

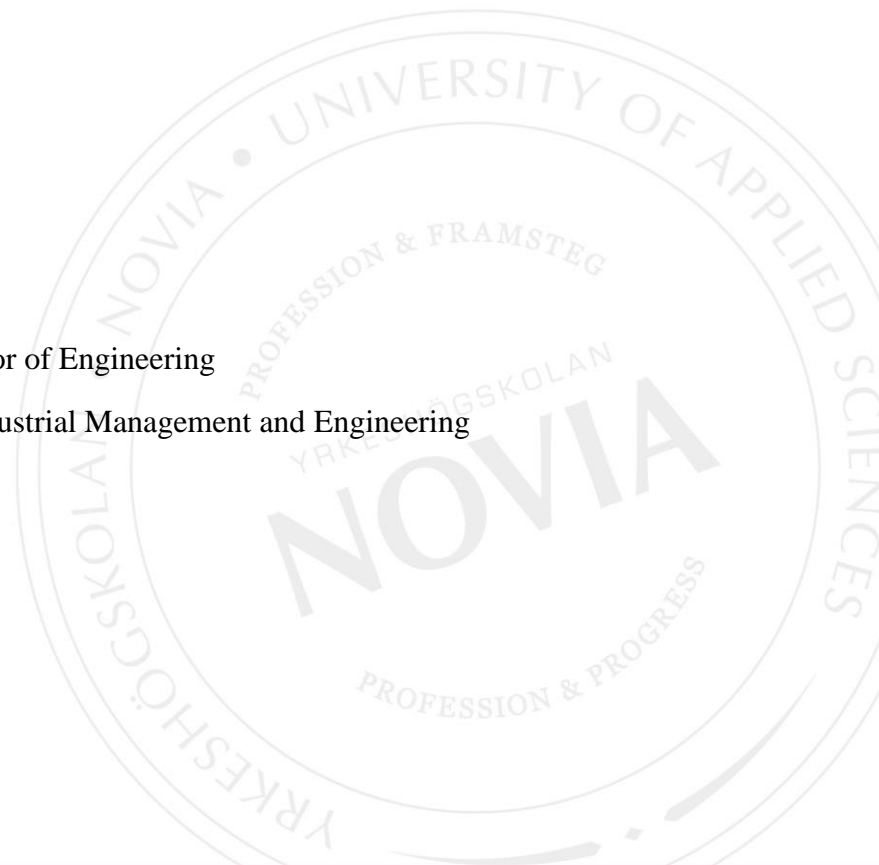
# **Cost-effective Warehousing for Mirka Ltd**

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Degree Thesis for Bachelor of Engineering

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## BACHELOR'S THESIS

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### Abstract

This thesis is made on behalf of the Operations (Forwarding) department in Mirka Ltd. Mirka Ltd is a part of the KWH Group. The department produces different types of abrasive products for finishing processes and polishing machines. Mirka's headquarter and main production unit are located in Jeppo, Finland. The purpose of this thesis is to find a cost-effective way of warehousing Mirka's finished products. This will be achieved by investigating different types of transport scenarios. The main scenario for the thesis is to investigate if it is more cost-effective to transport finished products through Mirka's main storage in Belgium to the distribution centers than to transport them directly from the production center in Finland.

In order to reach cost-effective warehousing for Mirka Ltd calculations on cost for different types of transport to the distribution centers will be performed. An analysis of the calculated transport costs will be performed and the scenarios where changes in transport routes would be profitable will be selected for further calculations. Calculations of costs of warehousing and tied-up capital are performed for this selected scenario and distribution center. This in order to make it possible to calculate the total savings for Mirka Ltd in a reorganization.

Most of the results in the thesis are composed of figures and graphs that present the calculations. By an analysis of the transport costs to the distribution centers, an observation was made, that there was only one distribution center where a reorganization in transport routes would be profitable. The total savings that Mirka Ltd will earn if they go through with the reorganization in transport routes for this distribution center are presented in the results.

