Integrated Masters Programme

Master Thesis No 2003: 4

Alternatives for Consumer Goods Distribution

Direct Delivery and Cross Docking

in SCA Hygiene Products

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Abstract

Discussions about alternatives for traditional distribution in the company are taken up more often nowadays as the constantly increasing demands and requirements on the markets put pressure on logistics of the suppliers and manufacturers.

The Master Thesis, conducted for SCA Hygiene Products, is devoted to alternatives for goods distribution in Consumer Division in Nordic countries.

The concepts in logistics, namely Direct Delivery Distribution System and Cross Docking, are discussed through the research and tested on logistics set up of the case company.

Acknowledgements

The authors would like to express sincere gratitude to the supervisors in SCA Hygiene Products, Consumer Division, Mats Lagerholm and the supervisor in School of Economics and Commercial Law at Göteborg University, Lars Brigelius for kind assistance and guidance throughout the research process.

Many thanks to the management in Consumer Logistics at SCA who provided us with valuable sources of knowledge and support.

Fruitful meetings and interviews with representatives of the companies like Schenker, DHL/Danzas, Celexor allowed us to get inspiring ideas for the work and we are very grateful for useful information we received.

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I. Introduction

Nowadays companies live in a fast moving and rapidly changing business environment. Customer requirements become more rigorous not only on the product's quality but on the quality of the services and value adding activities as well. The notion saying that products have to be delivered at the right time, to the right place, in the right quantity and damage free is relevant today as never before, obviously, if you want to stay competitive in the market.

Moreover, severe competition in the market forces companies' managers and executives to search for innovative solutions to satisfy customer demands and at the same time reduce costs and make profits. Production processes are complex, marketing necessitates introducing new products and at the same time reducing inventories in warehouses, distribution network nodes are widespread and dependent on each other, customers' requirements put pressure on the whole system.

Therefore, in order to control or at least manage all the logistics processes efficiently, many different systems and models were approached. Some of them will be more developed in this thesis project. The main focus of this work is one particular company, i.e. SCA Hygiene Products, which is taken as a case company.

We found that the subject, provided to us by SCA HP, is very interesting and is relevant and topical to many companies in different industries. That is why, we believe it is going to be beneficial for both company and us, students, to examine this problem more deeply in order to get knowledge for relevant topics and perhaps help to make a decision for the management.

1.1 Thesis outline

Introductory part of the thesis project contains primary description of the case company, problem definition, purpose and objectives, as well as scope and limitation of our research.

In research methodology we defined research design, strategy and methods we have chosen. Here we followed existing concepts and approaches for management research in order to structure our work and to achieve our objectives in the most suitable way.

Theoretical framework is the background of the whole research project. We reviewed existing theories relevant to our subject and used them to conduct the analytical part.

The present distribution system is described and presented in the empirical research part, followed by the analysis of the alternatives and solutions.

The last chapters of the paper provide recommendations to the company, concerning the new alternatives to the distribution system and conclusions of the whole research project.

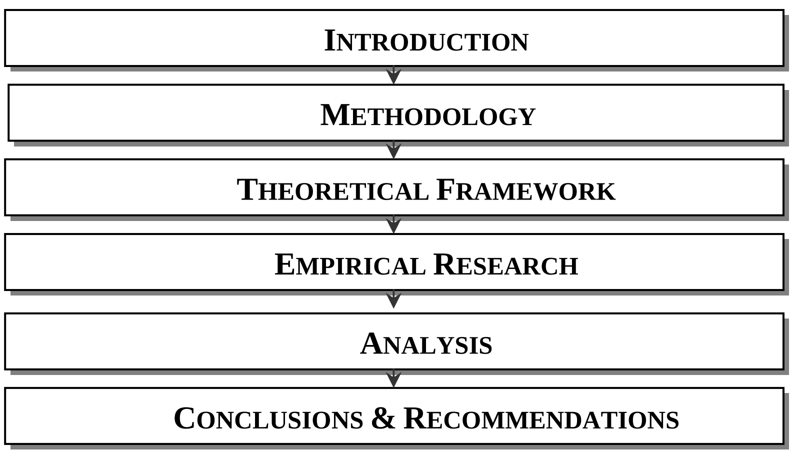

Figure 1. Thesis outline

1.2 Background of the case company

Svenska Cellulosa Aktiebolaget or SCA is one of the world market leaders dealing with absorbent hygiene products, packaging solutions and publication papers. There are three business areas within SCA company: SCA Hygiene Products (further referred as SCA HP), SCA Packaging and SCA Forest Products. This thesis project is conducted for SCA HP.

The SCA Hygiene Products comprises Consumer Goods, Away From Home and Incontinence Products Divisions. Figure 2 illustrates organizational structure of the company.

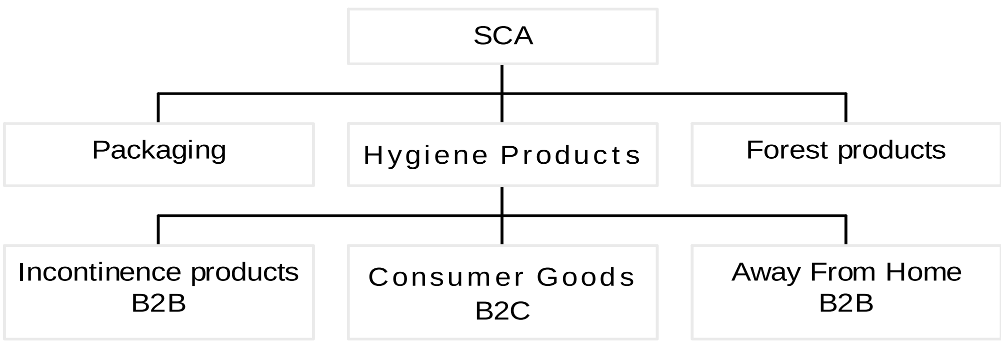

Figure 2. Organizational structure of SCA

Incontinence products include everything from adult diapers used in nursing homes to extremely thin protective pads marketed to consumers through retail outlets and pharmacies (SCA annual report 2002).

Away From Home deals with the operations, which are primarily based on sales of tissue products to industrial sectors, offices, hotels, restaurants and catering, healthcare and other institutions. The products are distributed via wholesalers and service companies, or directly to individual customers (SCA annual report 2002).

Consumer Goods deal with tissue (napkins, toilet paper, towels, etc.) and fluff (feminine protection, baby diapers, etc.) products. They are distributed through retailers under the brand names of the company or under retailers' brands. The Consumer Goods Division will be the main focus of this thesis project.

SCA HP has many production locations all over Europe. Two mills are located in the southwest of Sweden, Falkenberg and Lilla Edet. Every production site has its own warehousing facilities, which are utilized not only for storage, but used as distribution centres as well.

1.3 Problem definition and problem analysis

As it was mentioned before, SCA HP works in a fast moving consumer goods business. The environment of the business is getting more and more competitive, this arises the situation when product cycle time becomes shorter, i.e. the time from the production to the final consumption. The lead times of goods distribution are decreasing as well and the companies have to keep large inventories in order to respond quickly to market changes. Therefore safety stock buffers are formed in order to cope with demand and avoid stock-outs. But in SCA HP safety stocks and level of inventory in the warehouses exceeds "safe" level and even increases constantly. This affects not only warehouse balance sheet but also influences the whole distribution network, e.g. increased transportation costs, shortage of facilities, imbalances in goods flows, increased total logistics costs and so forth. This is a problem that SCA Hygiene Products has faced.

In order to solve a problem we have formulated research questions to be answered in our thesis project. In our research we analysed different alternatives of increasing logistics efficiency of the company. Logistic efficiency we defined in terms of customer service, distribution costs and tied up capital, while with the alternatives we refer to direct deliveries and cross docking stockless platform. And logistic efficiency is relevant to the overall logistics activities of the company and was taken as a main problem in the paper, which is to be solved by improving the physical distribution in the company. Thus we defined two types of the problem such as a main problem and a research problem, as it is shown in Figure 3.

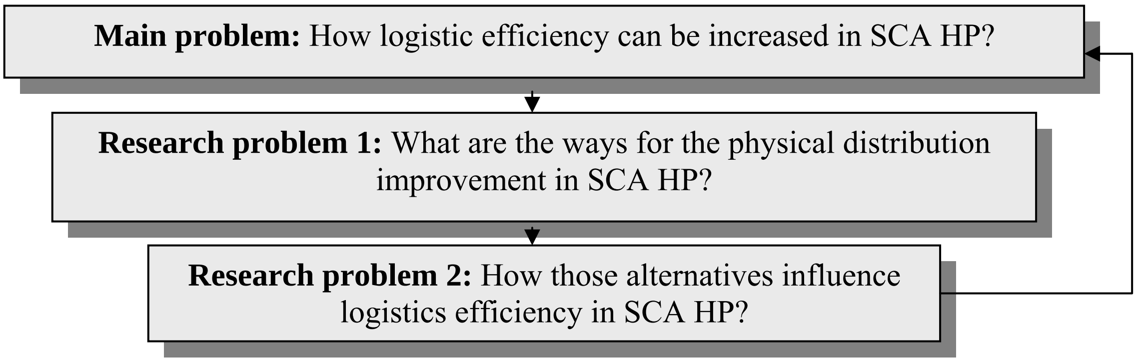

Figure 3. Problem definition

A broader approach is taken in the main problem and when going deeply into the problem we can define the research problem, which is relevant to our case in particular. While the answer to the research problems will contribute to the logistical efficiency of the company.

1.4 The Purpose

The aim of the thesis project is to investigate possibilities to reach a more efficient distribution of Consumer Goods in SCA HP. In order to achieve the purpose of the thesis project, we decided to present and analyse the different alternatives for physical distribution network improvement, which are:

- Direct delivery distribution
- Physical distribution via a cross-docking/stockless platform.

Afterwards, feasibility research will be conducted by calculating as well as comparison of existing distribution systems with proposed physical distribution alternatives.

The different models will be presented further as a result of this paper. Direct delivery distribution and physical distribution via a cross-docking/stockless platform is supposed to decrease the inventory level at international distribution centres (further IDC) in Sweden and eliminate additional activities in the network, such as storage, handling, etc.

1.5 Scope and Limitations

The scope of the thesis project is only physical distribution network in the company, not taking into consideration other logistics activities such as material management or suppliers' side. Production processes and end customers are beyond the scope of the paper.

There are two production sites with their distribution centres in Sweden, located in Falkenberg and Lilla Edet. The mill in Falkenberg produces fluff goods and the mill in Lilla Edet manufactures tissue products. The present distribution network is designed so that consumer goods, produced in European factories of SCA HP, go via DCs in Sweden for further distribution to Swedish and Norwegian retailers. Therefore, when talking about physical distribution, the distribution of the goods produced in Europe is taken into consideration and elimination of those flows from IDCs in Sweden supposed to make the improvements in physical distribution and contribute to logistic efficiency in the company.

The description of the product flow starts at different distribution centres in Europe and ends in distribution centres of the retailers in Sweden. In case of direct delivery distribution Norwegian customers are included as well. Figure below illustrates the scope of the thesis project.

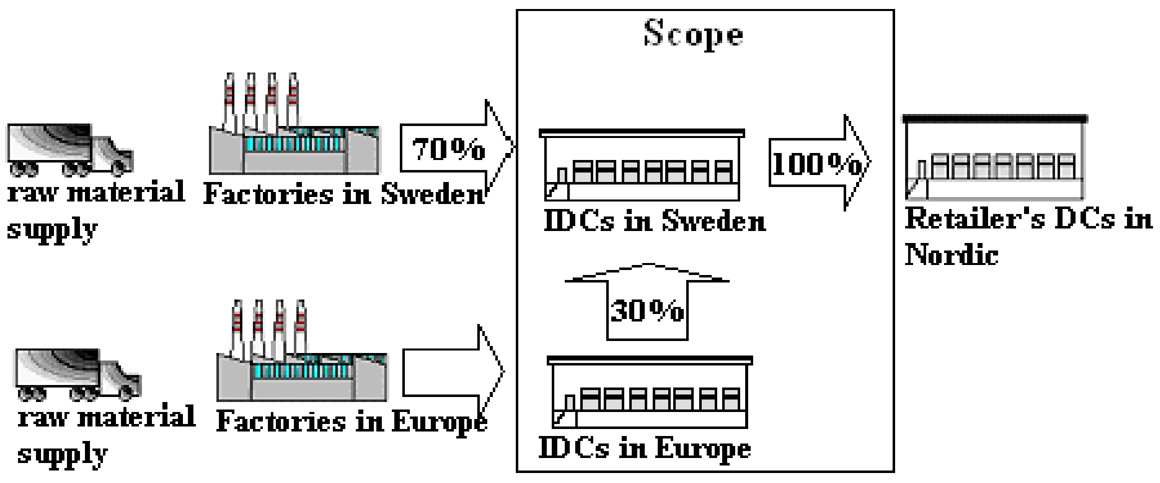

Figure 5. Scope of the thesis project

As shown in the picture above, The Nordic market is served by 30 percent of the Consumer Goods produced in European mills of SCA and the mills in Sweden supply other 70 percent. We should mention here that 80 percent of the volume produced in Swedish mills is distributed in Nordic countries directly to the customers without previous storage. Therefore, the volumes produced in Europe were chosen for the alternative distribution models described further on in the research.

Furthermore, mainly big customers or retailers will be analysed, i.e. 20% of customers generating 80% of volume. This is done for the reason that in Sweden and Norway only three customers out of over fifty generate largest amount of volume.

In our research we chose only two alternatives, i.e. direct delivery distribution and distribution via cross docking/stockless platform, for the physical distribution improvement. But according to the literature, there are more ways to improve goods distribution in a company, for instance, vendor management inventory, profile replenishment and others.

II. Research Methodology

This chapter aims at explaining different methods of conducting research as well as tools and techniques typically used in research.

2.1 Research design and strategy

The research design is the overall plan for relating the conceptual (theoretical) research problem to relevant and practicable empirical research (Ghauri/Gronhaug, 2002). In other words, research design may be seen as the “bridge” between activities at the conceptual and empirical levels.

The aim of a research design is effective creation of the wanted information. In order to conduct good research, we have to choose a strategy, which we will be following during the entire research. In the research literature, a distinction between two strategies is made:

- Theory before research (deduction); and
- Research before theory (induction).

In the first case, present knowledge allows for structuring the research problem so that researcher knows what to look for, what factors are relevant and what hypotheses should be tested empirically. Researchers must be able to select, adjust and apply related concepts (theories) to the chosen problem.

In the second case, the prime task is to identify relevant factors and construct explanations (theories). It starts with observations/gathering data and concludes with “theory construction” (Ghauri/Gronhaug, 2002).

In our thesis project we have chosen theory before research strategy. This strategy suits our thesis purpose best, which is how physical distribution network can be improved. Another reason why we chose theory before research strategy is that the main focus of the project is to answer the question “how”. Due to the lack of practical experience we decided to test theory in real life instead of constructing a theory of existing knowledge. Since we have chosen to follow deductive approach in our thesis project, exploratory research type has been determined. The purpose of exploratory research is to formulate hypotheses regarding potential problems present in the decision situation.

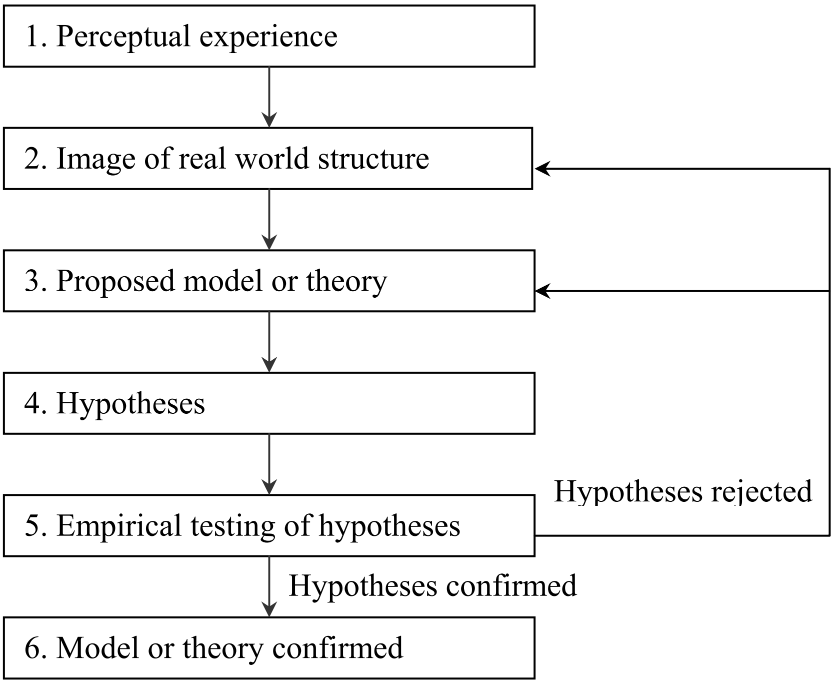

Figure 6. Outline of exploratory research (Thietart et al., 2001)

In the first stage, we identified general logistics problems for SCA Hygiene Products. After that, we made precise formulation of the problem and identified variables operating in a situation. A proposed theory or model was direct deliveries and stockless platform set up to solve a problem, so we formulated a hypotheses, saying that our proposed model – direct deliveries and stockless platform set up will increase physical distribution efficiency. In other words, changed distribution structure will improve performance. This statement can be expressed mathematically:

$$F'(Y) = X11 + X12 + X13 + \ldots Xn$$

Where,

F'(Y) – independent variable (structure – direct deliveries, stockless platform)

X11 +….Xn – dependent variables (performance – different costs and customer service level).

The next stage of the research was to test the relationship between variables empirically and confirm or reject hypotheses.

2.2 Research methods

Research methods are rules and procedures, and can be seen as tools or ways of proceeding to solve problems. Generally research theory describes two data collection methods: qualitative and quantitative.

Qualitative research is a mixture of the rational, explorative and intuitive, where the skills and experience of the researcher play an important role in the analysis of data (Ghauri/Gronhaug, 2002). It focuses on understanding from respondent's/informant's point of view, explorative orientation and takes subjective "insider view" and closeness to data. Qualitative data is sometimes referred as "soft data", which can be attitudes, values, beliefs, etc. Interviews, observations are considered appropriate for qualitative studies.

Quantitative research is based on findings arrived by statistical methods or other procedures of quantification (Ghauri/Gronhaug, 2002). It focuses on facts and/or results for social events, hypothesis testing and takes objective "outsider view" distant from data. Quantitative data is referred as "hard data", is what can be described with some specifity, which usually means that is quantified. Questionnaires are considered suitable for quantitative research methodology.

These two methods are not mutually exclusive. The difference between quantitative and qualitative methods is not just a question of quantification, but also reflection of different perspectives on knowledge and research objectives. In some studies, data may be quantified, but the analysis itself is qualitative.

While conducting thesis project we were using both qualitative and quantitative data collection methods. Qualitative method was used while analysing the possibilities of stockless platform set up. This type of distribution is relatively new for a company, so that's why they do not obtain enough historical knowledge and experience in this field. However, direct delivery distribution system has already been established for particular flows, so some information was available from before. Thus, we applied more quantitative data collection method in this part of the research.

