as bridges, tunnels and other difficult passages, it causes limited capacity in the rail network and increased transit times. It is believed that policy makers must be careful with increased taxation on road traffic because if there are limited capacity on the other competitive modes, that will only lead to increased transportation costs for shippers and no change of transportation mode. Hence, infrastructural capacity is a constraint and a determining factor in modal choice (Ribbink et al., 2005). The ease of access to the transportation mode is the second most influential attribute in a modal choice study in Greece (Moschovou & Giannaopoulos, 2012). It is also found that rail is a generally preferred mode for a lot of logistics and transport managers but that the current predominance of road in Europe is caused by current restrictions in the rail mode rather than mode-specific preference (Bolis & Maggi, 2003).

In addition to costs, transit time, distance and access to infrastructure, some other critical quality service factors in modal choice are identified in literature as well. Frequency of the transport service is a determining factor (Curty et al., 2011; Feo et al., 2011; García Menéndez et al., 2004). Reliability of the transport service is also a significant determining factor (Beuthe & Bouffioux, 2008; Bolis & Maggi, 2003; Feo et al., 2011; Fowkes, 2007; Moschovou &

Giannaopoulos, 2012) as well as flexibility in the transport service (Beuthe & Bouffioux, 2008; Bolis & Maggi, 2003; Fowkes, 2007).

The characteristics of the goods is another attribute that affect the modal choice. A study by Feo et al., (2011) investigates the impact of transport attributes on the choice of transportation mode in Spain. Road transportation and short sea shipping are the modes studied, and the variables tested in this study are transit time, costs, delivery time reliability and frequency. It is significant in the study that the value of the goods transported affect the desirable transport attributes, hence the mode of transportation. There were significance results indicating that the higher relative value of the goods, the higher is the probability that road transport is the mode chosen ahead of combined transports. Thus, a hinterland with a presence of high goods value sectors are likely to call for road transports with high quality in transit time, reliability and frequency, while a hinterland with a presence of low goods value sectors are more likely to call for cost-efficient solutions. Similar results are found by Wang et al., (2013). Their study compared road transport and rail transport and confirm that transport mode is determined by the value of the commodity. Commodities with a high value are more likely to be transported by road while commodities with low value are more likely to be transported by rail. de Jong and Ben-Akiva (2007) also find the characteristics of the goods and commodity-types to significantly determine modal choice. They find in their study that high-value goods are more likely to be shipped in smaller shipment sizes, up to 15 tonnes, preferably by road services. Moreover, larger shipper firms are more likely to use rail over other modes.

Generally, cost is of great importance for low-value goods (Beuthe & Bouffioux, 2008). Further, transit time and reliability are of great concern for middle-value goods and flexibility and safety are important factors for high-value goods. Which logistics strategy a company has may impact their modal choice, that is studied by Bolis & Maggi (2003). In their paper, costs, transit time and reliability are important factors for modal choice. Frequency and flexibility are important as well for companies operating in a Just-In-Time context, when the product is sent as finished goods or when the company directly serves the consumer market. There is also evidence showing that companies producing to order place a high value on frequency in transportation while companies producing to stock recognize costs as the important factor in transportation. Their study found differences in importance of factors determining transportation modes based on the logistics strategies of the companies rather than the

characteristics of the goods. In a study by Fowkes (2007), the cost of time in transit for goods are investigated and monitored. There are great differences depending on what commodity to be transported. Time in transit were a higher cost for non-bulk commodities than for bulk commodities. Among non-bulk commodities, express goods experience highest costs in transit time followed by containers and finished goods.

Environmental issues such as emissions, noise and accidents have not been addressed frequently in the context of modal choice during the years (Bask & Rajahonka, 2017; Macharis et al., 2016), the main research have rather been focused on utility and cost efficiency. However, external effects have gained more attention in transport decisions recently even though it is hard for shippers and logistics providers to emphasize this because of the tough competition in transport costs and time (Hyun-Chan et al., 2017). In a study on modal choice decision of container transports in Belgium, external effects were given different weights of importance. The study shows that maritime transports and rail transports are more preferred as transport options if the external effects are of greater importance for the decision maker, and road transports are more preferred if external effects are of less importance (Macharis et al., 2016).

3 Methodology

This chapter provides details regarding how this thesis was constructed and how data was collected and analysed. It explains the reasoning behind the design of the thesis and discusses the research quality.

3.1 Research philosophy

There are two main philosophies in research, positivism and interpretivism. Positivism strives to mathematically verify its findings through quantitative methods from an objective standpoint. Interpretivism is different where the findings are partly based on social realities which are highly subjective. It focuses on gaining an interpretive understanding by exploring the complexity of social phenomena, and interpretivism is suitable in qualitative research. (Collis & Hussey, 2009)

In this thesis, an interpretivist philosophy is taken as the objective is to get an in-depth understanding of the subject studied. It is an appropriate philosophy as the study has a qualitative approach, where the results will be based on individuals' subjective perspectives and views.

3.2 Research purpose

Collis and Hussey (2009) present four main classifications of research purposes; exploratory, descriptive, analytical and predictive. In this case, based on the classifications presented by Collis and Hussey, it is a case of an exploratory research purpose. Exploratory research is usually conducted on subjects with little or no previous research. It intends to explore a subject and find ideas, patterns and a potential hypothesis. However, it does not require a hypothesis to be tested against empirical evidence or data. The subject researched in this thesis aligns well with the description of exploratory research in that (1), little previous research has been conducted on the subject, (2), it is not possible to gather data (empirical evidence) which can

be used to test an hypothesis and (3), this thesis will gather a wide range of impressions and data that is relevant to the topic but will not provide any conclusive answers to the future outcome of container and trailer trade between Sweden and European nations located south of the Fehmarn Belt link.

3.3 Qualitative research

Research is usually classified as either quantitative or qualitative in its approach. Quantitative research is when numerical data is collected and later analysed, usually through statistical methods. Qualitative data is not collected in numerical form, but rather collected from interviews or texts and subsequently analysed with an interpretative approach (Collis & Hussey, 2009). According to Bryman and Bell (2011), the most basic definition of qualitative research is “any research that is not quantitative”, but they stress that this is a very simplified definition. Further, they describe how a qualitative research approach allows for a more open and deeper understanding of the subject. It is open to constructed views from individuals and how they perceive a phenomenon in their social context.

In this essay, a qualitative approach is used. The primary data was collected through interviews with stakeholders from the transport industry and the secondary data was collected from articles, books and websites and is presented in text form. Based on the research questions, the lack of available quantitative data and the exploratory research purpose, a qualitative method is used in this thesis.

3.4 Secondary data

A literature review is necessary to gain knowledge about the studied subject by identifying similar research that have been conducted in the field. It should be used to get basic knowledge on the subject that is studied and identify potential gaps in existing research (Patel & Davidsson, 2015). The literature review in this thesis is presented in chapter two. Most of the work presented in the literature review have been retrieved from scientific articles posted in journals. These articles were found by utilizing several search engines, namely *Google Scholar*,

ScienceDirect and the University of Gothenburg's search engine *Supersök*. The books that have been used to retrieve pertinent information have been previously known to the authors of this essay in most cases, and in a few cases the books have been discovered through the above-named search engines.

Other sources that have been utilized to retrieve information are web-based and reports published by organizations such as the European Commission and SCB. The information from these sources are mostly presented in the introduction of this thesis.

3.5 Primary data

In qualitative research, interviews are a common method used to collect primary data. The way the interviews are structured may however differ. Usually, the methodology research separates between structured and unstructured interviews where the former is designed with clear questions and deviations from the questionnaire is undesirable. Unstructured interviews are different as questions are generally more open and the person carrying out the interviews may well deviate from the questionnaire by asking relevant follow-up questions to the respondent. Likewise, the person being interviewed is given the freedom to expand the answers beyond the initial question and therefore an unstructured interview may evolve into what is better described as a conversation. Between the two types of interviews described is the semi-structured version. This is a type of interview where it is allowed to ask follow-up questions and the respondent is also given the freedom to expand the answers, but unlike the unstructured method, a semi-structured interview still has a general framework and a questionnaire that it sticks to throughout the interview. (Bryman & Bell, 2011)

In this thesis, semi-structured interviews are the chosen method for collection of primary data. In order to answer the research questions, input was needed from people working in the transport industry and the objective with the interviews was to get different perspectives of the Fehmarn Belt tunnel's potential impact on future freight flows between Sweden and European countries located south of the tunnel. According to Patel and Davidsson (2015), by trying to make an interview more like a conversation it is possible to avoid having the respondent inhibited. Therefore, the questionnaire was used only as a template. In order to facilitate for the

respondent, the interviews sought to be directed more towards a conversation rather than a questioning. This meant that the questions were not necessarily asked in the same order as in the questionnaire. Further, follow-up questions that were not included in the questionnaire could be asked during the interviews.

3.5.1 Interview respondents

The objective with the interviews was to get new insights into the potential impact of the Fehmarn Belt tunnel from people working in the transport industry. People at leading positions at Swedish freight forwarders and transport companies were contacted. Freight forwarders were considered as good respondents because they can provide useful insights from different modes of transports. Another advantage is that they have an insight into shipper's, their client's, views. In many cases these shippers are from different industries which further broadens the freight forwarders expertise. Thus, the majority of respondents are freight forwarders but some transport companies focusing on one mode of transport are also interviewed to give a deeper understanding of that certain mode in relation to the tunnel.

