University of South-Eastern Norway

The barriers of transferring goods from road to sea

And a tailored seaborne transport solution in Hardangerfjorden

Candidate name: Synnøve Sunne Hasslan

University of South-Eastern Norway
Faculty of Technology, Natural Sciences and Maritime Sciences

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Abstract

This research aims to explore the reasons why the governments ambitions of transfer of goods from road to sea is not completed. As a way of identifying why the cargo owners has not changed their transport mode, this thesis focuses on the barriers of using seaborne transport. The identified barriers will also be used to design a tailored transport solution to four factories in Hardangerfjorden in Norway. The chosen method for this was literature review and a single case study. To draw results, abductive reasoning has been used. The results showed that there are several barriers affecting seaborne transports competitiveness. The author also presents a short sea solution for the transport in Hardangerfjorden that is based on trying to avoid the barriers.

Keywords: *short sea; transfer of goods; barriers; transportation; competitiveness; shipping; environmentally friendly*

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1 Introduction

1.1 The problem

Environmentally harmful emissions have heavily increased since the industrial era, and global warming has become a concern for the whole world. This has resulted in a global effort to decrease the environmental emissions throughout every aspect of human behaviour. As one of the more visible polluters, this naturally also extends to the topic of transportation and distribution. “Transfer of goods” has become a buzzword and is being continuously brought up as a measure to reduce the environmental impact caused by the increasingly high consumption of goods. In spite of the goals and measures, there is still an overwhelming amount of goods transported throughout the country by road-based transport. There is also an observable amount of goods being imported to Norway with the use of foreign trucks. Through my thesis I want to explore why road transport still is a heavily chosen mode by transporters, when it is the most environmentally damaging of the obvious modal choices. I intend to explore this theme through looking at seaborne transport’s challenges, more specifically their barriers.

My first research question (RQ1) is as follows:

> *What are the barriers of using sea transport in place of road transport over longer distances?*

I chose this research question as I am aware that transfer of goods has been a goal for several years, however little goods are actually transferred to sea transport from road transport. According to the national transport plan (Samferdsdepartementet, 2021) the goal applies to transport work over 300 km. As this has been a goal for multiple NTPs, there has to be a reason for the lack of transfer. I will research this from the point of the cargo owners, as they ultimately are responsible for the actual shift of transport mode. I want to study the reason cargo owners still choose road transport over sea transport a majority of the time. For this research question I have two hypotheses:

1. The road transport is necessary even with the use of ships on the longer hauls of the transport. It may therefore be easier for the cargo owners to use road transport the whole way rather than use road – sea – road.

2. Sea transport is a slow transport mode and requires multiple time-consuming operations. These includes loading and discharging. The cargo owners want their goods as soon as possible and will therefore choose a faster transport mode.

As this research question sets out to explore barriers, there is a high probability that several barriers will be identified. My hypotheses for this research question are several hypotheses that can be proven in the sense that it is either identified as a barrier or not. They could all be identified as barriers, or not identified as barriers at all.

My second research question (RQ2) is as follows:

Can a short sea feeder be competitive in Hardangerfjorden?

This Research question was supposed to be related to the Pilot-E project. Early in the process of my thesis, the project failed to apply for financial aid making the project delayed. I chose to continue with my research as the I was not dependent on the project going ahead for my project. Hardangerfjorden is an area that is now largely served by truck. Through the answers of my first research question, I want to explore this area and the opportunity to create a seaborne solution considering these barriers. My first hypothesis is:

1. It is possible to execute a seaborne transport solution in Hardangerfjorden, containing the four identified factories.

I first want to explore the possibility of such a solution. If it is possible to find a transport solution that fit each of the factories' individual needs. Secondly, I have another hypothesis:

2. By working to avoid the barriers, a short sea solution in Hardangerfjorden could be competitive.

I theorize that the barriers identified in research question one is the factors that make a seaborne solution less competitive. Because of this, I have the hypothesis that by avoiding, or tailoring to those barriers, I will be able to find out whether a short sea solution might be competitive or not.

1.2 Impact of the problem

Transferring goods from road to sea is identified as one of the measures to reduce the amount of emissions from the transport sector (Miljødirektoratet et al., 2020; Samferdsdepartementet, 2021). By identifying and exploring the barriers that is hindering the transfer of goods, one might also find ways of overcoming those barriers. This can therefore identify solutions that can cause more transfer of goods, which in turn will have a positive environmental impact. Reducing the number of trucks on the roads are also beneficiary for several reasons. One of them being that a reduction is beneficiary is because trucks are damaging to the road network and is continuously increasing the amount of degradation on the roads. In addition, less traffic on the road can lead to less accidents on the road. A third advantage of less trucks is less noise emissions, in addition to the exhaust and other environmental emissions coming from cars. Roads are often located around houses, making this a disturbance to the surrounding population. Finally, less emissions can also mean less pressure on the road network, lessening the overload that is currently on the road network leading to less queues for the other cars on the roads.

1.3 Goal of the thesis

My goals for this thesis are to explore the topic of "transfer of goods". I want to derive why the governments goals for this has not yet been fully executed based on the barriers found in my research question one. Specifically, I want to target the barriers in my research as these are the reasons the cargo owners are choosing to use road transport instead of using sea transport. Many barriers are possible to overcome when identified and I think it is important to look at this as an ongoing project which can still be improved. In addition, the identification of barriers can help practitioners and other interested parties understand the problem of transfer of goods better, in addition to adapt the current seaborne transport solutions to the current barriers. By investigating the issue and what barriers that stops the project from moving forward, one can figure out solutions to more likely be able to

complete/follow through with the project. This also helps us figure out where to focus our efforts to make a viable solution.

My goal for research question two is to either prove or disprove my theory that sea transport can be equally as useful in a case where road transport has traditionally been used. This research question is heavily connected with the first, as those results are used in the case. In addition, research question two is an attempt to show how the barriers can be used in practice to improve the current transport solutions.

1.4 Structure of thesis

My thesis will start off with a theoretical background. This chapter involves the basic information to understand the thesis, as an addition to definitions and explanations of important concepts that will be relevant for the rest of the thesis. Following will be the method chapter. This chapter describes what methods I have used in my thesis and how I have done the research necessary to explore the research field and answer the research questions. In addition, this chapter will show how I have arrived at my conclusions. After the theory chapter, there will be a review of the relevant literature concerning the first research question. This is the first part of my results and will go through central governmental documents and articles. The rest of my results will be presented under Case study. This chapter contains the information about how the case study is built up with background, some information about the process and the results of the case study. After the presentation of the results, there will be a discussion chapter. In this chapter I will discuss the identified barriers from research question one, in addition to discussing the results of the case study. Following this we find conclusions and topics for further research. Lastly my sources will be listed.

1.5 Assumptions made

1. All passenger transport is excluded from this thesis. This is strictly about the transport of goods.

2 Theoretical Framework

In this chapter I will go through all essential definitions and theories needed to understand the rest of the thesis. Included in this chapter is the definitions I have used to define key terms, and description of theoretical perspectives that has influenced how the data has been found through my work with my thesis.

2.1 Transport theory

The purpose of transport is to overcome space which originates because of other economic activities. Transport is shaped through several factors like distance, time, geography and topography. Another point to transportation is that the movement of the goods are bestowing the goods an added value (Rodrigue, 2020). This means that the movement has increased the value of the goods. This could be that the good is moved from a market where it is considered low value and moved to a market where the good is considered more valuable. The transport has then indirectly increased the value of the good. Another way of transportation increasing the value of the goods is transporting the good to a destination where its needed. This could be moving cotton from the farms to the factory.

Locations are often referred to as nodes. A node can be an access point to the distribution chain, such as a warehouse or distribution centre, or it can me intermediary locations within the transport chain, such as a port or a consolidation centre (Rodrigue, 2020). These nodes are often also referred to as transport terminals. Rodrigue (2020, p. 208) defines a terminal as "a facility where freight are assembled or dispersed". In other words, it is any location in the transportation process where goods or passengers are handled in some way. Different terminals have different purposes. Some terminals are strictly for modal change, some are for repackaging or consolidation of goods, and some are pick-up points and delivery points. A terminal can have different functions in different transport chains, or multiple functions in the same transport mode. A port can function as a modal change between ship and road, an interchange within the same mode between a larger ship and a feeder, and a consolidation centre where goods from several trucks are placed on the same ship. In addition, a port can function as a modal change and a storage area.

A large port is, as mentioned, a node. This can be connected to transport networks. A transport network refers to a framework of routes within a system of nodes (Rodrigue, 2020). There are multiple different transport networks, one common within the maritime being the hub-and-spoke network. The hub is a central point of the transport. The hub will often function as a sort of consolidation centre for the goods. Often times this type of network is seen in form of one single large port with feeder distribution to smaller ports(spokes). Another common way of the hub-and-spoke network to protrude is with one large port being the hub and inland destinations being the spokes.