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## EXAMENSARBETE

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### Abstrakt

Det här examensarbetet har gjorts enligt uppdrag av logistikavdelningen på Mirka Oy. Mirka Oy, som är en del av KWH-koncernen, tillverkar slipmaterial och slipmaskiner. Största delen av Mirka Oy:s produktion är beläget i Jeppo i Finland. Syftet med examensarbetet är att undersöka ett kostnadseffektivt sätt för Mirka Oy att lagerhålla deras färdiga produkter. Det här kommer att göras genom att se på olika scenarion för transport. Det huvudsakliga scenariot är om det är mer kostnadseffektivt att transportera färdiga produkter genom Mirkas centrallager i Belgien, till de distributionslager som är inkluderade i examensarbetet, jämfört med direkt från produktionen i Finland.

För att komma fram till en kostnadseffektiv lagerhållning för Mirka Oy görs uträkningar av transportkostnader till distributionslagrena för olika scenarion. En analys av transportkostnaderna görs och scenariot som visar sig vara lönsamt när det gäller förändringar i transport rutter till distributionslagrena väljs ut. Vidare uträkningar av lagerhållningskostnader och kapitalbindning görs för det här scenariot och distributionslagret för att senare kunna beräkna den totala besparingen av förändringarna för Mirka Oy.

Största delen av resultatet utgörs av figurer och grafer som presenterar uträkningarna i examensarbetet. Vid en analys av transportkostnaderna till distributionslagrena kunde det konstateras att det endast fanns ett distributionslager var förändringar i transport rutter skulle vara lönsamt. I resultatet presenteras den totala besparingen som Mirka Oy skulle göra om de genomför ändringar i transport rutter för det här distributionslagret.

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Språk: Engelska

Nyckelord: logistik, lagerhållning, kostnadseffektiv

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# Table of Contents

1	Introduction .....	1
1.1	Background .....	1
1.2	Purpose.....	1
1.3	Delimitation .....	3
1.4	Disposition .....	3
2	Mirka Ltd.....	5
2.1	Mirka today.....	5
2.2	Location .....	5
2.3	Products .....	6
2.4	Distributors .....	6
3	Theory.....	7
3.1	Logistical efficiency .....	7
3.2	Logistics costs.....	8
3.2.1	Transport and management costs .....	9
3.2.2	Administration costs .....	9
3.2.3	Inventory costs.....	9
3.2.4	Tied-up capital.....	11
3.3	Inventory and stockholding .....	11
3.3.1	Reasons for stockholding .....	12
3.3.2	The use of distribution centers.....	13
4	Methods .....	15
4.1	Data collection .....	15
4.2	Calculations required for further analysis.....	15
4.3	Transport costs .....	15
4.3.1	Calculations for slow movers .....	15
4.3.2	Total transport costs per distribution center .....	15
4.4	Savings from reorganization for TDC Turkey.....	15
4.4.1	Tied-up capital.....	15
4.4.2	Changes in stock places and costs of warehousing .....	15
4.4.3	The total savings at a reorganization .....	15
5	Results .....	16
5.1	Results of transport costs for slow movers .....	16
5.2	Results of total transport cost per distribution center .....	16
5.3	Results of changes in tied-up capital .....	16
5.4	Results of savings from reorganizations for TDC Turkey.....	16
5.5	Discussion of results .....	16
6	Conclusion.....	17

6.1	Summary .....	17
6.2	Problems .....	17
6.3	Proposal of further research .....	17
6.4	Final words .....	17
7	References .....	18

## Table of Figures

Figure 1.	One of Mirka's polishing machine. (Mirka, 2018b).....	6
Figure 2.	One of Mirka's abrasive products, Abranet. (Mirka, 2018b) .....	6
Figure 3.	Distribution inventory system. (Sadler, 2007, p. 48) .....	13
Figure 4.	Transport route from production in Finland and the mode of transportation (current situation). .....	15
Figure 5.	Transport route using EDC Belgium and the mode of transportation. (Scenario 1 Sea, scenario 2 Air and scenario 3 Road).....	16
Figure 6.	Transport route using LDC Vantaa and the mode of transportation.....	16
Figure 7.	Transport costs for slow movers. ....	25
Figure 8.	Total transport cost, specified in euro, to ADC Asia. ....	27
Figure 9.	Total transport cost, specified in euro, to BDC Brazil. ....	27
Figure 10.	Total transport cost, specified in euro, to SDC Shanghai. ....	28
Figure 11.	Total transport cost, specified in euro, to TDC Turkey. ....	28
Figure 12.	Pipe Month before and after changes.....	29
Figure 13.	Stock on hand, specified in euro, before and after changes. ....	30
Figure 14.	Savings from reorganizations for TDC Turkey, specified in euro.....	31
Figure 15.	Percent of products (product availability), for each distribution center, found in EDC Belgium after changes. ....	32