2.3 Data collection

In this part different tools for obtaining information and its processing will be described.

2.3.1 Secondary data

Already existing data is referred to as secondary data, such as literature, documents and other publications (Wiedersheim-Paul & Eriksson, 1999).

Before starting actual writing of the thesis project, firstly, we determined to search for external secondary data, such as academic literature, internet sources, databases, articles, case studies with the purpose of getting suggestions for how to solve the problem, methods how to handle data and broader comprehension of how things are working.

When it came to the empirical research, mainly internal secondary data was used. Internal secondary data is information that has already been produced by organization or private individuals (Thietart et al., 2001).

The main source of information was Business Warehouse database, which is part of internal SCA database. We used flow approach method to follow the physical flow of the products. We started with international distribution centres in Sweden and other European countries and finished with customers' distribution centres to see how the flows circulate, what volumes are transported in the whole supply chain. The reason why we decided to map the current situation is to reveal where processing delays may occur and the effects of such delays on subsequent processing (Emshoff, Sisson, 1970).

2.3.2 Primary data

When secondary data is not available and can not help answer our research questions, we, ourselves, must collect the relevant data. Primary data can be obtained by experiment, observation or communication (Thietart et al., 2001). In our thesis project the latter two were used.

Observation is a method of data collection by which the researcher directly observes processes or behaviour in an organization over a specific period of time (Thietart et al., 2001). Two forms of observation can be distinguished: participant and non-participant observation. We were using non-participant observation with the aim to investigate and collect preliminary data in the field visits. Verbal data obtained during the interviews was supplemented by observed data.

Communication involves questioning respondents either verbally or in writing (Thietart et al., 2001). In our thesis project we were using structured and unstructured face-to-face interviews and semi-structured questionnaires, which were sent by email to respondents.

At the first stage of research, the problem was of an unstructured nature; so we started with semi-structured interviews with logistics managers of the company and logistics managers of production site in Lilla Edet, in order to better understand the problems and the processes in the supply chain. Furthermore, we continued with the observation of the activities in mills' distribution centres. We believed that closer look would help us to direct our research and solve the problem more effectively.

At the second stage of research the data was collected from the questionnaires, sent to distribution manager at distribution centre in Falkenberg in order to obtain missing information.

As it was mentioned before, stockless platform set up is relatively new to a company, so the meetings with consultants and transport companies were

arranged. Through the discussion we got deeper understanding of different setups in physical distribution network. Acquired information helped us to make better analysis. Also, informal meetings with supervisors in SCA HP and university were held during the working process.

2.4 Reliability and Validity

Reliability and validity are essential to measurements and research procedure designs. These two concepts are distinctly related. While high reliability does not warrant validity, a study cannot achieve validity without reliability.

2.4.1 Reliability

Reliability is concerned with the accuracy of the actual measuring instrument or procedure. It asks the question: "Did we measure accurately?" Reliability describes scores, not people, subjects or participants (http://writing.colostate. du/ references/research/relval).

At every stage of data collection, the information was revised following the discussion with our supervisors in the company and in the university. We tried to get outsider's view, which is biased towards our research, e.g. customer service, financial department in SCA HP, consultants and even discussions with other students.

As we take into consideration only Consumer goods, and not flows with Incontinence products and Away from Home, which in its turn have the same routes and go through IDCs in Falkenberg and Lilla Edet, there is always a risk that the figures obtained from the company's databases deviate from the reality. One of the reasons is that in some cases different types of the products arrive from the continent in the same transport mode and in the database we found some information gap which was difficult to obtain otherwise.

2.4.2 Validity

Validity refers to the degree to which a study accurately reflects or assesses the specific concept that the researcher is attempting to measure. Validity is concerned with the study's success at measuring what the researchers set out to measure (http://writing.colostate.edu/references/research/relval).

Researchers should be concerned with both external and internal validity. External validity, defined as "the extent that a study is generalizable to other people, groups, investigations, etc." (Newman & Newman, 1994, p. 119, see at: http://emedia.netlibrary.com/reader/reader.asp?product_id=22497).

Internal validity refers to (1) the rigor with which the study was conducted (e.g., the study's design, the care taken to conduct measurements, and decisions concerning what was and wasn't measured) and (2) the extent to which the designers of a study have taken into account alternative explanations for any causal relationships they explore (Huitt, 1998, see at: http://writing.colostate.edu/references/research/relval/pop2b.cfm).

There are many research studies done in physical distribution areas, so we do not feel that we contributed theory in general by our research. But our purpose was to improve distribution network, with the particular focus on SCA HP. This study can help other companies to solve similar problems or at least get some ideas from it.

Information and data was gathered from different sources in a company. For instance, the data about volumes was collected from local managers in Lilla Edet and Falkenberg and from central database in headquarters. Because there was a big amount of data, some contradicting information has appeared. We tried to clarify all “mismatches” with responsible persons within a company. Thus the combination of secondary and primary data was applied to check the credibility of the findings. We observed and measured only data, which was relevant to the research objectives.

The fact of existing constraints during the research process, such as time, money and skills of researchers should be taken into consideration.

III. Theoretical Framework

As was mentioned in Research Methodology part, we apply an existing theory in real life instead of constructing a theory of existing knowledge. Theories presented in this part of paper reflect the research problem and give understanding of logistics efficiency, physical distribution and strategies for improvement.

3.1 Logistical efficiency

The main problem of our thesis projects is how logistical efficiency can be increased in SCA HP. In order to start presenting possible variants how to achieve it, some explanation, what does efficiency mean, is presented.

According to K. Lumsden, "logistical efficiency can be described in terms of service, costs and tied up capital", directly influencing profitability of the company. There is a strong connection among these efficiency components, because one cannot be overseen without the other. For example, reduction of transportation costs is obtained through decreasing the number of shipments. This reduces the costs but at the same time company has to keep larger volumes in stock while awaiting large enough shipment quantities. This involves increased tied up capital. Furthermore the customer service is deteriorated by the lower shipment frequency. This dilemma is sometimes called the "logistical goal mix", i.e. the intention is to try make the three components concur in a way that will optimise the total result (Lumsden, 2002).

Following this logic it is important to find the optimum balance between different components of logistics efficiency, so that the profitability of the company is maximised.

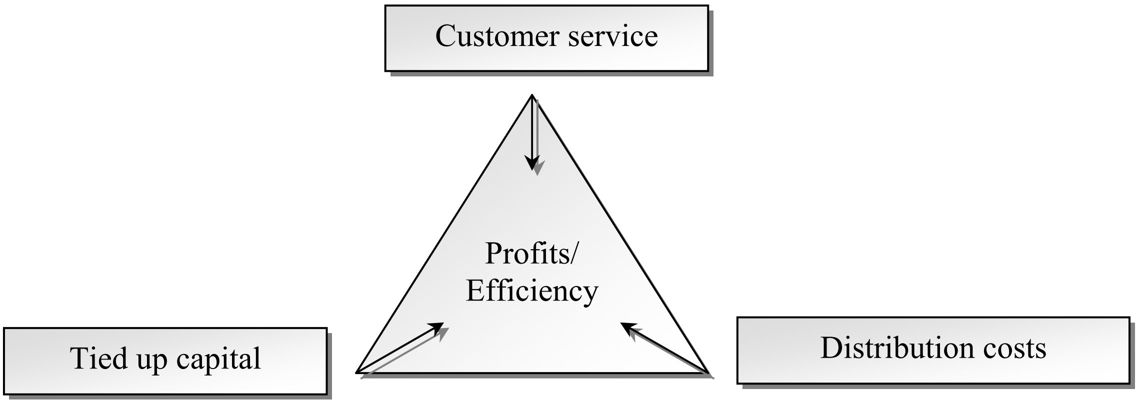

Figure 7. Logistics Triangle (adapted from M.Christopher, 1992 and K.Lumsden, 2002)

The problem is that a measure taken to improve one part of the business can entail negative effects for other parts. A measure intended to reduce the costs might at the same time deteriorate the service and thereby the revenues in a long run perspective (Lumsden, 2002).

We used the logistics triangle model (Figure 7) as a background to our research.

In the following chapters, based on different literature reviews, we will describe every element of logistics triangle separately, in order to get a clear picture of what constituents are involved.

3.1.1 Customer service

What is important to the customer from the supplier is exact pursuing of responsibilities defined in the bilateral or multilateral agreement. In other words, logistics customer service is the quality with which the flow of goods and services are managed.

So, what is the key element in customer service or what is prioritised by the customers? Obviously, it is impossible to answer explicitly, because it varies from company to company. To some companies it is the time it takes for a delivery of a customer order, to others, it is stock availability, or it is reliable distribution that the goods are never damaged during transportation.

According to D.J. Bowersox et al., logistical customer performance is measured in terms of:

- availability
- operational performance
- service reliability

Availability is the capacity to have inventory when desired by a customer. The traditional paradigm has been the higher inventory availability, the greater is the required inventory amount and costs. Nowadays information technology provides new ways to achieve high inventory availability for customers without high capital investments.

Operational performance deals with the time required to deliver a customer's order. Operational performance involves delivery speed and consistency, flexibility and malfunction recovery.

Naturally, most customers want fast delivery. However, fast delivery does not have any value if inconsistent from one order to the next. A customer gains little benefit when a supplier promises to deliver next day but more than often delivers late. To achieve smooth operations, firms usually focus on service consistency first and then seek to improve delivery speed.

Flexibility involves a firm's ability to accommodate special situations and unusual or unexpected customer requests, e.g. ability to ship once a month a LTL, when regularly all shipments are FTLs.

Malfunction is concerned with the probability of performance failures, such as damaged goods, incorrect assortment or inaccurate documentation. When such malfunctions occur, a firm's logistical competency can be measured in terms of recovery time (Bowersox et al., 2002).

Service reliability involves quality attributes of logistics. It is defined as trustworthiness of the delivery, i.e. being able to deliver exactly when promised. In many cases a high reliability is more vital than short lead-times. For instance, it is more important to deliver exactly at the right hour day three than promise a delivery sometime during day one or two (Lumsden, 2002).

For any given level of customer service, the goal within should be minimize the total costs of providing that level of service. However, as service level increases, the total of associated logistics costs will increase at an increasing rate and diminishing returns will result in terms of the impact of service on revenues (Stock/Lambert, 2001). Figure below shows the impact of customer service level on revenues, logistics costs and profits.

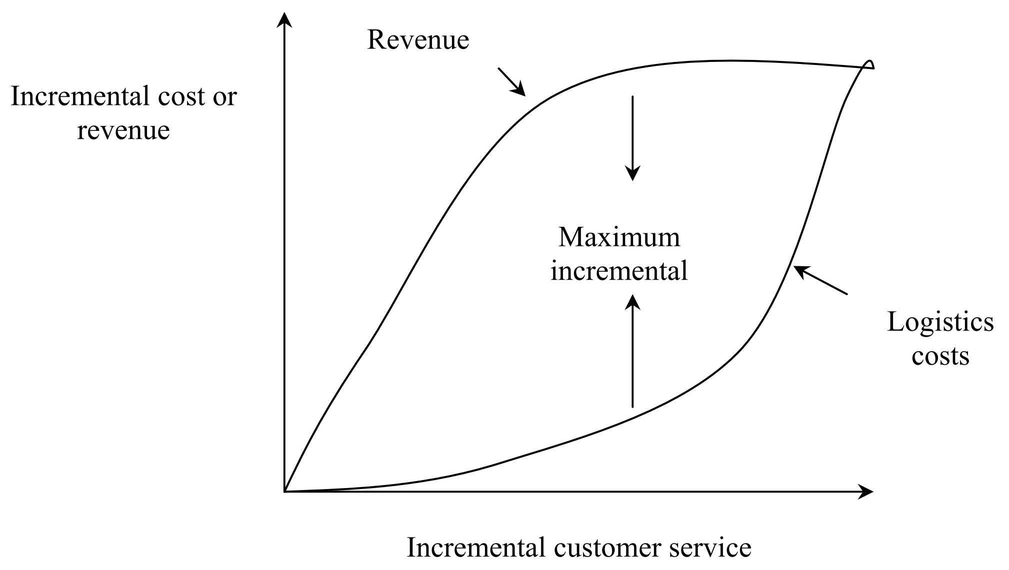

Figure 8. The impact of incremental customer service level (Stock/Lambert, 2001)

The service differentiation can be based on customer product contribution. The ABC analysis used to improve customer service efficiency is similar to the ABC analysis used for inventory planning. The logic behind this approach is that some customers and products are more profitable than others. Thus a company should maintain higher levels of customer service for the most profitable customer profit combinations (Lectures of A.Jensen, 2001).

Not all products should be provided the same level of customer service. This is a fundamental principle for logistics planning. Different customer service requirements, different product characteristics, and different sales levels among the multiple items that typical firm distributes suggest that multiple distribution strategies should be provided within the product line. Managers have made use of this principle when they broadly classify their products into limited number of groups such as high, medium, and low sales volume and then apply a different stocking level to each. To a lesser extent, the principle is also applied to the inventory location. When a firm stocks all products at all warehouse locations, it may do so to simplify administration, but this strategy denies the inherent differences between products and their costs, and it leads to higher than necessary distribution costs (R.Ballou, 1999, p.42).

3.1.2 Distribution costs and total logistics costs concept

Due to the fact that the scope of the paper from the beginning was only physical distribution, it is relevant to give a deeper description of distribution costs, which were defined as order processing and information costs, warehousing costs and transportation costs. As the distribution costs are only a part of the total logistics costs, the total logistics costs concepts are to be mentioned in this chapter as well.

An analysis of the total distribution cost shows that several individual cost elements influence each other in a complex way. To minimise one cost element can for example lead to the fact that the total cost increase (sub-optimisation), e.g. a decreased delivery frequency can lead to a loss of customers. For instance, high resource utilisation with low transport costs quite easily can be created. If the customer is not taken into consideration, the resource utilisation can be extremely high and the transport costs extremely low. To increase the resource utilisation without considering the customer leads however to deteriorated customer service and consequently to deteriorated sales. It is consequently important to find the optimum balance between high delivery service and low flow cost, so that the profitability for the company is maximized (K.Lumsden, 2002, p.394).

We would like to pay attention to two concepts, which are widely used in recent logistics theories before going into distribution costs: 1) cost trade-off and 2) total cost concepts. As "the central to the scope and design of the logistics system is trade off- analysis, which, in turn, leads to the total cost concept" (R.Ballou et al., 2002, p.39).

According to Ballou (1978) the concept of the cost trade-off is fundamental to physical distribution management. The cost trade-off is the recognition that the cost patterns of the various activities of the company sometimes display characteristics that put them in conflict with one another. For instance, decision to increase number of warehouses in a system may reduce transport costs; shorter distances for small volume shipments, but on the other hand, inventory costs will increase because more stock is needed to maintain the same level of stock availability.

The total cost concept goes hand in hand with cost trade-off. The total cost concept is the recognition that conflicting cost patterns should be examined collectively and balanced at optimum. (R.Ballou et al., 2002, p.39)

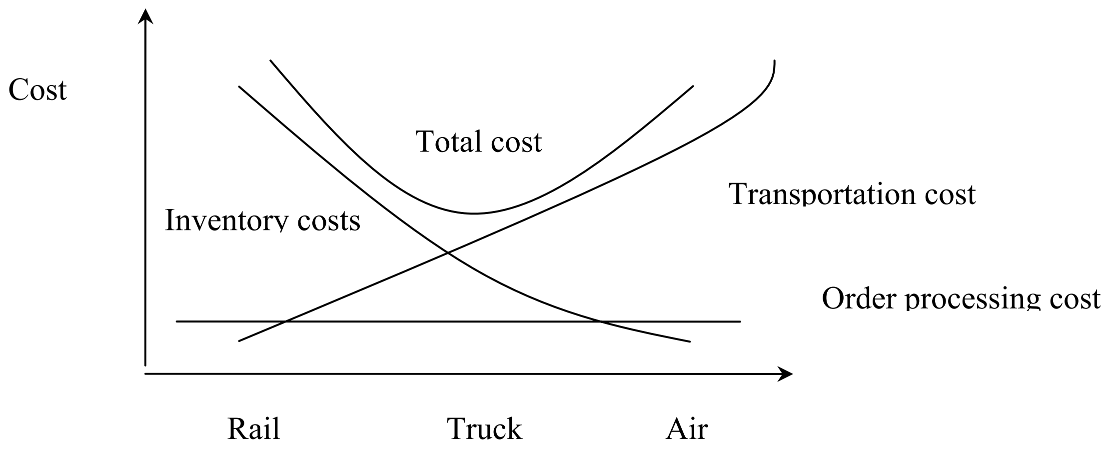

Figure 9. Cost trade-off in selecting a mode of transportation (Ballou,1978)

The logic behind the figure above is that the least cost point on total cost curve is not at the point where transportation cost is minimum or where inventory or orders processing costs are minimum.

It was recognized that managing transportation, inventories and order processing activities could collectively lead to substantial cost reduction when compared with managing them separately. The total cost idea is instrumental in deciding which of a company's activities are physical distribution activities. Thus, the essence of the total cost concept is to consider all the relevant cost factors in a particular decision, add them to form the total cost, and search for the minimum total cost alternative (Ballou, 1978, p.).

As it was discussed earlier the major goal of organization is to reduce total costs of logistics activities rather than focusing on each activity in isolation. Attempts to reduce cost of individual activities may lead to increased total costs. Figure below shows five cost categories of logistics, which are inseparable with customer service.

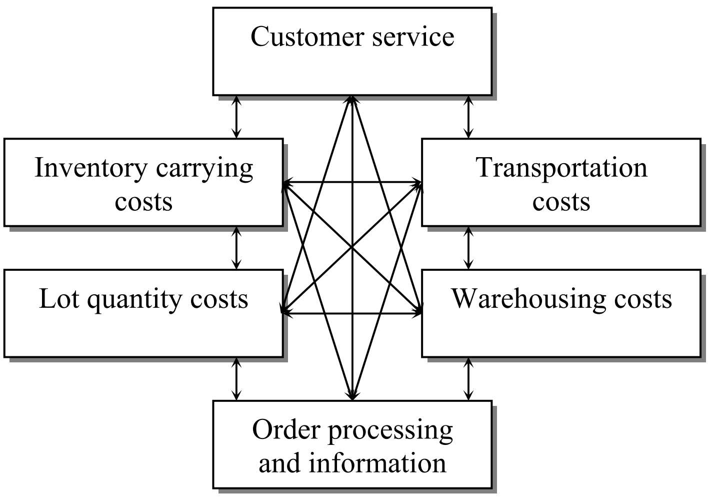

Figure 10. Logistics costs (Stock/Lambert, 2001)

Following the figure above the distribution costs are described more in detail.

Order processing and information cost: Order processing and information costs are related to activities such as processing customer orders, distribution communications and demand forecasting. Order processing costs include order transmittal, order entry, order verification, order handling and related internal and external costs such as notifying carriers and customers of shipping information and product availability.