In total, 27 companies were identified and contacted, and the geographical scope was limited to the southern parts Sweden. The respondents were selected based on two major factors; the company should be operational with transports in Europe, either via rail, road, sea or a combination of the modes and the respondent should have a strategic role in the organisation. The contact was made mainly through telephone and e-mail and, as mentioned above, the contact was aimed towards people in leading positions and these were often presented on the companies' websites. In some cases, a recommendation to interview a specific person in the company was received. This ended up with 7 interviews with respondents from different companies. The following table presents each company and respondent.

Table 2. A presentation of the interview respondents and the firm they are representing. One respondent preferred to be anonymous.

Name	Business Position	Company	Segment	Company description
Lennart Johansson	Manager Business Development	Green Cargo	Rail operator	<i>Swedish freight rail operator. Licensed to operate in Sweden, Norway and Denmark. Offers direct international lines from Sweden to Belgium, Austria, Italy and Denmark.</i>
Mikael Nyman	Director Sales and Marketing Scandinavia	CFL Cargo	Rail operator	<i>An international rail operator with a Swedish subsidiary located in Nässjö. Offers container, trailer and bulk transports by rail, currently operating direct lines in Sweden, Denmark and Germany.</i>
Magnus Winberg	Managing Director	Trans-Action	Freight Forwarder	<i>Mainly providing road trailer transports, both national and international to countries in Europe. The headquarter is located in Varberg with 5 employees.</i>
Johanna Brorsson	Head of International Freight Forwarding	Kerry Logistics	Freight Forwarder	<i>The company mainly import to Sweden by road, sea and air transportation. They are offering third-party logistics services as well. In terms of road transport, their main markets are Turkey, Italy and Portugal. Turnover of around 150 million SEK and approximately 50 employees.</i>
Jonas Olofsson	Managing Director	C Land Logistics	Freight Forwarder	<i>Mainly focusing on maritime, rail and air transport solutions, inter-continental and transports within Europe. The main customer segment is Swedish small- and medium-sized enterprises. Turnover of around 120 million SEK.</i>
Thomas Ström	Managing Director	NTEX	Freight Forwarder	<i>The company offers transport services via road, sea and air. The main segment is semi-trailer road transportation in Europe. A turnover of around 1.6 billion SEK.</i>
Anonymous 1	Operations Manager	Anonymous	Freight Forwarder	<i>A global logistics provider. Moves trailers and swap bodies by all modes of transportation. On routes between Scandinavia and Central Europe, road is the only transportation mode. The office in Gothenburg has approximately 50 employees.</i>

3.5.2 Interview process

Once the respondents had agreed to participate in interviews, e-mails were sent with prepared questions to each respondent. The participants were kindly asked to think about these questions but also consider other important factors outside of the questionnaire before the interviews were held. The prepared questions that were sent were identical, irrespective of respondent, and all participants were also provided with some background information on the tunnel and the purpose of the study. The questionnaire was mainly formed based on findings in the literature review and contained of four parts. The first part included questions about the respondent's firms in order to receive general information about their business. The other parts were about factors affecting modal choice, cross-border traffic and a tunnel-related part. The questionnaire in full can be found as an appendix. All interviews were conducted over telephone.

3.6 Research quality

In quantitative studies, reliability and validity are often used to describe the consistency and relevance of the collected data. In qualitative studies such as this thesis, it is not as straightforward to evaluate the quality of the collected data through the two concepts. Reliability serves as a measure to describe the consistency of the results if the same data collection was to be repeated, and validity is a term used to measure the relevance of the data that is collected. As mentioned above, the application of the two concepts are not always clear in qualitative research but can still be used as tools to secure the quality of the data collection. (Bryman & Bell, 2011)

The primary data collected in this study was retrieved from interviews with actors from the transport industry in Swedish companies. Interview respondents were selected based on two factors, all had a strategic role in their organisations, for instance managing directors or members working with business development. The other factor was that the respondent's firms were operational with transports in Europe, either via rail, road, sea or a combination of the modes. These few but important factors was an effort to increase the validity of the study.

As the interviews were semi-structured, a set of prepared questions acted as a guidance but was allowed to deviate from, either by initiative from the respondent or the interviewer which could impact the reliability of the results. Another factor that could impact the quality of the primary data is the fact that the respondents may struggle to be objective and honest for different reasons, one way to mitigate these risks was to offer all respondents the possibility of being totally anonymous and thereby leave out information like name and what company they represent. Further, the respondents are from companies located in southern parts of Sweden, this could perhaps affect the data in unknown ways.

The secondary data represented in the first two chapters of the thesis are carefully considered before being used. In order to secure the quality of the secondary data, only scientific sources were considered from known journals or highly regarded books. Some of the sources that have been used are over ten years old, meaning that the presented information could be outdated to some degree. In order to compensate for this fact, the objective has been to find several sources confirming similar results on occasions where old sources were used.

4 Empirical findings

This chapter presents findings from the interviews that have been conducted. The findings from the interviews are presented under three different headlines. A detailed summary of every interview is available as appendix where individual answers can be found if that is of interest to the reader.

4.1 Potential barriers and cross-border traffic

All interview respondents were asked to consider existing and potential barriers which may hamper the potential benefits that the tunnel could offer. These barriers do not have to be in direct connection to the tunnel but can still have a significant impact on its potential benefit in container and trailer trade.

The most significant barriers that the interview respondents shared were concerning rail freight. Several respondents mentioned the legal barriers that the railway operators must take into consideration. For instance, Lennart Johansson at Green Cargo explained how a locomotive driver needs to be able to speak the language in the country he or she operates the train in, which means that in order for a train to travel from Sweden to Germany with today's regulations, the driver must be able to understand Swedish, Danish and German. The language barrier was also confirmed by Mikael Nyman from CFL Cargo. However, Nyman did not consider this as a big barrier for the firm as the borders were located favourably for their operations, meaning that the borders along their routes served as a good time to change drivers anyway.

Technically related barriers within rail traffic also came up during the interviews. Many of the technical barriers that came up relates to different standards between countries. One of the most significant technical barriers mentioned by Johansson from Green Cargo were the different power systems used between countries. As an example, Sweden and Germany have the same systems to power the electrical locomotives, but Denmark is using a different one. In order to drive a train between Sweden and Germany via Denmark, locomotives need to be compatible with different systems or a change of locomotive is required by the borders. Further, Johansson added that locomotives with double power systems are naturally more expensive compared to

the ones compatible with a single system. Another technical aspect lifted by Johansson was the different signaling systems between countries which is a problem when conducting international traffic. EU have started a project to harmonise these systems but this is at a “fairly” early stage and as a rail operator with long lead times and expensive locomotives, you want to know this kind of information prior to setting strategies and investing in new ones, Lennart concluded.

Several of the technical factors that might become bottlenecks regarding rail freight are capacity related. For instance, an example given by Nyman from CFL Cargo is the train bridge over the Kiel Canal which has a weight limit that is lower than the weight limits in the adjacent railway systems. Potential weight restrictions could become a problem according to Johansson as well, but at the time of the interview neither the respondent or interviewer knew the exact weight restrictions that might be enforced in the Fehmarn Belt tunnel or its adjacent rail infrastructure. Johansson added that he is hopeful that the tunnel and new railways being built in its surrounding systems will have increased capacity to be able to carry heavier trains in the future. The respondents did not know technical specifics on German and Danish railways and the planned expansions on the routes around the tunnel but are hopeful that the new tracks will allow long and heavy trains, preferably two way traffic and long passing loops in cases where it is only one track. On the potential capacity issues in the Swedish railway network, Johansson at Green Cargo wished to see expansions of the network. He believed that it is sufficient but vulnerable to disruptions which sets in motion domino-effects of delays. Nyman from CFL Cargo believed that the capacity in Sweden is sufficient for their operations but one issue is that passenger traffic gets favoured ahead of freight trains, especially around city regions. Both Jonas Olofsson From C Land Logistics and Thomas Ström from NTEX believed there is a risk that the Swedish railway network can become a bottleneck and thus reduce the potential for Swedish railway transports to mainland Europe once the Fehmarn Belt tunnel is opened.

In terms of road transports, the barriers mentioned in the interviews were significantly fewer compared to railway. The main issues that the respondents mentioned were different laws related to weight and length of vehicles. Johanna Brorsson from Kerry Logistics and Anonymous 1 both mentioned that Sweden allowed longer vehicles compared to other countries in Europe. Anonymous 1 mentioned that Sweden and Denmark allow longer vehicles compared to Germany which is problematic to the freight forwarders. Further, Anonymous 1 was hopeful

that more harmonised regulations will come into place in the future where longer vehicles are allowed in all countries. Harmonisation would allow for better planning and fewer trucks on the road which would benefit the environment as well. Another potential barrier mentioned by Anonymous 1 was transportation of dangerous goods through the Fehmarn Belt tunnel. The respondent was concerned that a wide range of dangerous goods may only be allowed to use the tunnel during certain hours and such regulations could of course impact the decisions whether to use the tunnel or not.

4.2 Important factors for shippers

Shippers and freight forwarders' customers put requirements on the transports. The interview respondents were asked what requirements and demands their customers have on the transport services. The factors that are required from the shippers differ between the organizations. However, the price is an important factor mentioned by all respondents. Several respondents have explained that the fee for going through the Fehmarn Belt tunnel will decide how much it will be used. Anonymous 1 discussed the fee and said that the price of the transport is one of the most important factors for their customers, so if the fee for going through the tunnel will be higher than the other ferry lines' fee, there will be little incentives to use the tunnel. According to Nyman from CFL Cargo, the rail segment is highly dependent upon costs. Therefore, the fee for going through the tunnel will be of importance for the business. Lennart Johansson at Green Cargo said their company expects the future fees for using the rail tracks in the tunnel to be reasonable in order for the infrastructure to attract operators, and it would be unfortunate to build a tunnel that does not attract operators because of an excessive fee. Magnus Winberg at Trans-Action explained that the current route via Rödbby and Puttgarden, including fees for passing through the Öresund bridge, the ferry fee and the extra kilometers for the trucks to operate on the road, is slightly more costly than using the ferries from Malmö or Trelleborg to Travemünde. However, Winberg also explained that the costs absolutely matter but it is not necessarily the most important factor for their business. The company are mainly running Just-in-Time transports and therefore they focus on providing high quality to their customers. Quality, like reliable transports and arriving at the right time are important factors, according

to Winberg. Further, Winberg explained their company is more focused on shortening the lead time of the transports than reducing the costs.