## **Abbreviations**

MIOS	Mirka Integrated Ordering System
EDC	European Distribution Center
LDC	Local Distribution Center
TDC	Turkey Distribution Center
BDC	Brazil Distribution Center
SDC	Shanghai Distribution Center
ADC	Asia Distribution Center
LCL	Less than Container Load

# **1 Introduction**

This chapter presents an introduction to the thesis. The introduction includes the background of the thesis, its purpose and delimitation. Chapter one also includes the disposition of the thesis.

## **1.1 Background**

This thesis is made on behalf of the Operations (Forwarding) department in Mirka Ltd. The background of this thesis is that Mirka has an interest in finding an optimal flow and become as cost-efficient as possible when it comes to their logistics to their distribution centers. Most of Mirka's production takes place in Finland but less and less quantity of products are today kept in stock in Finland until selling to customers. Mirka has distribution centers all over the world and the products are mostly transported from Finland to these. The customers near the distribution center order the products directly from this warehouse instead of ordering from Finland.

The question for this thesis is where and how it is best to stock the products. In other words, how will Mirka reach a cost-effective warehousing, a large amount of products at one place or smaller amounts in several places. A larger amount of products at one place means that the transport to the distribution centers will become larger but fewer. Smaller amounts of products in several places will give the outcome of smaller transports but they will have to occur more often. As mentioned before, Mirka has an interest to find the optimal flow for this transports that are as cost-efficient as possible. Therefore, the cost of transport and warehousing needs to be investigated to be able to get a cost-effective warehousing.

## **1.2 Purpose**

The purpose of the thesis is to help Mirka Ltd find a cost-effective warehousing, this by investigating different types of scenarios of transport. The main subject for the thesis is to investigate if it is more cost-efficient to store and transport Mirka's products through one of their main warehouses, located in Belgium, instead of directly from production in Finland to distribution centers around the world. To do so analysis of calculated results and cost-estimates will be done, including several warehouses.

Transport costs from both production in Finland and one of Mirka's main warehouses, located in Belgium, to the distribution centers will be calculated by using data for the products stored in the warehouses and transport prices. In order to make the calculations clearer these different transport costs to the different distribution centers will be named as current situation, scenario 1, scenario 2 and scenario 3. Current situation is transport from production in Finland, scenario 1 are transport from Belgium by sea, scenario 2 are transport from Belgium by air and scenario 3 are transport from Belgium by road.

Together with the calculations an evaluation will be done to observe if there are any distribution centers where reorganization in transports would be profitable in order to reach a cost-effective warehousing for Mirka. Reorganization means to use transport scenario 1, 2 or 3 instead of the current situation. If there are distribution centers where reorganization in transports would be profitable further calculations for these ones will be performed. For example, tied-up capital and costs of warehousing will be calculated for the chosen scenarios in order to get the total saving of the reorganization.

This thesis purpose in bullet points:

- Find a cost-effective warehousing for Mirka.
- Four different types of transport scenarios (transport routes).
- Calculations of transport costs for these scenarios (from Finland and Belgium to the distribution center).
- Analysis of the calculated transport costs in order to find the ones where reorganization in transports would be profitable for reaching a cost-effective warehousing for Mirka.
- Calculations of tied-up capital and cost of warehousing for distribution centers where reorganization in the scenario would be profitable.
- Calculations of total savings for Mirka after a reorganization of scenarios.

In the end there will hopefully be a conclusion of which reorganizations that should be performed and what those changes could do in order of saving money for Mirka Ltd. All calculations in this thesis are based on statistics from sales, transport prices and stock prices provided from Mirka Ltd and their suppliers.