Warehousing costs: Generally, warehousing costs are created by warehousing and storage activities, and by the plant and warehouse site selection process. Companies are often at various levels of sophistication in terms of warehouse accounting and control. Four levels of sophistication have been identified (Ernst and Whinney, 1985):

- Warehouse costs are allocated in total, using a single allocation base
- Warehouse costs are aggregated by major warehouse functions (e.g., handling, storage, administration, etc.) and are allocated using separate allocation bases for each function.
- Warehouse costs are aggregated by major activity within each function (e.g., receiving, put-away, order pick, etc.) and are allocated using a separate allocation base for each activity.
- Costs are categorized in matrix form reflecting each major activity, natural expense and cost behaviour type. Separate allocations are developed for each cost category using allocation bases that reflect the key differences in warehousing characteristics among cost objectives.

Transportation costs: According to Stock/Lambert, there are three general types of transportation costs that need to be considered:

- Fully allocated costs, which include all costs involved in the movement or transport of a shipment.
- Semi variable costs, which include all costs involved in the movement or transport of a shipment, except overhead-related expenses.

- Out of pocket costs, which include only the costs requiring an actual expenditure of money to perform the movement or transport of a shipment.

Transportation cost can be categorized by customer, by product line, by type of channel, by carrier, etc. The costs vary considerably with volume, weight of shipment, distances, transport mode and etc. But as was mentioned in the beginning of this chapter, effective management and real cost savings can be accomplished only by viewing logistics as an integrated system and minimizing their total cost given the firm's customer service objectives.

Inventory carrying costs and lot quantity costs we consider as tied up capital costs, so the description of them is included in the following chapter.

3.1.3 Tied up capital and asset management

Fifty percent or more of a company's current assets are often tied up in inventories. Logistics is concerned with all inventories from raw material to finished goods. The company's policies on inventory levels and stock locations influence the size of total inventory.

Assets level consists of three major components, which are cash and receivables, inventories and fixed assets.

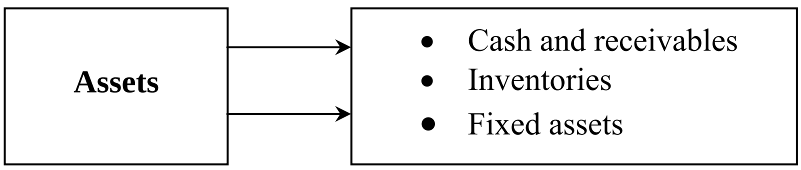

Figure 11. Asset deployment

Cash and receivables: This asset component is crucial to the liquidity of the business. Logistics variables have direct impact on cash and receivables. For instance, the shorter the order cycle time, from when the customer places the order to when the goods are delivered, the sooner the invoice can be issued. Likewise the order completion rate can affect the cash flow if the invoice is not issued until after the goods are despatched (Christopher, 1992).

Inventories: Fifty percent or more of a company's current assets are often tied up in inventories. Logistics is concerned with all inventories from raw material to finished goods. The company's policies on inventory levels and stock locations influence the size of total inventory.

Fixed assets: Usually in a logistics system of any business fixed assets are heavily used. The plant, depots and warehouses represent a substantial part of total capacity employed, because they are usually owned by the company than rented or leased. Materials handling equipment, vehicles and other equipment involved in the storage and transport can also add considerably to the total sum of fixed assets. Companies are doing business for a long time and get use to the same "procedure" and in a period of time some assets are not being deployed effectively anymore.

Complexity in transport operations is a major factor affecting decisions on where to keep inventories. In general, too many companies have been operating with too many depots and too much inventory as a result of rigidities in the transport market. Figure below illustrates the point that many companies could not only reduce inventory costs by rationalizing their depot network, but could also achieve savings in total logistics costs (Cooper et al., 1994).

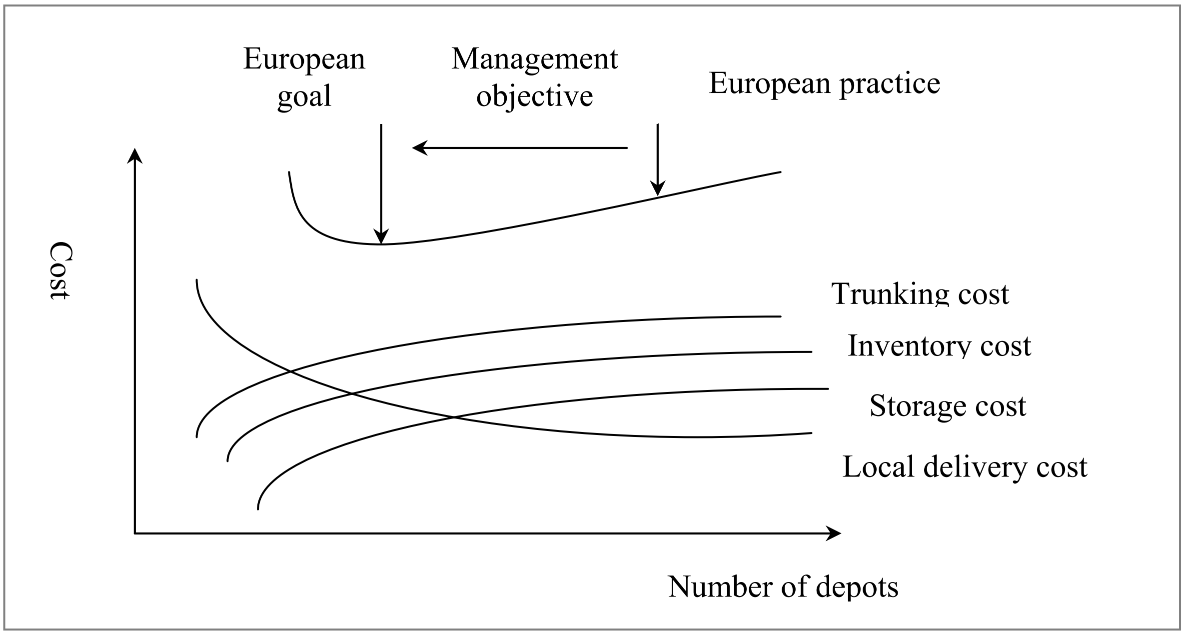

Figure 12. Total logistics costs reduction by reducing the depot network

Source: Adapted from Cooper et al., 1994

Asset utilization reflects effectiveness in managing the firm's fixed assets and working capital. Fixed capital assets include manufacturing and distribution facilities, transportation and materials handling equipment, and information technology hardware. Working capital represents cash, the inventory investment, and differential in investments related to accounts receivable versus accounts payable. In particular, by more efficiently managing the assets related to logistics operations, the firm should be able to liberate assets from the existing base. This freed capital is known as cash spin, which can be used for reinvestment in other aspects of the organisation. Overall asset utilization is particularly important to shareholders and to how the firm is viewed by financial markets (Bowersox et al., 2002. p.556)

Tied up capital involves inventory carrying costs, which include inventory control, packaging and salvage, and scrap disposal. Next to the cost of lost sales, inventory carrying costs are the most difficult to determine. For decision-making purposes, the only relevant inventory costs to consider are those that vary with the amount of inventory stored. According to Stock/Lambert four major categories of inventory carrying costs are:

- Capital cost, or opportunity cost, which is the return that the company could make on the money that it has tied up in inventory.
- Inventory service cost, which includes insurance and taxes on inventory
- Storage space cost, which includes those warehousing space-related costs that change with the level of inventory.
- Inventory risk cost, including obsolescence, pilferage, movement within the inventory system and damage.

Another group of costs related to tied up capital is lot quantity costs. They refer to production and procurement activities. These costs vary with changes in production lot size or order size or frequency. They include:

- Production set up costs
- Materials handling, scheduling and expediting costs
- Procurement costs

3.1.4 Relevance of the theory

The logistics efficiency theory presented above is contiguous to our subject of the problem. We limited ourselves to analysing only one company's case, so "logistics triangle" model, adapted from M.Christopher and K.Lumsden, is used as a backbone for our research. We feel that customer service, costs and tied up capital are main indicators for the company to test the efficiency.

More detailed explanation of the efficiency components is provided in order to understand the composition of the variables, which will be used in empirical and analysis part.

3.2 Physical distribution system

In our thesis project we have limited ourselves to analysing only physical distribution systems. We considered explaining what is physical distribution, defining the components and place in logistics process.

The physical distribution is a term applied to the outgoing product flow from the firm to customers through some defined network of transportation links and storage or distribution nodes (Stern et al., 1996).

Lumsden (2002) describes the physical distribution as the network for distribution with links points in network.

The conventional networks for goods distribution to a large extent built up by direct transports between producing and consuming units. This type of transport networks often results in a large number of transport relations, which in turn leads to a poor utilisation of the transport units and low frequency in the transport if the volumes are small. One of the solution in order to obtain increased profitability is to operate the transports in established networks with connecting routes and use consolidation of as much goods as possible. (K.Lumsden, 2002, p.347).

According to Bowersox et al. (1986), from the viewpoint of logistical operations physical distribution is the critical interface between customers and manufacturing.

The key to understanding physical distribution is to keep in mind that the customer initiates activity by order placement. The logistical response capability of the selling enterprise represents one of the most significant competitive factors in overall marketing strategy (Bowersox, 1986).

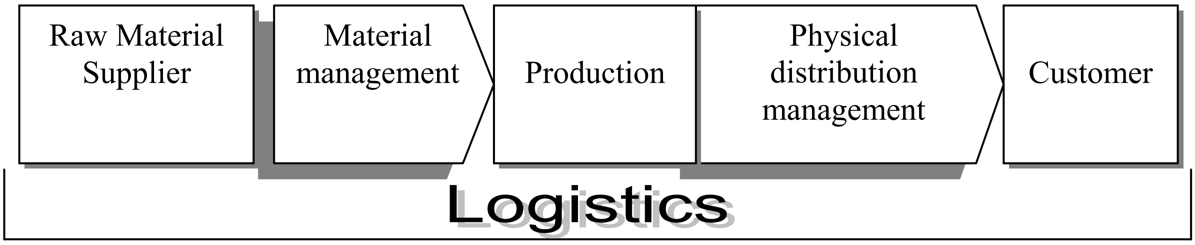

Figure 13. Physical distribution as a part of Logistics

According to the theory, the physical distribution system is made up of several elements. Different authors gave different aspects to logistics activities. For instance, Ballou (1978) divides them into primary and supporting activities. This means that some activities are more important than others or at least are of primary importance in achieving cost and service objectives. According to Ballou (1978) logistics activities are:

Primary activities: Transportation, Inventory maintenance, Order processing

Supporting activities: Warehousing, Materials handling, Protective packaging, Acquisition, Product scheduling, Information maintenance

Conflicts might arise in a company when drawing a strict line between these activities, that’s why subsequent authors such as Stock/Lambert (2001) do not draw any line at all and consider all logistics activities equally important.

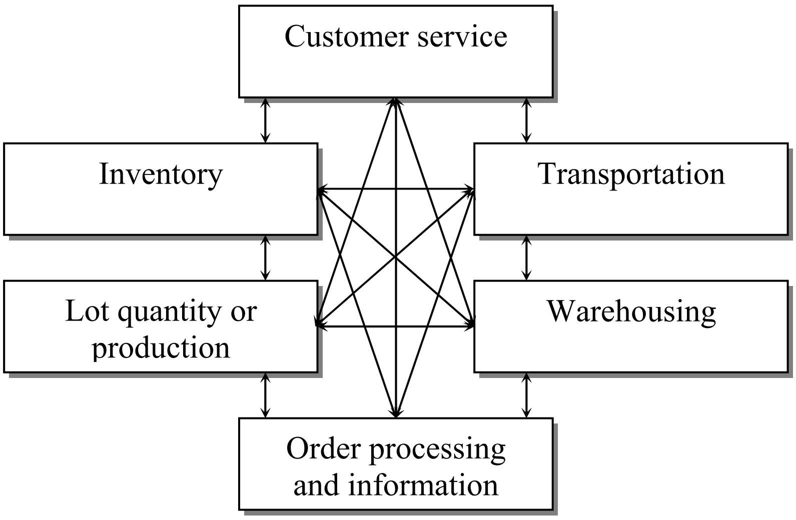

Figure 14. Logistics activities (Stock/Lambert, 2001)

Customer service can be considered the measure of how well the logistics system is performing in creating time and place utilities, such as delivering the correct product to the right place, time, cost, quantity, and quality.

Warehousing provides time utility by enabling firms to compensate for dissimilar production and consumption rates.

Transportation is movement or delivery from plant to warehouse, warehouse to warehouse and warehouse to the customer.

Inventory management is the purchasing and control of products based on market forecast. Inventories are typically a buffer between production and the customer. Inventory management consists of: forecasting requirements, procuring orders, and managing what's on hand.

Order processing facilitates product flow. It consists of three main tasks: order entry, order handling, and order delivery. Order processing can be done manually, but it is usually accomplished through electronic means of data interchange.

Lot quantity or production activities related with production set up; materials handling, scheduling and expediting; procurement etc.

3.3 Direct Delivery Distribution structure

According to Bowersox et al. (2002), the potential for logistics services to favourably impact customers is directly related to operating system design. Many different facets of logistical performance requirements make operational design a complex task, as an operating structure must offer a balance of performance, cost and flexibility.

One of the widely utilized structures in physical distribution networks is defined as *Direct Distribution* structure, which implies that products are shipped directly to customer's destination from one or a limited number of centrally located inventories. Direct distribution typically uses premium transport combined with information technology to rapidly process customer orders and achieve delivery performance. This combination of capabilities, designed into the order delivery cycle, reduces time delays and geographical separation from customers. Examples of direct shipments are plant-to-customer truckload shipments, direct store delivery, and various forms of direct to consumer fulfilment required to support catalogue and e-commerce shopping. Direct logistical structures are also commonly used for inbound components and materials to manufacturing plants because the average shipment size is typically large.

Usually logisticians choose direct delivery alternative to reduce anticipatory inventories and intermediate product handling. On the other hand, the deployment of direct logistics is limited by high transportation cost and potential loss of control (Bowersox et al., 2002).

Lumsden K. (2002) defines Direct Delivery Distribution (further referred to as DDD) system also as very resource-demanding for transport. Suppose there are a number of manufacturing units and a number of customers. Each manufacturing unit produces different products, and therefore each customer in extreme cases needs goods from all producing units. Consequently, all units must be connected with all customers, which create a practical distribution problem with demand for a large number of transport relations.

At the same time the fact is pointed out that in a system built on direct relation, there are no item restrictions, i.e. all existing transport in the system is totally disconnected from each other. This leads to a large freedom to adapt the transport need to the transport buyer's time demand (Lumsden, 2002, p348).

According to Lumsden (2002), in an extensive distribution system where there are many sources, each node must meet the demand of every customer, i.e. there must be a large number of relations (m x c). It is easy to realize that a number of problems arise, for example low frequencies in each link, low recourse utilization, large demand of vehicles etc.

Fleischman et al. (1998) describe DDD structures where order's size limit exceeds, say 1 or 2 tonnes, and they are shipped directly from the origin (or central warehouse) to the destination. But if the order size is small, several orders can be consolidated in one truck in order obtain a full truck load (FTL). And according to Fleischman et al. (1998), this tour can contain 2, 3 or at most 4 deliveries. The composition of the tours is mainly restricted by the vehicle capacity. In a carrier distribution network, transport to transhipments points are often combined with direct delivery tours.

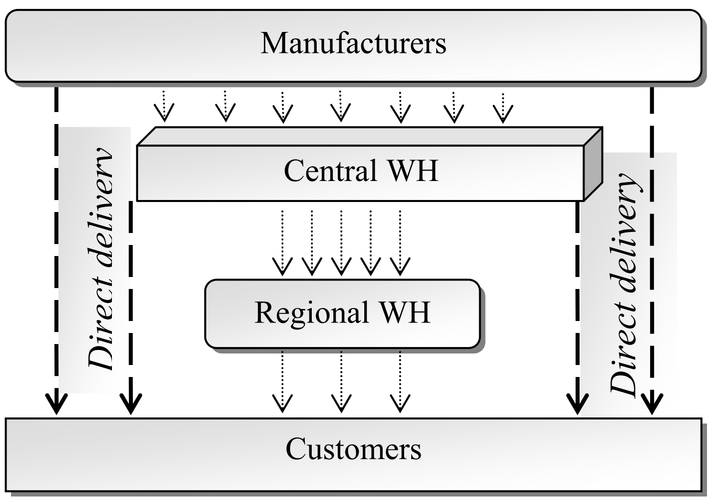

Figure 18. Distribution network, which contains direct delivery.

Source: Adapted from Fleischman et al. (1998), p321

In analysis of DDD structures made by Abrahamsson and Brege (1995), it is stressed that by using modern information systems and by implementing a more effective distribution strategy, the goods can be delivered directly to the customer from a central warehouse or directly from a production site. The main focus here is on centralisation of the distribution structure.

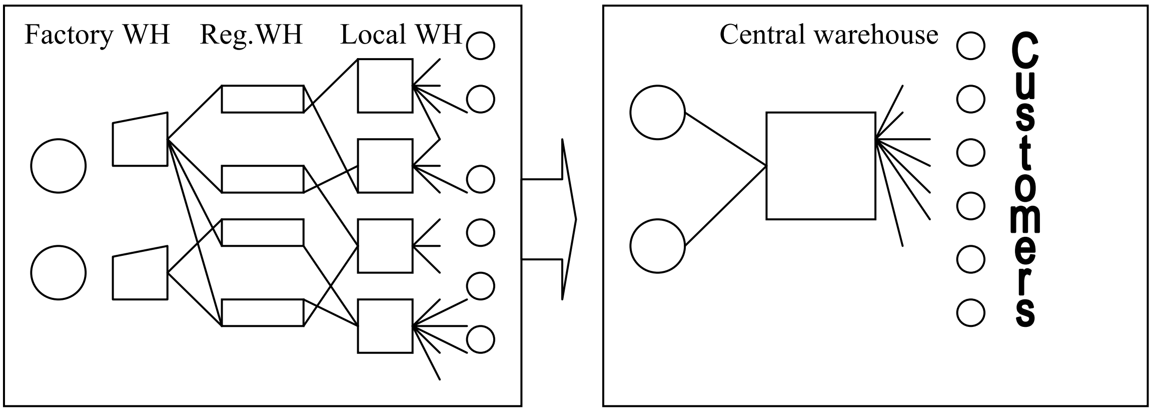

Figure 19. The difference between traditional distribution structure and DDD structure. Source: Adapted from Abrahamsson and Brege (1995)

Previous studies of the companies who implemented DDD showed that the companies changed focus from production and sales orientation to effective material flow orientation (Abrahamsson and Brege, 1995)

Thus, the border between sales activities and logistics activities gets eliminated and allows the creation of a unique service for customers in terms of high delivery service and decreased total logistics costs.

Based on his studies Abrahamsson (1995) defines the impacts of DDD structure on the manufacturer and retailer in terms of logistics costs and value added services:

- Lower fixed distribution costs: decreased costs for staff, warehousing space and administration
- Lower variable distribution costs: transport costs can be kept at a defined constant level

- Integration feedback: centralised control of the material flow leads to the recourse decrease in sales department
- Quicker integration of the new products and distribution system is not so sensitive to variation in volumes
- Decreased and lead-time for all the markets and the entire assortment.
- Improved delivery service
- Differentiation: opportunity to provide different services to different customer groups
- Better information provided to customers: reliable information from the "first hand" about inventory level or product availability.

