Logistic solutions
Slovakia – Sweden

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Foreword

We would like to thank all those who have been involved in this report. All staff at Hörle Wire Group AB, both in Nitra and in Hörle. A special thanks to Jesper Bundgaard, CEO and mentor at the company, who took the time to help us, show us around at the company and answer our questions and concerns. Thanks to Richard Tóth, sales and logistic manager, at Hörle in Nitra. Also, thanks to Hörle Wire’s customers, NKT and Södra Cell, who have been very helpful in our contact with them. Another thanks to the mentor at the School of Engineering in Jönköping, Leif Svensson.
Abstract

This report is a bachelor thesis project conducted by Isabelle Andersson and Wiktoria Rydin as a part of the education Mechanical Engineering, Industrial Economy and Production Management, at the School of Engineering, Jönköping University. The project is a collaboration with Hörle Wire Group AB, a company that produces round and flat-rolled wire of high-quality and they belong to one of Europe’s leading suppliers of wire.

The purpose of the bachelor theses was to review Hörle Wire’s transport solutions from their facility in Nitra, Slovakia, to their two main customers in Sweden. Hörle Wire has a problem with gaining profitability regarding these transports. The cost of transporting the goods from Nitra to the customers is so high that the profit margin becomes very low.

The problem was studied through qualitative and quantitative data collection in the form of interviews with staff at Hörle Wire and with their customers. The resulted in a clear picture of the emerging problem, and with the theories and facts studied in the field, proposals could be processed.

Based on this, some suggestions for improvements were made that Hörle Wire could apply in its efforts to affect the transport. Some different proposals have been made, for example completely changing the means of transport, changing the appearance of today's transportation and to establish a warehouse.
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1 Introduction
This bachelor thesis project was performed by two students at the School of Engineering at Jönköping University. It is a part of the education Mechanical Engineering with the alignment Industrial Economy and Production Management. In this section the problem will be introduced, and the research questions will be presented.

1.1 Background
Transports between different countries are very common today, and its effect on the environment is enormous. This is a very current issue since the environment has high focus in today’s society and companies who do not take responsibility gets increasingly contested. Companies have to take the environment issues into their daily work. At the same time, it is important that the transports occur efficiently, which makes the companies limited in their choices of transports.

This thesis is a collaboration with Hörle Wire s.r.o. in Slovakia and Hörle Wire Group AB in Sweden. Hörle Wire is a company that produces and sells galvanized steel wire, and they belong to one of Europe's leading suppliers of wire. Their customers are located in eight countries around Europe. The primary segments, which is provided today, is reinforcing wire of underwater cable, staple wire and fence wire. They are also trying to get into the market of ACSR, which stand for Aluminium Conductor Steel-Reinforced Cable. All of the market segments, except fence wire, is to be exported and around 60%-70% is delivered to the Nordic countries, distributed as following, of total 28 300 ton per year [1]:

- Sweden – 9200 ton
- Finland – 5300 ton
- Norway – 2500 ton

These transports from Slovakia are very expensive and take a lot of the profit.

At the request of Hörle Wire Group AB and their chief executive officer (CEO), Jesper Bundgaard, this project will try to help them to develop new transport solutions which shall be more cost effective and more environmentally friendly. The project will focus on the two primary customers in Sweden, NKT in Karlskrona and Södra Cell in Mönsterås, Mörrum and Väröbacka. The study will contain calculations of different transports and other reviews.

1.2 Problem statement
In Hörle Wire’s supply chain, transport is a significant and important part. They feel that the transportation from their unit in Nitra, Slovakia, to their most significant customers in Sweden are too expensive. Nowadays, about 70% of Hörle Wire’s customers are located in the Nordic region. This means a lot of long and costly transports from the facility in Nitra, Slovakia, and the profit that remains is not enough. Due to the high demand for transports northward, these transports are way more expensive than the ones from the Nordic region.

Besides, there is a great deal of interest in the environment and to reduce the environmental impact of the transports. Environmental emissions are a global problem that every company needs to think about today, and Hörle Wire has a significant interest in ensuring that their transports are as environmentally friendly as possible.

It is also important for Hörle Wire to meet their customers’ demands in delivery, such as lead time and delivery safety. They want to see if it is possible to achieve approximately the same results at lower costs.
1.3 Purpose and research questions
The purpose of this project is to reduce the costs for the transports from Nitra, Slovakia, to their main customers in Sweden without neither reducing the delivery security nor increasing the environmental impact.

Hence, the central research questions for this project are:

1. How does the existing supply chain look like?
2. Are there any alternative methods for supply of the material to the customers?
3. Is moving the production to Hörle, Sweden, an appropriate alternative?
4. What are the environmental effects of the alternative transport solutions?

1.4 Research focus
- The project concern only the two, primary customers of Hörle Wire; NKT and Södra Cell. No other customers will be taken into account.
- Time is a limit for suggestions on improvements
- The project will only make recommendations for changes and not create any practical implementations
- It will only concern costs for the transport and what environmental impact the transports will make
- The report will not include calculations of the moving costs of the production
- Costs for transportation of raw material to Hörle respectively Nitra will not be calculated

1.5 Disposition
The report is made up of seven different main chapters with some subheadings. Chapter 1 contains an Introduction with a background and description of the problem. Here, the purpose and research questions, which is a basis for the rest of the report, are presented. Coming chapter are Theoretical framework, which describes the theories and facts behind the alternatives and solutions to the identified problem. Chapter 3 presents the Methods used in the report to execute and perform the work. Further is a description of the current situation in chapter 4, and in chapter 5, the Analysis of the work has been presented. Discussion and action proposals are described in Chapter 6, giving a clear picture of what options which are considered appropriate and which are not. At last, the report is finished with Chapter 7, Conclusions, where the conclusions of the work and continued work or research are presented. See Figure 1 for an overview of the disposition.

Figure 1 - Overview of disposition
2 Theoretical framework

In this section, some fundamental theories and concepts, which is connected to transport and environment, will be presented. The chapter will provide a basis for the analysis in the end.