### **1.3 Delimitation**

This thesis delimitations will be within a few of Mirka's warehouses around the world and delimitate to the most common MIOS-classes (Mirka Integrated Ordering System). The warehouses that will be included are located in Belgium and Finland and distribution centers located in Asia, Brazil, Shanghai and Turkey,

Reasons for the delimitations of the warehouses are that some of the countries that Mirka has distribution centers in, requires special labels. This means that there is no point to transport them through the stock keeping in Belgium because the products are labelled for that specific country and cannot be sent to any other countries. The reasons for the delimitations within MIOS classes are that some of Mirka's classes are ones that will be sold off or are only produced when a customer orders it. All products from Mirka's subsidiary Cafro S.p.A. in Italy are also delimited. These products are produced at and transported from Cafro S.p.A. in Italy. This thesis only investigates transports of products produced in Finland, not in Italy and thus are the products produced in Italy delimited from this thesis.

### **1.4 Disposition**

The first chapter introduce the thesis to the reader. This chapter includes the background and the purpose of the thesis. Delimitations for the thesis will also be included in chapter one. The end of this chapter contains the disposition of the thesis.

The second chapter presents the company, Mirka Ltd. This chapter presents information of Mirka Ltd, their products and their main distributors.

The theory for the thesis can be read in the third chapter. The theory chapter presents the theory of logistical efficiency, logistical changes and logistical costs. Theory of inventory and stockholding are also included.

The fourth chapter presents the methods of the thesis. This includes explanations about how the thesis has been accomplished in detail. In other words, data collection and calculations in order to reach the results.

Chapter five presents the results of the investigation and calculation in the thesis that are presented in chapter four. Most of the results are presented in figures and graphs. The results are also discussed in this chapter.

The sixth chapter presents a conclusion of the thesis. The chapter includes thoughts about the thesis work, summary and challenges. A proposal of further research and final words are also included in this chapter.

All references used in the thesis can be seen in Chapter 7. The references are presented using the Harvard – Anglia style.

## **2 Mirka Ltd**

This chapter presents the company, Mirka Ltd. The chapter includes Mirka today and their main products and customers.

### **2.1 Mirka today**

Mirka Ltd is a part of the KWH Group, which is a Finnish family-owned company established in 1984. Mirka produces polishing machines and abrasive products for many different markets, for example the Automotive Refinishing Trade, Construction and Marine. Mirka was the first abrasive company in the world who established the three most important quality standards and nowadays Mirka is found all over the world as an international company. In 2019, Mirka Ltd had a turnover at 307 million euros and the company is exporting more than 90 percent of their products to more than 90 different countries. At the moment there are around 1500 people working at Mirka. 870 of these are located in Finland, whereof 500 in Jeppo. The rest of the employees are located all over the world. (Mirka, 2019a)

A few years ago, Mirka also bought a company named Cafro S.p.A. which is located in Fino Mornasco in Italy. Cafro mainly produces superabrasive wheels and tools such as Diamond, Cubic Boron Nitride (CBN), Polycrystalline Diamond (PDC) and Polycrystalline CBN (PCBN). (Mirka, 2019a)

### **2.2 Location**

Mirka's headquarter is located in Finland and their production sites can be found in five different places. Four of these are in Finland and the fifth in Belgium. The main production of abrasive is in Jeppo and Oravais. Power Tools polishing machines are manufactured in Pietarsaari and some production of materials for the abrasive production is located in Karjaa. In Oplabbeek in Belgium belts are produced. The company has 16 subsidiaries located in America, Asia and Europe. (Mirka, 2019a)

## 2.3 Products

As mentioned before Mirka produces different types of abrasive products for finishing processes, accessories for the products can also be bought from Mirka. Mirka's department Power Tools is also developing and manufacturing advanced polishing machines.

Mirka produces ready-to-use products, polishing compounds and jumbo rolls. Jumbo rolls are big rolls of manufactured abrasive that the customer itself produces finished products from. Mirka also sells products with private labels, which means that it is Mirka's products, but they are own branded products (the distributors name on it). Mirka's best-selling products are abrasive products as Gold, Abranet, Abrasiv and Abralon also their polishing machines Deros is a bestseller. (Mirka, 2019a)



**Figure 1. One of Mirka's polishing machine. (Mirka, 2018b)**



**Figure 2. One of Mirka's abrasive products, Abranet. (Mirka, 2018b)**

## 2.4 Distributors

Mirka's customers are distributors. Instead of selling their products directly to the users Mirka often sells them through distributors. These distributors sell them on their behalf to the actual users of the products. The main distributors for Mirka are Imbema Rhiwa B.V., BP Techem SA, Bulldog Abrasives and Autograph.