From organisational point of view the distribution structure with direct deliveries is more flexible than traditional structure. But in order to implement the structure successfully some requirements should be met. There is the number of requirements for a successful implementation of DDD structure; one of them is large capital investments in order to cover high operating costs.

Efficient information systems as well as reliable transport service provider with flexible transport fleet are crucial points for effective DDD structure. The information technologies in the company should help to minimise order administration lead-time and help to integrate information flows in the whole organisation.

As for the first task, the total lead-time consists of administrative part and operative (or physical) part, and administrative part includes order receiving, registering, drop size planning, issue of the transport documents. Before, it could take about 90% of the whole lead time in the company. The goal here should be to decrease administrative time to zero. Nowadays, the information systems can reduce it to less than 20 hours.

Organisational integration should unite sales departments and departments dealing with physical distribution to achieve full control over inventory level, information about deliveries and the whole process in common.

Thus, it is more beneficial to have the production site closer to the market, because it allows a quicker reaction to the changes on the market.

As was mentioned above, the DDD structure is recourse demanding and logistics managers must be creative in applying innovative ideas and technologies as well as proven approaches that will make sense. Since transportation costs usually increase in this case, the benefits can be easily offset. Also the DDD structure requires a concentration of a volume in a given transportation lane in order to be cost effective.

When implementing DDD the cases of small shipments and Less Than Truck Loads (LTL) will arise and here it's very important to take into consideration freight consolidation techniques in order to achieve transportation efficiency.

Bowersox et al. (2002) mention such a concept as time-based distribution strategy, where managerial attention must be directed to the development of ingenious ways to realize benefits of transportation consolidation.

According to Abrahamsson (1992), the time-based distribution strategy is a relevant concept to DDD structure. The main difference between those concepts is that in time-based distribution the distribution measurements are made in time, while in DDD they are based on costs or customer service level. The distance between shipping point and the customer is defined in lead time, in terms of the time from the order receipt till order delivery to the customer. Thus, the distance is measured in time instead of kilometres and geographical measurements.

3.4 Stockless platform using cross docking strategy

The theoretical framework of stockless platform using cross docking strategy was mainly based on two articles, written by Michael Johnson from TNT Logistics and Uday M.Apte (Edwin L.Cox School of Business, Southern Methodist University, Dallas, USA) & S.Viswanathan (Nanyang Business School, Nanyang Technological University, Singapore) from two business schools. The reason why we chose them is to show the interrelation between academic and practical interpretation of this concept.

Cross docking, according to Ballou (1999), is one of the innovative warehousing strategies, that has great potential for controlling the logistics and distribution costs while simultaneously maintaining the level of customer service. A simple definition of it could be:

Cross docking is a warehousing strategy that involves movement of material directly from the receiving dock to the shipping dock with a minimum dwell time in between. (M.Apte & S.Viswanathan)

Or

An operational technique for receiving, allocating, sorting and dispatching product, whilst it remains on the dock of a Distribution Center (DC) and therefore does not rely upon withdrawing stock from storage. (M.Johnson, TNT Logistics)

Figure 20 shows the structure of cross docking. Stock provided by suppliers A, B and C is transported to the DC, through the inbound docks. Once received and checked it is sorted into the required order profile and through the outbound dock is transported to the pre-determined retailer. Consequently, inbound volume should be equal to outbound volume. At the end of the working shift no stock should remain in the DC.

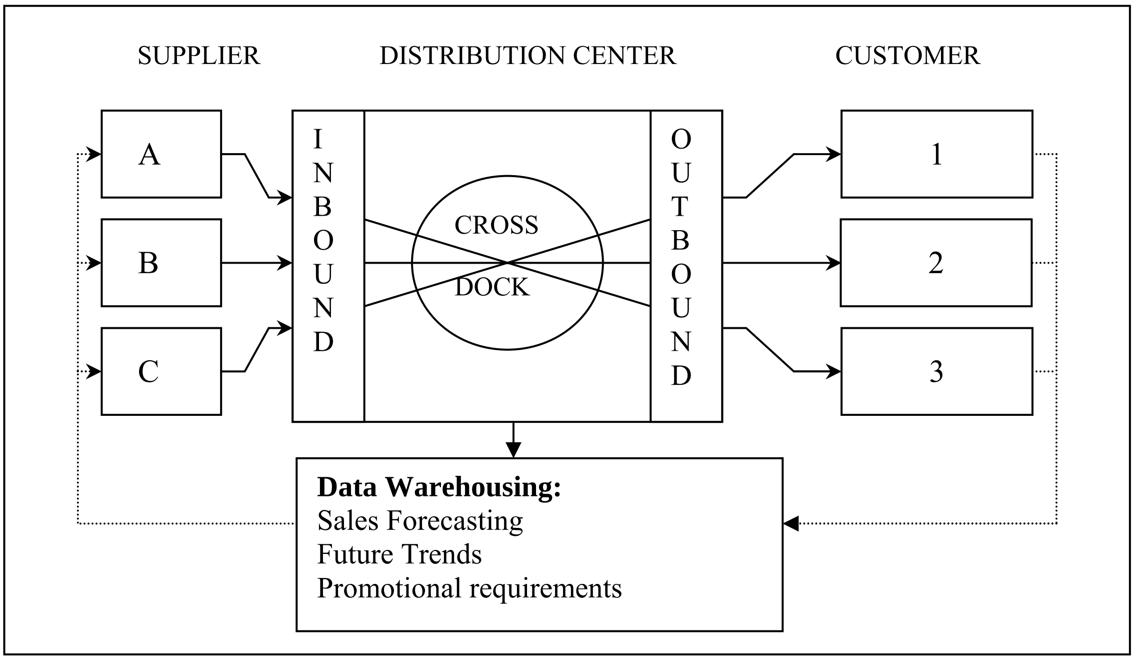

Figure 20. Structure of cross-docking

3.4.1 Benefits and Awareness

Stockholding warehouses and DCs are coming under greater pressure to meet the requirements of a more demanding consumer market, while reducing operational and overhead costs to maintain profit growth. In other words, general resources have to be reduced yet overall performance increased. Cross-docking is not going to solve all issues, it does offer significant opportunities to reduce costs in the DC by reducing inventory and hence physical size, whilst accepting and managing a larger range of product lines at greater throughputs (TNT).

Cross docking may offer significant benefits. They include:

- Reduced inventory lead times
- Rapid replenishment cycles from suppliers to the stores
- Increased assets productivity, since large holding spaces and supporting equipment are no longer required

- Reduced operating costs for handling, storage, damage, obsolescence, etc. (Copacino, 2003)
- Cuts shipping and receiving errors
- Lets retailer obtain larger orders at better prices (Kristen, 1995).

However, all these improvements are achieved at a cost. One of the main disadvantages of a cross-dock system is the reduced contingency for failure throughout the supply-chain. Highlighted next are some of the pressures, which could reduce the efficiency of a system and must, therefore, be viewed as challenges to be either overcome or managed.

Essential stock holding: Although an aim is to reduce inventory there may be a requirement to hold some stock in storage.

- Slow moving product - Should daily demand fall below an economic order quantity, as agreed with the supplier, it may be necessary to hold a level of stock within a warehouse to retain order demand satisfaction and to maintain a market profile.
- Imported stock - containerised goods arriving from overseas create a large stockholding, only reducing by order depletion until the next delivery. In effect, managing the inventory to a saw-tooth profile. Due to the inherent nature of the transportation channels, stock could not be relied upon to fulfill the criteria for a cross-dock operation.
- Start-up – At start-up sufficient stock, specifically of best selling lines, should be held and only reduced once confidence in the system has been achieved.

Supplier freedom: As explained, cross docking enables the retailer to increase the product lines. Yet on the reverse side this limits the freedom to deal with just any supplier. It increases the reliability for success on suppliers who are willing to enter into a “Trust in Partnership” agreement. Whilst being optimistic, these can be controlled successfully. However, if not managed and organized well, then the retailer has the potential to lose significant control of the operation due to the onus of reliability being placed on the suppliers. This further emphasises the absolute need for a “Secure Partnership” agreement.

Transportation: One cause of failure in cross docking, which is worth highlighting is the increase in road traffic congestion. Precision timing is of critical importance. Failure to meet with the operational time slots could delay other connected activities within the supply-chain. Should sales floor stockholding be reduced to a single day with no supplementary stockroom storage then a delay in delivery could mean a complete stock out. Though contingency should be designed into the transportation network, it must be calculated and balanced against the likely occurrence of failure, for example:

- Identify slow moving and imported stock, including pre-promotional build-ups and store in a centralised warehouse. By nature, this should be smaller and cheaper to run than a warehouse to hold all product lines and volume. It should be able to respond to specific order requirements by despatching to the cross-dock operation either in batch form prior to the sorting operation or coordinated to consolidate with the sorted order prior to despatch.

- Maintain a certain level of contingency whilst retaining the benefit of cross docking, by diversifying the cross-dock operation into regional stockless centres creating multi-purpose consolidation depots. These could receive stock from the pre-mentioned centralised warehouse - slow moving, imported and promotional stock - and product lines direct from suppliers for immediate sortation and consolidation. If required, value added work can be undertaken to ensure that the stock will arrive in a “floor ready” condition.

- Exploring a regional supply base could lead to reduced transportation costs and give greater flexibility and response in transportation scheduling. Stock not supplied regionally could be despatched through the DC - primary sort - into batch lots consolidating with the slower moving stock to be transported to the depots.

Supply-chain: It is believed that by 2005 home shopping will account for between 30% and 40% of all consumers purchasing. Consequently, retailers may have to re-evaluate their current supply-chain strategy to ensure that this demand can be matched and expanded when required. This will entail not just designing for speed and volume of throughput, but incorporating a high level of flexibility to be able to respond to the variances of consumer choice while causing minimum disruption. A cross-dock system, integrated within a designed channel of distribution will play a vital role in ensuring that Efficient Consumer Response (ECR) is achieved and maintained.

Controlling delivery: The increase in availability of both consignment tracking and dynamic route management packages assists in reducing the risk of failure to deliver the goods. Though essentially separate systems, it is believed that, in the future, they will be interrelated.

Stock out consideration: Another important factor that influences the decision to use cross docking is the level of unit stock-out cost or the cost of lost sale on a single unit of product. Cross-docking inherently leads to a minimal level of inventory at the warehouse, and thereby strips the system of safety stocks traditionally held at the warehouse. Consequently, cross docking raises the probability of stock-out situations. However, if the unit stock-out cost is low, cross docking can still be the preferred strategy, since the benefits of reduced transportation cost under cross docking can outweigh the increased stock-out cost. As shown in Figure 21, cross docking is therefore preferred for products with stable and constant demand rate and low unit stock-out cost. On the other hand, for products with unstable or fluctuating demand and high unit stock-out cost, the traditional warehousing and distribution strategies are still preferable.

Unit stock-out costs	Cross-docking can be implemented with proper systems and planning	Traditional warehousing/distribution preferred
High	Cross-docking can be implemented with proper systems and planning	Traditional warehousing/distribution preferred
Low	Cross-docking preferred	Cross-docking can be implemented with proper systems and planning
	Stable and constant	Unstable and fluctuating
	Product demand rate	

Figure 21. Decision-making on implementing cross docking.

Other factors that can influence the suitability of cross docking include the distance of the warehouse from other points in the distribution channel, the service requirements for the product and the density of business in the region. The technology and systems used in cross docking can be quite expensive. Therefore, apart from stable demand, the total volume handled by the warehouse for the region should result in scale economies and should also be stable across time. When the warehouse is located close to several demand points or retailers, then scale economies and stability of demand are easier to achieve. The service requirement for the product essentially impacts the stock-out cost or lost sale. Generally, high service requirements imply greater fluctuations in demand, and therefore make it more difficult to operate the cross docking facility.

Information systems: In order to establish a successful cross-dock system, accurate and up-to-date integrated information is needed about every stage in the supply chain. There are integrated two information systems for cross-docking implementation, namely Electronic Point of Sales (EPOS) system for capturing and compiling accurate on-line information and Electronic Data Interchange (EDI) for ensuring that the data is quickly and efficiently transferred throughout the operating structure. The information acts as the main driver to the supplier dictating the next batch delivery from inventory and synchronizes it with the production in maintaining minimum levels of inventory.

Operational issues: It is of great importance that the cross-docking system fulfils operational requirements as well such as material handling equipment, which can be automated or manual and the quality of equipment and after sales service is paramount and must be treated on an equal basis along with performance and cost.

There are aspects, which are to be considered thoroughly when implementing cross- docking system:

- ***Manpower*** - The changes to a cross-dock operation, irrespective of its automated or manual nature, could result in a complete culture change throughout an organisation. This can be handled and managed successfully by involving all the relevant people in the project as soon as possible and undertaking comprehensive training programmes at all levels.
- ***Dock and yard management*** - The interface between an efficient distribution network and a cross-dock system is the DC receiving and despatch docking bays. Investment in a yard management system will ensure that the correct trailers are positioned to the correct dock, and that the shunting team is in full communication with the operations in order to respond to immediate requirements and prioritise traffic flow.
- ***Operating environment*** - Simple floor space is a priority for an efficient cross-dock whether an automatic or manual operation. It is important, wherever possible, to design in contingency without affecting performance or efficiency.
- ***Computer simulation*** - Simulation should be considered essential when planning either a simple or sophisticated operation. The system should be capable of simulating both inbound and outbound traffic, including yard management, and the full operational procedure within the DC, whether a centralised or regional operation (Johnson, 2003).

3.4.2 Relevance of the theory

More detailed description of the benefits and awareness presented for DDD and distribution via cross-dock/stockless platform would help us to investigate and see if the theory of the proposed alternatives is applicable to SCA HP. The theory should help us not overlook some points during data collection and not overestimate our findings in the analysis part.

3.5 Facility location

Ballou H. (1999) stresses, “locating facilities throughout the logistics network is an important decision problem that gives form, structure, and shape to the entire logistics system” (Ballou, 1999, p.483). In our research, we used the point of gravity method for locating cross-docking platform. The method described by Lumsden (2003) is applicable not only for terminal localisation but for the localisation of other warehousing facilities.

The method is based mainly on the localisation of the facility in the point of gravity of the customer demands for goods and a stated distribution area. The method requires that the positions of all involved units can be positioned in a coordinate system (Xi, Yi) and that the only one terminal (X,Y) is to be located and used in the total goods distribution system. The number of consumers (n-customers) and producing units (m-suppliers) to the terminal can be unlimited (Lumsden 2003, p.377).

In our case, a number of producers (Xsj, Ysj) will deliver to several customers (Xki, Yki) via terminal. The total volume of goods from all suppliers (ΣVsj) is equal to the total volume demanded by the customers (ΣVki). The existing transportation cost for every single relation (Tsj) influence the relative significance of every supplier (Vsj*Tsj). (Lumsden K, 2003)

$$X = \frac{\Sigma(Xlj*Tlj*Vjl) + \Sigma(Xki*Tki*Vki)}{\Sigma(Tlj*Vjl) + \Sigma(Tki*Vki)}$$

$$Y = \frac{\Sigma(Ylj*Tlj*Vjl) + \Sigma(Yki*Tki*Vki)}{\Sigma(Tlj*Vjl) + \Sigma(Tki*Vki)}$$

Where, i = 1, …..n (number of customers)

j = 1, ……n (number of suppliers)

IV. Empirical research

In the following chapter we describe the distribution structure in the SCA HP, Consumer Goods. This part aims to describe and analyse the current physical distribution network in SCA HP, using selected theoretical methodologies. As with any other empirical research, the first step of the research process was the collection of data. The collection of the internal secondary data was used as well as primary data such as observations or communication (interviews). In order to present a clear picture of the current distribution system in the company we used mapping of different flows.

4.1 Present distribution system in the company

The logistics structure of SCA Hygiene Products consists of factories, factories' warehouses, distribution centres and stockless platforms/split-points, it comprises:

- Stocking points and inventory management
- Transportation
- Customer service
- Management information system (MIS).

Consumer goods division has its own logistics department, which is not integrated with Incontinence and AFH products, taking care of all Consumer Goods flows in Europe. The distribution to the customers in Sweden is mainly operated through IDCs in Falkenberg and Lilla Edet. Deliveries are created according to predefined lead times and conditions agreed with customers, e.g. full truckload, direct deliveries.

There are four objectives defined by the company, in order to improve the current distribution system:

- Minimal number of warehouses (de-complexity)
- Direct Delivery where possible, Consolidation where needed (in order to serve customer requirements)
- Stockless Platforms shall be used to avoid warehousing
- Share facilities where feasible and economical

There are a number of factory warehouses in Europe providing internal inflows of Consumer Tissue, mainly in Great Britain (Prudhoe), Holland (Hoogezand), Belgium (Stembert), Germany (Manheim), Austria (Ortman), Slovakia (Gemerska Horka), Poland (Olawa). Belgium, Germany and Austria generate the biggest amount of total flows to Swedish market.

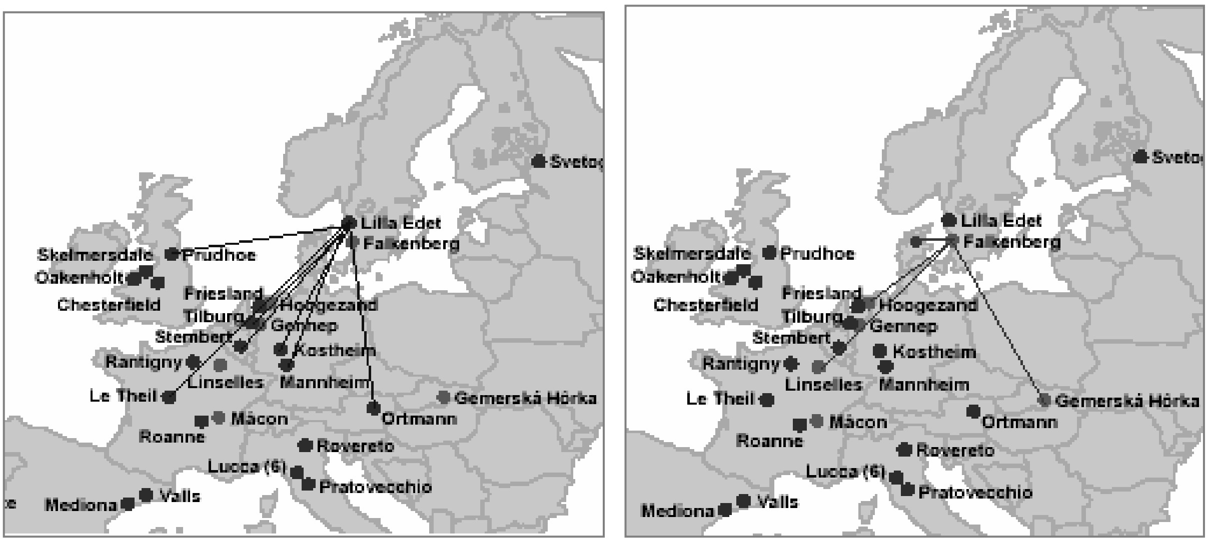

Figure 23. Major Internal Flows to IDCs in Lilla Edet and Falkenberg

Source: Adapted from www.sca.com

From Lilla Edet distribution centre goods go to the customers' DCs as outbound flows. There are 57 destinations for tissue delivery.