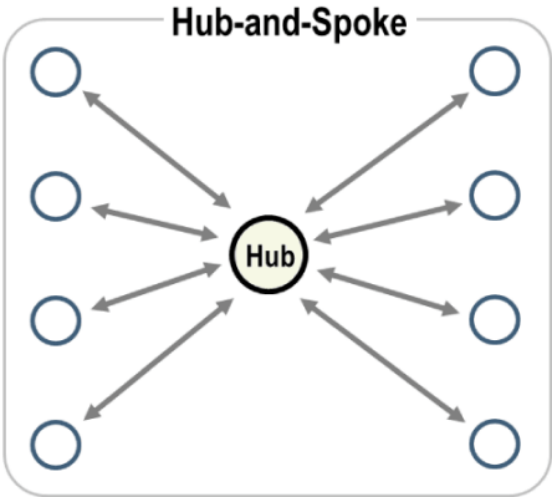

Figure 1 – Hub-and-Spoke network from: "Rodrigue, J.-P. (2020). The geography of transport systems (5th ed.). Routledge."

A central term in transport theory is hinterland. Natural hinterland is the land area where the terminal sells its services (Rodrigue, 2020). A ports hinterland is therefore the inland area where the goods are transported to from the port. A distribution centre will have its hinterland to the places where it distributes. The size of the natural hinterland will therefore be dependent on the area it serves and on the competition of other ports nearby. Another defined hinterland is the competitive hinterland, which is where the terminal must compete more intensively to win (Rodrigue, 2020). All spokes in a hub-and-spoke system falls under the definition of natural hinterland, but some might not fit the description of competitive hinterland.

2.1.1 Transport modes

Transport is often split into different modes. Each of the transport modes have different strengths and weaknesses. A transport chain, meaning the whole transport work from departure location to destination, often includes multiple modes of transport. This is referred to as multimodal transport. The different transport modes are air, road, sea, rail and pipelines (Rodrigue, 2020). Both road, meaning trucks and other vehicles on roads, and rail are land based transport modes. However, they differ in many areas: one being that rails are more

restricted than road transport. Trains requires rails to be able to transport goods, and rails are a heavy investment. Roads are much more widespread globally compared to rails, making roads more adjustable to both delivery place but also accidents in the network. Both air and sea transport are appropriate for long distance transport. They are also less affected by congestion within the transports' networks, meaning in the air or on the sea. However, air transport is very costly and sea transport is a slow transport method. Further expansion on maritime transportation and land-based transport will follow. The environmental impact of each of the transport modes will also elaborated further in the theory chapter.

2.1.2 Choice of transport mode

When it comes to the choice of transport mode there are many impacting factors. The selection process can be split into four different processes.

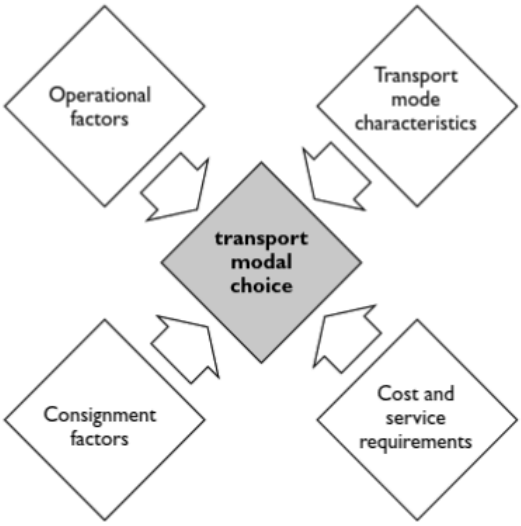

Figure 2 – Factors impacting transport choice. From «Rushton, A., Croucher, P., & Baker, P. (2017). The Handbook of Logistics and Distribution Management: Understanding the Supply Chain. Kogan Page Publishers. Page 426»

The operating factors can be split into four categories: external factors, customer characteristics, the physical nature of the product and other logistics components. The external factors are factors that is impacting the external environment of the transport modes. Customer characteristics are factors that matters to the intended customer.

External Factors	Customer Characteristics	Physical nature of the product	Other logistics components
Infrastructure	Service level requirements /agreements	Volume to weight ratio	Supply points
Trade barriers	Delivery point constraints	Value to weight ratio	Production plans
Export control and licences	Credit rating	Substitutability	Warehouses and storage facilities
Law and taxation	Terms of sale preference	Special characteristics	Depots
Financial institutions and services, and economic conditions	Order size performance		Marketing plans and policies
Communications systems	Customer importance		Supply philosophy
Culture	Product knowledge		Existing delivery system
Climate			

Table 1. Based on Rushton, A., Croucher, P., & Baker, P. (2017). *The Handbook of Logistics and Distribution Management: Understanding the Supply Chain*. Kogan Page Publishers.

One of the most important considerations when choosing a transport mode is the cost-factor. This factor is impacted by many aspects such as type of goods, size and amount, geographical market, destination and terminal costs. Sea transport is often low in variable costs, nevertheless this transport mode often "loses" to road transport on short distances and low volume as the fixed costs cannot compete (Rodrigue, 2020).

2.1.3 Seaborne transportation

Maritime transported is defined as “shipment of goods and people by sea or other waterways” (GFPTT, 2003). Maritime transport is important in the global flow of goods, and therefore also the global trade, as approximately 80% of the worlds goods is moved by sea. The maritime transportation has increased yearly in volumes the last 15 years, except for two years (UNCTAD, 2020, p. 3). These years includes the financial crisis of 2009 and 2020’s COVID-19 pandemic.

Maritime transport is traditionally split into different sectors. Amongst these we find container shipping, wet bulk shipping and dry bulk shipping. The different sectors have corresponding ship types, e.g., container ships, tanker ships and bulk ships. Technical improvements on this transport mode, though often taking a long time to be implemented, has changed the way that many goods are shipped. The distinction between bulk and break-bulk has blurred after the introduction of pallets and containers (Rodrigue, 2020). Since the containerization started in 1956 (Levinson, 2016), the shipping of small bulk has been heavily streamlined. The containers make the mode change easier and more efficient, reducing the amount of loading and discharging time.

One of the advantages of maritime transportation is the low cost per unit. In fact, the only transport mode that is cheaper, in ton-mile, is the pipeline (Christiansen et al., 2007).

2.1.4 Land transportation

Land transportation can be either road transport or rail. These are land-based transport modes which requires built infrastructure to be able to transport goods. The use of trains requires a built system of rails to each of the destinations, while road-based transport requires roads to be built to each destination. Road-based transports are more widespread compared to rails, as it is not just used for movement of goods. It is common for the population to own a car for their own personal use, which also uses the same roads as road transport. Road transport has also gotten increasingly more funding yearly from the government, resulting in their infrastructure being more invested into compared to other transport modes. In comparison to seaborne transport, road transport has received approximately 1900% more funding. Rails received 175% more funding compared to seaborne transport (Riksrevisjonen, 2018).

Land transportation such as road has the advantage of being very flexible (Rodrigue, 2020; Rushton et al., 2017), making the mode able to execute a single-mode transport solution with door-to-door delivery. In addition, the transport mode is fairly quick and can be competitive on price (Rushton et al., 2017).

Road transport can be split into two different categories. The first being primary transport, meaning a single delivery with one destination, while the second consists of multiple deliveries. Both primary and secondary transport are focused on cost reduction, however, primary transport has this as its primary concern. Secondary transport are often more focused on customer satisfaction, as this is often an important part of a company's customer service (Rushton et al., 2017).

2.2 Competitive theory

The transport modes are often in competition, even though multimodal transport is very often used. There are, however, competitions everywhere. When it comes to long distance transport air, sea and road transport are heavily competing though on different terms. In Norway, we see a large number of eastern European trucks on the roads, leading us to believe that a number of containers are moved by truck over long distances. This could also have been done by feeder ships, or air freight. Ships and planes are more adjusted to long distance transport; however, we also have short-sea shipping which is short distanced transport done by ships. Each transport mode has their strengths and weaknesses:

Mode	Typical usage	Strengths	Weaknesses
Road	Door-to-door	Flexible, high frequency, heavily adapted infrastructure	Environmental impact
Rail	Domestic and continental	Environmentally friendly, appropriate for heavy goods over long distances	Limited infrastructure, often low frequency
Air	High value goods with short lead times	Fast	Environmental impact, expensive
Sea	Bulk, long lead times	Cheap, low environmental impact, economies of scale	Slow, limited adaptability, limited flexibility

Table 2. Based on Rushton, A., Croucher, P., & Baker, P. (2017). The Handbook of Logistics and Distribution Management: Understanding the Supply Chain. Kogan Page Publishers. And Rodrigue, J.-P. (2020). The geography of transport systems (5th ed.). Routledge.

Competitive advantage is defined by the Cambridge dictionary as "the conditions that make a business more successful than the businesses it is competing with, or a particular thing that makes it more successful" (n.d.). A competitive advantage is always relative, meaning that it is compared to something else. It is common to compare to either the competitors in the market, or a benchmark based on the market (Rothaermel, 2017). In the context of transport modes, the different modes are often compared against each other. As the modes differ greatly, an industry average can be hard to determine. Competitive advantage can be restricted to certain conditions (Rothaermel, 2017). In other words, something can be a competitive advantage in certain conditions, but a competitive disadvantage in other conditions. As an example, there is a transport need for 25 containers from China to Germany. A container ship has a competitive advantage, as they are made to transport many containers over long distances. However, if the need was for transport of a single phone charger between two cities in England, a container ship would be at a competitive disadvantage.