Nyman from CFL Cargo stated that their customers care about the price and do not value transit time very highly. A shortening of five hours in transport time would not matter for their customers and thereby, the reduction in transit time that the Fehmarn Belt tunnel will provide will not benefit CFL Cargo's customers. However, he clarified that reduced transit time has some benefits. Shorter transit time would help the company reduce costs, for example reduced salaries for the train driver, reduced operating costs of the trains and it would give the opportunity to operate more and longer trips per day. Anonymous 1 believed the decrease of one hour in transportation time that the Fehmarn Belt tunnel will generate in the road segment is not decisive for their customers, lead time is an important factor but one hour is not very influential on long-distance transports. According to Johanna Brorsson at Kerry Logistics, the factors most important for their customers when deciding transportation solutions are depending on the characteristics of the goods. She said that the price is important for all kind of goods. If the goods are of cheaper nature, the price becomes even more important, and the time in transit becomes less important. Further, when goods are of expensive nature, shippers usually value speed, flexibility and reliability in their transport requirements and are often willing to pay extra for it.

In addition to price and transportation time, several respondents have mentioned other factors important for their customers. Reliability and flexibility are mentioned by some respondents. Two respondents believed the Fehmarn Belt tunnel will increase the reliability for transports between Sweden and Continental Europe, that the trucks would be able to pass the straits even if there is for example a storm. Today, the ferries might be delayed or postponed due to bad weather and that is happening a few days per year. Anonymous 1 explained that except the price, the quality of the transports is the most important factor for their customers. Jonas Olofsson at C Land Logistics stated that reliability and flexibility are the most important factors for their customers together with costs. Thomas Ström at NTEX said flexibility and reliability are very important factors for their customer and recognized the Fehmarn Belt tunnel's potential to make quicker deliveries with increased flexibility for their semi-trailer segment. Nyman from CFL Cargo said the rail segment is very much dependent upon costs and is not a very flexible transport segment. The business in this segment is rather a matter of long-term planning of

capacity and hence the train mode will not be able to offer more flexibility to the customers because of the Fehmarn Belt tunnel.

All interview respondents were asked whether environmental awareness among their customers existed, and if the awareness had increased in recent times or not. Almost all respondents testified to increased environmental awareness among their customers. However, most of the respondents also explained that even if customers are more concerned about the transport's environmental impact, few customers are willing to pay more for a greener transportation mode. Two respondents stated the importance for customers to measure their CO₂ emissions. Johanna Brorsson at Kerry Logistics believed that their clients are much more aware of environmental issues these days compared to ten years ago. The main change which is seen is a switch from air transports to sea and rail transports. However, the respondent explained that the lead times can serve as a constraint for a switch to more environmentally friendly modes, which is why road and air transports remains popular choices. Both of the interviewed rail operators believed train has an advantage over other modes from an environmental perspective. Lennart Johansson at Green Cargo hoped that shippers in the future will choose rail freight to a greater extent as it is environmentally the friendliest mode, if it is run on green electricity. The problem today is that it often comes down to costs for the shippers, where few are willing to pay extra for the greenest alternative, according to Johansson. Mikael Nyman from CFL Cargo explained that the environmental aspect is becoming more important for the customers in their transport choices, and train has an advantage over other modes in that aspect. The respondent of NTEX explained it is still very important to be able to offer good prices and very few shippers are willing to pay extra for green services, but it is a competitive advantage if your services are greener than the competitors whilst the prices are similar.

4.3 Preparations and potential outcome of the Fehmarn Belt tunnel

Three out of seven respondents said that they have been discussing or taken the Fehmarn Belt tunnel into account in their business' long-term planning, while four respondents explained that they have not been discussing or planning for the tunnel in their organization at this stage. Some

of these respondents explained that the reason for not planning for the tunnel are uncertainty of its impact on the business and because the tunnel is completed too long into the future.

4.3.1 Rail

Lennart Johansson at Green Cargo explained that the organization have actively discussed their future strategies with the Fehmarn Belt tunnel in their minds. Getting a license in Denmark in 2019 was one of their first steps and they are very interested in being able to run trains via the Fehmarn Belt route in the future. Currently, Green Cargo do not have a license to operate in Germany, but they are actively considering the possibilities of getting a license or develop strategic partnerships with German actors. Mikael Nyman from CFL Cargo explained their business has been considering the future impact of the Fehmarn Belt tunnel but admitted that it is a long time until it is operational and therefore difficult to predict its real impact. However, Nyman believed the tunnel will affect their business in some way. He further explained that the tunnel will not likely impact the current flows and solutions with their customers significantly, but it will absolutely bring opportunities to attract new customers and result in an increase in transport movements by train in the area.

According to the CFL Cargo respondent, the most important advantages the Fehmarn Belt fixed link will yield is an increase in total capacity on the rail infrastructure and shorter distance and transit time, so that costs can be reduced. Currently, they operate along the Great Belt route, and he explained that they still could use the Great Belt route even after the Fehmarn Belt tunnel is operational if needed. Furthermore, he highlighted that the cost of going through the tunnel will decide the use of it. There is a fee for crossing the Great Belt as well, the fee for going through the Fehmarn Belt tunnel compared to the fee going over the Great Belt will be decisive for which route they will operate, as cost is of great importance for the business. Further, Nyman from CFL Cargo thought that the railway sector could start competing with air cargo traffic as a consequence of shortened transit time between Germany and Sweden.

The Green Cargo respondent explained that on the international lines to Austria and Italy, they use train ferries between Trelleborg and Rostock to get from Sweden to Germany. With the Fehmarn Belt tunnel in place, the respondent believed that their international lines and future

lines of similar setup will use the fixed link instead of the ferries, assuming that the tunnel fees will be reasonable.

Jonas Olofsson at C Land Logistics explained how his international colleagues often describes Sweden as a pretty poorly located country when it comes to freight train services. Further, Olofsson said that the freight rail operators the company buys capacity from is using train ferries between Sweden and Germany to get to mainland Europe. However, Olofsson is confident that rail bound freight between Sweden and mainland Europe in general will benefit from the new tunnel. For example, Olofsson mentioned that today some transportations with Sweden as destination shifts the mode from rail to road in northern Germany. If these modal shifts can be avoided in northern Germany and a freight train could reach Sweden via the Fehmarn Belt fixed link instead, it would improve lead time, have a positive environmental impact and lower the cost of transport for the shippers.

4.3.2 Road & Sea

Thomas Ström at NTEX explained that their organization do recognize the increased flexibility and potential to make quicker deliveries via the Fehmarn Belt tunnel for their semi-trailer segment but has not specifically discussed strategies regarding the tunnel at this early stage. Today, NTEX is mainly using RoRo ferry services from Belgium, Germany and the Netherlands to Sweden. Ström believed that the company will use these RoRo services even once the Fehmarn Belt tunnel is operational but admitted this is at an early stage and may change once the tunnel is opened.

Johanna Brorsson at Kerry Logistics said their company has not started to plan for the introduction of the Fehmarn Belt tunnel. She speculated that the new tunnel perhaps could impact their choice of route in the road segment. Today, the majority of international road services provided by Kerry Logistics use the ferry service between Trelleborg and Rostock. The tunnel will provide more flexibility, and as a driver you will not be tied to a timetable if you drive through the tunnel compared to using RoRo ferry services. The frequency of the Trelleborg-Rostock ferry route is satisfactory today with at least three departures per day. Assuming the frequency remains at the same level in the future when the tunnel is operational,

Brorsson did not believe that the company will change route unless a departure is missed or the goods are very time sensitive. Further, Brorsson added that a factor which is important to consider as well is that you save money on fuel and wear-related issues when using the ferry services. The respondent of Trans-Action, Magnus Winberg, said approximately 95 percent of all their international truck transports are currently using the RoRo ferry services from Malmö or Trelleborg to Travemünde. The route passing through Rödbby and Puttgarden is not used frequently but only if the trucks cannot catch the ferry in Malmö, Trelleborg or Travemünde in time. Further, Winberg did not believe the tunnel will affect or change their business once it is operational but emphasized this is not analyzed in detail. The current setup suits the business well, but if the used ferry lines change their frequency, it might force the business to change their setup.

Anonymous 1 said that the company section in Gothenburg has not taken the Fehmarn Belt tunnel into consideration for future planning and strategies and the respondent did not know if the company has done so on a global level. The reason is that the tunnel is operational too far into the future and because of too many uncertainties, the fee for going through the tunnel was mentioned as an example. The respondent believed the tunnel will probably not provide a lot of new customers to the company. The reason is that the decrease of one hour in transportation time that the tunnel will generate is not decisive for their customers. Neither it seems to be cheaper going through the tunnel compared to using the ferry services. Anonymous 1 explained that if the fee for going through the Fehmarn Belt tunnel would be higher than the ferry fees, there are none or very little reasons for using the tunnel.