As for the Consumer Fluff products, Falkenberg IDC has internal inflows mainly from Netherlands (Hoogezand), France (Linselles), Slovakia (Gemerska

Horka), Denmark (Grenå). Netherlands and France are the principal countries for big volumes. There are 58 destinations for fluff deliveries. The customers, in our case retailers, are mainly the same for both types of Consumer goods.

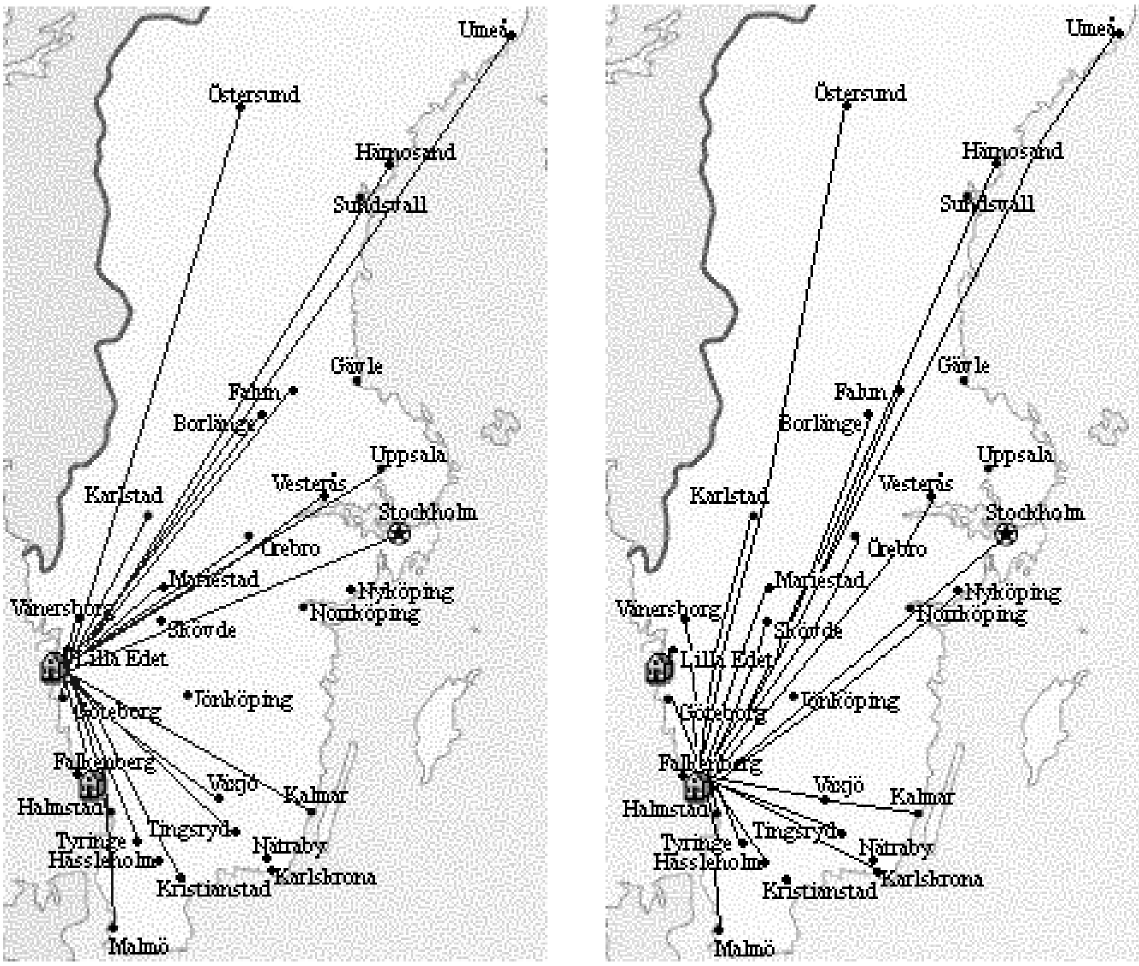

Figure 24. Customer locations in Sweden

4.1.1 Stocking points and Inventory management

SCA HP develops a policy towards decreasing the number of warehouses. In this case increasing deliveries directly to customers, as well as establishing stockless platforms is a method to optimise costs and improve a whole distribution system, thus decreasing stocking place demand.

As it was mentioned earlier, SCA has two distribution centres in south of Sweden, Lilla Edet and Falkenberg, which are the focus of the research study. The IDCs have function both as manufacturing warehouses for plants in Sweden and International Distribution Centre (IDC) for consolidating and stock keeping the goods for Nordic market coming from the continental manufacturing warehouses in Europe.

The IDC in Lilla Edet has the operating capacity of approximately 450 articles and in Falkenberg around 520 articles. Inventory turnover in the IDCs in Sweden is counted in days and it is approx. 30 days in Lilla Edet as well as in Falkenberg's IDC but the target is to decrease it up to 15 days.

SCA strategy steers internal flows by replenishment principle. The supply between internal SCA stock points is based on demand, available stock, and target inventory level, lead-time and delivery frequency as it is described in Supply Chain Book of SCA. Re-allocation of the stock may be initiated between SCA stock points in order to maintain the right stocks, e.g. avoid backorders, reduce non moving (a product in stock with no forecast or no sales during the last 8 weeks) and slow moving (a product in stock with more than 8 cover weeks products).

4.1.2 Transportation

The transportation within Consumer Products in SCA is the most important part as high focus on transport management ensures cost efficiency, service levels and win-win solutions with the customers. The transport planning in the company is outsourced in most of the cases.

Domestic and to most of the international destination deliveries are made by lorries. But there are some links between SCA warehouses that use railway connections almost up to 100%, such as Manheim in Germany to Lilla Edet in Sweden, Ortman in Austria to Lilla Edet in Sweden and others. Railway connection gives the opportunity to use a cost efficient transportation of the products. SCA Hygiene Products has an overall target to reduce its total logistics cost by 7% in the coming years. As the transportation is a big part of the logistics cost the company develops methods in order to find cost reductions in distribution part.

Within the company they try to reduce cost by increasing drop size, increasing the amount of direct deliveries and improving pallet fit etc, as well as current transport prices. The transportation services providers in Sweden are mainly small and medium size companies.

The main factors, which influence costs for transportation in SCA HP, are the number of drops, drop sizes and truck fill rate. Thus, there are different techniques that are developed in order to reduce those costs. Freight to customer is the biggest part of costs in total distribution costs.

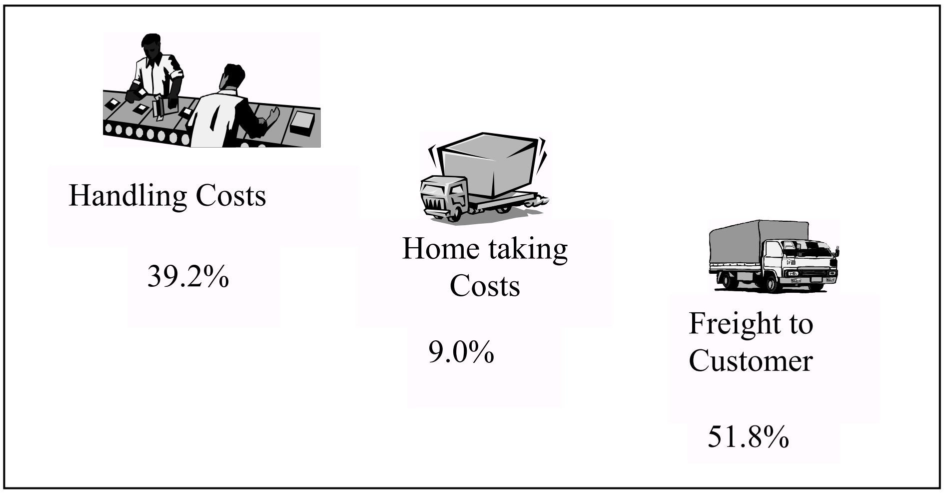

Figure 25. The current logistics costs within Consumer Products Division in SCA HP

Source: Adapted from www.hq.sca.com (Business logistics)

4.1.3 Customer Service

Customer service level in SCA is estimated as 97%, which is regarded as a very high index. But according to customer logistics managers in SCA HP, the service level is up to 90%. Customer service department has a goal to reach 98% service level. Customer service level is calculated by percentage of delivered orders divided by percentage orders received in a period of time. For instance, if 40 orders were received and only 38 delivered, it means that customer service level is 95% (38/40*100=95%).

The main customer service prerequisite in SCA HP is delivery on time. For different customers in different locations different lead times are set. But they vary only on a 3 day scale in Sweden or 1-2-3, which means that the customer order is received on day 1, day 2 it is picked in the warehouse and prepared for shipment, and day 3 goods arrive at customer's warehouse door as shown below.

Priorities are given to the main customer - ICA, where lead-time is one day almost to all locations in Sweden. ICA is the main customer for SCA HP and the company is heavily dependent on them. ICA generates approximately 60-65% of SCA HP sales. The lead times for ICA are mainly one day, which means that orders are received, shipped and delivered on the same day.

Other main customers like Dagab or Axfood generate 20-25%, Coop approximately 15% and the rest are small customers, like grocery store retailers.

Some customers in Norway pick the goods themselves or do ex-works. On one hand it seems that SCA save some money on transportation, but from the discussion with logistics customer service manager, it turned out that it actually causes more disadvantages than advantages. For instance, SCA loses buying power for transport, in terms of volume, loses control in managing incoming fleet (e.g., it is easier to deal with one transport company than with ten). Furthermore, complexity arises for implementing new projects like cross docking, etc.

There are some problems that SCA HP customer service department faces. One of them is lack of communication and information sharing among employees inside SCA HP. For instance, if the decision about stopping some production processes is made, without informing customer service people, automatically out of stock situation arises. But if customer service is informed in advance, the situation might be dealt with or at least managed. The customer service in the company should have access to the updated information about stock availability and possible stock out situations, in order to keep the customer service on the same high level. The stock out situation arises due to the transport problems and mainly with products that are coming from European distribution centres, in other words products that are not produced in Sweden. Volumes to be distributed on Swedish market, for consumer tissue, are rather small for European IDCs, so it might not be considered as the first priority country, when it comes to deliveries.

Another problem we saw is the uncertainty about goods arrival at customer's warehouse. SCA has the information when the truck leaves its warehouse but do not know when it arrives at the customer premises. From the discussion with customer service managers we can assume that backorders situation arises quite often (it was mentioned that stock out happen everyday for one or two products). The customer places the order next day if some articles are not available at the moment, so in SCA terminology there are no backorders at all, because there is no "waiting order" in the system.

The customer service is improved by facilitating the further development of joint projects with the company's customers (retailers) as well as by supporting the organizational development of the customer interface to pro-actively meet the future demands of the key customers. Customer service department is working on EDI invoicing project (customer receives invoice via EDI instead of paper), dispatch advice project (to control when customer receives goods, control the trace ability of goods flows, etc.) in order to increase customer service level.

4.1.4 MIS in the SCA HP, Consumer Goods

Nordic SCA production sites, sales organization and distribution centres are connected to one central order system (SAP), which is comparatively new. In the existing SAP system the customer service department forms a part of the sales organization of SCA Hygiene Products and is the closest interface to the customer. They receive orders from customers and put them into the central order system. Customer service determines all aspects regarding delivery (e.g. delivery date, time, drop size, etc.).

The order processing starts with the receipt of the customer order that is put into a system to create an internal demand. This demand is then allocated to supplying warehouse according to predefined rules through an optimised loading and transport procedure. Requested delivery date is set according to Customer demand and predefined lead times. “Best choice” for delivering factory or warehouse (direct deliveries) is chosen to optimise costs and customer demand (Supply Chain Management Book within of SCA, 2003). The European production sites and DCs are only in the process of switching from the old order system (SOP) to a new one (SAP). Figure below visualizes information flows in Nordic and European countries.

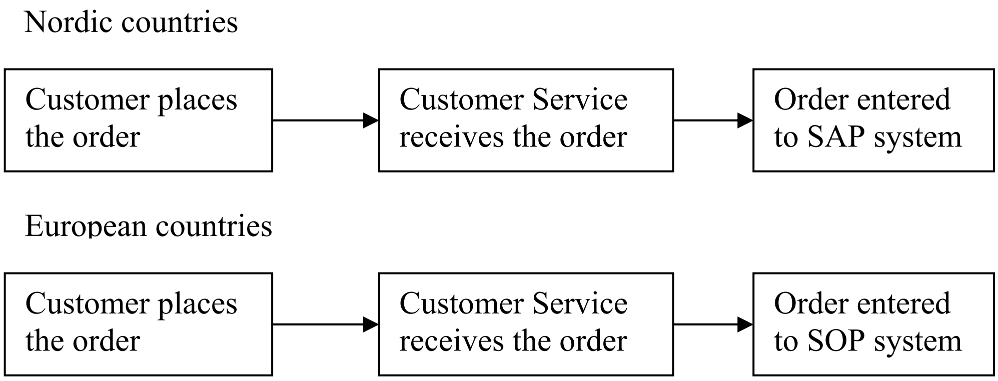

Figure 26. Difference between information flows

Some complexity in the system is added when customer service order some products from European DCs for direct deliveries. As it was mentioned before Swedish and European divisions are not using the same system, so interface – global sales & forecasting - between two systems is implemented. Theoretically it should work smoothly, but from the discussions with customer service managers we find out that some problems still arise from both Swedish and European sides.

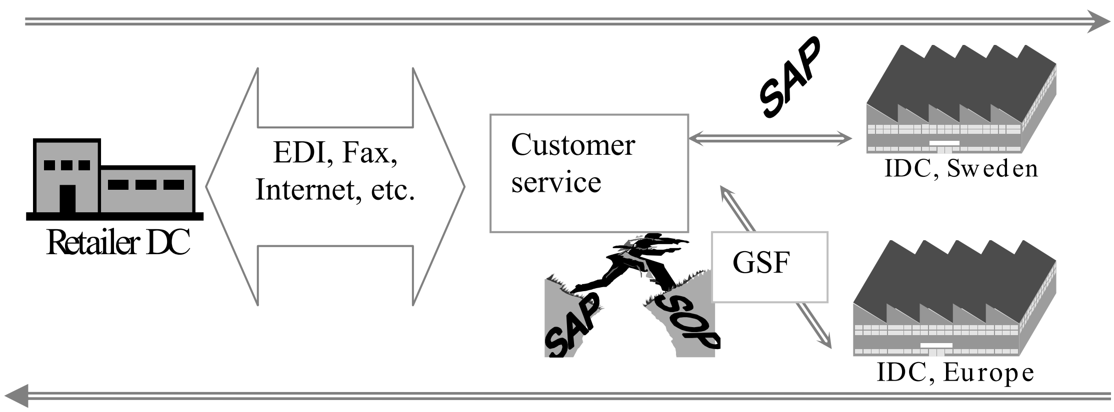

Figure 27. The information flows in SCA HP, Consumer Goods

But despite that, there is a tendency to integrate order transmital system within the whole organization in all countries, even it is still regarded as a project.

4.2 Distribution Costs

One of the steps of the present physical distribution analysis is to assess the total distribution cost structure in the company. Three types of costs have been considered: warehousing cost, home taking cost (delivery from IDC in Europe to IDC in Sweden) and delivery cost to the customer. This is probably the most difficult and tedious task of the whole analysis. Obviously, this will be the basis of comparison for potential distribution changes. The simplification can be obtained by the principle of "relevant costs". Relevant is only what is different between different alternatives. In most cases only approximate costs can be obtained.

As it was mentioned in delimitation chapter, we started analysing warehousing costs at IDC level. These costs vary from country to country. For instance, handling costs per cubic metre in Netherlands and France are the highest reaching €13/cbm, while in Germany and Austria a little bit more than €3/cbm. Meanwhile in Sweden handling costs are around €6/cbm. Further on, handling costs are presented which were obtained from internal logistics reports of SCA.

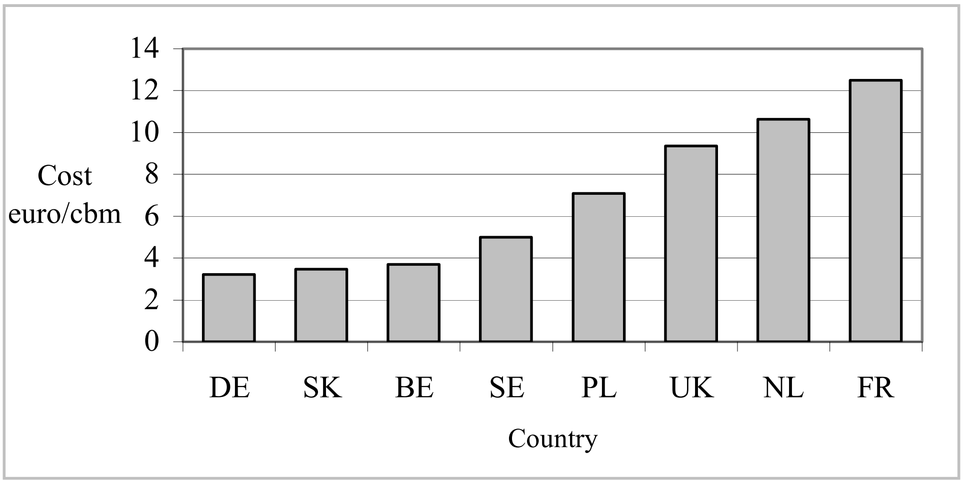

Figure 28. Handling costs by countries

Transportation costs from one IDC to another IDC differ significantly because of different transport modes used. Trucks transport fluff products from

Hoogezand in Netherlands only by trucks, while tissue products are shipped by rail. Rail connection availability in Lilla Edet makes its IDC very favourable compared to the other IDCs and to the cost reduction possibilities as well. First of all, economies of scale are gained than transported in larger volumes and secondly, rail transportation is cheaper than road transport.

When goods arrive either to Lilla Edet or Falkenberg in Sweden, they have to be handled and stored one more time before being distributed to the customer. That generates costs again. As it was said before, warehousing costs in Sweden are not so high, as for example in France, but still it is additional costs, which can be reduced considering direct deliveries strategy.

The last total cost component in present distribution system of the company is transportation costs from Swedish IDC to the Nordic customer.

SCA Hygiene Products has an overall target to reduce its total logistics costs by 7% in coming years. However, considering increase in transportation costs according to forecasts in the company the total distribution costs will be difficult to reduce.

4.3 Direct Delivery Distribution structure in the company

Direct deliveries in SCA HP are understood as when the goods from the production site are shipped to the customer's warehouse, avoiding any storage at SCA warehouses, in other words goods are not put on the shelves for storage but immediately shipped to customers.