2.1 Link between research questions and theory

In order to deliver goods as quickly and safely as possible, it is vital to have efficient logistics. The entire purpose of logistics is to improve the company’s efficiency, and if the company succeed from that point of view it will have a positive impact on the result. To make it easier, efficiency can be expressed in some variables where each one of them represents an area of effectiveness. If this is done in a transparent way, understanding increases and it will be easier to follow up and compare results. This can also be used as a competitive advantage in some respects, as it shows that the company has control over its flow and has an effective thinking. [2, pp. 26-27]

2.2 Efficiency material flow

In planning the logistics flow, Storhagen’s model, in Swedish “Seven R’s”, are useful (see Figure 2). In this section, a summary was made where inspiration was taken from these steps, but it is not directly translated. Some steps have been removed, due to no relevance to this thesis. [3, pp. 137-142]

![Efficient material flow diagram]

Figure 2 - Efficient material flow

Reviewing these steps gives a clear picture of how important it is to make the right decision when choosing transport. It is not always a natural choice to pick the right transport alternative, and it is possible that more than one option can be suitable, just that they cater to different needs. Since companies continuously work on developing their flows for a faster and more refined flow, higher demands are set on having as few disturbances as possible. This, in turn, means that companies sometimes have to deselect a cheaper but more insecure means of transport and instead invest in a more expensive but safer alternative. [3, pp. 137-142]

2.2.1 Customer

The customer is an essential part of the company’s flow, and by having excellent customer service, you can achieve good results. Companies that succeed in activities related to customer contact and delivery of products, and services are often appreciated by their customers, which gives revenue to the company. Having a logistics system can help to create excellent customer service in the form of good delivery service and to provide customers with information about the material flow. [2, pp. 27-28]

There are several different parameters to take into consideration when measuring the level of customer service of a company. These parameters can also be different in different situations and depend on which customer it is. How well the company can keep what they promise in delivery date, delivery flexibility and delivery time are often important elements in many
Theoretical framework

situations. If the company is customer-ordered-managed or stock-managed can also be variables that matter when the customer chooses which company to purchase from. [2, pp. 27-28]

2.2.2 Material
A company consists of multiple supply chains, and in each supply chain there is a material flow to take into account. It includes the entire flow, from the company’s supplier to the customer. Jonsson and Mattsson mention four common issues that companies should take into account [4, pp. 59-60]:

- How large quantities are requested, and when?
- How much is available to deliver?
- How large quantities must be manufactured, and when?
- What capacity does it require to produce these quantities?

These issues help in the planning process, both from a material flow perspective and from a capacity perspective. There is always a critical balance between the need to deliver and the opportunities to produce, and the boundary between them is thin. [4, pp. 13+59-60]

Material flow is a primary flow in logistics, as it represents values, has a significant impact on the environment and often requires large resources. In a manufacturing company, the flow into the company consists of raw materials and components, while the flow out of the company consists of finished products to the customer. As the design of the packaging of the products has a direct impact both on transport, storage and material handling, these can also be seen as a component of the material flow. [2, pp. 50-51]

2.2.3 Amount
Quantity and volume are important factors to consider, mainly as these factors are common factors of a company. Some companies manufacture small, lightweight components while others make large and heavy parts that take up a lot of space. The transportation and managing of the products consequently become very different, and this affects the delivery flexibility, which is an important part of the flow. The extent to which you can be flexible in its volume is determined by the ability to increase or decrease production and delivery volumes quickly. This regardless of whether mix changes occur or not. It depends on, for example, delivery times, stock size and lead times. [2, p. 29]

2.2.4 Place
Where a manufacturing company should place their facility is of great importance and in many cases, it is crucial for the future of the company. There are some factors that companies should take into account when locating their business. For examples where the customers and suppliers exist, existing facilities, business environment and the market. Another factor that is important to consider is the access to external resources. This in order to be able to develop the company’s resources. These factors are examples of what companies take into account but vary depending on companies. [5]

2.2.5 Time
Time-to-customer (TTC) is a term of delivery time and is an important parameter in a company with customer-ordered-production. Delivery time is a measure relating to the time from receipt of customer orders until delivery takes place. The length of delivery is determined depending on the product characteristics and production methods. [2, p. 30]

Delivery time to the customer contains two main parts. The first part has to do with the business itself. Some examples of what is included in that section are: [2, p. 30]

- Deal with administration and order processing times
- Production lead times
- Production preparations times
- Delivery and shipping times
Theoretical framework

To offer the customer as short delivery time as possible, advanced and efficient logistics solutions are required. To make it more effective, some of these parts could be automated and other would just need more planning. [2, p. 30]

The second central part has to do with current load. Depending on how the material flow and production flow is controlled, this can affect the delivery time that has to do with current capacity. These two main parts, concerning delivery time, will enable companies to interact to offer as short delivery time as possible and then become competitive. [4, p. 38]

2.2.6 Cost
The last aspect to consider was the cost. It is not justifiable to choose transport only on the basis that the goods have to arrive quickly and efficiently. It also has to be made at reasonable costs. For example, there is no significant gain in flying heavy products that have a low price, because then the transport will cost more than the value of the goods. One tool to use in comparing various proposals is to calculate the number of ton-kilometers, i.e., calculate the number of shipped tons multiplied by the number of kilometers traveled. [3, pp. 138-139]

2.3 Alternative means of transport
Today's society is utterly dependent on different types of transport, private as well as companies. Freight transport is done every day, 24 hours a day, to satisfy people's needs. There are many different means of transports to choose between. They all have a common factor; they affect our environment. Today, companies have become more aware of the environmental impact of the transports and the consequences this brings to the future. Costs have always been at the center, but today the environment also is. [6]

This report focuses primarily on trains, trucks, ships and airplanes. Over time, it has become evident that the development of the different means of transport must be done in an overall perspective. When a product's flow is studied, from raw material to finished product, it is seen that both materials and products must be handled on several occasions. This also means that transport sometimes has to take place between the different parts of the flow. In several cases, this causes that various means of transportation must be used to optimize the flow. [6]

There is something called intermodal transports. It means that at least two different means of transport are used, and that leads to an essential development of both the means of transportation and the equipment. Combining transport is also an active argument from an environmental point of view. The idea of using trains on longer distances, and then switch to trucks on shorter routes, could be a significant gain for the environment. This is further described later in the report. [3, pp. 139-140]

2.3.1 Train
Railway traffic has potential to be a good option in the reducing of the total emission of climate-affecting gases. They cause a lot of noise, but that is still a minor problem in the context. Building and operating railways are, however, less favorable for the environment as it leads to high energy consumptions and high emission. It gives barrier effects to both animals and humans and rubs the balance in soil and water. [6]

When constructing rails, the steel in the railroad is a significant energy shutter, and it is a considerable amount of fossil fuels involved in the manufacturing. There are essential differences in energy consumption between different steelworks, but unfortunately, it is not taken so much responsible for that. [7]

On the other hand, rail traffic only accounts for one percent of all transport emissions in the transport sector, which makes it very convenient to use trains in heavy goods transport. This low environmental impact is mainly due to the fact that electricity mostly powers the rail network and that it is possible to carry large quantities of goods at the same time. In comparison with the truck, a freight train can take as much load as thirty trucks with trailers can take. The cost of transport with high volumes is low, and the transport capacity is high. [8]

A problem with the railroad is that the it is not as easily accessible and does not reach all places easily. You cannot offer door-to-door transport in the same way as you can do with, for example
a truck. The railroad must also relate to fixed timetables and adapt to other trains, which leads to lower flexibility and a lower frequency of transport. [8]