The respondents at Kerry Logistics, Green Cargo, Trans-Action and NTEX all mentioned that the ferries serve as a break for the truck drivers. Winberg at Trans-Action said that if a truck is running between Sweden and mainland Europe, the ferries serve as a natural break for drivers. If these trucks will go through the new Fehmarn Belt fixed link instead, a break for the drivers along the road somewhere else will be required instead. On road transports, the current ferry services between Rödbby and Puttgarden serve as an opportunity to rest according to the regulations for truck drivers, thus the Fehmarn Belt tunnel may be of less advantage for the truck transports between Sweden and Germany, according to the respondent of Green Cargo.

4.3.3 Flows and modal choice

The respondents were asked to discuss whether they think the Fehmarn Belt fixed link will affect the transport patterns and change the share of each transportation mode on the route. Four respondents believed that the rail mode will gain shares when the Fehmarn Belt tunnel is operational. Two other respondents believed that the current shares would not change significantly, but if it is changed anyway both respondents believed the train mode is the one that will gain shares as well. One respondent explained that the freight forwarders in the road segment could gain from the new tunnel, and also thought the rail segment could gain shares from the maritime sector.

Anonymous 1 explained the train segment is characterized by high volumes and longer lead time compared to the road segment. Thus, these segments are not really competing with each other here. So, the respondent did not believe any mode of transportation will gain or lose any significant shares because of the new tunnel. But the respondent added that if the rail infrastructure is upgraded on both sides of the tunnel, both in Denmark and Germany, the rail mode may gain some shares. The respondent from Trans-Action did not believe the Fehmarn Belt tunnel will change the current share between the different modes of transportation between Scandinavia and the European continent significantly. He thought there might be an increase of rail transportation if trailer trains between large nodes in Sweden and Europe are established, and that might affect the share between the modes slightly. The respondent believed governmental restrictions on the road segment, for example increased taxes, will contribute to a change from road to rail and sea to a higher degree than the tunnel itself.

The respondents of Kerry Logistics, CFL Cargo, Green Cargo and C Land Logistics all thought that the rail mode will gain shares once the Fehmarn Belt tunnel is opened. Brorsson at Kerry Logistics speculated that rail may take some market shares in the FCL segment and believed that the LCL transports will remain on the roads. However, Brorsson added all this is hypothetical and many factors such as future fuel prices and tunnel fees could change the outlook in 2028 when the tunnel is expected to open. Nyman from CFL Cargo believed it is unlikely that the train mode will lose shares to road traffic because of the Fehmarn Belt tunnel. From a rail segment perspective, he thought there are no negative aspects of building the tunnel but added that if the cost of going through the tunnel will be very high, there will not be a lot

of positive aspects either. The respondent was quite sure that the railway transport patterns in Denmark will be change completely after the completion of the tunnel.

Theoretically, the train industry should be the mode that benefits the most as it will be a significant reduction in time and probably also in costs, according to Lennart Johansson at Green Cargo. Further, Johansson points out that this is speculation and it will probably take a few years before more reliable predictions can be made. Ultimately the train operators are still dependent on a lot of outside factors in the infrastructure and political decisions may change the outlook as well. The respondent from C Land Logistics believed that road transports will lose out and that rail freight will gain from the opening of the Fehmarn Belt tunnel. The respondent added that this forecast is very speculative and that a lot of important changes will happen prior to the opening of the tunnel which may change the outlook.

How the maritime sector is believed to be affected by the Fehmarn Belt tunnel opening was not mentioned by all respondents. The tunnel will have little impact on the maritime feeder services between Sweden and Europe, and the possibility of competing by setting up train lines to the port of Hamburg or Rotterdam has not been discussed by the company, according to the Green Cargo respondent. The C Land Logistics respondent said that the potential impact that the Fehmarn Belt fixed link could have on maritime feeder freight transports will probably be very little and motivated it with the fact that sea transports will remain the best choice for large volumes. However, Thomas Ström at NTEX believed the contemporary feeder traffic between Rotterdam and Hamburg to Sweden will see increased competition from rail bound transport once the new tunnel is operational. Thus, Ström warned that the railway capacity in Sweden and Germany may become constraints to this assumption.

5 Analysis

This chapter will combine the literature review with the empirical findings. The three main modes of transports are discussed and analyzed in separate sections where every section contains three parts: Barriers, The tunnel's impact on modal choice factors, and Potential outcome.

5.1 Road transports

5.1.1 Barriers

Basically, two main obstacles were found in the literature regarding cross-border and long-distance road freight traffic; Divergence between European countries regarding regulations and standards such as the maximum weight and length of the trucks and the social legislation in order to ensure fair working conditions for the drivers and road safety. These issues are also mentioned by respondents in the empirical findings.

The maximum length of a truck is set to 25.25 meters in Sweden and 18.75 in many other countries in Europe (Lumsden, 2012). This is mentioned by several respondents as an issue in international road freight transportation. It is stated by one respondent that a harmonised regulation between the European states would benefit the road industry and the environment in general as fewer trucks would be able to carry more goods. However, this may hamper the road transport segment in general, but it is difficult to suggest that the Fehmarn Belt tunnel outcome for road transports will be negatively affected by this as this is not a new obstacle.

A barrier that could affect the outcome of the Fehmarn Belt tunnel is the social legislation regarding truck driver's resting time. A truck driver is not allowed to drive a lorry for more than 4.5 hours without taking a break of 45 minutes, and after 9 hours of driving, 11 hours of rest is required (Goel, 2018). Thus, several respondents explained that if there is a truck operating between Sweden and mainland Europe, on long-distance routes, the ferries serve as a break for drivers. Hence, if the trucks will be operating through the new Fehmarn Belt tunnel instead, they are required to stop and take a break somewhere else along the road instead. Logically, the

time saved when using the tunnel instead of using the ferry will be cancelled out when the driver needs to rest. There are no signs this kind of rest legislation will disappear, so this will hamper the potential time saving benefit for road transportation.

Another potential barrier not covered in the literature review but mentioned by one respondent is the possibilities of transporting hazardous goods in the Fehmarn Belt tunnel. Currently, Scandlines operates a ferry between Rödby and Puttgarden specialized for hazardous goods. According to the respondent, there may be restrictions in the new tunnel only allowing trucks with hazardous goods going through during the night due to safety reasons. This may naturally affect the route choice, and dangerous goods is a segment that may not frequently be transported through the new tunnel.

5.1.2 The tunnel's impact on modal choice factors

According to several sources in the literature, cost is the most or one of the most determining factors on modal choice (Bolis & Maggi, 2003; Curty et al., 2011; García Menéndez et al., 2004; Ribbink et al., 2005). That is confirmed by several respondents who stated that the cost is of great importance to the shippers. Especially the fee for using the Fehmarn Belt tunnel was mentioned as a deciding factor to which degree they will use it. Anonymous 1 stated that if the fee for using the tunnel will be higher than the fee for using the ferries, the incentives for using the tunnel are negligible. The respondent from Trans-Action mentioned that the route via Rödby and Puttgarden today is slightly more costly than using the ferries from Malmö or Trelleborg to Travemünde. Hence, if the fee for using the Fehmarn Belt tunnel will be similar to the current ferry prices there will not be any substantial cost savings for road transportation by using the tunnel. However, the respondent of Kerry Logistics mentioned that by using the ferries instead of the tunnel, wear-related issues will save some money for the firms. Overall, it is clear that the fee for using the Fehmarn Belt tunnel will be decisive whether the road transportation segment will gain a cost advantage thanks to the tunnel or not. If the tunnel fee will not be cheaper than the current ferry fees, no substantial cost savings related to the tunnel can be expected by using the tunnel.

Transit time is regarded as a decisive factor in modal choice in literature as well (Bolis & Maggi, 2003; García Menéndez et al., 2004; Moschovou & Giannaopoulos, 2012; Ribbink et al., 2005). It is stated that for container transportations, some days in reduced transportation time can be worth hundreds of Euros, and that is a reason why road transportation plays a decisive role in long-distance transportation even if railway and waterborne services exist on the route (Tentacle, 2017). It is confirmed by Anonymous 1, who explained lead time is an important factor for their customers in the road segment. However, Anonymous 1 also mentioned that the one hour decrease in transit time that the new Fehmarn Belt fixed link will generate is not influential for customers on long-distance transports. Further, as mentioned earlier in the analysis and by several respondents, the expected time savings that the tunnel will generate is expected to be cancelled out by a required break for truck drivers at another place along the route. Hence, it seems unlikely that the road segment will gain any serious advantages in reduced transit time because of the Fehmarn Belt tunnel. Capacity limitations may affect the transit time, and hence it may affect modal choice. However, no capacity limitations on the road infrastructure such as potential increased traffic or congestion were mentioned by any respondent as a current problem or a possible problem as a result of the Fehmarn Belt tunnel, so it can be suggested that is not a factor influencing the modal choice here.

Reliability and flexibility are also mentioned important modal choice factors in literature (Beuthe & Bouffioux, 2008; Feo et al., 2011). Two respondents believed the reliability in long-distance road transportation will be increased once the Fehmarn Belt tunnel is operational. They mentioned that it would be possible to pass the water passage even if there is bad weather, for example a storm, when the ferry services might not be able to operate. Tomas Ström at NTEX believed that the flexibility would increase for the semi-trailer segment as the Fehmarn Belt route could be a complementary route to their RoRo services between Sweden and Hamburg-Rotterdam. Hence, there is potential for increased reliability and flexibility in the road segment thanks to the Fehmarn Belt tunnel. In literature, a mass of researchers found the characteristics of the goods a decisive factor for modal choice. For example, qualitative factors such as frequency, flexibility and reliability are important for companies in a Just-in-Time context (Bolis & Maggi, 2003). Magnus Winberg at Trans-Action confirmed this and said that reliability in transit time is important for their customers because they are mainly running Just-in-Time operations. Winberg explained they are currently not using the Rödby-Puttgarden route frequently and will probably not do so once the Fehmarn Belt tunnel is opened, because they

are satisfied with the reliability and the frequency of current ferry services they use today between Sweden and Germany. So, even if the Fehmarn Belt route would increase reliability in the road segment, it could be suggested that transport companies will not just naturally switch route towards the Fehmarn Belt route once it is opened because of this.