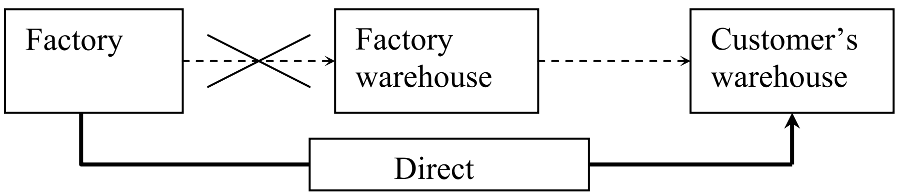

Figure 29. Direct delivery in SCA HP

There are 71.6 percent of Consumer goods distributed directly taking into consideration all production sites in Europe and Sweden for the moment. As for direct deliveries from Europe to customers in Sweden, there is namely only one flow from the factory warehouse in Hoogezand to the customer in Malmö, COOP as the customer has quite big volumes and its geographical situation allows savings with DDD structure for the moment.

Table 2. Percentage of DD

SCA in Countries	Volume/m^3	DD Volume/m^3	DDIX
AT	411 079.3	252 676.3	61.5 %
BE	384 705.3	301 919.8	78.5 %
DE	1 891 800.9	1 426 349.0	75.4 %
FR	1 314 668.5	908 494.7	69.1 %
NL	533 735.2	294 207.8	55.1 %
SE	308 055.0	225 260.2	73.1 %
SK	7 835.0	5 019.0	64.1 %
Overall result	4 851 879.2	3 413 926.8	71.6 %

Source: SAP Database

4.4 Stockless Platforms/Cross Docking set up in the company

In our research we regard the two concepts Stockless Platform and Cross Docking as the similar tool for goods distribution. Further those two concepts will be referred to as SP/XD.

Discussions about SP/XD in the company are taken up more often nowadays as the constantly increasing demands and requirements on the markets put pressure on logistics of the suppliers and manufacturers. SP/XD is a challenge and it is “established more and more often to reduce cost by driving out further inventories of the supply chain, increasing transport utilization and reducing lead times. This is possible because of the well established central distribution networks” (Roland Berger, 2001).

According to the researches made in SCA, cross-docking platform can take different places in a supply chain. Upstream example shows that cross docking can be made at manufacturer’s facilities or a manufacturer is the one who makes a cross docking and delivers the goods to the retailer’s distribution centre. With that kind of set up 10% of supply chain costs can be saved. In a downstream case, cross docking is made at retailers’ facilities and the products are delivered directly to the stores. According to the research, with this kind of set up 15% of supply chain costs can be saved.

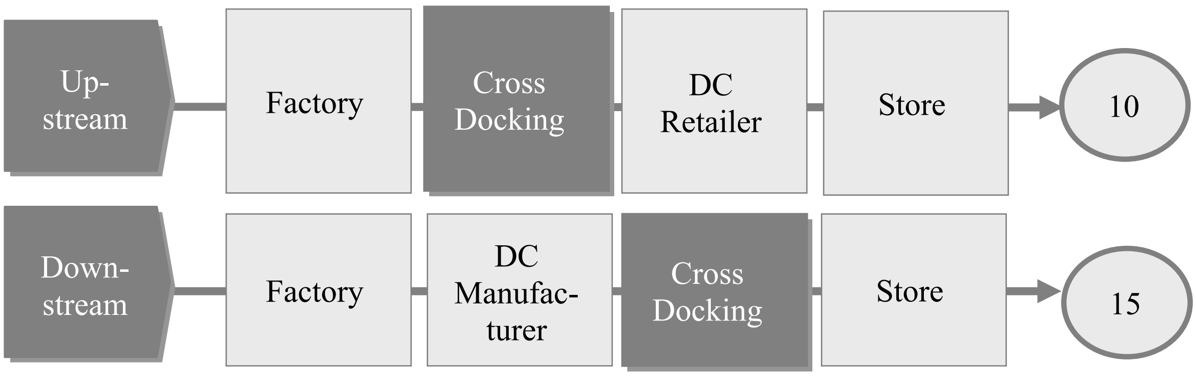

Figure 30. Cross docking place in a supply chain. Source: Adapted from Roland Berger

Physical distribution systems in SCA’s vary from country to country, because of different markets and customer needs. The goods distribution via cross-docking/stockless platform is one of the alternatives for improved physical distribution. Only few stockless platforms are already operating in SCA’s distribution network, meanwhile some other cross docking platforms for particular flows are still in a project phase.

There is a functioning cross docking platform in Great Britain. It is implemented at customer’s ASDA Wal Mart premises, which has 240 shops all over Great Britain. The set up allowed locking ASDA Wal Mart to SCA and it was completely dedicated and focused on ASDA with no complexity, no distraction. Challenge also set to provide optimum cost warehousing and distribution solutions for Asda by exploiting cross docking system. And the changes in the distribution set up allowed SCA to gain competitive supply chain advantage over SCA's competitors and become Asda's preferred soft tissue and supply chain development partner. The service level was increased up to 100% and deliveries of 60% of the products are made within 12 hours and 100% are made within 24 hours. Current cross-docking capabilities provide improved availability and competitive differentiation and are partly funded by Asda (Consumer Division UK).

The goods consolidated at the Asda's platform are pre-picked in the pallets, which means that hardly any handling is involved at the customer's transhipment facilities, just loading and unloading from one truck to another.

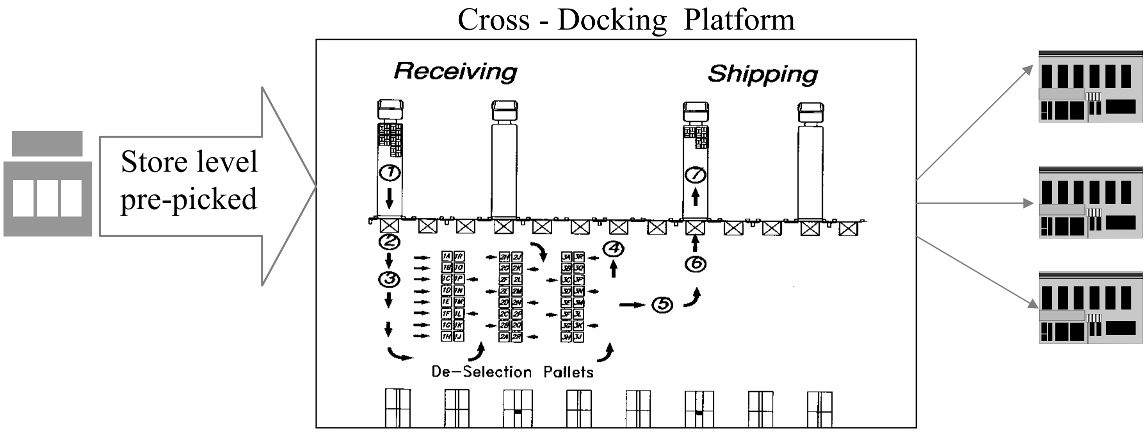

Figure 31. Cross Docking of SCA Consumer Goods at ASDA Wal Mart premises

With this kind of set up, the customer does not have to keep his products in stock at DC level anymore; only stock at the outlet level will remain. Let's say that with the old set up the DC of the customer has to keep 10 days stock in order to meet the demand of his outlets. Five days of stock is kept at outlets level, so total is 15 days of stock. While with cross docking set up only up to 3 days of stock will be in that part of supply chain.

Table 3. Stock in days with different distribution set-ups

	DC deliveries	Store deliveries	Cross Docking
DC level	7 + 3* stock days	No stock	No stock
Outlet level	2 + 3* stock days	7 + 3* stock days	3* days
Total	15 days	10 days	3 days

* Estimated safety stock

Source: SCA Consumer Product Division – Business Logistics

There is a SP/XD projected in North of France, retailer distribution centre (RDC) Auchan Sainghin, which is similar to the SP/XD in Great Britain. The total distribution costs for SCA in this case are expected to increase while costs for the customer will decrease. SCA adds costs in more frequent transportation because the trucks are not always fully utilized, while the retailer makes savings in working capital and reduced storage at outlets' level, in that way retailer increases his return on investment. Thus, such distribution was proved to be more beneficial for the customer than for SCA HP. Therefore, SCA needs to re-negotiate pricing, in order to take part of the savings.

The experience of the SP/XD set ups of Consumer Goods in other European countries can be certainly used for Scandinavian market as well. In the SP/XD proposed for Scandinavian market we considered impacts on the present distribution system. Sometimes is difficult to express the impacts in qualitative measures but for our pre-studies it was the most suitable way to make the analysis.

Several pitfalls and benefits were defined in SCA as a result of running different projects and working constantly on improvement of the distribution system and increasing customer service. The benefits and pitfalls shown in the table below were defined after the project and implementation of cross docking platform dedicated to the major customer in England ASDA Wal Mart.

Table 4. Benefits and Pitfalls of Cross Docking

	Benefits	Pitfalls
SCA	Reduced Total Supply Chain Costs; Value Added Service Securing and developing Business with Customer; Preferred Supplier; Partnership and locking a customer to SCA; Collaboration - improved FIX and SL	Need for an integrated IT-system: ASN, EDI, SSCC, etc.; Safety stock only on SCA-side (increased inventory); Cultural changes within SCA from push to pull (no year end loading); Warehouse configuration: different space requirements Economies of scale (will not fit for small customers); Operating problems: time accuracy, higher complexity and risk
Retailer	More warehouse space; 10% improvement in on-time delivery; 8% improvement in damage claims; 1 day reduction in transit times; Minimized unnecessary product handling: Improved freight management	Need for an integrated IT-system: EDI, ASN, SSCC, etc.; Initial retailer investment in software): 3-5 million US$; Cultural changes within retailer from push to pull; Tactical management issues: reaching volume targets; Operating problems: time accuracy, back-up process; Higher risks, moving responsibility of shelf availability to supplier; Less freedom to switch a supplier.

Adapted from: Consumer Product Division-Business Logistics

4.5 Different players' perspective on SP/XD set up

Following the previous experience in SCA, we made an investigation about cross docking platform feasibility for Scandinavian region with different players in the market. We arranged some meetings with transport providers (3PL), such as Schenker BTL and DHL and 4PL provider – Celexor AB.

4.5.1 Reasons to cross dock

In a discussion with transport providers, we formed an opinion that cross docking solution is not often phenomenon for fast moving consumer goods industry. The main reason for that is the value of the goods. Mainly the industries like electronics, automotives have high value goods or product components, whose storage increases tied up capital heavily.

Another group of products used for cross docking is perishables. Quality and freshness are the most important factors for a fast delivery and storage reduction in this case.

The reason why to cross-dock consumer goods, in our case fluff and tissue, is the size of the volume; even though the value of the products is low. Especially tissue products are very bulky and take a lot of space in the warehouse. This is naturally involves more handling, which adds more costs. So, the main savings can be achieved on handling and storage. In broader perspective the main reason to cross dock is reduce inventory in the whole supply chain.

Another motive for cross docking stressed by transport providers was transport costs. Large size shipments or FTLs arriving at XD/SP and the same size shipments leaving to customers should reduce total transport costs, but as we will see later on from our calculations done on transport costs it is not exact in every case.

4.5.2 Main factors for success

Interesting interview was held with a company Celexor. It gave us a different approach on physical distribution of Fast Moving Consumer Goods. The company deals with logistics process and project management and provides value added service, mainly for IKEA. They created stockless platform for IKEA in south of Sweden, which has a function of coordinating the goods for further distribution to IKEA’s supermarkets and DCs in Scandinavian countries. Celexor does not own any assets, they mainly manage information flows and information systems for IKEA.

The cross docking set up is very resource consuming and it requires very accurate and deep research and more profound analysis in this area in order to make it really cost efficient and effective. The time frames at every stage of physical distribution should be constructed so that it takes into focus customer satisfaction.

It was stressed at the meeting that the information systems play an important role in integrating the supply chain. The companies use different information systems as trade-offs in its business. But, according to Goeffrey Nairn "technology is no panacea" and that "supply chains are all different, and what works in one company may not work for another" (Financial Times, 01-10-2003).

We made a conclusion that good information systems are necessary for cross dock set up, but it is significant to be aware that information technology should be used as a tool to a solution, but not as a solution itself.

While talking with business logistics managers' in SCA, 3PL and 4PL providers, it was emphasized that good relationship with the customer is very important. A detailed preparation, understanding of the processes, mutual communication with the customer and other parties (e.g. transport provider) involved in a project is a key to successfully implement new physical distribution set ups. Good relationship with the customers and other business partners is considered a strategic advantage of the company.

V. Analysis

This chapter develops discussion of distribution alternatives and different aspects, which can positively influence and add some savings in Consumer Goods distribution in Sweden and Norway. Different test results of the hypotheses are presented as well, which were worked out during the project. In proposed redirecting of the DD flows we tested through calculations the impacts of the changes in the distribution on the distribution costs. As for XD/SP we analysed the different opportunities and location decisions. Those tests were conducted through the behaviour of the three components, which has direct impact on logistics efficiency of the company as described in theory. First two, tied up capital and distribution costs are tested in a quantitative way while customer service is tested in a qualitative way.

5.1 DD distribution structure

Consumer goods in our case company are delivered directly to customer up to 80 percent in some of the reports, the remaining 20 percent go to the stock. Most of the products produced in Sweden are regarded to be the subject of DDD structure as they are not kept in stock and can be shipped directly from factory warehouse after packaging and consolidation.

Drop size of such customers as Dagab, ICA, Coop allows the delivery the goods directly from factory to the retailers' warehouses on condition that the demand and frequency of orders is constant. The geographical distances between manufacture site and the customer benefits to the DDD structure make it easy to use.

By introducing more DDD flows into the system, where it is cost efficient, savings can be made mainly by reducing handling costs, decreasing inventory stock at the DCs, eliminating home taking cost which is almost 9%.

In our thesis project we set ourselves the task to find possible locations and volumes for direct delivery set up. Further on, we will describe the process of direct delivery calculations and their findings. The mapping of current distribution system we started by identifying geographical locations of production sites in Europe, which deal with Lilla Edet and Falkenberg IDCs. Furthermore, we identified the volumes of goods going to Lilla Edet and Falkenberg in a period of five months, January-May, 2003.

Another step in mapping goods' flows was locations identification of the customers and volumes shipped to them. We limited ourselves to indicate only biggest customers, who generate 80% of the total volume in Nordic market.

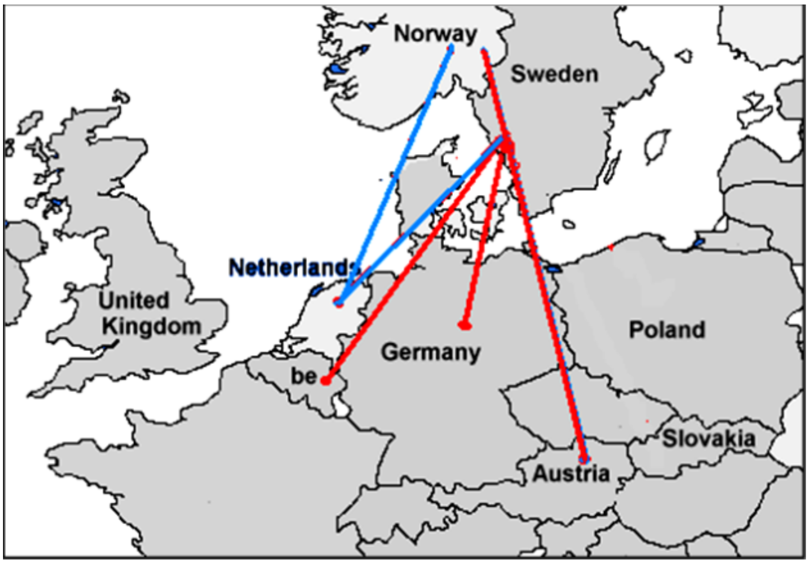

Figure 32. DD Volumes for Consumer Goods

The major SCA Hygiene Products' Nordic customers are big grocery retailers located in Stockholm, Gothenburg, Växjö and Malmö areas. The volumes shipped during five months vary from five to thirteen thousand cubic meters. The rest of the customers are small grocery store retailers, which are spread all over Sweden. Their volumes do not exceed more than 100 cubic meters in the same period of time. That is why, direct deliveries for those volumes are not considered.

Table 5. The major customers for DDD consideration

Retailer	Location
ICA HANDLARNA ÖST AB	Stockholm
DAGAB NORD AB, HANINGE	Stockholm
ICA-HANDLARNA VÄXJÖ	Växjö
DAGAB VÄST	Göteborg
ICA GÖTEBORG	Göteborg

In order to make a feasibility calculation for the direct delivery distribution network, we suggest looking at redirecting product flows which are going from production plant's distribution centre in Europe to Nordic market customer, without going to Lilla Edet and Falkenberg. Thus, we decided to look at the company's databases for final customers or who is a customer for a specific volume. According to interviewed managers at SCA, production process does not start until the order is received. This means that goods issued from the European DCs have the final destination/retailer.

When analysing outcomes of the following redirected flows we considered only those customers and those flows, which have more than 1000cbm (in a period of five months). One of the reasons for this is that the economies of scale gained when achieving FTL. In other words, we assume that at least one full truckload has to be sent during a week.

Some assumptions were made calculating transportation costs; mainly related to the distances, transport modes and price per kilometre. The reason behind that is direct delivery transportation is made by road only; not considering rail connection anymore. These assumptions were made according to Transport Monitor tariffs in SCA. We added extra 350 kilometres for the products going to Oslo, 200 km to Stockholm, 100 km to Växjo and 20 km to Kungälv.

5.1.1 Hypotheses Testing 1 for DDD

In this chapter we will confirm or reject the defined hypotheses for DDD set up vs. total distribution costs as follows.

Hypothesis 1: DD set up will not retain the same total distribution costs for some flows:

$$\sum_{i=1}^{4} Xi, pd \neq \sum_{i=1}^{4} Xi, dd$$

Where,

X1 – Handling costs in European DCs
X2 – Home taking costs
X3 – Handling costs in Lilla Edet or Falkenberg
X4 – Transport costs to the customer
pd – present distribution
dd – direct deliveries

In the table below illustration of the possible distribution cost saving are shown. Savings are done mainly by eliminating home taking costs of the volumes produced in Europe for Nordic market and handling costs at Swedish IDC

Table 6. Possible distribution cost saving using DD set up

Product	Flows	PDS* in euros	DD proposal in euros	Savings in euros
Fluff	NL–SE	393 312	323 230	70 082
Fluff	NL-NOR	162 689	148 354	14 335
Tissue	AT-SE	48 524	48 235	289
Tissue	BE-NOR	39 961	40 966	-1005
Tissue	DE-SE	31 719	31 475	245
	Total	**676 205**	**592 260**	**83 945.4**

*Present Distribution Set up

From the presented savings we can state that for fluff products 32% of the total flow volume (to Sweden and Norway) can go directly to the customers, while for tissue products 4.1% could be shipped directly to the customers. Table below shows tissue and fluff volumes coming from European warehouses and possible volumes to go directly, calculations are made on 5 months basis.

Table 7. The comparison of volumes in m^3 for different distribution set ups

	Volumes in PDS	Suggested volumes for DDD	DD %
Fluff	43 357	13 897	32%
Tissue	58 813	2 458	4%

We can make a conclusion that hypothesis 1 is confirmed, the total distribution costs for those flows will not remain the same with DD set up, they will be reduced by 12.5%.