2.3.2 Truck

The most common way of transporting goods between different parties is by truck, and this applies to both short and long-term means of transport. Truck, as a means of transportation, has its advantages such as flexibility, direct delivery and that it fits different types of goods. Despite benefits, there are obvious disadvantages, and the biggest is the environmental impact. [2, p. 85]

The truck is a flexible means of transport when it comes to delivery of goods. By truck, different types of products can be transported, and size and weight are less important for its ability. It is possible to customize transport for the customers to achieve the best delivery service, as long as there is an executable road. The flexibility allows to eliminate the loading and unloading process, and the goods can be transported directly from point A to B. This saves time and companies avoids variation of transport costs. These examples of benefits make the truck competitive. [2, p. 85]

Using truck as a mean of transport when transporting goods, have its advantages but also its disadvantages. If you compare truck with other means of transport it has a significant disadvantage, and that is the cost. It is costly to carry goods by truck. Also, the truck does not have the same load capacity compared to train, boat and airplane which means that you may need to transport the goods more often if the customer request high quantities. This becomes both more expensive and significantly affects the environment. The truck contributes both noise, air and water pollution and its carbon dioxide emissions contribute to the greenhouse effect. More and more laws are introduced regarding the environmental impact of the truck, which limits it in the choice of means of transports. [6]

Another aspect to consider is the truck’s tire as it also has an impact on the truck’s emission. The truck’s fuel consumption is affected by the tire rolling resistance. When the tire begins to tear, rubber particles will loosen, leading to hazardous chemicals. [9]

2.3.2.1 Different truck combinations

When a truck is described, it is easy to imagine only one truck type and that it may be a trailer connected to it, but it is not always that simple. If trucks are carefully studied, it will soon be discovered that it is possible to make different combinations of cabin, semi-trailers and containers. The combinations can also contain so-called dollys. A dolly is a trailer that is intended to support a semi-trailer with a guide shaft, and it is also equipped with a coupling device for a semi-trailer. [10] [11]

Below, in Figure 3, Figure 4, and Figure 5, three different options were drawn up. The first one (A) is only a cabin with a semi-trailer. The second alternative (B) is a cabin used with a platform, a dolly and a semi-trailer. The third one (C) is not so common but could be very useful. It is a cabin with two trailers where the second one is twice as big as the first one and could fit two standard containers. Beware that the total platform length may not exceed 21,86 meters. Depending on the amount of goods transporting, these combinations could be very efficient. [10] [11]
Today, about 70 percent of freight transports are carried out by sea. Shipping is based on our most important natural resource; water. 70 percent of the Earth’s surface consists of water and utilizing this resource correctly is vital for sustainable development. Maritime transport is a convenient way of transporting large quantities of goods, as it has high cargo capacity. It is also one of the cheapest means of transport when it comes to long-distance transport, as it gives a lower transport cost per ton-kilometer compared to for example a truck. The ship, however, is the slowest way of transporting goods, which is a disadvantage as it has to be planned for a long time. [2, pp. 82–84] [12] [13] [14]

Maritime impacts on the environment occur both above and below the surface, as well as regionally and globally. The work on shipping's environmental impact is regulated by both the United Nations and the European Union, which sets rules for the shipping. Nitrous oxide, carbon dioxide and sulfur oxides are some examples of the emissions that ships are causing the surface, and emissions of nitrogen oxide have unfortunately increased over time. Maritime transport also constitutes a risk of causing water pollution through the cargo they carry and by the refuse, for example food, that occurs on board. Emissions in the sea create acidification and also affect the wildlife below the surface. [7] [15]

2.3.4 Airplane
Freight transport by air has gradually increased, mainly thanks to improved airplane materials and airport expansion. When transporting over long distances, airplanes have a significant advantage as they can handle long distances in a short period. Aircraft is, in several cases, to prefer instead of boat because boats have a long transport time and a significantly more uncertain arrival point. One disadvantage with flights is that it is tied to airports, i.e. it is not possible to fly and land anywhere. Instead, there are specific places where the goods arrive, and
from there the goods have to be reloaded and transported with another means of transportation. Another limitation of flights is that it is only suitable for small and light goods that have a high value, due to the fact that airplane has a limitation in cargo capacity. [3, pp. 141-142]

When transporting sensitive and fragile products, it is an advantage with airplanes, as the transportation is considered to be very safe and fitting products of that kind. A disadvantage, however, is the impact the aircraft has on the environment. As seen in Figure 6, airplane stands for up to 80 times more energy usage in grams per ton-kilometer than the trains do, which says a lot about how much impact the planes have on the environment. There are also significant costs of shipping goods by air. Since it is such simple and efficient transportation, it is also sought after, which increases the prices. [2] [16]

Figure 6 - Energy application

One factor to consider is the height of the flight. For shorter flights, the airplane can stay below 10,000 meters height, which makes fewer emissions of the greenhouse gas than on trips over 10,000 meters in height. This is due to the so-called high-altitude effect. High-altitude combustion is considered to be closest to the dual climatic effect compared with the same combustion on the ground. Most of the effect is due to the formation of oxides of nitrogen and water vapor in the high atmosphere as they have been shown to increase their negative impact significantly at higher altitudes. The transformation of nitrous compounds into nitrous oxide is also a problem for the ozone layer, as it has a noticeable adverse effect on it. [17]

2.3.5 Intermodal transport

An intermodal transport means that at least two different means of transports are combined, for example transport by train and truck. This in order to take benefits of different means of transports and to make transport as efficient as possible, especially in an environmental point of view. This means that a more environmentally friendly alternative can be used on one route and then be combined with a more flexible alternative to reach the customer’s facilities. In order to be as efficient as possible, it is important that the cooperation between the different means of transport is designed efficiently. This, for example, by using standardized device loads, such as containers, that can be moved smoothly with standard equipment without re-loading. [2, pp. 87-88]
2.4 Environment
The environment has become a more and more aware issue, both as an individual but, above all, as a company. What often becomes an obstacle to the environment is when it becomes expensive to be environmentally friendly, and when it becomes too expensive to be that. Economy and environment go hand in hand, but sometimes it can be hard to see how they are connected. [18]

To achieve increased economic growth, the value of all goods and services produced in the country must increase. On the other hand, the value increase can be done in two different ways. One way is through inflation, i.e., prices are rising. The second way is by producing more goods and services, i.e., economic growth without inflation. Increased consumption leads to increased production, which in turn leads to more raw materials being collected from nature. These raw materials should then be extracted and transported in order to be converted into finished products to customers. Usually, it becomes more than one transport before the finished product has been collected by the end customer, where it is consumed. At last, the products are recycled in some way. For this reason, it is difficult not to see the connection between environment and economy. When there is an increase in consumption, the environmental impact also increases, which is important to take into account. [18]

An important factor from an environmental perspective is the transports. They have a negative environmental and health impact that has to change for the better. At present, fossil fuels account for a large part of the Swedish transports fuel consumption and fossil fuels account for the biggest contribution to the greenhouse effect in the world. [19]