### **3 Theory**

In this chapter the theory for the thesis can be read. This chapter includes theory about logistical efficiency and changes, logistical costs and warehousing.

#### **3.1 Logistical efficiency**

According to Jonsson & Mattson, (2016) is the logistical purpose to achieve profits by improving the efficiency. The efficiency can be divided into five different variables flexibility, time, costs, customer service and tied-up capital. (Jonsson & Mattson, 2016)

Oskarsson, et al., (2013)'s definitions of logistical purpose differ a bit from Jonsson & Mattson's. Oskarsson, et al. mean that the logistical purpose is that customers will be able to get their products to the right place at the right time without spending a fortune. In other words, logistical costs and delivery service are important variables in the logistic system. (Oskarsson, et al., 2013)

“Logistics is that part of supply chain management that plans, implements and controls the efficient, effective forward and reverse flow and storage of goods, services, and related information between the point of origin and the point of consumption to meet customers' requirements” (Oskarsson, et al., 2013, p. 23)

The logistical efficiency could be described by three terms, service, costs and tied-up capital. These three terms affect the profitability connected to the return on capital employed. These terms are connected to each other, which means that an effort to do savings in one of them might have a negative effect on the rest of them. If an organization decreases their transport costs, less but larger transports are done. This leads to higher costs of warehousing which on the other hand leads to increased tied-up capital and inferior customer service. To maintain logistical efficiency the big picture of these three terms must be as good as possible. For example, small downgrades in one of them can be balanced by the upgrades in another one. (Lumsden, 2012)

” To understand the important and changing role of logistics in any company, it is insufficient to state that logistics has an important strategic impact. Instead, it is necessary to fully comprehend and reveal the opportunities logistics imply. In order to accomplish this, one has to understand what makes logistics important as well as why, when and how. In other words, one has to consider how the company’s logistics activities contribute to creating a competitive advantage. To do this, logistics should be linked to the business strategy - a linkage that is neither evident nor very well explored.” (Sandberg, 2015, p. 15)

Larger logistical changes often take several years to complete. In order to do things right the company both need to know what to do and how to do it. In order to increase profitability through logistical efficiency, changes in four different levels should be done, physically, systemically, informationally and organizational. (Lumsden, 2012; Bowersox & Closs, 1996)

This chapter is relevant to the thesis because logistical efficiency and logistical changes are relevant to the subject of the thesis. In order to reach cost-effective warehousing, knowledge about these two is important.

### **3.2 Logistics costs**

Logistics costs are as the name suggests costs that are connected to the logistics. Logistics costs includes management, movement (transport, inventory costs, costs of tied-up capital and administration costs. Products in transport ties capital, this is the explanation why costs for tied-up capital is included in logistics costs. Capacity costs and cost of underage are indirect logistics costs. (Jonsson & Mattson, 2016)

In order to keep transport and costs of warehousing down, the distribution needs to be done in an efficient and cost-effective way. This is done by using a bill of distribution that includes a picture of the supply network. The purpose of the supply network is that products will reach the customer in an efficient way. The reason why this is relevant for this thesis is that a supply network likely what Mirka wants to accomplish by changing their way of transporting and warehousing products. (Olhager, 2013)

In order to investigate Mirka’s most cost-effective way of warehousing all these logistics costs except administrations costs will be calculated in this thesis. Administration costs will be excluded from this thesis because they would not be affected by the changes (reorganizations). It would be same administration costs wherever the products are stored or transported from.

### **3.2.1 Transport and management costs**

Tonndorf, (1998) means that transport costs are the largest costs in a distribution system. Transport and management costs are those who appears at internal transports between the company's facilities and at external transports from facilities to distributors or customers are called transport and management costs. Activities like packaging, loading, transshipment and unloading are also management costs. Transports between workstations in a facility are excluded. (Björklund, 2018; Jonsson & Mattson, 2016; Tonndorf, 1998; Gattona, 1990)

### **3.2.2 Administration costs**

Administration costs are costs that appears from the administration of the logistics. For example, costs for order processing or salary payments. Purchase and operating costs for material management systems is also included in administration costs. (Björklund, 2018; Mattson, 2012; Oskarsson, et al., 2013)

As mentioned earlier will administration costs not be calculated in this thesis. This because the administration costs will be the same for Mirka wherever products are stored and transported from.