The volumes, which can not be shipped directly to the customers, will be transported the same "old way", using present distribution system, just delivery frequency to Swedish DCs will be reduced and the goods will be shipped when full truckloads are possible.

5.1.2 Hypotheses Testing 2 for DDD

Hypothesis 2 is defined as: DD set up will not retain the same tied up capital cost for some flows.

$$\sum_{i=1}^{3} X_{i,pd} \neq \sum_{i=1}^{3} X_{i,dd}$$

Where,
X1 – cycle stock cost
X2 – stock in transit cost
X3 – opportunity cost
pd – present distribution
dd – direct deliveries

According to the theory, the tied up capital and capital costs for inventory are the largest parts of inventory carrying cost. Other costs, such as inventory service costs, storage space costs, inventory risk costs are not included in our calculations. To compute capital cost we included cycle stock and stock in transit costs.

The cycle stock we expressed as: Cycle stock cost = *Q *C*I*

Where,

Q – average inventory (the order quantity*days of inventory, C - cost per unit in m3, I - interest rate.

To calculate the cost of holding stock in transit the following formula was applied: Stock in transit cost = *Q'*C*T*I*

Where,

Q' – total quantity or volume, T - transit time in days, I - interest rate, C - cost per unit in m3.

As we were told at the company, the opportunity cost of capital, minimum acceptable rate of return on new investment is around 20% (before taxes). As our calculations are based on 5 months, for the sake of simplicity, we converted it from yearly base to daily base, which is 0.05 %.

Another important thing to mention is, while calculating cycle stock or average inventory of the present distribution system, the batch size of the order we based on the working days. We assumed that there are 100 working days in a period of 5 months. It should be emphasized that the interest rate is based on 360 days.

As it was discussed before, in order to achieve high utilization of the trucks, we considered only the flows that can be divided into at least one FTL per week This means that with direct delivery set up the delivery frequency will be reduced from 100 to 20 times (it was assumed that with present distribution set up deliveries are made everyday from each location). But some volumes are big enough to deliver FTLs even 4 times a week. So, for the flows coming from Hoogezand in Netherlands, the delivery frequency of 80 times was calculated.

As a result of our calculation, we can state that some savings in tied up capital costs could be achieved for same flows as shown in the table below. We can draw a conclusion that hypotheses 2 is confirmed, the capital costs for those flows will not remain the same with DD set up, they will be reduce by 13.6%.

Table 8. Possible capital cost savings in euros using DD set up

	Present set up		Direct Delivery set up	
	Tied up capital	Cost of capital	Tied up capital	Cost of capital
NL - SE	€ 10 914 343	€ 74 016	€ 7 355 560	€ 41 519
NL - NOR	€ 5 744 889	€ 34 882	€ 5 622 150	€ 24 244
AT - SE	€ 1 048 727	€ 7 126	€ 502 721	€ 2 027
BE - NOR	€ 557 343	€ 3 834	€ 303 072	€ 1 233
DE - SE	€ 1 010 188	€ 5 221	€ 348 317	€ 1 048
Total:	**€ 19 275 490**	**€ 125 079**	**€ 14 131 820**	**€ 70 070**

More detailed calculations are made, but due to confidentiality of the information it is not presented in the paper.

5.1.3 Hypotheses Testing 3 for DDD

Hypothesis 3 – Xcs,dd > Xcs,pds: DD set up will increase customer service level.

Where Xcs,dd – customer service level using Direct Delivery set up

Xcs,pds - customer service level using present distribution set up

In the table below the comparison of impacts of two distribution systems on customer service performance are shown. The evaluation of the present distribution system regarding customer service was made according to the primary and secondary data collected in the company. But proposed DD set up evaluation is based on the best estimates and theories described in DD literature.

Table 9. Comparison of PDS and DD setups on customer service performance

Customer service	**Present**	**DD setup**
Inventory availability	Medium	High
Operational performance: Flexibility Malfunction recovery Speed and consistency	 High High High	 Medium Medium Medium
Service reliability	High - Medium	High (Must be high!)

In the present distribution system inventory availability we defined as medium, because of repeated backorders cases. As we were told at the company, the articles that are not available usually come from Europe. From the discussions with customer service managers we conclude that delays are caused because of problems related with transportation and not because of actual inventory unavailability in European warehouses. While with direct delivery set up, customers' orders will go directly to the place where products are originally produced. This means that goods flows from European warehouses will go directly to the customers' warehouses, without any stocking in Lilla Edet or Falkenberg, so in that way no safety stock is created near the customer, but at original manufacturer's place instead.

Flexibility is high with present distribution system, because products are close to the customer, which allows any changes according to customer's specific requirements. While with direct delivery set up, flexibility level is reduced because of rigid order requirements, such as drop size, which lessens flexibility for customer. The minimum drop size has to be defined by SCA in order to achieve high vehicle utilization.

Malfunction recovery time and costs increase with direct delivery set up. In case of performance failure, such as damaged goods or wrong assortment, it might be very costly for SCA to send new shipments and, certainly, increased recovery time for the customer.

With the direct delivery set up, physical transportation speed will increase, in those cases where transportation by rail will be replaced with the transportation by trucks, but on the other hand road transport is more congested nowadays (because of increasing traffic on the European roads) than railway transportation, so delivery consistency might be affected by that.

Despite all possible problems, service reliability has to be guaranteed with new set up. Until now, SCA succeeded in delivering on promised dates and times, so we do not see any obstacles to reaching this target and with direct delivery set up, even this customer service index might be improved with new set up.

Therefore, on establishing DD, the target for the customer service level should be at least on the same level as it is with the present distribution system or even higher.

Table 10. Lead times, delivery and order for different customers

		ICA	**DAGAB**	**COOP**
Lead time	Tissue	1Gtb-1Växjö-3Sthlm	1Gtb-3Sthlm	3 Days
	Fluff	1Gtb-1Växjö-3Sthlm	3 Days	3 Days
Delivery frequency	Tissue	Every day	Every day	Small for tissue
	Fluff	Every day	2-3/week	2-3/week
Order frequency	F&T	Every day	When needed	3times/week on certain days

Based on the evaluation of customer service measurements, it can be concluded that hypothesis 3 is rejected, because the customer service level will decrease with direct delivery set up.

5.2 Distribution via XD/SP structure

Locating facilities for a distribution system means to determine the number, the size, and the locations of facilities – together with the allocation of customers to the facilities – such costs of distribution are minimized (Fleshcman et al., 1998p.241). The geographical location of the XD/SP was found using the centre of gravity method described broadly in the theoretical framework chapter. Thus, as the result of the tests below, the most beneficial set up will be proposed for the Consumer Goods distribution.

In our research we made an analysis of different locations for cross docking platform for Swedish region. The situation, when XD platform is placed in a market or upstream cross docking, will be presented in this chapter. Both tissue and fluff product flows will be considered for consolidation at the platform. In this situation we analysed two location alternatives for the platform serving the region of Sweden: 1) platform in Germany and 2) platform in Denmark.

5.2.1 The size of the platform

Rough estimation for the size of the platform was based on the information that we received from warehouse manager in Schenker. We took a study visit to a cross-dock platform in Skara, operated by Schenker. Based on SCA volumes, we calculated that approximately 500 pallets (both fluff and tissue) have to be handled at the platform. This volume requires around 1000m^2 of floor space. As we were told in Skara platform, 1 pallet takes 1m^2 of floor space and the same square meters have to be added for handling. As it was mentioned before, the products are bulky and require more floor space.

The main cost components for the platform are labour cost, cost for rent and information systems (e.g. EDI). We considered labour costs as the biggest part of the total cost, moreover, they are slightly different in Germany, Denmark (possible countries where platform can be placed). So keeping in mind those costs, we calculated the average cost per the pallet. The result was 2.9 €/pallet in Denmark and 2.6 €/pallet in Germany. The difference in cost is mainly because of different labour costs in these countries. For example, in Germany the gross monthly earnings of employees in a distributive trade are approximately €2800 and in Denmark €3100. (Federal Statistical Office, Germany, Demark). As we were told in Skara platform, for cross docking set up the costing is based on the volumes, the more volume that passes the platform, the cheaper cost per unit is going to be.

After finding approximate location, we can define costs involved and show the impacts of this kind of physical distribution set up.

5.2.2 The location of the platform - Germany

When calculating this location we took the volumes produced in Europe without taking into consideration those volumes produced in Lilla Edet and Falkenberg. Furthermore, the consolidated goods (fluff and tissue products) going to the market in Sweden were divided into four regions Stockholm, Göteborg, Malmö, Växjö, as shown in the Table below. Thus, in this case we have six supply points and four regions with specific demand, which corresponds to the volume of the supply.

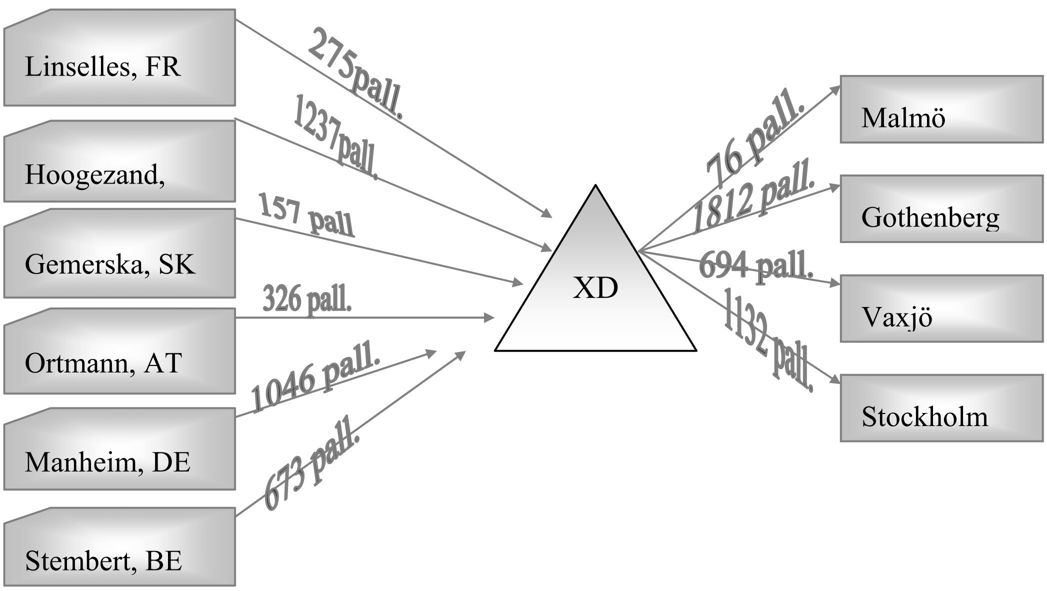

Figure 33. Volumes to and from the platform.

The geographical location of the XD/SP was found using the point of gravity method. Thus, using the equation below (Lumsden, 2003), we defined the approximate coordinates for the platform location.

The result we have got is approximately 53° North of Equator and 8-9° degrees East of Prime Meridian (The Prime Meridian runs through Greenwich, England). After using AutoRoute Express 2000 program, we located the coordinates on the map. The location for those coordinates is Hamburg area in Germany as shown in the figure below. For more detailed platform location coordinates calculations see Appendix II.

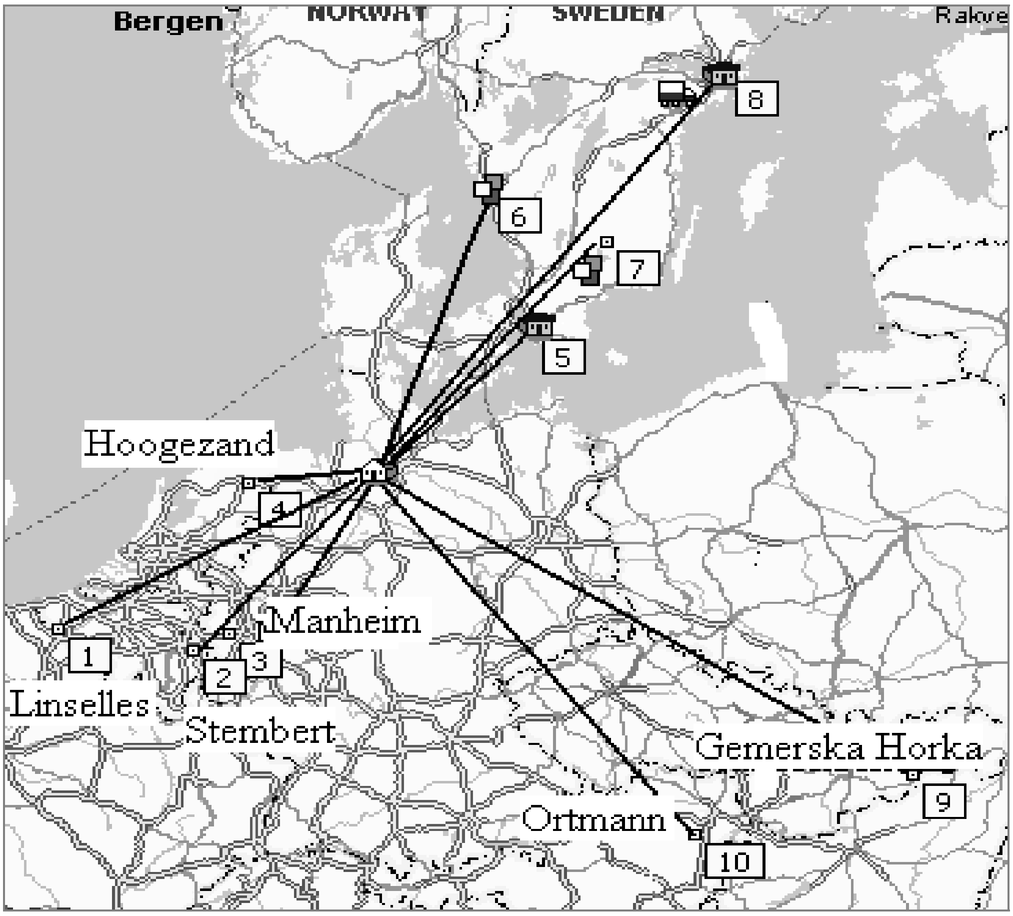

Figure 34. Possible location in Germany

After locating the stockless platform, we proposed the time frames for the distribution via XD/SP, but it is important to be aware that the first orders after the cross docking implementation have to be shipped from the stock in IDCs in Sweden in order to keep the same delivery frequencies.

Day 1: Order is received at EDC until 10:00.

Activities: picking at the warehouse, labelling, pallets handling, transport planning, issuing transport documents.

Day 2: Order (pre-picked pallets) is ready for shipping until 12:00.

LTL (in most of the cases) is loaded and shipped to the consolidation point in Hamburg area Germany

Day 3: The LTL enters the ramp at the platform before 10:00 (+/-3 hours depending on the distance). FTL is shipped before 19:00 to the customer. Activities: Unloading, sorting/cross dock activities (or placing on the right track at XD), loading and shipping. The pallets are loaded according to the sequence of drops due to customer location.

Day 4: The truck arrives at the customer's DC at 19:00.

Activities: Unloading, sorting, sequencing at customer warehouse for further deliveries to shops and outlets.

Day 5: The goods are on the shelves at the shops.

5.2.3 The location of the platform - Denmark

We defined the location in Denmark for the upstream cross docking, because we wanted to see how transport and handling costs would change with different locations. For that reason, we randomly chose the area of Vejle in Denmark. There are few reasons for this decision. First of all, we wanted to compare the costs between different locations. Secondly, there are already existing platform facilities in this area, owned by one transport company. Another reason is geographical location suitability, if considering using this platform not only for

Swedish market, but for the Norwegian and Danish customers as well. Also, there is a good road infrastructure in this area.

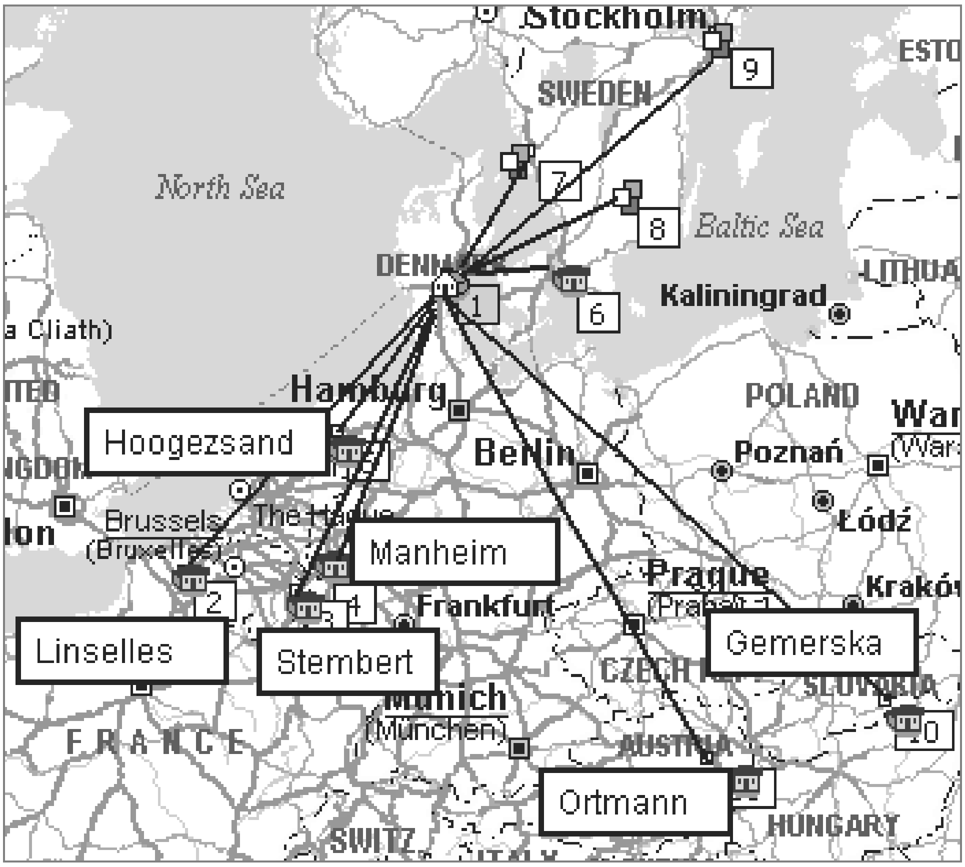

Figure 35. Possible location in Denmark

5.2.4 Hypotheses Testing 4 for Cross Docking

In the following chapters the hypotheses for Cross Docking will be tested, the hypotheses for the distribution via cross docking/stockless platform will be confirmed or rejected.

Hypothesis 4 – XD/SP set up will not retain the same total distribution costs for some flows

$$\sum_{i=1}^{4} Xi,pd \neq \sum_{i=1}^{4} Xi,xd/sp$$

Where,

X1 – Handling costs in European DCs

X2 – Home taking costs (transport costs from European DC to the platform)

X3 – Handling costs in Swedish DCs or stockless platform

X4 – Transport costs to the customer

pd – present distribution

XD/SP – cross docking/stockless platform

To test Hypothesis 4, we made the comparison analysis purely on transport and handling cost between present distribution set up and new upstream cross docking set up in Germany and Denmark. In order to show the benefits or shortcomings in economic value, for the sake of simplicity, we took into consideration only "relevant" costs, which are handling costs in European DCs, home taking costs (from DC in Europe to DC in Sweden or XD platform), handling costs in Swedish DC or platform, transport costs from DC or platform to the customers.