It is required that the proportion of fossil fuels in transport decreases. To be able to do that, the vehicles must become more energy efficient and the proportion of vehicles powered by renewable fuels must increase. Even if this happens, it will not be enough. Traffic by car, airplane and truck must be reduced in its entirety, which is not in harmony with the increased consumption that society is facing today. [19]

Figure 6 shows the amount of energy that the different means of transport use. The table is based on energy usage in grams per ton-kilometer per traffic stroke. According to this, flights make up to 80 times more energy consumption than the train does and just over 11 times more than a heavy truck. It is also seen that heavy trucks make up seven times more energy consumption than train does. [2]

In order to reduce the environmental impact of transports, measures must be taken both within existing infrastructure and by implementing new infrastructure. This new infrastructure must be developed in such a way that means of transport with less impact on the environment, such as rail and shipping for freight transport, can be chosen. Not least, it is crucial that these means of transport are not only possible, they must also be attractive so that they can be chosen first and foremost. [19]

2.5 Factory location
The selection of where manufacturing companies locate its plant is of great importance. There are factors that companies have to take into account when establishing their companies, which in many cases may be crucial for the company’s future. Some examples of factors are where the customers and suppliers exist, existing plants and the market. Another factor that is important to consider is the access to external resources, such as highly educated staff and raw material. This in order to be able to develop the company’s resources. Companies also considering how the country is governed, taxes and what the standards look like, so it benefits their manufacturing. When a manufacturing company is located, emphasis is placed on the possibilities of good logistics. Good logistics is important both to and from the company. Even though companies take these factors into account, they sometimes realize after a period that they did not get the result as expected, which could lead to a relocation of the production. [4, pp. 49-51] [5]

2.5.1 Customer distance
Where the customers and the market exist is significant factors when the location for a manufacturing company shall be decided. It is important parts since the companies want the
customers within reach to be able to create strong relationships and offer the best customer service. By having their customers close, long transports with goods can be avoided, which would reduce emissions from the means of transports. Placing the factory close to its customers would be not only profitable from an environmental point of view but also profitable for the company as their transportation costs reduce. [5]

2.5.2 Supplier distance

As mentioned earlier, supplier distance is an important aspect, and to provide efficient supply chains, the distance between companies and its suppliers is of great importance. A significant choice for companies is the choice of local and global suppliers and also to choose where the limit of distance should be. The choice of where a manufacturing company locates itself can in many cases be determined by assets on materials, inputs and components. [2, pp. 201-203]

Local suppliers mean that the suppliers will be at a short distance from the company. Choosing these suppliers is important for building strong relationships that can develop into more advantages, like better prices, faster delivery and more flexibility. The advantage of local suppliers is that they will be short deliveries, which means low transport costs and that deliveries can occur more frequently. Another advantage with local suppliers is that it becomes less environmental impact due to shorter transports. [2, pp. 201-203]

To be able to get global suppliers, the companies have to search and establishes supplier relationships worldwide, regardless of distance. This has its advantages in reaching out to several different suppliers, but also disadvantages, such as differences in culture, language and time. English is the official language in the business world, but despite this, there may be language shortages in some countries. This complicates the exchange of information and increases the risk of misunderstandings. When companies establish supplier relationships globally, there is a risk that countries will be in different time zones, which can complicate communication and flexibility. If the countries are located in different time zones, it means different working hours, which in turn means that different time limits must be taken into account. [2, pp. 201-203]

2.5.3 Relocating the production

There are different definitions of relocating a production; outsourcing, insourcing and back sourcing. Outsourcing means moving away from the core business. Insourcing and back sourcing means that you move closer to your core business. [5]

A company continuously reviews its costs and revenues to estimate how they are in relation to their goals. If the company does not fulfill their goals, it is time to evaluate the work for better results. In some cases, companies may find out that the best solution is to relocate the whole production. There are reasons why companies relocate their business. Some examples are that they want to move closer to the core business, come closer to its customers or suppliers, the need for more space and to increase the efficiency. Before considering relocation of a company, carefully reviews have to be done. It is necessary to control if it has to be moved or if there are any other actions that has to be considered. Relocation of a company can take place both within the same country but also to another country. If a company consider the option of moving production closer to the core business, it could be in order to gain better control over manufacturing. [5]

There are risks of moving production and it also arises expenses. The expenses vary depending on the reasons for why a company relocates and the costs should include skills development, investment of new machines and costs for components and new buildings. If a company chooses to relocate, it is important to keep the same customer service and delivery service as before to avoid losing customers. [5]

It is not only disadvantages with moving a production. There are also several benefits, such as reaching out to new customers and a wider market. Moving production closer to the core business gives you better control over manufacturing and it increases the knowledge of the company. Moving production closer to customers can reduce transport costs significantly, which reduces emissions of exhaust gases from the means of transports. This is positive for the environment since shorter transports lead to decreased emissions. Before considering
relocation, it is important to compare benefits with disadvantages as it requires a lot of resources. [5]

2.6 Inventory
There are different types of inventories and in order not to end up in shortage in any part of the supply chain, inventories can be used. Due to the different speed in different parts of the flow, some parts of the stream may need to be decoupled from each other. In these cases, a stock is an option in order to solve these problems. Examples of stocks that are commonly used are cycle stock, fluctuation stock and smoothing stock. However, in this report, only fluctuation stocks will be taken into account, as it is the only relevant inventory in this project. [3, pp. 137-138]

Creating a product and put it in stock gives no value to the company that created it. When the product is transported to a location that makes it available to the customer, it starts to generate a value for the company and creates place utility. These transports are a critical point in the company’s product flow and material flow since it is the last step in the flow. Delays or problems that have occurred in the past can reduce the transport time, since it is important to deliver on time to the customers. Therefore, it is essential to have reliable, fast and stable transportation for the goods. An alternative for the company is to have a stock close to the customer, which makes the product available to the customer whenever they need it. That adds additional value and time utility is created, but it takes up a lot of capital which could have been used for other things. [3, pp. 137-142]

2.6.1 Fluctuation stock
Inventories that contain finished products that are available to cover up unpredictable incidents are called fluctuation stocks. A company can have this kind of stock to be sure that they can deliver to their customers no matter what problems are encountered. If a company has a fluctuation stock, they do not have to be worried about delays in delivery to customers in unpredictable occurrences, since they have an inventory that will cover up for these situations. Unpredictable incidents, such as late deliveries or higher demand for products, may occur and then the products in the fluctuation stock are to be used. This to keep the same delivery service to its customers and also become competitive. [2, p. 309] [20]