Road transportation is generally a mode contributing to several negative externalities such as emissions and congestion according to literature, and often responsible for more emissions per tonne-kilometer than the rail segment and the maritime segment (Alises & Vassallo, 2015; Frémont & Franc, 2010). A great majority of the respondents confirmed that the environmental awareness has increased in recent years, and many shippers are worrying about the environmental impact of transports. Even though the road segment has an environmental disadvantage, few shippers seems willing to pay for more environmentally friendly transport solutions. The main constraint to use more environmentally friendly mode such as rail and sea is the transit time where road has a big advantage, said the respondent of Kerry Logistics. If the transport services are greener than the competitors whilst the prices are similar, it could be a competitive advantage, according to the NTEX respondent. Hence, the environmental factor seems to be an important factor in modal choice but outplayed by other factors such as costs and transit time. If any other more environmentally friendly mode can compete with road transport on price and transit time, it can be suggested that the environmental factor could play a decisive role for modal choice.

5.1.3 Potential outcome

Generally, based on the discussion above, it seems like the determining factors for modal choice is not likely to be improved considerably in the road transportation segment. The costs, which is a very important determining factor on modal choice according to both the literature and the respondents, is not likely to change substantially compared to the current ferry service between Rödby and Puttgarden. Presumably, the decreased transit time of approximately one hour that the Fehmarn Belt tunnel itself will result in will likely be cancelled out by the break the driver needs during long-distance transportations. However, on short-distance transportations, less than 4.5 hours, the transit time will be reduced to some degree. There may be improvements in reliability and flexibility for the road segment once the tunnel is operational, but it is unclear

by how much and how decisive these factors are for modal choice. Overall, it can be suggested the determining factors on modal choice in the road segment will not be impaired, but neither substantially improved because of the Fehmarn Belt tunnel.

One respondent thought that the road segment could gain shares because of the Fehmarn Belt tunnel, but in general few respondents thought the tunnel will result in any significant improvements for road transportations between Sweden and mainland Europe. Some respondents rather speculated that the rail segment could gain shares from the road segment while other interviewees believed the road segment will not be affected significantly by the new tunnel, and thought future governmental restrictions like increased taxes on road traffic will contribute to a modal change rather than the Fehmarn Belt tunnel itself. Overall, there are some different views on how the road segment will be affected once the tunnel is operational, but it can be suggested no dramatic change is likely to take place.

5.2 Rail transports

5.2.1 Barriers

Many of the barriers discussed during interviews aligned with findings from the literature review. In terms of legal barriers, two respondents confirmed the findings by Zunder et al. (2012) which states that a driver must master the language in the country where the train is currently operating. This serves as a barrier within Europe where countries are many and the language between them varies. For rail transports, this is a clear competitive disadvantage compared to road transports where a driver has no such language requirements to comply with. Zunder et al. (2012) also states that the lack of mutual driving license for rail operations is a competitive disadvantage compared to road transports.

In terms of technical barriers for international rail transports from Sweden, several potential bottlenecks were mentioned by the interview respondents. One of the main bottlenecks in international rail traffic is the different power systems between countries which may require a change of locomotive at the borders (Mortimer et al., 2012). This issue was highlighted by Johansson from Green Cargo, he explained how this issue required expensive locomotives

compatible with several power systems, or a change of locomotive by the borders. Other technical barriers mentioned by the interview respondents were weight restrictions on certain paths and the lack of long passing loops along single lines. The major worry expressed from most interview respondents were the capacity of the Swedish railways. Several respondents would like to see an expansion of the current network and believed it has little leftover capacity for increased traffic as things stand today, this aligns well with the research by Vierth et al. (2019) which highlights capacity constraints in the Swedish network. According to Eom et al (2012), one of the reasons behind capacity constraints in railway networks is the passenger traffic which is often prioritized ahead of freight traffic. These findings aligned with the views from one of the interview respondents as well. The mutual worry regarding Swedish railway capacity expressed by several respondents suggests that expansions of the networks are required if significant increases in volumes are to be made possible in the future.

5.2.2 The tunnel's impact on modal choice factors

Cost is one of the most important factors for shippers when deciding upon which transport mode to use (Bolis & Maggi, 2003; Curty et al., 2011; García Menéndez et al., 2004; Ribbink et al., 2005). All interview respondents confirmed that the cost for transports is a very important factor for their customers as well. Two of the interview respondents that perform rail services explained how their services today use train ferries to get from Sweden to Germany. Both respondents believed that they will be able to use the tunnel at a lower overall price for their train lines compared to today's setup with train ferries. This suggests that the tunnel will lead to lower costs for the operators and ultimately better prices for the shippers.

Other factors that are important in shipper's modal choice are transit time, frequency, flexibility, and reliability (Beuthe & Bouffioux, 2008). The importance of all these factors were corroborated by most of the respondents, albeit in different descending orders. As previously stated, several interview respondents mentioned capacity constraints in the Swedish railway system as a problem. Further, Johansson from Green Cargo expressed the railway system's vulnerability to disruptions, and how one problem along a line may set of a "domino effect" of delays. The lack of potential routes in Sweden makes the railway mode vulnerable and might hamper the potential benefits that the Fehmarn Belt tunnel can offer transports between Sweden

and mainland Europe. Compared to road freight, the railway segment is less flexible and the reliability is lower in general. But with the introduction of the tunnel, another possible route is added which might improve flexibility and reliability for the segment. In terms of transit time, it is very likely that the route through the tunnel will be faster compared to today's options via train ferries or the Great Belt. However, this estimation is dependent on the development of the rail infrastructure adjacent to the tunnel.

Several researches have concluded that the characteristics and value of the goods have impact on modal choice. High value goods are usually transported via road and air, as this type of commodity usually come in small packages and require high reliability and short transit times (de Jong & Ben-Akiva, 2007; Feo et al., 2011; Wang et al., 2013). Similar conclusions are confirmed by several respondents. With the opening of the Fehmarn Belt tunnel, rail will likely improve its' transit times, but it is unlikely that the segment's share of high value goods will increase as a result.

Another factor with growing importance in the modal choice decision is sustainability. During the last ten years, the shippers and transport providers have become more aware of their transport-related emissions (Hyun-Chan et al., 2017). As many of the interview respondents are freight forwarders, they provide insights to many different customers (shippers) and what is most important for their transports. The replies regarding sustainability's importance for the shippers were consistent in the interviews. Most shippers are more aware of their transport-related emissions compared to ten years ago and are willing to make efforts in order to improve their environmental footprint. However, it is generally something that they are not willing to pay any significant extra sums for at this time. Railway is considered to be an environmentally friendly transport solution assuming that it is powered by green electricity. With the opening of the Fehmarn Belt tunnel, the environmental footprint could perhaps decrease as train ferries can be avoided, but such improvement would likely be minor.

5.2.3 Potential outcome

The section above suggests that rail freight between Sweden and mainland Europe will improve on several aspects as a result of the Fehmarn Belt tunnel. Factors important to modal choice

such as flexibility and transit time will likely improve. As suggested by literature and confirmed by interviewees, cost is a very important factor for shippers when deciding on mode of transport. Two of the respondents with expertise on rail freight believed that it will be less costly to use the tunnel compared to train ferries, this of course is dependent on the future fees of the tunnel. Together, this suggests that the Fehmarn Belt tunnel will be valuable to the rail freight industry as shippers could be offered improved prices.

All respondents were asked to speculate on the potential of a future modal shift in container and trailer transports as a result of the Fehmarn Belt tunnel. As presented in the Empirical findings, a majority could not see any reasons for why rail would lose shares of the freight flows as a result of the tunnel. Several respondents believed that rail was the mode that would benefit the most from the new tunnel. However, all interviewees emphasized that this was speculation at such early stage, and other factors such as future regulations and other infrastructure projects can change the outlook.

5.3 Maritime transports

5.3.1 Barriers

Most respondents that offered maritime services did so on an intercontinental scale, but a few of the freight forwarders did offer services between Sweden and Mediterranean countries. The respondent's main relation to intra-European maritime transports was RoRo and train ferry services between Sweden and Germany. No significant barriers were mentioned for maritime transports between Sweden and mainland Europe in the interviews. The lack of barriers from respondents is logical because maritime transport does not experience border crossings in the same concrete way as the other transport modes. And considering that this thesis is focusing on short sea shipping, it concerns small ships which can be handled by a large share of ports. In comparison, large ships may experience technical barriers in ports due to their massive size, thus the selection of ports become narrower, and this is not a problem for smaller ships.

The main barrier for maritime transports identified in the literature review was regarding policies. Marie and Cappuccilli (2011) stated how intra-European short sea shipping were

suffering from inconsistencies from the European Commission. On one hand, the Commission have started several programs to shift goods from road to rail and sea with environmental objectives, such as the EU White papers and Marco Polo programs, but at the same time the Commission funds infrastructure projects that are beneficial to road freight. Another barrier from the literature review is the sulphur limits which are lower in the English Channel, Northern Sea and Baltic Sea compared to other areas. No interview respondent mentioned this barrier, and according to Trafikanalys (2018) the worries prior to the new limits have not been as bad as initially expected. With the new 2020 global sulphur regulations lowered to 0.5%, the difference in cost between north western Europe and other areas are mitigated.