### **3.2.3 Inventory costs**

Inventory costs are divided into costs of warehousing and inventory carrying costs. According to Storhagen (2018) should these two costs be included in logistics costs. By accepting these two costs a decrease could hopefully be obtained in other costs. (Storhagen, 2018)

For instance, by buying, transporting and producing large volumes at once, large advantages could be reached. For example, transport companies offer cheaper transport prices if transport volumes per time is larger. In order to decide a proper economical order quantity, different costs need to be considered against each other. (Oskarsson, et al., 2013; Storhagen, 2018; Grant, et al., 2006)

### **Costs of Warehousing**

Costs of warehousing emerges when something needs to be kept in stock for a time. Warehouse stuff, put away, registration, product picking, inventory and so on are included into costs of warehousing. In order to keep stock on products, area for the warehousing need to exist. This means that also warehouse building costs are included into costs of warehousing. Administrative systems and warehouse equipment such as trucks are also needed. If volume changes are hold into a small interval neither of these two costs (administrative systems and warehouse equipment) depends on the stored volume. (Oskarsson, et al., 2013)

According to Tonndorf (1998) are costs of warehousing the second largest costs in the distribution system after transport costs. Because of this, costs of warehousing will be included into the calculations in this thesis. Costs of warehousing are however the easiest part of the distribution system to manage reorganization and savings in. Large stock on hand were earlier connected to affluence but nowadays it is known that activities like warehousing are a financial strain that weakens a company's competitiveness. Warehousing is therefore well deliberated today. (Tonndorf, 1998)

### **Inventory carrying cost**

All products that are kept in stock contributes to locked resources. Costs for raw material, production etc. has been paid but no earnings for sales of these products has yet emerged at the company's bankroll. If products are found in a company's flow, they will contribute to a company's tied-up capital. By releasing this capital, it could instead be used to something that would give the company profit. For example, other investments with a good profit or marketing for better sales. (Oskarsson, et al., 2013; Björklund, 2018; Grant, et al., 2006)

To conduct stock keeping also causes risks. Stored products might get damaged or stolen and the lack of control of products leads to wastage. Inventory carrying cost depends on the stored volume unlike cost of warehousing. (Oskarsson, et al., 2013; Björklund, 2018)



### **3.2.4 Tied-up capital**

A company's assets can be divided into two different categories, current assets and capital assets. Assets which are not permanent and are intended to be used continually are defined as current assets. Current assets contain stock on hand, material flow and accounts receivable. The opposite of current assets is capital assets, capital assets are intended for permanent use. For example, a factory building is a capital asset. (Mattson, 2012)

Inventories in assets ties up capital. The company's cash flow and capacity to pay are affected by the tied-up capital. Tied-up capital is also related to costs, this because of that the rate of return that the money would have created if they were on a bank account are lost. The tied-up capital affects the profitability both direct and indirect because it affects the delivery service. This is the reason why the tied-up capital needs to be calculated in order to analyze a company's logistics. (Jonsson & Mattson, 2016)

Products stored for intended sales or distribution has a large effect on tied-up capital. These products do not have any other function than representing a guaranteed delivery for customers. Cost of capital is the largest reason for the tied-up capital cost. A product reaches its maximum tied-up capital when it is stock hold as a finished product. (Olhager, 2013)

The volume of the tied-up capital depends on the transport time. Expensive products with small volumes are therefore transported with a mode of transport with low occupancy of time. In this way the time for the tied-up capital is short. (Olhager, 2013)

### **3.3 Inventory and stockholding**

There should always be a reason why products are stock hold. To maintain stock on hand is not in itself an end if we are not, for example, dealing with cheese or wine. The formation of the warehouse affects the management and stock keeping of products. Effective management is often in conflict with the stock on hand because effective stock keeping needs high exploitation meanwhile effective management needs easy access. (Lumsden, 2012)

Generally, the stock on hand should be held as low as possible, meaning that the inventory turnover should be as high as possible. Nevertheless, some restrictions still need to be considered. Avoid production disruption, keep up the delivery service and an effective exploitation of equipment for transports are all restrictions that still need to be considered. To keep a guaranteed number of products ready for delivery is probably the most primary motive for stock keeping. (Storhagen, 2018; Persson & Virum, 2001; Grant, et al., 2006)

Inventory, stockholding and reasons for stockholding is relevant to this thesis because the subject of the thesis includes warehousing. Knowledge about the use of distribution centers is relevant because the thesis investigates four different types of distribution centers.