If a company has production far from their customers, long journeys are required, which costs a lot and affects the environment. From a financial and environmental point of view, it is important that these transports are fully-loaded. If they are not, it could be beneficial to have a fluctuation stock between the production and the customers. In that case, fully-loaded transports can be transported from production to the fluctuation stock, and shorter distances with not fully-loaded transports occur. This is also a gain for the environment since it leads to reduced emissions. [2, pp. 307-308] [20]

2.6.2 Inventory control
Inventory control, which is also known as stock control, means trying to maximize and regulate a company’s inventory to achieve maximum profits at as low cost as possible. This should happen without impacting customer satisfaction levels. Inventory control is also about to have excellent knowledge about your stock and to ensure that everything is at its right place, at the right time. [21]

It is important to separate inventory control and inventory management, which in some cases is misused. This can quickly lead to misunderstandings, especially since they deal with two different aspects of inventory optimization. To clarify this, a definition of the two aspects will be presented. [21]

Inventory control involves warehouse management. This includes [21]:

- Keeping track of the stock that is already in the warehouse. This includes knowing what products are being stocked and how much of a particular item is available.
- Aspects of warehousing designs, such as knowing where everything is and ensuring that the products are stored well.
Inventory management, on the other hand, involves [21]:

- Stocking the right amount of inventory
- Paying the right amount of your inventory (Economic Order Quantity)
- Knowing your reorder point
- Ensuring you have the right amount of inventory in the right place

Before inventory control is described further, the question "Why Stock?" is a reasonable start. The primary purpose of having stock is that different parts of the flow in a supply chain must be separated from each other, for example different production lines. There are several reasons why it needs to be done and one example is that a purchase is made on a pallet basis, but when the products are to be sold, it will be sold per unit. [3, pp. 120-122] [22]

Another important reason for having stock is to cover up uncertainties and risks associated with purchasing and sales. Due to inventory, you can handle incorrect deliveries or fluctuations in demand which was not expected, without fail to deliver the products to the customers. [3, pp. 120-122] [22]

If it was possible to be able to have large quantities of all products in stock, the company should be insured against any possible problems along the way, and the goods to the customer had never expired. Of course, this is not possible as it would tie up too much capital, capital probably needed elsewhere in the company. It is therefore often tempting to reduce the stock as much as possible to set capital free, but it is essential to be a little bit careful. The risk when reducing the stock is not to succeed in delivering to the customer when it is needed and, in the worst case, get rid of that customer and lose significant revenues. Another risk is that deliveries cannot be done as planned, which leads to expensive delay fees. [3, pp. 120-122] [22]

It is not as simple as imagined. On the one hand, one wants to have stock to meet needs, but on the other hand, it ties up very much capital that may be needed elsewhere in the company. [3, pp. 120-122] [22]
3 Methods

In this section, different methods and approaches used during the thesis will be reported. How the collected data was analyzed and the reliability of it. In Figure 7 an overview can be seen.

**Figure 7 - Overview of methods**

### 3.1 Link between research questions and methods

First of all, an analysis of the current situation was needed to understand how the transport logistics and production looked like today. The analysis was done primarily through interviews and data collection to get a clear picture as possible of the situation today. This was an important part to understand the problem and to define the reasons for it. The interviews were conducted with different people in different positions, both at the company, Hörle Wire, but also with persons at the two main customers, NKT and Södra Cell. This, to get a wide and fair picture of the problem as possible.

The other main method was to collect as much data as possible, including data for different transport, freight and production costs. The data were used to enhance the current image and to compare to how it could be. At last, literature was used to gain basic knowledge of transport, production and factory location and how we could count on this.

### 3.2 Data collection

When an improvement work is to be performed, a collection of data and measurements is of great importance. This for decisions to be made on facts and not assumptions. There are different methods of investigation for collecting data, and it is also possible to choose if it shall be quantitative or qualitative data. [23, pp. 13-14]

To answer the questions, different types of data have been necessary to collect. The methods which will be used in this report are interviews, document studies, with both primary and secondary data, and literature reviews. It will also contain some data analysis and calculations.

#### 3.2.1 Primary and secondary data

Separating primary data from secondary data is vital. What the proximity of the information provide determines the difference between these two. First-hand information, eyewitness sources and information collected for the first time in this particular study are called primary
data. All other data are called secondary data, i.e., literature studies which are made to strengthen the results of the study. Using secondary data is an excellent complement to the primary data. [23, p. 69]

3.2.2 Literature review
The literature reviews have been done through loans of literature from the library at Jönköping University and, in some cases, through books from further courses. Search for scientific articles has also been made with the purpose of strengthening the validity and reliability of the report. This is to create a report with a high level of credibility as possible.

3.2.3 Interviews
Interviews were a method used in the study, as a qualitative data collection method. Semi-structured interviews were used to make it possible for the respondents to answer freely and also have the opportunity to develop their answers. Interviews were conducted on a continuous basis during the project when issues emerged in the meantime. [23, pp. 81-83]

The interviews were conducted with employees at Hörle Wire in both Sweden and Slovakia. This qualitative interview method was chosen to get a understanding and a basis to answer the main questions. Different people with different roles were selected for the interviews in order to get as much information as possible. In addition to interviews, e-mail was also used with employees at Hörle Wire in both Sweden and Slovakia and with their customers, Södra Cell and NKT. Questions that emerged during the project were easier to ask by e-mail and therefore this method was used.

When the interviews were conducted, no recording was used. The reason for not recording the interviews was to make the interviewed people feel comfortable. This to get as developed answers as possible and also to lead to a discussion. One disadvantage of not using any recording is that the respondent’s answers is not recorded accurately. [23, p. 87]

3.3 Calculations
To be able to determine which means of transport that will be the most suitable for transport from Slovakia to Sweden, some calculations will be needed. Through interviews and e-mails with the employees at Hörle Wire, a collection of numbers has been made, which has led to different calculations. These calculations have made it possible to see Hörle Wire’s current cost of transport from Nitra to their customers and also achieved the profit margin, which Hörle has today.

3.4 Data analysis
Despite to the limited time allocated to this project, the purpose and questions could still be answered thanks to the interviews and other collected data. An understanding of the problem was provided by a survey of the current situation and frequent contacts with interested persons at Hörle Wire, their customers and also teachers at Jönköping University. Together with literature studies, theories could be established, and the theoretical framework is based on these theories. Finally, the theoretical framework was compared with the collected data and a result, a conclusion and a discussion could be presented.
4 Current situation
In this section, a description of the current situation is presented.