5.3.2 The tunnel's impact on modal choice factors

As previously mentioned, some key factors such as cost, flexibility, reliability are vital to shipper's decision of modal choice (Beuthe & Bouffieux, 2008). Compared to road and rail transports where new possible routes will be made available through the Fehmarn Belt tunnel, the possible routes for maritime transports remain the same. Therefore, the important factors in modal choice will probably not be affected in maritime transport as a result of the tunnel in general. Most of the respondents that use RoRo services for their semi-trailers to get between Sweden and Germany believed that they would continue to do so in the future as well, assuming that the frequency of ferry departures remains at the same level or better. Frequency is an important factor for shippers (Curty et al., 2011; García Menéndez et al., 2004; Feo et al., 2011) and with increased competition from road and rail due to the tunnel, RoRo ferries between Sweden and Germany may not be able to keep the same frequencies in the future if they lose shares of the goods volume.

The characteristics of the goods is an important factor in modal choice as well as the distance (Feo et al., 2011) and according to Olofsson from C Land Logistics, maritime transport is an obvious choice for big volumes over longer distances and will likely remain unthreatened in the segment. In terms of sustainability, it is unlikely that the Fehmarn Belt tunnel will change maritime transports performance in this area.

5.3.3 Potential outcome

No arguments have been put forward during the interviews which suggest that maritime freight transport would gain shares as a result of the tunnel. The lack of argument is logical as the maritime industry and its potential routes are unchanged, compared to road and rail where new routes are made available, adding to the existing ones. It is likely that RoRo services between Rödby and Puttgarden will be affected in a negative way, and loose shares to the other segments as a result of the direct competition with the Fehmarn Belt tunnel.

Train ferries between Sweden and Germany will likely lose shares, where several respondents believed that the tunnel would be both faster and less costly to use for train operators. But once again, the respondents emphasized that these thoughts are speculations at this stage and factors such as tunnel fees, adjacent infrastructure to the tunnel, and regulations may change the outlook in a few years.

Most of the respondents mainly used RoRo ferries between Sweden and Germany for their truck and semi-trailer segments. A vast majority believed that they will continue to do so even once the Fehmarn Belt tunnel is opened, thus it seems like the RoRo traffic between Sweden and Germany will not lose any significant shares of trucks and trailers. Several interviewees acknowledged that the tunnel will offer increased flexibility. It is likely that urgent express deliveries will go via the tunnel instead of using RoRo alternatives.

Overall, respondents believed that feeder traffic of containers between Sweden and mainland Europe would be unchanged. However, Thomas Ström from NTEX believed that the feeder services between Sweden and Hamburg/Rotterdam can receive competition from rail traffic in the future as a result of the tunnel, but he warned that capacity constraints on the Swedish railways may become a problem. His views align findings from Stopford (2009), which argue that feeder traffic is in direct competition with rail traffic. Another aspect which aligns is the distance, according to Rodrigue et al. (2013), train freight is a generally a good option on distances between 600-1500 kilometres.

6 Conclusion

The objective of this study has been to investigate whether the Fehmarn Belt fixed link will impact current distribution of freight flows between Sweden and European countries located south of the Fehmarn Belt link. The aim was to investigate if the share of containers and trailers between the transport modes of road, rail and sea will change once the Fehmarn Belt tunnel is operational and predict each transport mode's likeliness to lose or gain shares. This has been done through an explorative research based on existing literature and a data collection through interviews with stakeholders in the transport sector. In this chapter, the research questions are answered and propositions for further research are provided.

6.1 Answers to research questions

- *Will the distribution between road, rail and sea transport of containers and trailers between Sweden and European countries located south of the Fehmarn Belt link change once the fixed link is opened?*

The determining factors for modal choice will likely be improved differently for each mode of transportation once the Fehmarn Belt tunnel is operational. It can be suggested that the rail mode will experience improved cost efficiency, reduced transit time, increased capacity on the infrastructure and become slightly more flexible. These factors all influence the modal choice, and these are all positive improvements for the rail segment. At the same time, the rail segment faces some barriers related to cross-border traffic and capacity constraints on the infrastructure that may hamper increased traffic between Sweden and countries located south of the Fehmarn Belt tunnel. It seems like the road mode will not experience as much improvements on determining modal choice factors as the rail segment. The costs once the Fehmarn Belt tunnel is operational seems to remain on approximately the same level as before. The transit time is likely reduced between 0-1 hour. The flexibility and reliability are likely to be improved in the road segment. Overall, sea transports are not directly impacted as the Fehmarn Belt tunnel contains of a new road and rail infrastructure. No direct changes in costs, transit time or flexibility related to the opening of the Fehmarn Belt tunnel have been found in this study.

Depending on the operating ferry companies, the reliability and frequency of the ferry services between Sweden and mainland Europe might change. However, the RoRo service between Rödby and Puttgarden will face increased competition as the tunnel is built on the route. It is generally difficult to find indications the Fehmarn Belt tunnel will bring positive aspects to the maritime sector.

Overall, it can be concluded that several modal choice factors will be improved for freight transports because of the tunnel. These improvements are not distributed evenly between the three modes of transport, thus a change in the distribution between road, rail and sea transport of containers and trailers between Sweden and European countries located south of the Fehmarn Belt link is likely to occur.

- *If a modal shift in container and trailer transports will occur along the investigated routes as a result of the Fehmarn Belt tunnel, which transport modes will likely gain market shares and which will likely lose?*

It is however debatable how influential the mentioned factors above are on modal choice. Both the literature and the empirical findings state that cost is of very big importance in terms of modal choice. The fee for using the Fehmarn Belt tunnel is therefore an aspect that will have a big influence. The road segment is expected to face similar fees as the current ferry services between Rödby and Puttgarden while it remains unclear for the rail segment what the fees will be. However, the rail segment seems to gain the greatest advantages in terms of cost reduction. It is expected that operating through the tunnel will be cheaper than using complementary train ferries. The reduced transit time the tunnel will imply for the rail segment is likely to result in further cost reductions related to salaries and operating costs. In this study, no indications of a possible change in the cost aspect for the maritime segment has been found. In terms of transit time, the rail and road segment may gain improvements. The rail transports may reduce the transit time by approximately up to 2 hours while the road segment is likely to reduce the transit time by 0-1 hour once the tunnel is opened. However, the empirical findings indicate that the reduced transit time of 1 hour in the road segment and some hours in the rail segment is not very decisive for the shippers on long-distance transports. The rail and road segment could gain improvements in terms of flexibility, and road could also become a more reliable transportation mode on the route.

Overall, the rail segment is supposed to experience significant improvements as a result of the Fehmarn Belt tunnel. The determining modal choice factors for road segment will not likely be impaired but neither substantially improved, while the maritime segment does not seem to experience an influential change at all. Ultimately, it is hard to find logical reasons for why rail would lose shares after the tunnel is opened and it is likely that if any transport mode will gain shares in container and trailer trade, it is this one. It can be suggested the maritime sector is expected to lose shares as a result of improvements for the other modes. The road segment seems to be in between. Basically, it is difficult to predict whether the road segment will lose or gain shares or if it will remain on the same level.

6.2 Proposition for future research

The empirical findings in this thesis were collected through interviews with five freight forwarding companies and two rail operators. Most of the interviewed freight forwarders' main transport services were related to road, rail or intercontinental maritime transports. Thus, a detailed insight into daily operations in feeder traffic, RoRo and train ferry services are lacking. Future researchers should strive to get a deeper understanding regarding how these services will cope with the introduction of the Fehmarn Belt tunnel, which will subsequently have an impact on potential shifts in modal choice. In this thesis, only Swedish actors from the transport industry was interviewed. Future research should aim to gain perspectives from German and Danish actors as they likely can provide valuable information on the tunnel and other important factors.

Adjacent railway systems to the tunnel is another area where more detailed research should be conducted. In this thesis, the possible constraints and planned expansions on the German and Danish side of the tunnel is not covered in detail in the literature review or the empirical findings. The future capacity of the Danish and German railway system will likely have a significant impact on a potential shift in transport mode between Sweden and mainland Europe.

Finally, a very important factor which will impact shipper's modal choices are the fees for using the tunnel. This thesis has not compared any concrete prices between the different transport solutions, i.e. the cost of going through the tunnel compared to using RoRo and train ferry

services. Thus, future researchers could have a quantitative approach where costs can be compared. However, such quantitative research may be a challenge at this early stage as tunnel fees are yet to be decided.

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Appendix A - Detailed summary of interviews

This appendix presents detailed summaries of all conducted interviews. It contains summaries of the most important findings from each interview, hence it is not verbatim presentations.

Lennart Johansson - Green Cargo

Lennart Johansson is working for Sweden's biggest freight train operator Green Cargo. Other than Sweden, the company is licensed to operate in Norway and Denmark. Johansson's title is Business Developer which is mainly a role that falls under sales/marketing. Further, Johansson is responsible for the company's direct international lines which are operated in collaboration with other international railway companies. It is four direct lines from Sweden, which runs several times per week on fixed schedules with destinations in Belgium, Austria, Italy and Denmark.

The company is actively discussing their future strategies with the Fehmarn Belt tunnel in their minds. Getting a license in Denmark last year was one of their first steps and it is no secret that they are very interested in being able to run trains via the Belt in the future. Currently, they do not have a license to operate in Germany and they are actively considering the possibilities of getting a license or if it is better to develop strategic partnerships with German actors. The respondent added that getting the licenses can be time consuming and costly.