To gain or sustain a competitive advantage, one needs to supply a product or service with a higher perceived value, or at a lower price, than its competitors (Rothaermel, 2017). Specialization is important when it comes to maintaining or creating a competitive advantage. Porter (2011) goes as far as to state that specialization are required for an economy to maintain both productivity and competitive advantage.

Competitiveness in transport is compromised of many different premises. Distance is an important premise. If a good is to be transported from Europe to America, a transport mode that are able to cross the ocean is required. This means that road transport and rail transport are so competitively disadvantaged that they are unable to compete on this part of the transport. Another premise is the type of goods that are being transported. Bulk carriers, ships carrying bulk cargo, biggest competitor is traditionally railway (Coyle et al., 2011, p. 229). According to Rodrigue (2020) is competition between the different transport modes influenced by public policies like funding.

2.3 Third-Party logistics providers (3PLs)

Third-party logistics providers is a company that have, traditionally, performed a logistics activity in the supply chain for another company (Chopra, 2010). This essentially means that a company outsources some of the logistics activity in their supply chain to the 3PLs. This could be services like storage, transport and cross docking. Some well-known 3PLs are UPS, Khuene & Nagel and Bring. The 3PLs are able to tailor transport solutions to their clients, making sure that the transport suits their needs.

2.4 Innovation and organizational change

Innovation can be viewed as a process, which means that innovation is the process of turning an idea to reality and then implementing said idea (Tidd & Bessant, 2013). By implementing a new idea, one does make changes. The changes are dependent on what said innovation is, but every implemented innovation will lead to a change within the organization. Innovations can be split into two different categories: radical innovation and incremental innovation. Incremental innovations are improvements on existing products/processes/targets of innovations, while radical innovations are brand new innovations (Tidd & Bessant, 2013).

One example of an incremental innovation within the transport sector is the introduction of the standardized shipping container. This innovation revolutionized how we ship goods and the further development of the transport modes (Levinson, 2016).

Innovation can also be categorized by what is being innovated. There are many targets of innovation and there are many different ways of innovating. Examples of this is product innovation – where a project is innovated, process innovation – where a process/a way of doing something is being innovated, and network innovation – where the way cooperation with other "players" are being innovated as a means of creating value (Keeley et al., 2013).

One change being promised from the Norwegian government is the transfer of goods from road to sea and rail.

2.5 Drivers and barriers

Drivers are "something that makes other things progress, develop, or grow stronger" (Cambridge Dictionary, n.d.-c). This is very relevant when it comes to innovation and change processes. The drivers in these processes are the forces that supports and encourages this change. In innovation, drivers can be part of the sources of innovation. Two of the largest drivers mentioned by Tidd & Bessant (2013) is the need-pull, meaning an innovation that comes from a need, and knowledge-push, meaning an innovation that comes from new knowledge. Still, drivers can also be supporting factors that in some way encourage, support, or drives the innovation forward. These can be external factors such as regulations, financial aid/incentives, and the public can be drivers of change.

The opposite to drivers is barriers. Barriers are "something that prevents something else from happening or makes it more difficult" (Cambridge Dictionary, n.d.-a). The barriers are therefore the forces working against a change. When looking at change, the aspects of drivers and barriers are important.

It is important to remember that something can be considered both a driver and a barrier. The later years we have seen increasingly stricter environmental policies and demands. The new demands can be considered both a driver for change, but also barrier for change. As a demand is put in place, these need to be followed, however, they can also be a barrier as they might be hard to adapt to.

2.6 Environment

The world today is heavily impacted by the need to go green. This means that cutting the harmful emissions caused by humans, both directly and indirectly. Naturally, this impacts the transport sector as a whole. Transport of goods is an activity that increases the global trade and is therefore significant to all societies on our globe. However, transportation of goods does emit several dangerous greenhouse gases. In shipping, several of the emissions are being heavily restricted in a measure to be able to reach the climate goals of the United Nations (UN) and the Paris agreement (UNFCC, n.d.). The International Maritime Organization (IMO for short) is an agency of UN and is tasked to improve the safety and security of international shipping. In addition, IMO does have a responsibility regarding prevention of pollutions from ships worldwide. IMO has 174 member states (International Maritime Organization, n.d.). This means that most of UNs 193 member states (United Nations, 2014) has also joined IMO. When IMO legislates a new regulation, the member states are individually responsible for implementing the new regulation as part of their own national law. The member states can choose whether or not to adapt the new regulations from IMO. IMO has chosen to be very involved in the climate change, and is actively working towards the cut of harmful greenhouse gases (International Maritime Organization, n.d.).

Transport accounts for 30% of all emissions from Norway. About half of this is caused by the road traffic (Statistisk Sentralbyrå, 2019). As transport accounts for such large parts of the national emissions, there is a need to drastically reduce these in the following years. One of the means of reaching the ambitious goals is the transfer of goods from road transport to other, more environmentally friendly transport modes(Miljødirektoratet et al., 2020; Riksrevisjonen, 2018; Samferdsdepartementet, 2021). These are respectively sea and rail. Transfer of goods is not necessary the most obvious choice when transporting goods, as both sea and rail are restricted modes of transport. Sea transport requires the switch to another mode as a way to be able to offer door-to-door transport. Very few destinations are placed in the actual destination port, meaning that the goods need to be transported further. However, this will heavily reduce the use of road transport as the amount of transportation work(ton/km) done by truck will reduce. The extent of the rail network is also heavily restricted. In addition, in Norway the transportation of goods by rail is relatively low. As of

now, large parts of the rail network are overloaded by the passenger trains, making it difficult to increase the amount of goods transported by rail.

3 Research method

3.1 Introduction

Research methods are the way we gather and analyze data. This chapter intends to explain what methods I have used during my thesis to gather the needed data needed to be able to answer the research questions. It is important to use the appropriate methods to be able to gather the appropriate data. In addition, it is important to be open about the data collection as the results should be able to reproduce by using the same method. This ensures ethical and honest research.

This study seeks to explore the two stated research questions. These research questions are quite different in their nature and what they intend to explore. As a result of this, the needed research methods for each research question will differ to be able to thoroughly explore the field. In this chapter all methods used to explore the research questions will be described. In addition to this, philosophical aspects of methodology will be discussed such as epistemology and method of reasoning. These are the cornerstone of how my research has been executed and how I was able to come to the final conclusions of my thesis.

3.1.1 Epistemology

Epistemology is really about to what extent it is possible to gain true knowledge about the world (Jacobsen, 2015, p. 23). In this subject, one tries to understand what it means to know (Gray, 2018).

There are several types of epistemological views one can take as a researcher. For my thesis, I have chosen to use the epistemology Critical Rationalism. This worldview was derived from Karl Popper, and is based on the idea that it is impossible to arrive at secure knowledge. An important part of this epistemological view is that hypotheses are not used to confirm. Quite the opposite, the hypotheses are used as a way of falsify statements (Flick, 2015).

3.1.2 Falsification

In my thesis I want to clarify and explain the principle of falsification. This concept is important in the research context. Falsification as a concept came from Karl Popper (1902-1994), an Austrian-British professor. In his book, *Logik der Forschung*, from 1934 he wrote about research methods as a tool for falsification rather than verification. Falsification is about

disproving a theory, rather than verifying it, through research. One important lesson to come out of his theories is that scientific knowledge is provisional – meaning that it is the best we can do at this moment with the information available (McLeod, 2017). As my research questions and their conclusions are limited to the current time period, this is especially relevant in relation to this thesis. New technology and new solutions are always being developed. This means that in a few years my conclusion to the most environmentally friendly transport option might not be true anymore. The barriers and the competitive situation might also largely differ from their current situations. My thesis will then be built on data no longer relevant to answer the research question, as new data that might significantly differ from my data will be available for research.

3.1.3 Abductive reasoning

For my thesis, I have chosen to use abductive reasoning as my way of reaching conclusions. Abductive reasoning differs from the traditional inductive and deductive reasonings by being a continuous process. Inductive reasoning is a kind of bottom-up kind of logic and the deductive reasoning is a top-down kind of logic. Abductive reasoning is more of a circular process of reasoning where possibilities are continuous being ruled out. The object of abductive reasoning is to eliminate as many solutions/theories as possible and in the end be left with the most probable solution/theory. The abductive process can be compared to Sherlock Holmes famous quote; “When you have eliminated the impossible, whatever remains, however improbable, must be the truth?” (Doyle, 2010, p. 10). Abductive reasoning will be a more time-consuming approach of reasoning compared to both inductive and abductive reasoning.

3.2 Research design

To be able to try to answer my research questions, the choice fell on mixed methods. Mixed methods are useful when exploring complex situations and/or problems. This research method combines several methods to be able to explore the situation/problem more extensive than one method is able to. In my thesis I have used literature review to be able to identify the barriers from research question one, and I have used a case study to be able to answer research question two.

I have mainly used qualitative research methods. Qualitative research is an appropriate research method when relatively little is known about the subject/phenomena (Gray, 2018).

3.2.1 Literature review

Literature review is an important part of my thesis. Literature review focuses on using secondary data from established research and published work (Jacobsen, 2015). I have used literature reviews in both research questions. For the first research question, I used literature review to identify barriers for transfer of goods. In this work I started with governmental documents that concerned transfer of goods, and afterwards I searched for articles concerning transfer of goods.