### **3.3.1 Reasons for stockholding**

Oskarsson, et al., (2013) means that warehouses are found in almost every company even if it seems like stock keeping is something negative. According to Storhagen, (2018) are there several different reasons why stockholding after all is a good thing to maintain. From a logistical aspect there are four main reasons why companies maintain stockholding. These reasons are production and market related, the coordination between assets and market as well as lower production and transport costs. (Storhagen, 2018; Oskarsson, et al., 2013; Segerstedt, 2018)

One of the main reasons for stockholding are production related because the company wants to achieve economies of scales. Larger production units lead to a longer distance to market. This problem needs to be corrected by more effective governance and transports as well as increased stockholding. Market related reasons for stockholding includes a good delivery service towards customers. The value for customer increases if products always are available in stock. (Storhagen, 2018; Sadler, 2007)

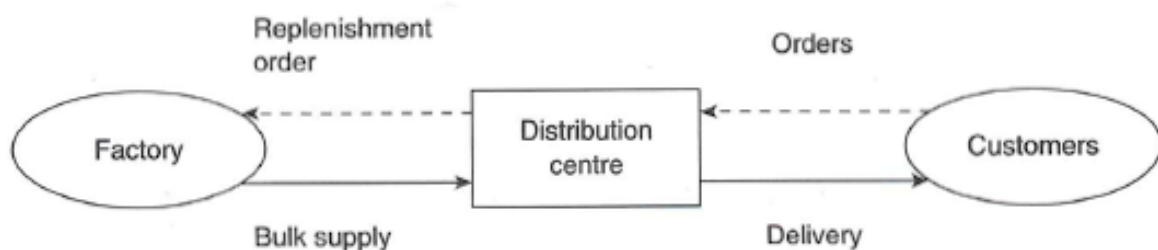
In order to keep up production, the coordination between assets and market is important. The coordination includes both production and sales. A longer production stop would not affect a company's delivery service, thanks to stockholding. Stockholding also balance cyclical fluctuations. (Storhagen, 2018; Oskarsson, et al., 2013; Sadler, 2007; Segerstedt, 2018)

Continuous, long and economical production series and varying customer deliveries on behalf of the finished goods inventory helps in order to lower production and transport costs. Transport costs are affected by stockholding because larger transports can be done less often if products are kept in stock. This lowers the transport costs for each single product. (Storhagen, 2018; Sadler, 2007)

According to Storhagen, (2018) it is not necessary to store every single product in every single warehouse, especially not if terminals are used. For example, products that does not have a frequently selling amount could be limited to only one warehouse. This would decrease the tied-up capital and costs of warehousing. (Storhagen, 2018)

### 3.3.2 The use of distribution centers

The shortest way between two destinations does not always has to be the most profitable way of transport. This is the basic idea for the use of terminals, to keep a low centralization rate. A terminal or distribution center is a place for stockholding and transshipment of components or finished products. The purpose for terminals or distribution centers are to be close to the market due to their localizations, secure customer service and lower total transport costs. A lower total transport costs can be achieved by a combination of different flows and modes of transport. Terminals or distribution centers function as goods reception and a place to coordinate transports and products. Final assembly or packaging of products might also be done here. General questions about terminals and distribution centers are the amount, location and management. (Storhagen, 2018; Björklund, 2018; Teodorovic & Janic, 2017)



**Figure 3. Distribution inventory system. (Sadler, 2007, p. 48)**

In Figure 3 can a typical distribution inventory system be seen. All customers order products from a distribution center and the distribution center on the other hand orders replenishment from the factory. The factory offers bulk supplies to the distribution center that delivers the products to the customers. The distribution center is a middle hand for orders and deliveries.