4.1 Hörle Wire today
Hörle Wire is a company that manufactures and processes steel wire. They have production facilities in three places, Hörle in Sweden, Nitra in Slovakia and Hagen in Germany. Together they produce 80,000 tons of wire per year and have about 150 employees. [1]

A large part of Hörle Wire’s production is currently located in Nitra, Slovakia. Since about 70% of their customers are located in the Nordic region, there are many and long transports that are incredibly costly, which contributes to the loss of the profit. Transports northward, from Slovakia to Sweden, are way more expensive than transports from the Nordic region, due to the high demand on transports northward. [1]

The goods are transported first by truck from Nitra to a terminal of intermodal in Brno, in Czech, then by train to the coast and over to Trelleborg, Sweden. In Sweden, it arrives at another terminal of intermodal, where the goods switch to truck again. These trucks are then driven to different customers in Sweden. The transports are, in principle, always fully loaded, which means about 28 ton per container [1]. In that regard, the transport capacity is as optimized as possible. Delivery security is, according to Lars-Erik Robertsson at NKT, good. They measure on-time delivery, continually referred to as OTD, and have a 95% target, which Hörle Wire successfully achieves (see Appendix 1 – OTD for NKT). According to Robin Alsparr at Södra Cell, they do not make measurements like this, but they do have some delivery problem to their facility in Väröbacka.

Despite the high OTD factor and well-optimized transports, the problem remains. The costs for the transports of the goods to the main customers, NKT and Södra Cell, are so high that the profit margin becomes almost absent.

4.2 Systematic survey of the flow

Figure 8 - Stream mapping

I order to get a better picture of the flow it has been drawn up above in Figure 8. This is how the transport currently is taking place from Nitra, Slovakia, to the two main customers, NKT and Södra Cell, and their facilities. Hörle Wire uses intermodal transports. This means that two or more means of transport are used during the same transportation, but the goods do not need to be reloaded. The products remain in the same container all the time, and it is only the
container itself that is moved between the different means of transport. This is done to provide transport service with lower environmental impact and lower costs. [24, p. 16]

In this case, the goods first go by truck from Nitra to Brno, where the nearest terminal of intermodal is located. From there, the goods are transported by rail to Trelleborg, Sweden, and then again on the truck to customers in Sweden. The trucks are almost always fully loaded, and they do not take any detours on their way to the different facilities. Lars-Erik Robertsson tells that deliveries (2017) take place approximately 200 times to NKT, Karlskrona. Robin Alsparr tells that deliveries (2017) take place 62 times to Mönsterås, 34 times to Mörrum and 28 times to Väröbacka. As mentioned earlier, Hörle Wire succeeds in their delivers to NKT, this according to Lars-Erik Robertsson, NKT, and they usually meet the target of 95% OTD. Deliveries to Södra Cell have not been quite as good and they are not fully satisfied with the delivery safety. Currently, they do not have any system to measure this, which makes it difficult to determine the extent of the problem.

These data are shown in Appendix 2 – absorption costing. It also shows the calculations that have been made on Hörle Wire's absorption costing. It is apparent that their profit margin is incredibly low, and Hörle Wire hardly makes any profit at all of its main customers.
5 Analysis
This section answers the research questions related to what has been achieved. This together with the theories from the theoretical framework.

5.1 Alternative methods for supply of the material to the customers
In order for Hörle Wire to get the most effective flow from Nitra’s production to their customers in Sweden, different approaches have been developed. The various proposals, presented below, are based on the theoretical framework and collected data. To reach a conclusion, the various proposals have been compared with the pros and cons.

5.2 Alternative means of transport
Hörle Wire has a need of transporting its goods more efficiently, both from an economic and environmental point of view. At the same time, they want to continue to maintain high delivery reliability towards their customers, and delivery time should not be adversely affected. Through interviews, both with staff at Hörle Wire and their customers, it has been found that transports are expensive and require long-term planning on orders to ensure OTD. The costs of the transports to the main customers, NKT and Södra Cell, are so high that the profit is almost zero. Therefore, an analysis has been made of the four most common means of transports to see if there is any way to improve these factors.

5.2.1 Train
The goods that Hörle wants to transport to their customers is wire and this material takes a lot of space and is very heavy. Shipping the products by train is, therefore, an option since trains are intended for that type of products. In Nitra, there is no railway and the nearest terminal of intermodal is located in Brno. From Brno to Trelleborg, the goods travel by train, and in Trelleborg, it switches to the truck again. Letting the goods continue by train is an option. Both NKT and Södra Cell’s facilities have railroad all the way ahead so from that perspective it is a possible option. It would also reduce emissions when trains release significantly less than trucks. [25] [26]

However, there is a problem with this. Stefan Glatz, who works at the terminal of intermodal in Trelleborg, says that since the distance between Trelleborg and the different facilities is so short there is no train operator that sets up with the transports. This makes that option not possible. Therefore, another train-based option has been studied. That alternative involves not going through terminals of intermodal. Instead, the goods would be loaded on a truck in Nitra, as they do not have a railway. Then it would be taken to the nearest train station where the goods have to be reloaded to train, and then drive by this mean of transport all the way to customers’ facilities. In this case, it would not be possible to drive direct transport, but it may work anyway.

Thanks to the fact that Mörrum, Karlskrona and Mönsterås are geographically well in relation to each other, the train can drive freight to these three facilities at once. This, on the other hand, is unlikely to be actual because the deliveries are customer-managed-ordered and the need for deliveries varies a lot between the different plants. That Hörle Wire in Nitra could send so much goods at once that makes it worth sending an entire train is unlikely, so this option can, unfortunately, be excluded.

Reviewing and using this mean of transport may still be interesting as long as a facility can receive a full train container at a time, as they do today. In order for it to work, there must be enough of other nearby companies that have railways right up to their facility in Sweden. They must also be interested in this mean of transport. In that case, they could coordinate the transport as they do today. The problem is then that it can be difficult if not so many other companies have railroad all the way to their facilities. In that case they would still have to reload a lot of the goods and it will not be possible to drive by train as there are few containers left.

5.2.2 Truck
Carriage the goods by truck are one of the most used means of transport in today’s society [2, p. 85]. It is convenient since the truck can offer door-to-door transportation. When there is a
small amount of freight to be transported, truck is a simple alternative as it is easier to fully-load a truck than a train. Carriage by truck also goes relatively fast if the distance is not so long. The disadvantages of the truck are that the environmental impact is high. Because of its popularity, demand is also high, which makes it a costly alternative.

However, it is usually necessary to, at least once, use the truck on the route. This mainly due to availability and the ability to reach many facilities. In the way Hörle Wire carries its goods today, it is in principle inevitable to use truck, but it would be good to replace it, at least at some parts of the routes.

As mentioned before, there are a lot of different truck combinations to choose between. Sometimes it is the goods that are carried that limit the choice of truck combination, but sometimes it may only be the lack of knowledge about the different models that are the problem.

When an analysis of different combinations has been made, it appears that there is a combination that may be more profitable for Hörle Wire. The combination is shown in Figure 4, and it is made of cabin, dolly and trailer. The trailer together with the cabin is the combination Hörle Wire uses today (seen in Figure 3) and the trailer is fully-loaded with 28 tons of freight. If the other option was applied, another 12 tons of goods could be loaded at the truck, which would mean that customers would receive about 40 tons of goods at each order. A request to the primary customers NKT and Södra Cell was made, where it was asked if this would be possible. The response from Lars-Erik Robertsson at NKT was that it would be of great advantage to receive more goods and there was no direct disadvantage. Jimmy Syrén at Södra Cell was also cautiously positive, but he said that they might have some problem with the place for all the goods.