For my case study, a lot of the literature review is the theoretical groundwork. By establishing a theoretical groundwork for my thesis, I am able to more accurately concretize my research problem. A comprehensive literature gives the researcher(s) the ability to build upon established knowledge (Gray, 2018, p. 98)

The literature review for my case study has continued throughout the whole process of writing my thesis. Having to find more established data about themes that has occurred during the writing process is natural (Gray, 2018, p. 99). This is also in accordance with the abductive method, as each possible explanation/finding should be researched and evaluated. To be able to fulfill the objective of the abductive reasoning, new theory and established knowledge outside of the original boundaries of the research is needed. A search of established knowledge was therefore a continuous process during the work with my thesis.

3.2.1.1 Identifiers

An identifier is a key word that is used during the search in a literature search (Gray, 2018, p. 101). To find relevant literature I have mainly used three sourced whereas two of them are digital. Physically, I have used the university library. Online I have used the search engines Oria and Google Scholar. For my first research question, my most successful identifiers were:

- Transfer of goods
- Barriers, sea transport
- Road advantage transport
- Transport modes strengths and weaknesses

For research question two, the literature changed depending on where I was in the process. A lot of the literature I reviewed during this project did not make it to the thesis but was a big help when constructing the case. Some of my most successful identifiers was:

- Transport theory
- Break-bulk transport
- Barges for transport

3.2.2 Case study

For research question two the purpose is to explore the possibility of using the barriers found in research question one in a real situation. The choice fell naturally to case study, as this research method is specific and investigates the phenomenon in its real-life context (Gray, 2018). A case study allows the researcher to go in depth in the chosen number of cases and analyze them separately. However, case study has its flaws. This research method is known to be hard to generalize to other cases and situations, especially when using just one. However, if my hypothesis is correct, this may also apply to other cases. In my research I have no need to generalize my findings, as the task is to use the barrier to tailor a transport solution for a certain case. As a collective thesis, I seek to explore the possibility of a competitive sea borne option for transport of atypical goods.

For my second research problem, I chose to use a single case study, as this was the most fitting method of exploring the subject. As my field of research is quite narrow and needs direct answers, a case study is appropriate. A case study tends to be rather specific, which is needed to answer my questions (Gray, 2018). How to execute a case study is dependent on many factors, one being the chosen reasoning. I have, as mentioned, chosen to use abductive reasoning when working with my thesis.

3.2.2.1 Sample size and type of case study design

As there has never been an emission free short sea feeder in Hardangerfjorden, the number of exact cases like this is zero. The data needed is specific to Hardangerfjorden and the companies that resides there, meaning that other cases will not have the exact same circumstances and therefore result in other outcomes, the best decision was to create a case.

Using the concept of near-histories (March et al., 1991), I created my own case using some parameters from the concept idea from Pilot-E.

As the choice has fell on a single case study, the study can either be conducted holistically or embedded. In my research question I only ask about the competitiveness, but as a condition for the competitiveness, the project also has to be possible. As a result, I have multiple units of analysis, making the appropriate design an embedded single case study (Gray, 2018). This research designs allows me to have multiple units of analysis in one case. My chosen units of analysis are:

- The possibility of the project.
- The competitiveness of the project.

The possibility aspect is important, as this is a prerequisite for the competitiveness of the project. There are many variables in this case that can be adjusted and changed during the case study and using possibility as one unit of analysis is one way of securing myself from extra work, in addition to making sure the end result isn't unrealizable. This will be the first and main unit of analysis as this is also the most important.

3.2.2.2 Systematic Combining

Systematic combining is an abductive approach to case study. Normally, a case study is seen as a linear process. When using systematic combining the process is not linear. As seen in the figure (Dubois & Gadde, 2002), the case study process is built up by four important factors; the case, the empirical world, theory and framework. As essential in abductive reasoning, in this research the initial findings give direction to further research. This results in systematic combining being a continuous process until a satisfactory result is found. After conducting an initial case study, the finding(s) will then affect the framework, empirical data and theory. This can be

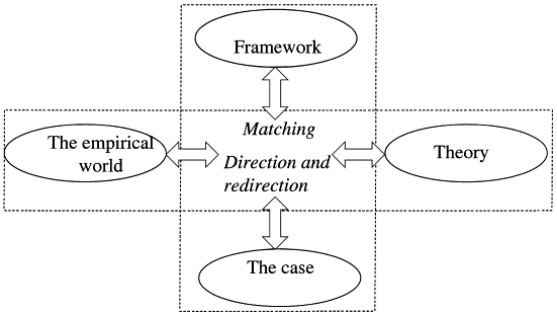

Figure 3 – Systematic Combining From: "Dubois, A., & Gadde, L.-E. (2002). Systematic combining: An abductive approach to case research. Journal of Business Research, 55(7), 553–560."

compared the diamond model by Van de Ven (2007). This diamond shaped model connects the model, theory, solution and reality with research elements like research design, theory building, problem formulation and problem solving. Van de Ven designed the diamond model as a way for scholars to "increase the likelihood of advancing fundamental knowledge of a complex phenomenon […]" (Van de Ven, 2007).

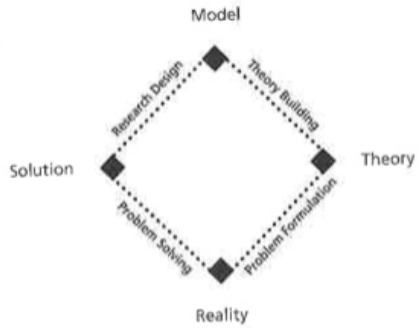

Figure 4 – Diamond model. From: «Van de Ven, A. H. (2007). Engaged scholarship: A guide for organizational and social research (p. XII, 330). University Press.»

The goal of systematic combining is to match theory and reality (Dubois & Gadde, 2002). It is therefore essential to execute this process until the goal is fulfilled. This means that for every time the case study gives findings, new empirical data needs to be collected and the framework, theory and case study needs to be adjusted to the new findings. This process goes continuously back and forth until a satisfactory result is obtained. This is essentially the matching process in this research method. This way of working with a case study is more work-intensive that inductive reasoning, however, it also has the potential to yield better results (Dubois & Gadde, 2002).

The analytical framework is an essential part of research. For systematic combining, a tight and evolving framework is suggested (Dubois & Gadde, 2002). Starting with a tight analytical framework is advantageous. Evolving should happen as a cause of findings and its along with its consequence on the theory, case and empirical data.

The results of a single case study have been debated. While some argues that a single case study gives the researchers an ability to go more in depth, other claims that a single case study are unable to result in a holistic picture of the reality as only a single case has been explored (Dubois & Gadde, 2002). With the prerequisite of the same amount of resources, a single case study gives the opportunity to go more in depth than with a multiple case study. That very amount of resources, such as time and money, would have to be shared on several cases. As a result of that, a multiple case study would therefore be much more superficial than an in-depth single case study. One advantage of using a multiple case study as they, in larger

part, allows for replication and therefore also eliminates “chance associations” (Eisenhardt, 1991, p. 620).

3.2.3 Quantitative questionnaire

I also wanted to add some support to the findings in research question one. As a way of identifying more, or the same, barriers I wanted to have a questionnaire for cargo owners. This intended to identify what is important for the cargo owner by looking at why they chose the transport mode that they did. I made an anonymous questionnaire in Google Forms and sent this to 30 cargo owners. Unfortunately, I only got two replies. Because of the low response rate, I chose to exclude this from the thesis. The two replies were within the barriers found in the literature review.

3.3 Ethical considerations

When designing the questionnaire i did a conscious effort of making the whole process anonymous as there was no need to record personal information. I made sure that the Google forms was open, and I sent to all recipients at the same time so that if they took the survey right after receiving it, it wouldn’t be identifiable. The e-mail addresses used was found on each of the cargo owners’ website.

4 Literature Review

The purpose of my literature review is to get an overview of the different transport modes, in order to be able to be able to locate fundamental barriers for changing the transport modes. In addition, I want to explore theories like organizational change and innovation in order to explore whether these also factor in as barriers to transfer of goods. Environmental factors are one of the main reasons to transfer goods from road to other transport modes. It is therefore important to get the environmental perspective included. This is also included as a way to identify barriers.

4.1 Governmental papers

A central document concerning the Norwegian governments work with the transfer of goods is Riksrevisjonen (2018). Their investigation showed that the government was not able to reach the goal that they set. The government put in few measures to ensure transfer of goods, and little to no real follow up or realistic and concrete goals. Riksrevisjonen concludes that road transport as become faster, cheaper and more flexible compared to rail and sea transport. In addition, the main road network has been facilitated in a much higher degree than ports and rail terminals. They compared the competitiveness of ships and road transport. Ships have a competitive advantage on price and environmental impact, whereas road transport is more competitive on punctuality, time, flexibility, frequency and safety controls. In this document, the monetary amount the government has allocated to each transport mode is also highlighted.