Today, on the international lines to Austria and Italy, the operator use train ferries between Trelleborg and Rostock to get from Sweden to Germany, with the tunnel in place, the respondent believed that their international lines and future lines of similar setup will use the Fehmarn Belt fixed link instead of the ferries. The company expect that the future fees of using the rail tracks in the tunnel will be reasonable in order for the infrastructure to attract operators, it would be unfortunate to build a tunnel that does not attract customers because of an unreasonable fee, he added.

On potential barriers that may hamper the future international rail traffic from Sweden, Johansson confirmed that a driver needs to master the language in the country where he or she operates the train. Other barriers are different electric power grids which drives the locomotives, Sweden and Germany have the same power system, but Denmark has its own. There are

locomotives that can handle both systems, but these are costly. Further, different signal systems are used in all three countries which is a barrier too. The EU have started projects to harmonise these signaling systems, but these initiatives are still at early stages. Denmark are apparently considering changing system accordingly and as an operator you want to know the status of such projects in order to set out your future strategy in terms of procuring locomotives, which are big investments with long lead times. Other more general potential barriers that are relevant in the entire system and not only in regard to the Fehmarn Belt link is the capacity of the tracks. The operators want to drive longer trains and the tracks must therefore be able to carry the weight and the passing loops needs to be long enough to fit the trains. On the Swedish railway network, Johansson believed it is a bit fragile to disruptions and the lack of potential routes makes the system vulnerable once a problem occurs at one line, a domino effect of delays is set in motion. This could impact shipper's willingness to use the trains once the Fehmarn Belt is open as well.

When the respondent was asked to speculate on how the tunnel will change contemporary freight flows between Sweden and mainland Europe, he answered that theoretically the train industry should be the mode that benefits the most as it will be a significant reduction in time but probably also in costs. On road transports, he added that the current ferry services between Rödby and Puttgarden serves as an opportunity to rest according to the regulations for truck drivers, thus it may be of less advantage for the truck transports between Sweden and mainland Europe. Finally, on maritime feeder services between Sweden and Germany Johansson believed the tunnel will have little impact and added that the possibility of setting up train lines to the port of Hamburg or Rotterdam has not been discussed by the company. Finally, the respondent reiterated that this is speculation and it will probably take a few years before more reliable predictions can be made. Ultimately the train operators are still dependent on a lot of outside factors in the infrastructure and political decisions may change the outlook as well.

Johansson hoped that shippers in the future will choose rail freight as it is environmentally the friendliest mode if it is run on green electricity. Today, it often comes down to cost for the shippers where few are willing to pay extra for the greenest alternative.

Mikael Nyman - CFL Cargo

The company is a European freight rail operator with a subsidiary in Sweden. Currently, the company has European operations running container, trailer and bulk transports. Mikael Nyman explained that the company has been thinking about the impact of the Fehmarn Belt tunnel in the long-term planning but emphasized that it is a long time until it is operational and hence difficult to anticipate its impact specifically. The respondent believed the tunnel will affect their business in some way. Further, he believed the tunnel will not likely impact the current solutions with their customers and flows significantly, but it will absolutely bring opportunities for new customers and an increase in transport movements by train on the route. The railway transport patterns in Denmark will change completely after the completion of the tunnel, speculated Nyman.

Nyman highlighted that all this is dependent upon what the cost of going through the tunnel will be. The business is highly dependent upon costs. The company is operating on the route through Funen and Jutland, and there is a fee for crossing the Great Belt as well. There are also difficulties and high costs for canceling an already booked spot on the Great Belt's railway tracks. As costs are significant for the business, the price for going through the Fehmarn Belt tunnel compared to the costs going over the Great Belt will be decisive which route they will operate. A reduction in transit time itself would not benefit for the company and their customers as the customers do not value transit time enough to care about a few hours. The respondent explained a shortening of five hours in transport time would not matter for the customers. But shorter transit time would help the company reduce costs, for example reduced salaries for the train driver, reduced kilometer-cost the train is operating, and it would give the opportunity to operate longer trips and more trips per day. However, Nyman believed that this could be different for other segments.

He explained there are no urging capacity problems on the rail tracks in southern Sweden and Denmark today. The company can expand their traffic, at least slightly, if they want to. The respondent said that some routes on the railway system in Denmark are one-track only, and that is not optimal from a capacity perspective. Another problem is the intense passenger traffic around the big cities, affecting the capacity for freight trains in a negative way. The bridge over the Kiel canal is a capacity problem, there are weight limits creating obstacles for heavy traffic.

The most important advantages the tunnel will bring according to Nyman are shorter distance/transit time so that the costs can be reduced and an increase in total capacity, because they can still use the Great Belt passage if needed. However, trains could start competing with air cargo traffic as a consequence of shortened transit time between Germany and Sweden. There are no obstacles for cross-border traffic for the company compared to other transportation modes. The train drivers are changed at the borders in order to follow the regulations about language knowledge. But that is not a problem as the trains are operating on long distances, the driver must be changed somewhere because of working conditions and regulations regarding the time a train driver is allowed to operate. Hence, one driver cannot drive the whole distance anyway. The respondent said an alternative is to educate the drivers in the languages. However, this is not a problem for cross-border train traffic from a CFL Cargo perspective.

Nyman explained that train is not a very flexible transport mode. It is difficult to quickly gain new customers; the business is rather a matter of long-term planning of capacity. Hence the train mode cannot offer more flexibility to their customers because of the Fehmarn Belt tunnel. Further, he believed the train mode will not lose shares to road traffic because of the tunnel. The train mode will benefit from it rather than losing shares, there are no negative aspects of building the tunnel for the train mode. However, if the cost of going through the tunnel will be at a very high cost there will not be a lot of positive aspects either. The environmental aspect becomes increasingly important for the customers in their transport choices, and train has an advantage over other modes from an environmental perspective.

Magnus Winberg - Trans-Action

The respondent is CEO in a freight forwarder company situated in Varberg. The company has 5 employees and provides mainly trailer transports, both nationally and internationally to countries like Denmark, Germany, France, Italy, Switzerland, Belgium and The Netherlands. Winberg explained the company has not taken the Fehmarn Belt tunnel into account for future strategies and planning. The tunnel completion is simply too long into the future. Also, approximately 95 percent of all their international truck transports are currently using the RoRo ferry services from Malmö or Trelleborg to Travemünde. The route passing through Rödbby and Puttgarden is not used frequently, but only if the trucks cannot catch the ferry in Malmö, Trelleborg or Travemünde in time.

The respondent did not believe the tunnel will affect or change their business once it is operational but explained this is not analyzed in detail. The current setup suits the business well, but if the ferry lines change their schedule, it might force the business to change their setup. In terms of costs the route via Rödbby and Puttgarden, including fees for passing the Öresund bridge, the ferry fee and the extra kilometres for the trucks to operate, is slightly more costly than using the ferries from Malmö or Trelleborg to Travemünde, but that is not very decisive for the company. The company are mainly running Just-in-Time transports. Therefore, costs are important but not necessarily the most important one. Quality, like reliable transports and transports arriving in time are important factors for their customers. The company is more focused on shortening the lead time of the transports than reducing costs. There are some risks with the ferry services associated to bad weather, but it does not cause any major problems. The environmental factor is growing in importance, but the shippers are not often willing to pay for it.

If a truck is running between Sweden and the European continent, Winberg believed the ferries serve as a natural break for drivers. If these trucks will go through the tunnel instead, a break for drivers along the road somewhere in Denmark will be needed instead.

He did not believe the tunnel will change the current share between the different modes of transportation between Scandinavia and the European continent significantly. There might be an increase in train transport of trailers between large nodes in Sweden and Europe, that might affect the share between the modes slightly. The respondent believed governmental restrictions

on the road segment like increased taxes will contribute to a change from road to rail to a higher degree than the tunnel. Finally, Winberg did not experience any barriers or obstacles in cross-border traffic.

Johanna Brorsson - Kerry Logistics

The respondent Johanna Brorsson is head of freight forwarding at Kerry Logistics. The company is offering transport services, mainly imports to Sweden, via road, sea and air. The company is also offering third-party logistics services such as warehousing. In terms of road transport, Kerry logistics provides transports all over Europe where their main markets are Turkey, Italy and Portugal. In the air and sea transport segment, their markets are global. Further, Kerry Logistics' main customer segment is within the fashion industry. The company employ around 50 people and has a turnover of 150 million SEK.

So far, Kerry Logistics has not started planning for the introduction of the Fehmarn Belt tunnel. When asked to speculate on the tunnel's impact on the organization, she explained that it could perhaps impact their choice of route in the road segment. Today, the majority of road services provided by Kerry Logistics takes the Ferry between Rostock (Germany) and Trelleborg to reach Sweden. The tunnel will provide more flexibility, and as a driver you are not tied to a timetable if you drive through it compared to RoRo services. The frequency of the Rostock-Trelleborg route are satisfactory today with at least three departures per day. Assuming the frequency remains at the same level in the future when the tunnel is operational, she did not believe that the company will change route unless a departure is missed or the goods are time sensitive. However, she added all this is hypothetical and many factors such as future fuel prices and tunnel fees could change the outlook in 2028 when the tunnel is expected to open. Further, Brorsson added that ferries serve as a good time for the drivers to rest. Another factor which is important to consider as well is that you save money on fuel and wear-related issues when using the ferry.

When asked on barriers within international traffic in Europe, Brorsson named a few regarding road traffic. Mainly the different weights of loaded vehicles that are allowed in different countries, she gave an example on the imports from Italy, where Austria serves as a constraint in terms of weight. Similar barriers are also true when it comes to the allowed length of the vehicles which differs between countries too.