5.2.3 Ship
Transporting the goods Hörle Wire produces by ship has its advantage regarding the quantity. Maritime transport is a convenient way of transporting large amounts of products, as it has high cargo capacity, which allows customers to order large quantities. The goods that Hörle Wire supply to their customers are heavy and take a lot of space, which makes the ship is an option since it can handle these characteristics. It is an advantage to pack the goods in containers, so the wire not gets damaged. Another advantage of using the ship is that it is environmentally friendly and does not cause as many emissions as other means of transport.

One disadvantage is that Nitra is not located by the coast, which means that they have to transport the goods with another means of transport to the coast before it goes by boat. To get the goods on the ship, it is needed to be reloaded. The customers’ facilities are located by the coast, which makes it possible to transport the goods directly without having to change to another means of transport. Mörrum, Karlskrona and Mönsterås are close to each other, and it would be possible to transport the goods to these facilities at the same time. However, Väröbacka’s facility is located on the west coast, which will be the other way. Maybe it will work to transport the goods with the same boat as to the other three facilities, but it will take longer time then. This requires good planning as it takes longer to ship by boat and then the goods can go to the four facilities in Sweden at the same time.

The transport distance in this case is not that long, which means that the alternative will not be as cheap as it otherwise is. The costs will increase because you need to use another vehicle that carries from Nitra and then reload on the ship.

5.2.4 Airplane
Using air as a mean of transport does not feel optimal for Hörle Wire since their goods consist of large and ungainly wires that weigh a lot. Aircraft are best suited for lighter goods, as it is harder to load heavy goods that takes up a lot of space on an airplane. The advantage of flights had been the short transport times, but since it is both an expensive and not environmentally friendly alternative, that advantage does not outweigh. The most significant reason why flights are not analyzed further, however, is that Hörle Wire’s goods are not suitable for air traffic because of its weight and size.
5.3 Factory location

Another alternative is to move the entire production from Nitra and produce everything in Hörle. As approximately 70% of the customers are located in the Nordic region, this option would significantly reduce the amount of transport and get closer to the customers. From an environmental point of view, this would be a big profit when emissions would decrease drastically. It would also be an economic gain on the transports, as transports southward to the rest of the customers are significantly cheaper than transports northward. This is due to the demand of transports southward is smaller. The total number of employees available today is likely to be higher than the whole number of employees that would be needed after a union of the two facilities. This since it is usually possible to optimize the work by staff when doing more in one place. However, it has to be taken into account that a production employee in Sweden costs significantly more than one production employee in Nitra. According to Jesper Bundgaard, CEO at Hörle Wire Group AB, and Ľuboš Meluš, Production Manager at Hörle Wire s.r.o., a production employee in Hörle earns an average of 2.2 times more per month than an employee in Nitra.

Making a relocation of the entire production involves large investment costs and closure costs. For example, new plants would be needed to be built up and most of the machines would have to be purchased. Specific machines available in Nitra today can be moved to Hörle, but then costs for moving and installing will be added instead. Today, Nitra has machines and facilities of considerable size and it would not be easy to move. Besides, they handle both lead and zinc in large quantities, which would be difficult to get permission for here in Sweden.

When the benefits are compared to the disadvantages, the analysis is that there is a lot to gain from having production in Hörle, Sweden. Should the choice been made today, it is likely that all production should have been located to Hörle, but that is not the case. The two facilities have already been divided for a long time and this option falls on the excessive costs that a move would mean. The risk of not obtaining permission for certain types of manufacturing in Sweden and that it would take a long time to get the permits possible, is also a major reason why this option does not feel reasonable.

5.4 Inventory

The possibility of having an inventory in Hörle in Sweden has been considered. This inventory would act as a fluctuation stock and, due to its geographical location, would come close to a large number of customers. The advantage of this is that Hörle in Nitra could send larger deliveries but more rarely. They could use means of transports that takes longer time but would instead be more environmentally friendly. This would reduce transport costs, but would probably be negligible, as costs for stock-keeping would increase instead. The benefit of a fluctuation stock is a gain for the company if they are having trouble with the level of delivery safety. It is also a benefit with that kind of inventory if the company is sending many transports that are not fully loaded. None of this is a problem for Hörle Wire, since they succeed in both maintaining a high level of delivery safety and also sends almost always with fully-load transport.
6 Discussion and action proposal

This section presents the study results and action proposals based on the results, as well as a discussion about the different options.

6.1 Alternative methods for supply of the material to the customers

In order to get the most effective flow, different approaches have been identified and considered in this report. The authors have chosen to focus on a certain number of options that are supposed to be the best but remain possible to apply for Hörle Wire. At last, the authors have come up with a few different alternatives that have the advantages and opportunities to make it more effective or to improve the supply of the material for the customers.

6.2 Alternative means of transport

As mentioned in the problem description, Hörle Wire’s transport costs of finished products to their customers are far too expensive. The mission was to find a cheaper alternative to transport the finished goods but not affect the environment more than today’s transport. In order to analyze the current situation, a survey was made of the distance from Nitra to their customers. It was also necessary to collect different types of data to get a clearer picture of the transports and thus find a solution of better and cheaper means of transport. The four different means of transportation examined in the study are train, truck, ship, and airplane. Early in the study, some means of transport could be ruled out as they did not hold the requirements that existed.

The materials to be transported from Nitra to the customers are heavy and impractical. Therefore, aircraft could be excluded quickly as it does not meet the amount of goods that are demanded by the customers. Aircraft are also a huge disadvantage when it comes to the environment as it releases huge amounts of carbon dioxide. Aircraft also require a lot of energy, and it requires 80 times more energy than a train does. For these reasons, transport by air was excluded quite promptly.

Ship could also be excluded early in the study as Nitra is not adjacent to any sea and the goods would need to be transported by another means of transport first. By using another vehicle first would increase the cost compared to just using a boat, which became a major disadvantage. As the ship takes the longest time of these four means of transports it would require a good planning from the customers and nothing in production may go wrong because you cannot make the delivery service uncertain.

Hörle Wire is today using transports of intermodal that includes truck and train. When the goods arrive in Trelleborg in Sweden, they change means of transport from the train to truck. The truck then drives to the respective customer, but since all facilities have a railroad, it would be possible to continue on trains all the way. This would also reduce emissions since trains release significantly less than truck does. But there is a disadvantage with this. Between Trelleborg and the various facilities in Sweden, the distance is too short, which exclude this option.