During the work with National Transport plan 2018-2029 a goods analysis was executed. In this analysis they found that one of the reasons for the road transports increased competitiveness is a higher demand for fast delivery. They also point out the relatively cheap prices of road transport, as transport exclusively on road is often cheaper inland compared to road – sea – road. The technological development is also considered a hinderance for seaborne transport as implementing new technologies is a long process. This is largely because of the large financial investments and time to build new ships (Marskar, 2015).

4.2 Articles

In their article, Pinchasik et al. (2020) identifies the road transports flexibility as one of its core strengths. This is a flexibility that seaborne transport is unable to compete with because of modal constrictions. Other weaknesses with seaborne transport that they identify is transhipment cost and ship size. They also point to seaborne transports need for "sufficient freight flows, both in terms of volume and regularity" (Pinchasik et al., 2020, p. 4)

Raza et al. (2020) has done a thorough literature review of the barriers to the transfer of goods from road transport to short sea shipping. This includes shorter voyages and transport networks. They found that there are several articles describing the barriers. The most identified barrier for the modal shift is "longer lead times at ports and in transit and slower speed" (p. 393). Other identified barriers are lower reliability, additional cargo handling cost, incompatibility of equipment and ICT systems, poor industry image, poor port hinterland connectivity and inconsistent policies.

In a study placed in Sweden, which is comparable to Norway, Rogerson et al. (2020) found that the barriers for changing modes from road transport to inland waterways can be placed into four categories: regulatory, financial, service quality or market characteristics. Within the regulatory barriers they point towards amongst others high costs for transhipment and investments in other transport modes infrastructure. Under financial barriers it is found that the distance between the ports and the departure/destination location is important. A large distance can cause the transport to be cheaper with the use of road transport only. For service quality it was found that reliability, meaning meeting the agreed time of delivery, was more important than transport cost. The time and additional handling of the goods were also identified as barriers to using inland waterways. One final barrier in this category is resistance to change transport modes from the customers.

4.3 Summary and results from Literature Review

Identified barriers for the transfer of goods:

- Flexibility (Pinchasik et al., 2020; Riksrevisjonen, 2018)
- Speed(Marskar, 2015; Raza et al., 2020; Riksrevisjonen, 2018)
- Punctuality/reliability (Raza et al., 2020; Riksrevisjonen, 2018; Rogerson et al., 2020)
- Time (Raza et al., 2020; Riksrevisjonen, 2018)
- Technological development (Marskar, 2015; Raza et al., 2020)
- Transhipment/change of transport mode (Pinchasik et al., 2020; Raza et al., 2020; Rogerson et al., 2020)
- Investment in other transport modes (Riksrevisjonen, 2018; Rogerson et al., 2020)
- Resistance to change (Rogerson et al., 2020)

5 Case study

5.1 Background on the case

The case is distributions from four factories all centered around the Norwegian fjord Hardangerfjorden. The four factories are Hydro, Elkem, TiZir and Boliden. All these factories produce very different products, meaning they all have different needs. Today, the distribution to, and from, these factories are done largely by truck. However, all these factories are placed conveniently besides the fjord with some port structure connected to them. This opens up the opportunity for each of these factories to use a seaborne alternative to the existing road-based transport systems already in use.

The road-based transport system is based on trucks driving on the local roads. This causes a lot of pollution for the surrounding population. This pollution consists of noise and air pollution from the exhaust. As of now, zero emission trucks are not very widespread in Norway, making it reasonable to assume that these trucks are running on diesel. Trucks are also limited in their carrying capacity. As all these factories have a high yearly production, this leads to large number of trucks transporting goods, and therefore also polluting the air. Trucks also have another disadvantage. They are using the communal road network, causing more traffic on the roads. This wears on the roads, leading to a cost for the community to repair the roads as they are being worn down quicker. With all traffic, there is also the risk of accidents. The Norwegian government has since 2002 had a goal that no one will be severely injured or killed in traffic. Every car on the road increases the chance that someone will be injured.

5.2 The factories

Hydro Husnes has been operating since 1965 and is currently has a yearly production of 94 000 tons of primary aluminum and 95 000 tons of foundry products. Their products include press bolts and forging bolts (Norsk Hydro, n.d.). These can be considered bulk goods. These are, however, also possible to store in a container as they are small and can be reasonably filled into a bulk container.

Elkem Bjølvefossen has been operating since 1905 and is producing ferroalloys for the international iron and steel industry. The factory is specializing in the production of ferrosilicon and magnesium-ferrosilicon (Elkem, n.d.). As they deliver to an international

market, seaborne transport is appropriate. Ferrosilicon is stone-like and therefore could be shipped as bulk goods. Containerizing could also be possible, but this limits the amount of goods transported at once, and also might create more effort into making the goods ready for shipping.

TiZir is a factory that is "upgrading" ilmenite to a high-value titanium slag. As a biproduct, this also makes pig iron. The titanium slag is sold to pigment producers, while the pig-iron is sold to ductile iron factories. This kind of upgrading facility is rare, with only six in the world. TiZir is the only one in Europe. The slag is considered bulk goods, while the pig-iron is containerized. TiZir already use seaborne transport modes for the bulk shipping (TiZir, n.d.).

Boliden was established in the 1920s and is a producer of zinc and sulphuric acid. Their primary raw materials are zinc concentrate and recycled zinc. They are producing approximately 192 kilo tons zinc and 127 kilo tons sulphuric acid (Boliden, n.d.). Sulphuric acid is liquid, and also considered dangerous goods (?). This should be stored in an appropriate tank or tank container. Zinc is also considered stone-like and can be transported as bulk.

Figure 5 – Placement of the factories. Made by author using PowerBI.

5.3 Assumptions made

Some assumptions made for the current situation:

- These factories have no collaboration today as far as transport goes.
- The transport load to and from each of the factories will largely differ. This includes quantities, type and shape of goods and their need to the transport system.
- The transport solution would be supplied by a neutral third party, e.g., a third-party logistics provider.

5.4 Designing the case

As the factories are not collaborating as of now, as assumption that they will need to collaborate perfectly for this project to be viable is unreasonable. Good collaboration takes time and effort, and while these companies are doing very good in their own areas there is unknown whether a transport collaboration is of interest. It is therefore reasonable to engineer a project that does not rely on collaboration. This also increases the chance for this type of project to be generalizable if it proves to be competitive in this scenario.

Hardangerfjorden is a known tourist attraction and is known as one of the most beautiful fjords and natural areas in Norway. This should be taken into account when designing a transport solution for this scenario. It is therefore reasonable to assume that the seaborne solution should not be considered "damaging" to the sight of Hardangerfjorden. This eliminates several possible solutions to the transport. The most obvious choices are therefore to either have a ship that are able to blend into the environment without being disruptive, having a transport solution that adds to the sight or execute the transport when the tourists are not present. As the intended load for this ship is both bulk goods that is non-containerized, tanker goods and containers designing a "beautiful" ship might prove difficult. However, sailing at night, when no tourists are present, is a logical possibility.

As for the type of ship, there are several needs. As the time for transport is now limited to the night, the loading and discharging of the ship is also limited. It is also reasonable to assume that not all companies are willing to extend the workforces working time to night to be able to load and unload the ship. The loading and discharging would require some crew to be present. In addition, the different companies have different needs as far as loading equipment as some have goods that are appropriate to load in a container

whereas some of them does not. This would either require each of the factories to have their own loading/discharging equipment, or the vessel having equipment for either container or bulk. By using the simulation software Chesscon I also found that the loading and discharging process, though not taking an excessive time, added to the time spent. A possible solution to these challenges is using barges. Barges comes in different sizes, and could be customized for the intended goods (Jha, 2020). Each factory would have the barges conveniently placed in the connected port making the barges loadable and unloadable during the normal working hours. Considering the fact that the transport is happening overnight, the barges are able to pick up full barges and sailing to the closest port, namely Stord port. At Stord Port, the barges are able to be unloaded and loaded again with the incoming raw material needed for the production. This way the seaborne alternative is able to supply both incoming raw materials to the factories, in addition to transporting finished goods to a distribution point.

As far as the route goes, the total distance is measured to be 78,53 nautical miles. This is when measured the shortest distance using the Norwegian "Kartverket" s sea map. The route is going between Stord and Odda, with stops on each of the factories. As we intend to use barges, we also have to assume the properties of this vessel. Barges are slow-moving vessels, averaging around 5 knots (Jha, 2020). Using 5 knots as an average speed would result in a voyage of 13 hours. This would mean that the tug would not reach Stord and back during the night, leading to the need of either two tugs or that the factories are without barges for some time/have at least three barges.

As each of the factories are able to have a barge of their own, they are able to regulate the number of times the barges are picked up during a specified time period. Essentially giving them the opportunity to fill up the barge as much as they please before requesting pick up. This increases the flexibility of the transport mode, as the pick-up does not need to be on a scheduled date and time. This allows for both peak times and eventual down times during the year. This also allows the transport modes to adapt to the needed capacity for each of the factories as they might not have the same frequency needs. If there are night where none of the factories are in need of transport, the transport might simply just not run that night. As one of the factors found in research question one is that seaborne transport lacks adaptability and flexibility, this might help improve this.