When asked on which factors are most important to the customers when it comes to transport, she said that it varies depending on the goods. Price is of course very important for everyone, but generally if the product is of cheaper nature, the time becomes less important compared to

the more expensive products, whose shippers usually value speed, flexibility and reliability higher and are willing to pay extra for it. On sustainability, she believed that their clients are much more aware these days compared to ten years ago and most of them measure their emissions. The main change that Brorsson has seen from their customers is a switch from air transport to sea and rail. But even on occasions where the customer wants to change to more environmentally friendly modes, the lead times can serve as a constraint which is why road and air transports still prevail.

Finally, when asked to speculate on the potential impact that the tunnel can have on all Swedish-European transports of containers and trailers, she believed that rail transport may take some market shares assuming that the load carriers are filled. She believed that the LCL industry will remain on road transports overall.

Jonas Olofsson - C Land Logistics

Olofsson is the CEO at a Swedish freight forwarding company focusing mainly on maritime, rail and air transport solutions. C Land logistics mainly work with inter-continental transports but do also have clients to whom they provide transport solutions within Europe. The main customer segment is Swedish small and medium sized enterprises (SMEs) and the firm have a turnover of around 120 million SEK. From a European context, most of their seaborne transports has its destination along Mediterranean coast lines, and in terms of rail transports, the main destination is Italy.

Olofsson confirmed that the freight trains that they buy capacity from is using train ferries to get from Sweden to mainland Europe (in this case Germany) and he explained that his international colleagues believes that Sweden is located pretty poorly when it comes to freight train services. On the potential impact of the Fehmarn Belt tunnel, he is confident that rail bound freight with its destination in Sweden would benefit. Other than train ferries, he added that another solution many companies use to reach Sweden is to shift the mode from rail to road in northern Germany. If these modal shifts can be avoided in northern Germany and a freight train could reach Sweden via the Fehmarn Belt fixed link, this would hopefully improve lead time, environmental impact and lower the cost of transport for the shippers.

Further, when asked about how he believes that the tunnel will impact the freight flows in general along the investigated routes, he thought that road transports will lose out and that rail freight will gain from the opening of the Fehmarn Belt tunnel. He added that this forecast is very speculative and that a lot of important changes will happen prior to the opening of the tunnel which may change the outlook. He warned that the Swedish railway network might become a bottleneck which could hamper the potential benefits of the tunnel and claims that investments are required in the Swedish network. On the potential impact that the tunnel could have on maritime freight transports, Olofsson believed that the impact will be very little and motivates it with the fact that sea transports will remain the best choice for large volumes over long distances.

When asked about customer's perspective on which factors are most important for their transports, Olofsson stated that reliability and flexibility are most important together with cost. He believed that information is vital as well, the customers wants to know where their goods

are at any time and when it will arrive, if delays were to occur, the customers wants to know straight away. On the question if customers are willing to pay more for greener transport alternatives, the answer is generally no, but even more important is that a greener alternative must not impact the reliability of the transports.

Thomas Ström - NTEX

Thomas Ström is the managing director at NTEX, a freight forwarder that offers transport services via road, sea and air. The company's main segment is road transport via semi-trailers in Europe. The firm has not specifically discussed strategies regarding the tunnel at this early stage, but they do recognize the increased flexibility and potential to make quicker deliveries via the tunnel for their semi-trailer segment. Today, NTEX is mainly using RoRo services from Belgium, Germany or the Netherlands to get the trailers to Sweden. Ström believed that the company will use these RoRo services even once the Fehmarn Belt tunnel is opened but added that this is speculation at such early stage and may change once the tunnel is open.

When asked to speculate on the impact that the tunnel may have on semi-trailer and container flows between Sweden and mainland Europe, Ström believed the contemporary feeder traffic between Rotterdam/Hamburg and Sweden will see increased competition from rail bound transport. However, he warned that the railway capacity in Sweden and Germany may become constraints and therefore reduce the potential that the tunnel may offer from a railway perspective. Continuing on Swedish railways, his impression was that today's capacity on railways going from the Skåne region to Stockholm and Gothenburg are very busy. Thus, he doubted that the system could handle a significant increase in demand. Further, Ström warned that the speed and regularity of repair and maintenance of the existing railways in Sweden are not at the required level to handle increased demand today. On road transports through the tunnel, he admitted it will increase the possibilities for the freight forwarders but added that drivers still have to rest at some point which is an important factor to remember.

On customer's perspective on which factors are most important when deciding upon which transport mode to use he said that price is generally very important. On sustainability, he explained that they work actively to reduce their carbon footprints by looking at alternative fuels and routing to give some examples. However, it is still very important to be able to offer good prices, very few companies are willing to pay extra for green services, but it is a competitive advantage if your services are greener than the competitors whilst the prices are similar. Flexibility and reliability are very important as well, Ström liked to separate between price and cost, and explains that NTEX is not always the company with the lowest initial price, but as a shipper you will have lower costs in the long run thanks to their reliability and flexibility.

Anonymous 1

The respondent is Operations Manager in a company which is a global logistics provider mainly transporting trailers and swap bodies by almost all modes of transportation. On the routes between Sweden and mainland Europe the company only use road as transportation mode. The company has approximately 50 employees in Gothenburg.

The company section in Gothenburg has not taken the Fehmarn Belt tunnel into consideration for future planning and future strategies and the respondent did not know if the company has done so on a global level. The reason is that the tunnel is operational too far into the future and because of too many uncertainties regarding the tunnel, the fee for going through the tunnel mentioned as one uncertainty.

The respondent was not sure but believed the current flow of container transports on the ferry line between Rödby and Puttgarden is limited but mainly consist of trailers and swap bodies. Generally, the train segment is characterized by high volumes and customers have accepted a longer lead time, so that segment is not really competing with road transports on price. So, the respondent did not believe any mode of transportation will gain or lose shares because of the new tunnel. But if the rail infrastructure is upgraded on both sides of the tunnel, both in Denmark and Germany, the rail mode may gain some shares.

In terms of cross-border barriers, the respondent believed the maximum truck length differences between the countries is a major challenge. Sweden and Denmark have similar regulations and trucks with a length of approximately 25 meters are allowed. Germany does not allow such long vehicles. It is not difficult to plan for this, but it gives fewer opportunities. Not a single company but the whole road transportation segment would economically gain on a harmonised regulation between the countries. The respondent believed some segments would for sure gain more customers, and the environment would benefit substantially if Germany allowed longer vehicles. The whole road transportation system between Scandinavia and Germany would be more efficient and would generate fewer trucks on the road as a result.

The respondent believed the Fehmarn Belt tunnel will not necessarily provide more customers to the company. The decrease of one hour in transportation time the tunnel will generate is not decisive for the customers. Lead time is an important factor but one hour less is not so

influential. A crucial factor for the company is the restrictions the tunnel will have on dangerous goods. More and more dangerous goods are being transported on the roads and a tunnel would mean restrictions on this segment. There are different rules for carrying dangerous goods on a ferry compared to a tunnel. There could be restrictions only allowing trucks carrying dangerous goods going through the tunnel during the night.

When asked about important factors for the shippers, quality and price of the transports are the most important factors. The tunnel would mean a small positive increase in reliability for transports, Anonymous 1 speculated. The trucks would be able to pass the strait even if there is for example a storm. Today, the ferries might be delayed or postponed due to bad weather, but that is just happening a few days per year. Environmental awareness among their customers have been intensified and are of great focus at the moment, especially CO₂ emissions. Another very important factor for the company will be the fee for going through the tunnel compared to using the ferry. If the fee for going through the tunnel is higher than the fee of the ferry line, there are little reasons for using the tunnel.

Appendix B – Questionnaire

General

- What kind of transport solutions does the organization provide?
- What types of transport modes does the organization provide?
- Which is the dominant mode of transport the organization provide?
- What are the number of employees in the organization?

The tunnel

- Has the organization prepared for or taken the Fehmarn Belt tunnel into consideration for future planning?
 - If yes: How?
 - If no: Why?
- Do you think the tunnel will affect your business?
 - If yes: How?
 - If no: Why?
- Do you think the tunnel will affect the transport flows in general?
 - Which types of transport mode do you think will benefit or disadvantage?
- What difficulties or barriers do you think the tunnel and its connecting infrastructure need to address in order to get maximum benefit and capacity?
 - Do you think there will be capacity problems on the connecting infrastructure in the future?
 - Are capacity problems on the connecting infrastructure a problem today?

Cross-border traffic

- Are there any difficulties or barriers with cross-border transports between Sweden and mainland Europe?
 - Is there a difference depending on the mode of transport?

Choice in transport mode

- Do you think the tunnel will affect the choice of transport mode?
- What are the main requirements, or demands, on transports from the shippers?
 - Do your customers demand or require environmentally friendly transports?
 - Is there a trend in recent times that customers demand or require more environmentally friendly transports?
- How are the costs affecting the modal choices?
 - How will the price of going through the Fehmarn Belt tunnel affect its use?
 - Are there any differences between different modes of transport?
- How are the transit time affecting the modal choices?
 - How will the decreased transit times of using the Fehmarn Belt tunnel affect modal choice?
 - Are there any differences between different modes of transport?
- Will the tunnel offer opportunities for better reliability or flexibility for transports?
 - Are there any risks with the existing ferry traffic?
 - Are there any risks with the Fehmarn Belt tunnel?
- Does the nature of the goods affect the choice of transport mode?
 - How will the Fehmarn Belt tunnel affect that?