Another alternative that was analyzed was to change the truck combination. The part of the transport where the goods are transported by truck is always of the same type. This type of truck takes 28 tons, (Figure 3), but there is another truck combination (Figure 4) that can be used to make the transports more profitable. That combination includes a cabin, a dolly and a trailer and it would then take another 12 tons during each transport. This would mean that there would be no need to drive as many transports a year to the customers, which also contributes to a reduced environmental impact. This is seen as an option that Hörle Wire can use.

6.3 Factory location

The largest part of Hörle Wire’s production is located in Nitra, Slovakia. This means that time and place are not an obstacle for Hörle Wire and their customer. From Nitra´s facility, the
Discussion and action proposal

finished products are transported to both customers around the world and to the production in Sweden. As mentioned earlier most of the products will be transported to the Nordic region, which means long and expensive transports. As the demand is higher north than south, transportation costs increase. In order to reduce these transport costs, the option of moving the production was studied, as it did not make any sense why it would be located in Slovakia.

When the option was studied further, several different obstacles appeared. Some parts differ in the various plants. In Nitra, there is a large plant for heat treatment of the products that contain lead. This type of plant is both complicated to move and it is difficult to get permission for this type of facility in Sweden. The facility in Nitra also contains another large plant with galvanizing. These different treatments are necessary for the products and cannot be replaced as it impairs the quality. It is not only different types of facilities that would be necessary to move but also some machines. Both the plant in Nitra and Sweden uses wire drawing, which means similar machines, and it is just about which ones that are the best.

Another important factor in production relocation is the resources, such as staff. In Sweden, there are about 34 employees that are working in the production and in Nitra, they have 43 employees. As mentioned earlier in the analysis, the salary between a production employee in Hörle and Nitra differ a lot. A Swedish worker earns 2.2 times more per month than an employee in Slovakia. The total number of employees today is probably higher than it would be if they move the production, but it will still be more expensive with all staff in Sweden.

Based on the various advantages and disadvantages, relocation of production is a major process that will require a lot of resources and permissions. These resources may be better placed elsewhere in the company and be used to improve the transport solutions that they use today, which means that this option is not actual.

6.4 Inventory

Another option, which has been studied, is to have a stock. In that case, it would be a fluctuation stock that would be located in Hörle, Sweden, where they already have both production and inventory. There are advantages for Hörle Wire with having a fluctuation stock. The risk of delayed delivery to customers will decrease if Hörle Wire uses a fluctuation stock to cover these needs. This would especially benefit Södra Cells who has mentioned that delivery security has varied in quality.

The deliveries to the fluctuation stock would be able to be better planned since it will be more time for that, which makes it possible to choose slower, but cheaper and more environmentally friendly means of transport. This would be of benefit, of course, but the risk that the economic gains disappear with the amount of tied-up capital that comes with stock is of great importance. In the end, this could even cost more for Hörle Wire than the transports do now.

Having a fluctuation stock is of most beneficial if several transports are not fully loaded. That is not the case for Hörle Wire since they are good at this and always driving with fully-load transports. This means that the benefits of having a fluctuation stock has decreased and almost disappeared. We do not believe that Hörle Wire would currently win anything by having a fluctuation stock in Hörle. Rather, they would tie up a lot of capital that could come to better use elsewhere within the company.

6.5 Environment

A central part of all ideas and proposals in this report has been the environmental perspective. Being a company with widespread environmental thinking is more important now than ever and Hörle Wire has pointed out that this is something they attach great importance to. This will be a limitation when it comes to the choice of means of transport, as it often turns out that the means of transport that can deliver fastest or cheapest is not the most environmentally friendly option. In some cases, it even has a very negative impact on the environment.
It is a difficult balance to succeed in getting all the pieces right in the puzzle. To be able to have a high safety of delivery, at a low price and also with as little impact on the environment as possible, is a real challenge.

In order for a company to function and keep its customers, it is not always possible to satisfy all parts. For example, it is not possible to use a mean of transport that takes a significantly longer time but is more environmentally friendly than another, if delivery time is a critical moment for the customer. This would cause the company a loss of customers and, in the long run, they would not manage it financially. Similarly, a company cannot justify using a means of transport that releases large amounts of environmentally hazardous substances just because they cannot plan their deliveries properly. It is important to make all stages of the chain more and more effective and to see where it is possible to reduce costs, time and negative impact on the environment.

Seen only from an environmental point of view, it is boat and train that makes the smallest environmental impact. Unfortunately, there are other disadvantages of these means of transport, which are considered in this report.

6.6 Discussion about case validity and reliability
The studies and work presented in this report are based on previous experience and knowledge obtained through finished courses at Jönköping University. Together with the mentor and the company, additional knowledge has been obtained that was necessary to complete the report. Other literature and articles have in some cases also been of great use. These sources have been of good credibility, which contributed to ensuring the validity of the report. Most of the data presented is data directly from conversations and interviews with people who are directly responsible for it. This has given the authors a insight into the problem and opportunities for discussion about it. Thanks to this, the reliability of the report can be assured.
7 Conclusions
This section summarizes the conclusions and recommendations that have emerged. The section also contains suggestions for continued work or research.

7.1 Conclusions and recommendations
There are different ways of transporting goods and there are also other possibilities for supplying the material to the customers, but Hörle Wire has today a well-functioning concept that has several advantages. They use efficient methods, drive fully loaded transports and maintain high delivery reliability. Furthermore, they have an environmental reduction with intermodal transport, which is a good and important aspect.

The authors still think it may be worth revising the proposals given in this report. The main focus should be on whether it is possible to transport the deliveries entirely by train and in cooperation with other companies. Also, to consider if moving the entire production would be possible and economically justifiable. Another recommendation is to review the choice of the truck combination on the last part of the trip, the part from Trelleborg to the customers. As mentioned above, there is a combination that could be possible for Hörle Wire to use. More goods would then be transported at the same time, but the transport would be more effective and, hopefully, cheaper.

This report will be mostly as a basis for Hörle Wire with a number of tools and ideas to be able to work on and an input from a slightly different approach.

7.2 Continued work or research
This work leaves several opportunities for further research. Something that would have been interesting to review is if there are more companies near Nitra’s facility that would be interested in shipping by train all the way. The presumption would be that they have facilities in Sweden with rails all the way to the plant.

Another aspect to study is to make an accurate calculation of what it would cost to have a fluctuation stock in Hörle, Sweden. To calculate how much capital would be bound in stock but also how much Hörle Wire could reduce its transport costs and reduce its environmental impact if there was no time factor to take into account.

Further research could be done by calculating what a move of the entire production to Sweden would actually cost. To calculate production costs and compare Nitra towards Hörle, calculate what the new transport costs would be and so on.
References


References


Appendices

9 Appendices

Appendix 1 – OTD for NKT
Appendix 2 – absorption costing
9.1 Appendix 1 – OTD for NKT
9.2 Appendix 2 – absorption costing