Stord port is ISPS certified and has appropriate features to accommodate the barges. The quays are respectively 50 and 80 meters and has a minimum depth of 9 meter (Laksund, 2018). The barges would be placed by each of the companies so that the companies are able to fill these up. A smaller vessel would pick these up at night and sail towards to Stord port. This would work as an isolated, small hub-and-spoke system. The companies would be the spokes and the port would be the hub. In this case, Stord port is also a part of a larger hub-and-spoke network, where Stord port would be a spoke.

Assumptions made for the case:

- No collaborations between the companies, besides using the same transport system.
- Sailing at night to avoid polluting the sight.
- Use of barges

5.5 Results of the case

The loading times for each of the factories would happen during regular working hours and is therefore of no interest to the transport solution. This makes the transport more effective, seeing as loading and discharging times are exempt. This makes the transport a little more reliable, as loading and discharging is activities that regularly disturbs the scheduled transport. In other words, one possible risk factor is made redundant and the risk for delays are reduced. This increases the reliability of the transport systems.

The barges would be transported to Stord by the use of a smaller vessel able to drag the barges to their destination. This would be a tugboat. This vessel would be eligible to be electric. As far as the electric vessel goes, there is a need for more electricity which comes at a cost. Electric vessels are considered more expensive than traditional, fuel-based vessels. In Norway we have incentives for improving the environmental impact that shipping has. One of these incentives is monetary incentives from Enova. Enova has a goal to make the electric vessels more competitive in the shipping sector as the investment cost can be a barrier (Enova, n.d.). The barges are able to each contain a battery package, ensuring that the vessel is able to sail on electricity during the entire voyage. This would take some of the available space on the barges, however, ensuring that the vessel has access to electricity is very

important. Electrifying the voyage would heavily reduce the emissions from the transport of the different goods.

Since the factories have their individual barges, they could also be adapted to the transport need of the individual factory. This means that the factories like Elkem, needing the transport of bulk, could have a barge with higher edges more adapted to the transport of bulk goods. Meanwhile, barges adapted to containers could be used by the factories using this. The barges can also be adapted to the loading gear available at each factory.

As far as the environmental impact goes, the tugboat is assumed to be fully electric. Norway is one of the leading nations when it comes to electric seaborne vessels. Each of the barges is assumed to have a battery pack installed making sure the tugboat has sufficient electricity to transport the goods to their destination. Each of the barges, in addition to containing the goods, would therefore work as a power bank. This will, unfortunately, take up some space on the barge, resulting in reduced space for goods.

6 Discussion

In this chapter I will first discuss all identified barriers from research question one individually. Afterwards, I will go into the case discussing the factors and the results of the case. Lastly, I will also discuss the topic of reliability and viability of my research.

6.1 Flexibility as a barrier

Flexibility is identified as a large barrier for using seaborne transport. The concept of flexibility can have many different meanings and effects. Through many of the sources during the literature review flexibility of shipping is seen as a major barrier. This is understandable as the cargo owner wants a predictable and secure delivery of their goods. Seaborne transport is restricted in several aspects. Because they are dependent on the sea, it requires waterways to their destination. As many of the intended destinations are inland there are no possible way for the ship to offer a door-to-door transport service. A modal change is usually needed for this possibility, efficiently increasing the cost, the risk and the time. This also restricts the flexibility of the transport mode.

As the ship size has increased drastically the last decades, another aspect of seaborne flexibility is the capability to physically sail to the destination. With the increase of the ship sizes many waterways and port structures has become unable to accommodate the larger ships. Deep sea shipping is dominated by large vessels carrying a large amount of goods over long distances. These goods are often times intended to a large number of destinations. Because many ports are unable to accommodate the larger ships, this requires a substitute of some kind to be able to deliver the goods to their rightful place. The substitute can come in the form of smaller vessels, known as feeder vessels, which are able to accommodate a smaller amount of goods but also are able to deliver to a larger number of quays. Another substitute is the other transport modes. Especially road-based transport mode is in heavy competition in Norway. The railroad network is not sufficiently expanded to be able to accommodate to this door-to-door need.

Another aspect of the flexibility, especially in large container ships, is that the goods are often owned by a large number of cargo owners. This heavily limits the flexibility of the vessel. Because there are several customers of the same service, adapting to the needs of one of them without compromising the service promised to another is difficult. As a voyage is set, all cargo owners depend on the schedule promised, and adapting the schedule to one of the

cargo owners will be a disadvantage to other cargo owners. As a result of this, seaborne transport is seen as more of a liner transport. This does not, of course, apply to the cases where a vessels cargo is fully loaded with one cargo owners' goods or when the cargo owner itself owns the vessel.

6.2 Reliability as a barrier

This barrier really concerns trust. When talking about reliability as a barrier, what is really talked about is the trust the customer has to the transport mode. Often times, when thinking about the vessel's reliability, and also seen through the literature review we see that reliability often is connected to punctuality. Punctuality, in this case, is being at the agreed place at the agreed time. Ships are often unreliable in this sense, as giving an exact call time to a port a month in advance is hard.

One reason for the questionable reliability is that ships are often delayed. Often times longer distances are often given an approximate shipping time. As they are prone to delays, they are not necessarily in place at the promised time. This causes an uncertainty for the cargo owners. They cannot be sure that the cargo is available at the port in the assumed time, forcing the cargo owners to be flexible with further transport from the port and when the goods arrive. There are many reasons as to why a ship can be delayed. Congestion is a familiar problem for seaborne transport. The congestion can be connected to the ports, but it can also be through canals and waterways. Canals have a tendency to get congested as many ships use them and they are limited in size. An occurrence in them can cause major delays in all seaborne transport. A recent example is the Evergreen ship stuck in the Suez-canal. This caused a massive delay as the enormous container vessel got stuck in the middle of the canal, making it impossible for any other ship to sail through the canal. The ship first got stuck the 23rd of March (BBC News, 2021) and the canal opened up a week later, the 29th of March (Safi, 2021). The congestion, however, did not clear up until 3rd of April (Reuter Staff, 2021). This entire happening caused a major delay in the global market. Canals like the Suez Canal and the Panama Canal are essential trade routes as they are heavily reducing the transport time and is therefore used in most voyages. As seen with the Evergreen example, the use of these canals can lead to major delays.

Another reason for delays with seaborne transport is the weather. This can disrupt the voyage and even force the ship to change course causing delays. Weather cannot be controlled, and neither is the predictions forward a month certain. The ship therefore has to adapt to the weather where they are. This can lead to delays in the transport because the ship has to adapt their voyage to the current weather situation. This can be because of much wind, storms and heavy rain. They might also have to adapt to a slower speed to ensure a safe voyage. This is a necessary evil, as the ship needs to prioritize safety.

Furthermore, delays can occur in ports. By using seaborne transport, the goods have to go through ports at both ends. Similar to canals and waterways, ports can also experience congestion. Most ports have limited quay lines, causing ships to have to wait when congested. One reason for congestion can be breakdown of equipment. Quay cranes are the most important equipment of the port, moving goods from land to the ship and vice versa. A breakdown of a quay crane can cause major delays as the ports often does not have any spares. It is also one of the more expensive equipment. Weather can also disturb the loading and discharging process at the ports causing a delay. With too much weather, loading and discharging has to stop.

Overcoming the barrier of reliability is hard. The delays because of the weather are hard to avoid and so is the congestion or delays in port. One way of giving a more secure arrival date is setting it even further, and therefore ensuring that the goods is there by a certain date. Though this leads to other issues. If the goods arrive too early, the cargo owner might not be able to retrieve the goods before the end of the grace period given by the port. This increases the cost of the transport. Another issue might be that the goods arrive too early to their destination. The cargo owners might not be ready to obtain the goods earlier than estimated as they might not have the storage - or the desire to pay for storage.

6.3 Transshipment as a barrier

Seaborne transport is dependent on ports to be able to transfer their goods to land. As mentioned, most of the transport work done by the mode is headed towards land-based operations and destinations. Because of this, transshipment is often a necessity. The concept of transshipment is that the goods is unloaded and then loaded onto another vessel or transport mode. Discharging and loading often poses a risk to the goods in the form that they risk the

goods being damaged. The containerizing has impacted the packaging in the shipping industry drastically. Packaging in the form of containers and pallets has made the shipping and handling a lot more effective, but they also pose certain risks. The goods can be damaged within the container, and there is the risk of smuggling and uncontrolled contents in the containers.

Another reason why transshipment is considered a barrier is because transshipment might introduce delays to the transport chain. There are several things that can cause delays during this critical phase of the transportation. Delays occurring because of equipment failure in port is a common happening. There are several of critical port equipment that can break. This is more likely to have a large effect in small ports with less equipment. Large ports, such as Antwerp and Bremerhaven, have a large number of cranes and are likely to have equipment substitute in the event of a breakdown, though it may cause a small delay. In smaller ports, such as most ports in Norway, the number of cranes is very limited, and a breakdown might cause heavy delays.

Another reason why transshipment is seen as a barrier to the transfer of goods is that transshipment leads to added cost. Many cargo owners are concerned with the cost associated with the goods going through the port. There are many costs added to this process, both to the port but also to the authorities for e.g., pilots.

Breaking the barrier of transshipment is a heavy challenge as transshipment is a necessary evil within seaborne traffic. The focus should not be about getting rid of the barrier, as the process itself is necessary and important, but rather be about how to reduce the risks associated with the barrier. Also, offering value added services during the transshipment can be a way of turning this barrier into a driver. Value added services such as consolidation of goods could be done while in port. Repackaging and labeling could also be a part of the transshipment process.