Terminal's building costs, investments in warehouses, management equipment, management and administration costs and the tied-up capital are incremental costs associated with terminals. By comparing these costs with the costs of not using a terminal a conclusion of what is more profitable can be done. In order to get an honest answer cost and earnings from delivery service needs to be included. Otherwise the better stock availability and less lead time, through smaller distance between finished products and customer with terminal use, will not be considered. Because of this (better stock availability and less lead time) terminal usage might lead to competitive advantages. (Storhagen, 2018)

High centralization rate on the other hand also comes with advantages. For example, the material flow is larger in warehouses with high centralization rate. This increases the possibility to invest in better techniques such as automatic warehouses, which contributes to lower transport and management costs. (Jonsson & Mattson, 2016)

## **4 Methods**

This chapter has been removed from the public version of the thesis because of the confidential content.

### **4.1 Data collection**

### **4.2 Calculations required for further analysis**

### **4.3 Transport costs**

#### **4.3.1 Calculations for slow movers**

#### **4.3.2 Total transport costs per distribution center**

### **4.4 Savings from reorganization for TDC Turkey.**

#### **4.4.1 Tied-up capital**

#### **4.4.2 Changes in stock places and costs of warehousing**

#### **4.4.3 The total savings at a reorganization**

## **5 Results**

This chapter has been removed from the public version of the thesis because of the confidential content.

### **5.1 Results of transport costs for slow movers**

### **5.2 Results of total transport cost per distribution center**

### **5.3 Results of changes in tied-up capital**

### **5.4 Results of savings from reorganizations for TDC Turkey**

### **5.5 Discussion of results**

## **6 Conclusion**

This chapter has been removed from the public version of the thesis because of the confidential content.

### **6.1 Summary**

### **6.2 Problems**

### **6.3 Proposal of further research**

### **6.4 Final words**

## 7 References

- Björklund, M., 2018. *Hållbara logistiksystem*. Lund: Studentlitteratur.
- Bowersox, D. J. & Closs, D. J., 1996. *Logistical Management - The Integrated Supply Chain Process*. Singapore: McGraw-Hill Book Co..
- Forex Bank, 2019. *Forex Bank*. [Online]  
Available at: <https://www.forex.fi/>  
[Haettu 15 11 2019].
- Gattona, J., 1990. *The Gower Handbook of Logistics & Distribution Management*. s.l.:Gower Publishing Company.
- Grant, D. B., Lambert, D. M., Stock, J. R. & Ellram, L. M., 2006. *Fundamentals of Logistics Management*. Berkshire: McGraw-Hill Education.
- Jonsson, P. & Mattson, S.-A., 2016. *Logistik: Läran om effektiva materialflöden*. Lund: Studentlitteratur.
- Lumsden, K., 2012. *Logistikens grunder*. Lund: Studentlitteratur.
- Mattson, S.-A., 2012. *Logistik i försörjningskedjor*. Lund: Studentlitteratur.
- Mirka, 2018b. *Product Catalog - An easy way to dust-free sanding*. u.o: Mirka.
- Mirka, 2019a. *Mirka*. [Online]  
Available at: <https://www.mirka.com/en-US/us/>  
[Accessed 25 10 2019].
- Olhager, J., 2013. *Produktionsekonomi: Principer och metoder för utformning, styrning och utveckling av industriell produktion*. Lund: Studentlitteratur.
- Oskarsson, B., Aronsson, H. & Ekdahl, B., 2013. *Modern logistik - för ökad lönsamhet*. Stockholm: Liber.
- Persson, G. & Virum, H., 2001. *Logistik för konkurrenskraft*. Malmö: Liber.
- Sadler, I., 2007. *Logistics and Supply Chain Integration*. Thousand Oaks (Calif.): Sage Publications.
- Sandberg, E., 2015. *Logistik och strategi - för lönsamhet och tillväxt*. Lund: Studentlitteratur.
- Segerstedt, A., 2018. *Logistik med fokus på Material- och Produktionsstyrning*. Stockholm: Liber AB.
- Storhagen, N. G., 2018. *Logistik - grunder och möjligheter*. Stockholm: Liber.
- Teodorovic, D. & Janic, M., 2017. *Transportation Engineering - Theory, Practice, and Modeling*. s.l.:Butterworth-Heinemann.
- Tonndorf, H. G., 1998. *Logistik för handel och industri - strategier för lägre kostnader och bättre kundservice*. Stockholm: Industrilitteratur.



Vestlin, J., 2019. *How to understand and use Mirka's ERP-system* [Interview] (14 10 2019).