6.4 Time as a barrier

Traditionally seaborne transport has been considered a slow transport mode. This is still the case. Ships are unable to deliver in speeds comparable to airplanes. In addition, for the shipowners the concept of slow steaming is lucrative. This involves sailing considerably slower than the vessels maximum speed. This causes the time spent in transport to be considerable. However, this is not without advantages: it is also one of the reasons why seaborne transport are able to compete on price. As the price for operating the ship is low, the shipowners are also able to offer low prices for the transport work. The expanded time can therefore be seen as a compromise for the low price.

Time is a barrier regardless of the distance the goods is transported, but the competitive transport mode changes depending on the distance. With longer distances such as from Asia to Europe, air and railroad is a competitor to seaborne transport. The distance from Beijing to Hamburg is reached with airplane in 10 hours (Travelmath, n.d.), by railway in 15 days and with ship 30 days (Rodrigue, 2020). If the cargo transported is in any way time sensitive the time used by ship might be excluded from the competition. With shorter distances such as from Oslo to Bergen road-based and railroads are the strongest competitors.

Although time is considered one of the main weaknesses of seaborne transport, it is important to mention that time also can be a driver. For time-sensitive goods this is naturally not the case, but for some goods time might be a driver and a reason to choose ships. As the transport time is fairly long this decreases the amount of time the goods have to be stored. This can cause an even more reduction of price in the whole supply chain, as seaborne transport already is considered to be a low-cost alternative. Especially in higher-cost countries, storage can be an expensive part of the supply chain of the goods. Reducing this can be seen as an attractive feature of seaborne transport.

Time is to a certain degree an unavoidable barrier for transfer of goods to seaborne transport. As it does not have the physical ability to compete with some of the other transport modes, the barrier has to be there. In the case of this barrier, it can also open up for an opportunity. As the vessel has a considerable amount of time where the goods are placed upon the ship, this is a point during the supply chain which no real value is added to the goods. The transport itself is adding value to the goods as it is placing the goods in an area where it has potential to make money in some way, like being sold or used in production. However, the extra amount of time that seaborne traffic uses, compared to the other transport modes, is not

adding value. This creates an opportunity to execute value-added services on board of the ship during this shipping times. Value-added services that could occur during the voyage can be assembly, repackaging, crossdocking and labeling. This is not without consequences as this would require more space and likely more people. Subsequently, this would also lead to higher prices for the transport work. In addition, this would not be possible to execute on every type of vessels and type of transport. Some of the applicable vessel and cargo types is container vessels, Roll On-Roll Off vessels and Lift On-Lift Off vessels.

By being able to execute these value-added services this could create a driver from the unavoidable barrier. This driver might be able to outweigh the barrier, increasing the competitiveness of seaborne transport.

6.5 Availability as a barrier

Availability of the transport mode is also regarded as an important barrier. Sea transport can be considered unavailable in several aspects. One of the ways the seaborne transport is unavailable is the amount of access points to the transport mode. The access point to seaborne transport is a port or a dock/quay. Most transport chains do not start and end in the port. There is therefore a need for transport to and from the access point, leading to other barriers such as reliability and transshipment.

Another way that availability is a barrier for seaborne traffic is that the ships sail rarely in comparison to other transport modes. There are a limited number of ships in the world and, as previously stated, they spend fairly long on each voyage. This also leads to a longer distance between each port call. For comparison, there are more trucks than transport work making trucks available for transport at any time. This makes them available for transport little time after a request is identified and communicated. For several reasons, ships are unable to compete with this. This is also connected to the perception of the transport modes flexibility. The ship is often unable to quickly turn around and change their voyage on short notice.

The impression of seaborne transport as unavailable is often connected to the fact that it is not able to accommodate the transport need right away. Other transport modes are able to fill this desire, making it a barrier for seaborne traffic not being able to. If the other transport modes also were unable, this would not be such a barrier, as they all would compete on

similar grounds. Transport is regularly a time sensitive component in the supply chain, making an available and adaptive transport more suitable. This is similar to the barrier of flexibility.

As far as the aspect of rare departure compared to other transport modes, this barrier can theoretically be solved quite easy. More available ships would solve the barrier. This is rather unrealistic, as this is a major initial investment and having ships without work is a very expensive affair. Heavily increasing the number of ships is unlikely to increase the competitiveness of the ships as many of the drivers, such as price, would diminish. Overcoming this barrier will therefore require other measures.

The impression of a transport modes availability is an individual experience. In essence, this means that every cargo owner has an experience and from there make up their mind. To overcome this barrier, I think one way could be designing smaller transport systems adapted to a certain area's needs. This would, however, likely strengthen other barriers such as transshipment. This is because smaller transport systems would become smaller hub-and-spoke networks. They would need to connect with larger hub-and-spoke networks to be able to transport the goods to their final destination. If one area, containing a limited amount of cargo owners, have a seaborne solution tailored to their needs by the use of reliable and scheduled transport this could decrease the impression of seaborne transport as unavailable. Often times, transport of goods is outsourced to 3PLs, giving them the opportunity to adapt to the different cargo owners.

6.6 Financial support as a barrier

This barrier is ultimately concerning the infrastructure. As the maritime has gotten significantly less financial support compared to other transport modes their infrastructure has less monetary resources to improve. This also concerns governmental priorities such as infrastructure around the ports. Norwegian ports are often under municipal ownership, but they are also mostly self-sufficient. Though they have municipal ownership they often have little influence of the infrastructure like the building and maintenance of roads and railroads surrounding the port. As seen in the Port of Drammen, having a railroad connection to the port has proved to increase the environmental impact and efficiency connected to the transport

to and from the port (Drammen Havn, 2021). As the ports are unable to independently decide to build such infrastructure, they are limited to what the government decides.

Kystverket has tried offering an incentive for cargo owners moving their goods from road transport to sea transport. The cost of this project has been 175 million NOK and has resulted in 760 000 tons transferred (Berg, 2021). This shows that financial support in the form of incentives also can be a driver. However, one of the criteria of this incentive is that the transfer of goods has to be of the character that this would not be a possibility without monetary support, meaning the incentive (Gulbrandsen et al., 2021). As discussed in chapter 6.2, transshipment adds costs in ports that is not included when talking about costs for seaborne transport. If cost is an important factor for the cargo owner, these costs might make seaborne transport a nonprioritized mode. They might not qualify for the incentive as they technically can afford the increased cost, however, this is not within their priorities.

In the climate aspect, seaborne transport does get some financial support. Incentives to build, or retrofit, ships for greener operations are in place and help support the environmental aspect of using seaborne transport.

6.7 Technological improvements as a barrier

This barrier is a monetary barrier. A ship has a fairly long lifetime, about 30 years, meaning that implementing new technology across the whole fleet is an expensive and time-consuming task. A large part of the world trade fleet is old vessels, not up to current standards. Though Norway is leading in electric and emission free vessels, a large part of the fleet are still old ships releasing a lot of emissions. Changing the fleet will be a long process and will be very expensive.

I believe, with the amount of publicity the innovative projects are getting, that this barrier will be gone in the near future. With innovative projects like Yara Birkeland and ASKO, seaborne transports image is slowly changing, and the general public are starting to get a more positive outlook on ships as environmentally friendly transport.

6.8 Unwillingness to change as a barrier

Unwillingness to change might sound harsh, but there is some truth to it. Many cargo owners pay little attention to the transport of their goods as long it goes smoothly. Making a change is often expensive. Even changing to a cheaper transport solution has some investment cost. These includes, but are not limited to, factors like loss of efficiency due to change of routines when shipping and pay for the employees working on the change. These employees are most certainly hired to other work to which gets delayed. A change can therefore have a large impact on the daily operation of a company. This can be a reason that many chooses to stay with the transport solution.

One way of looking at this is through an innovational kind of view. For the cargo owners, they would need to change their daily routines. In innovation, process innovation changes the routine in how the business operates. The premises for a change to be implemented may also therefore correspond to the premise for a process innovation to be successfully implemented.

Many are also choosing to outsource the transport chain, meaning that the cargo owners are not necessarily involved in the design of the transport solution. This will be discussed further in the next subchapter.

6.9 General discussion about barriers

I think the topic of barriers for the transfer of goods is important to those in the logistics and sea transport sector. As far as the identified barriers show, there is a lot that needs to be worked on. Even in the newest NTP, released in March of 2021, the transfer of goods is still mentioned as a goal. However, there are no mention about how we are going to reach this goal. By identifying barriers, one also identifies the challenges that needs to be solved in order for the project to be viable and sustainable. Though, identifying barriers is not enough, finding ways to overcome the barriers is essential.

I also think it is important to highlight the barriers as these are the factors stopping the transfer of goods. Drivers are important motivations, however, for there to be a change the drivers have to outweigh the barriers. There are many drivers to replace many of the trucks with ships, at least when looking objectively at it. The downside is that the cargo owners, only caring about their cargo, does not view the case objectively. Their focus is about themselves

and their cargos interest. Their needs are ultimately what decides what they choose as a transport mode. Drivers like environmental impact might not have as much weigh in the decision as time, when the cargo owner wants their goods as soon as possible.

A focus on what the cargo owner needs from the transport is therefore very important when attempting to reach the goal of transfer towards seaborne transport. As the goal has been set nine years ago, and there is still little concrete measure to reach it, the focus should be on how to make the transfer attractive to the cargo owners. The drivers of the road mode are therefore important in this context as the cargo owners are aware of the goal and is still choosing to use the road mode. Naturally, this leads to the thought that they value the drivers of the road transport more than they value the drivers of seaborne transport.

Based on the nature of business and outsourcing I also think that some focus should be placed on the 3PLs. They are not the cargo owners but has to tailor to the cargo owners needs to be able to be competitive. However, they are also able to in larger scale consolidate goods to further utilize their space. If the 3PLs had a larger focus on the transfer of goods, this might increase the actual transfer as they are responsible for the transport of a large amount of goods. In addition, the 3PLs preforming only transport only has that as a focus. This would, naturally, also change how they operate. Environmental focus is important in these days and focusing on delivering an environmentally friendly transport solution might be rewarding. In addition, by focusing on the 3PLs this can cause a real change in the industry without having to involve the cargo owners. The 3PLs main focus is offering transport services, while the cargo owners main focus is offering the cargo.

6.10 Discussion about the case study

In the context of transfer of goods, I have designed a case based on four factories placed in the Hardangerfjord. I have used the results found in research question to tailor a transport system to the transport work needed in this certain case. By using the barriers, and finding ways to overcome them, I hope to achieve a more competitive transport solution. As this is a very tailored case, the exact case may not be very applicable to other cases, however, the spirit of the task might be applicable. Tailoring a transport system can improve the customers experience with the transport solution.

One barrier that is hard to overcome is the time barrier. Using seaborne transport is a slow transport mode, and while it will take 13 hours by ship from Odda to Stord a truck will use around 2,5 hours (Google Maps, n.d.). Because of this, the transport has to have drivers and something that adds value to the transport as a way of making up for the time.

During the designing of the case, my focus was being able to please each of the factories. I found this to be of significant importance as, in the end, they are the customers. They have to see the value in changing their transport system for this to be even a choice, meaning that the transport system in some way has to be better than their current one. One of the barriers identified in research question one is seaborne transports inability to be flexible. A transport mode can seem inflexible when they are unable to adapt to the customers' demands, and as a result I wanted to make this one of my main focuses when designing the case. This leads to the adaptable barges and leaving the barges at their ports until they wanted pickup. This causes the factories to be able to independently load the barges in their own time and therefore be able to decide to ship full or not full loads. I also focused on the flexibility aspect with the fact that the factories are able to ship whenever, during set times. This means that the tug will only sail if at least one of the factories wants to ship their goods.

Even though ship is known as a cheap transport mode, this solution is not necessarily cheap. The adaptation of the barges might heavily increase the cost of the project, as each of the factories would need their own barges. To make the whole project efficient, the factories would need at least two barges – one for incoming raw materials and another for outgoing manufactured goods. These might also have to be of separate design as the raw materials might not have the same properties as the manufactured goods. All this resulting in at least 8 barges in addition to at least one tugboat. Two if import and export barges are expected to sail at the same time. This also involves cost for crew(s), fuel and other operating expenses for the shipowner.

The number of barges is something to be considered. This brings the endless discussion of cost vs. efficiency. The most efficient would be to have two adapted barges for each of the factories in addition to some spare barges with a basic design. This way, the ship would bring back import barges after bringing the export barges. This enables both the port and the factories to execute their loading and discharging during regular working hours. However, this would heavily increase the cost of the transport solution. This would amount to

eight custom order barges in addition to some basic barges. In addition, new loading equipment might be needed and the vessel dragging the barges. Shipping is considered a cheap transport mode for the consumers, but the investment costs are high. This might cause the cost to be higher than the cost of using trucks.

If the cost is not competitive, other aspects of the transport system has to be in order for the solution to be viable. For a solution to be viable it has to be competitive enough over an extended period. The solution therefore has to be based on sustainable competitive advantages, compared to just temporary sustainable advantages. The solution should also avoid many competitive disadvantages, while competitive disparity can be allowed. This is based on the VRIO analysis in strategic analysis for competitive placement. The competitive advantage is compared to the other competitors.

In this case, the other competitors are mainly road-based transport. There is no known use of airborne transport from these factories. The closest railway is in Bergen and would therefore require additional transport to the terminal. This transport can either come in the form of road-based transport or seaborne transport. In reality, the transport modes that are competing is road-based and seaborne transport.

Barriers like transshipment is still hard to avoid when using a seaborne transport system. This system is a smaller hub-and-spoke network expected to link up with a larger hub-and-spoke network at Stord. Stord would therefore be a hub in our system, and a node in the hub-and-spoke system the goods are entering when transported further. All out factories are exporting internationally. This involves some transshipment, as the barges are expected to return to the factories and therefore needs discharging and loading. The cost, risk and time would therefore still be a barrier in this transport system.

The benefits to a short sea solution are clear. Less traffic on the roads is beneficial to the local environment for several reasons. Fewer trucks results in less exhaust emitted into the local air, reducing the local air pollution. In addition to the reduction to the CO_2 emissions, other air pollutants like dust in the local air will also be reduced. Less traffic also means less wear on the local roads, leading to better roads for the civilians and less expenses for road maintenance. Noise pollutions for the population living near the roads will also be reduced. Road is the mode getting the most funding from the government, a large part of this going to the maintenance of the road network. By reducing the number of trucks on the roads one also

reduces the chances of traffic accidents. The only way to ensure the governments goals of "zero dead or seriously injured in traffic" is to remove all traffic. By reducing the traffic, there is less chance for a serious accident to occur.

6.11 Limitations

Validity concerns whether the research really measures what it intends to measure, while reliability concerns whether the research is reproduceable (Gray, 2018; Jacobsen, 2015). When it comes to validity, by using literature review for my first research question I tried to be rather specific in my identifiers. There are some differences in the sources used and what they researched. Some were concerning shorter voyages, while other such as the governmental literature, where concerning longer voyages. I chose to use barriers identified mostly in literature concerning both of these, as they would apply to both scenarios, and therefore also seaborne transport as a whole. I do, however, think that there would be a higher degree of validity for research question one if the quantitative questionnaire would have been successful.

For my second research question, the validity question is a little difficult. To be able to answer my research question, this would need further research more comprehensive research project. My master thesis was not able to answer such a large question, however, it is the beginning to be able to answer such a question. Competitiveness is dependent on the other competitors, and such an analysis would be needed for each of the competitors to be able to fully answer this research question.

What concerns reliability, I believe that the same results could be reproduced given the same conditions. There are many small factors in this research, and small changes could impact the result greatly. In addition, I have used an abductive reasoning causing especially the case study to change drastically during the process of working with the thesis. Poppers concept of falsification was also applied, as it should to assess reliability in qualitative research (Leung, 2015). Leung (2015) also mentions that data should be verified with comparison to other data. This was intended with the quantitative questionnaire, but I also attempted this by using barriers referenced multiple times during the literature review.

7 Conclusion

In my thesis I have successfully identified multiple barriers for the transfer of goods from road-based transport to seaborne transport. The most identified barriers are time, flexibility and reliability. These reflects the factors that are important to the cargo owners – to get the goods at the right time, at the right place and preferably fast. Transshipment was also seen as an important barrier. My hypotheses to this research question seemed to somewhat reflect the real world, however, from my work with the thesis they seem to not contain the whole truth. There seems to be many barriers working together to make seaborne transport a less competitive choice.

For my second research question, I have been able to construct a suitable and tailored transport systems for the four factories. Therefore, my first hypothesis seems to reflect the real world. The second however, and thereby the research question, has been explored. I have not been able to come to a conclusion as to whether it is competitive. More information, such as other transport modes competitiveness and accurate information such as cost is needed to be able to prove – or disprove – my second hypothesis.

This thesis brings forth an exploration of the barriers of the transfer of goods, in addition to a practical use of the barriers to make a transport system. This is thought to be more competitive than a standard seaborne transport solution.

By using the barriers as a basis for transport systems, and including multiple cargo owners, one could increase the amount of goods transported by sea both shorter distances and longer distances. Even though the goal from the government applies to strictly transport work over 300 km, I believe that by tailoring smaller transport systems the barriers could decrease.

Issues for further research

An interesting research topic concerning this subject is identifying the drivers of road-based transport and comparing them to the barriers to seaborne transport. This way, one could easier identify the reason why the transfer of goods is challenging. The same kind of research should be done as a comparison between rail-based transport and road-based transport as well. The transfer of goods goal applies to both seaborne transport and rail-based transport.

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Figures

Figure 1 - Rodrigue, J.-P. (2020). *The geography of transport systems* (5th ed.). Routledge.

Figure 2 - Rushton, A., Croucher, P., & Baker, P. (2017). *The Handbook of Logistics and Distribution Management: Understanding the Supply Chain*. Kogan Page Publishers.

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Figure 4 - Van de Ven, A. H. (2007). *Engaged scholarship: A guide for organizational and social research* (p. XII, 330). University Press.

Figure 5 – Made by author