Table 11. Distribution Cost comparison between PDS and XD set ups

Costs	PDS/euros	X-D in Germany/euros	X-D in Denmark/euros
Handling in EDCs	209 311	209 311	209 311
Home taking costs	544 594	294 828	504 694
Handling in DC/XD	110 036	48 275	53 846
Freight to customer (market prices (DHL))	87 972	632 763	468 595
Total	**951 913**	**1 185 176**	**1 236 445**

As it is shown in the table above handling or warehousing costs in European DCs will remain the same because the same amount of volume has to be handled in all three scenarios, meanwhile the handling costs on the cross dock platform will be reduced drastically comparing present and new distribution set ups. This is mainly due to the handling cost rate per cubic metre. But on the other hand, it is not enough to diminish the total distribution costs.

To calculate transport costs to the platform we used transport rates of the existing transport providers for SCA. Whereas, for the transportation costs from the platform to the customers' DCs, market prices were used.

Furthermore, it was assumed that number of drops in the route is equal to one, i.e. the truck leaving the platform has only one destination and does not stop during its trip for other pick-ups or drops. The amount of drops is reflected in the transportation pricing, in other words the price for transport is different if the truck has to stop 1 or 3 times on its route.

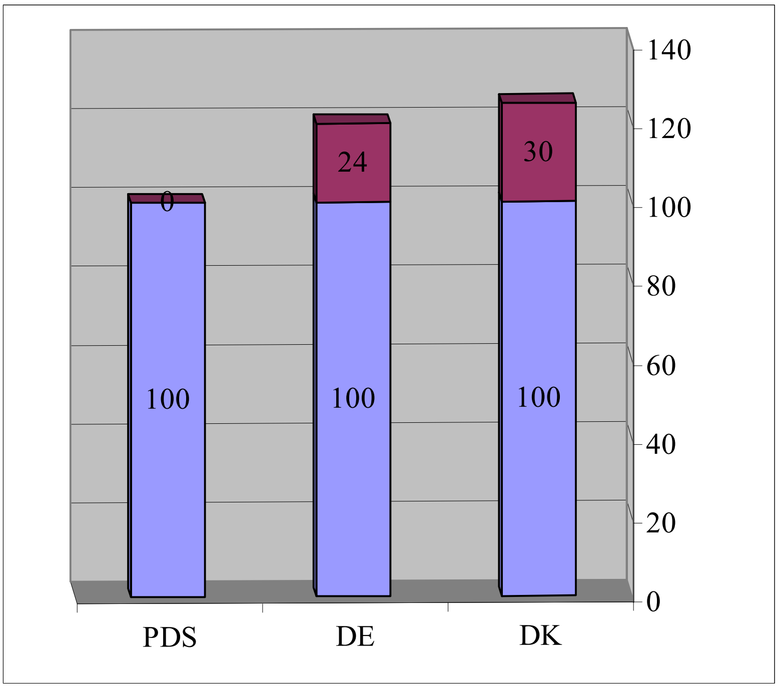

Figure 36. Increase in distribution costs with different locations

The cost estimation and simulation of the changes in Excel showed that the total distribution cost would increase up to 24% if the platform is placed in Hamburg, Germany and 30% if it is placed in Vejle, Denmark. The total distribution cost increases due to high transportation costs to customers, as the distance to the market will increase considerably.

5.2.5 Hypotheses Testing 5 for Cross Docking

Hypothesis 5 – with XD/SP set up will not retain the same tied up capital cost for considered flows.

$$\sum_{i=1}^{3} Xi,pd \neq \sum_{i=1}^{3} Xi,xd/sp$$

Where,

X1 – cycle stock cost
X2 – stock in transit cost
X3 – opportunity cost
pd – present distribution

XD/SP - cross docking/stockless platform

The tied up capital costs calculations for XD/SP set up were made using the same principle and formulas as for DD calculations. The authors would like to provide more detailed description of variable and fixed costs, which were used for calculating costs per unit. For cycle stock computations, in order to know how much products cost in different parts of distribution chain, we broke the costs into manufacturing costs (MC), handling costs at European DCs (EHC), home taking costs (HTC) and handling costs at Swedish DCs or stockless platform (SHC) per unit (m^3). In other words, we need to know how much the same products cost when they leave production site, what costs are added for handling and transportation.

Some of manufacturing costs for fluff products we have got directly from DCs account managers, while for tissue products the information was extracted from SAP system in a company. We have to admit that manufacturing costs differ greatly for tissue and fluff products, e.g. to produce 1m^3 of toilet paper cost six times less than to manufacture 1m^3 of baby diapers.

For calculating cycle stock of capital cost for present distribution system and XD/SP set up we included all MC, EHC HTC, SHC costs, meanwhile computing stock in transit costs of the capital costs, we included only MC and EHC. We think that HTC should be added when the goods reach SDC or platform and not when they leave EDC.

Another important thing when talking about tied up capital costs is a lead time or how much time it takes to carry the inventory. According to the theory, major savings could be achieved if the reduction of inventory days is made. We applied this statement for our case company, and with new XD/SP setup days of inventory can be reduced up to 40-50% (different IDCs in different countries have different inventory days). The main idea of cross docking is the elimination of storage or days of inventory in a node are equal to zero.

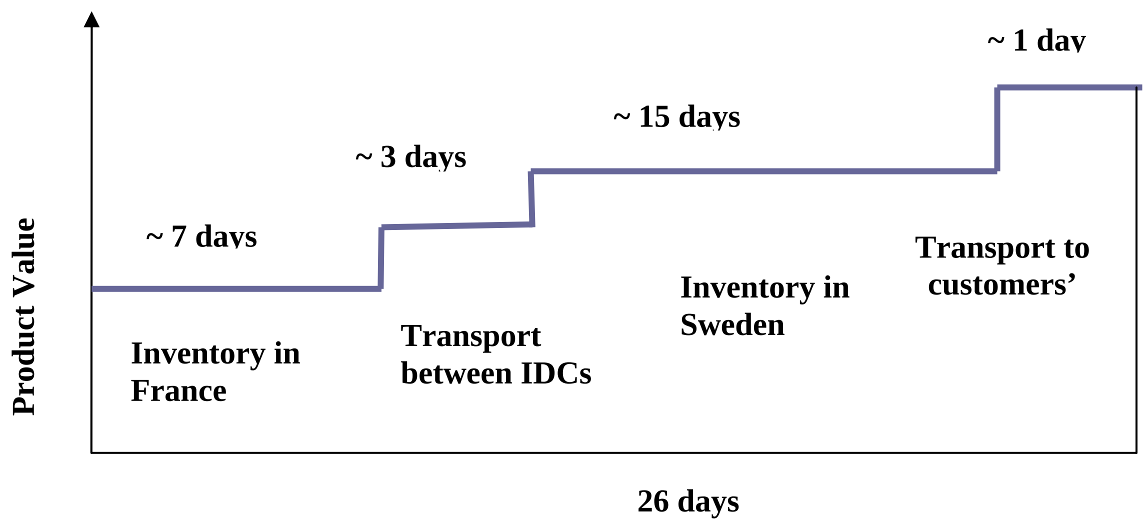

Figure 37. Days of inventory in a present distribution system

As it is visualized in figures 37 and figure 38, in a present distribution set up products' value is 26 days in France's case until they are ready to ship to the customer. With XD/SP set up the lead time can be reduced to 13 days. Days of inventory are different in each country and were analysed by countries separately.

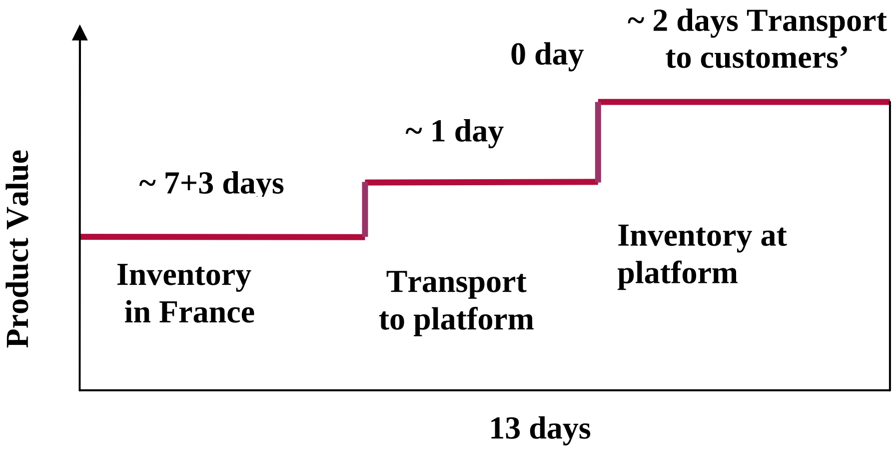

Figure 38. Days of inventory with the XD/SP distribution system

Table 12 presents results of tied up capital calculations. The numbers highlighted in different colour are the ones, which generate biggest savings, due to the change of transport mode, i.e. shorter transit time, and significant reduction of storage time in warehouses.

Table12 .Tied up capital and capital costs of present and XD/SP set up

	Present set up		X-Docking set up	
	Tied up capital	Cost of capital	Tied up capital	Cost of capital
NL	€ 12 704 822	€ 86 158	€ 12 213 626	€ 59 143
FR	€ 4 239 628	€ 21 735	€ 3 109 998	€ 10 814
BE	€ 4 213 761	€ 25 206	€ 1 815 926	€ 7 547
DE	€ 4 551 406	€ 28 468	€ 1 972 888	€ 9 337
AT	€ 2 987 065	€ 18 754	€ 1 496 378	€ 6 370
SK	€ 506 812	€ 3 330	€ 637 509	€ 2 674
Total:	**€ 29 203 493**	**€ 183 651**	**€ 21 246 325**	**€ 95 885**

With the new set up inventory turnover increases in some cases almost to 50%. Inventory turnover reflects the behaviour of logistical costs and while analysing tied up capital costs we used the data about inventory turnover received from warehouse managers. However, the figure can be calculated by taking the volumes of fluff and tissue sold during 5 months and dividing it by average inventory of products during 5 months.

5.2.6 Hypotheses Testing 6 for Cross Docking

Hypothesis 6 – Xcs,xd > Xcs,pds: XD set up will increase customer service level.

Where,

Xcs,xd – customer service level with cross docking set up;

Xcs, pds – customer service level with present distribution system.

Despite all the risks of malfunctions on changing distribution set up, the main target should be to keep customer service at the same level as it is at the present distribution system, where the customer service level is referred to as high as it was described earlier in Empirical research.

The factors such as inventory availability, operational performance and service reliability are to be on high level with a new set up as well, though the estimation of the customer service level with XD/SP set up is presented in a qualitative way based mainly on our perceptual experience and on theories. The customer service target can be achieved under some conditions as discussed below.

Inventory availability: the inventory with XD/SP is kept only at EDCs where the flows starts, therefore the availability should be fulfilled by keeping a small safety stock at IDCs in Sweden in order to avoid stock outs and fulfil customer demand. According to theories, high inventories are meant to achieve a high service level, but in our case we have to balance the inventory availability by fast transportation services and co-operation with service providers at the cross docking platform.

Flexibility as one of the components of operational performance: the demand increases when the retailers have promotions or some marketing programs; therefore the forecast is not to be used here. Though, it is not impossible to have a flexibility performance taking into consideration that there will be always stock in transit and the integrated information systems should contribute to flexibility as well. The information flow is to be one of the key points for success in this regard.

Malfunction recovery: it should be possible to ship the goods from SDC or to keep a small safety stock at the platform.

Speed and contingency: the order cycle should be increased here as the distance between the product origin and the market gets longer. Therefore if the stock in transit has to be average three days, as shown in the table 38 (under Hypothesis 5), and goods in the platform can be kept at least one day, the order should be placed minimum 5 days in advance. The other condition should be fulfilled here, the order transmission between sales organisation and EDC and order picking at DCs should take minimum 1 day.

Service reliability: As the last steps when implementing cross docking, the negotiations with customers about prices and other services are inevitable. The benefits of the new distribution set up for the customer should be consistent and the customer should be aware of the risks as well but the benefits are to have more weight in this case.

Thus, we can conclude that Hypothesis 6 is not an absolute truth as the delivery service with a new set up will suffer and it will be challenging to prevent all the uncertainties due to the fact that inventories will be pushed back in the supply chain. Though, the successful implementation of the cross docking and negotiations with the customer about the other conditions, which can make them happy, can bring a balance into those uncertainties.

5.3 Impacts of X-Docking

Here we defined and analysed the impacts of the proposed alternatives for the current distribution system as well as operational feasibility of the physical distribution network with the new set up. We should take into consideration that different distribution set ups will influence not only total logistics costs but also the whole distribution network, as for instance, staff at the warehouses or customer service department.

First of all, the complexity in Swedish DCs will be taken away by eliminating external warehouses. Instead of having the stock of the same products both in European and Swedish DCs, only European DCs will keep the stocks, even though their safety stocks will increase the total inventory level will be reduced. In other words, the responsibility of inventory level will be given to European DCs and inventory is moved closer to manufacturer.

There will be freed space at Lilla Edet IDC (approx. for stocking 1700 pall/month) and at Falkenberg IDC (approx. for stocking 2000 pall/month) to be utilized for other goods storage. This can result in costs decrease for external warehouses.

Another important thing is that Swedish DCs have their own fixed costs, which have to be covered, e.g. labour costs, handling equipment, etc. The reduction of product flows to the DC will require reducing working capital, which might have negative consequences for warehouse personnel. Looking at the situation from local DC level it would, definitely, cause more “damage”, but seeing the situation from the strategic level, a competitive advantage of the supply chain could be achieved.

Furthermore, the accuracy of the delivery becomes significant. The big distance difference between DCs in Europe requires time accuracy and coordination in shipping orders. For example, the truck with the goods from Slovakia has to leave earlier from the origin country if the goods have to be shipped together with goods produced in Germany. Otherwise the goods produced in Germany have to be stocked until arrival of the other goods from the same order/shipment.

Lead times should be carefully observed to avoid the risk of possible delays and back orders. Also, lead times with cross docking set up should not be changed, though in this case it is difficult to achieve. In the present distribution system the consumer goods produced in Europe are shipped from the stock at Swedish IDC to the customer with high delivery frequency (every day for ICA), thus, allowing a very short lead-time. In our case, a high degree of integration in supply chain will be needed in order to keep the same customer service level of 98%.

A new physical distribution set up contains some risks and uncertainties both for the supplier, SCA HP, and the customer in terms of order handling. The proposed set up will add complexity in order handling for SCA, as the order received from customer will be differently handled for tissue and fluff as it is now. After receiving the order for Consumer Fluff and Consumer Tissue Customer Logistics managers have to split info from their customer and send the information in different directions: (a) Consumer Tissue produced in Sweden, (b) Consumer Fluff produced in Sweden, (c) Consumer Fluff produced in Europe, (d) Consumer Tissue produced in Europe. This will add extra operations in splitting the order and sending it to different supplying countries. For instance, if the order consists of $65m^3$ of fluff produced in Gemerska Horka, Slovakia, $123m^3$ of fluff produced in Linselles, France, and $38m^3$ of tissue produced in Ortman, Austria, that means that customer service managers should first recognize product type and then the producing country and send the order in different ways, as the SAP is integrated only in Nordic countries.

And the last but not least impact on XD/SP set up is increased transportation costs, namely costs for freight to customers, due to long distances between consolidation point and the market.

VI. Conclusions

The aim of this chapter is to answer the question of our research problem, to explain and discuss the result of the research and its key findings. In the first part the conclusions of the whole work are made and it followed by the recommendations and propositions to the company for further research.

6.1 Key findings

To answer our main problem, which is *how logistics efficiency can be increased*, we found the answers to the research problems first.

For the answers to the first research question, which was defined as *what are the ways for the physical distribution improvement in SCA HP*, we looked through the discussions within the company and through literature review. Direct delivery and distribution via cross-docking stockless platform models for consumer goods distribution were presented in this paper as alternatives to the present distribution system.

The answer to the second research problem, *how those alternatives influence logistics efficiency in SCA HP*, was presented in empirical research and analysis parts. With the chosen criteria for hypotheses testing, we were able to answer how logistics efficiency will be influenced with different distribution system set-ups.

It was proved that the logistics efficiency in SCA HP can be improved by increasing Direct Deliveries flows from European factory warehouses to major customers in Nordic countries, namely customers like ICA and DAGAB located in Stockholm, Vaxjö and Göteborg. This is true mainly for Fluff flows from Hoogezand, Holland. The volumes, which are not delivered directly, are the subjects to distribution via cross docking platform. The distribution of Consumer Tissue is proved to be efficient in the present distribution system but there are two flows which can be taken into consideration in this regard, namely from flows Ortmann to ICA in Växjö and from Manheim to Dagab in

Gothenburg. Benefits of the proposed DD model were expressed in cost savings, which resulted in 12 per cent distribution cost savings on a five-month basis.

The Cross Docking concept has been modelled with locations on the market and was proved to be applicable in our case as well. The findings showed that even distribution costs will increase, the savings can be obtained from tied up capital costs perspective. The principles stated in the theory that it is absolutely necessary to evaluate any project from total costs perspective, than focusing only on one part of the costs was confirmed.

The simulation of the model in Excel was conducted disregarding such factors as frequency of trucks arrivals to the platform (number of stops there) and drop size at delivering from the platform to the customers due to the fact that the number of flows and customers is big and it was difficult to go into detail with every small flow, simulating drop size or delivery frequency of every customer. Those factors can influence sufficiently the real picture on implementing the cross docking. Thus, decreasing the number of less than truck loads and delivering full truck loads instead from the platform to the customer can be one of the trade offs in this regard.

6.2 Recommendations

As a result of the conducted investigation of the different physical distribution systems, some recommendations for SCA HP are provided below.

6.2.1 Direct deliveries

There is a big potential for cost savings if the number of direct deliveries was increased. The results of our computations showed that there is big volume of fluff products, which could go directly to the customers. Here, we are talking about the flows from Hoogezand in Netherlands to the Swedish and Norwegian customers, such as ICA and Dagab. For the tissue products, some flows from

Manheim, Ortman and Stembert should be considered as possibilities for direct deliveries to ICA and Dagab in Sweden and Joh-System AS in Norway. The main reason for that is reduced distribution and tied up capital costs for SCA HP.

In order to maintain the same customer service level, re-negotiation of minimum order size should be made with the customers or in order for the customer to accept bigger order size, part of savings have to be shared.

With the aim to increase direct delivery index, review of sales in different DCs should be carried out periodically.

Before making a decision about increase of direct deliveries, some awareness is recommended in transportation planning, such as coming German road tolls and their effect on transport pricing.

6.2.2 Distribution via XD/SP

The proposal of distribution via XD/SP is feasible for SCA HP in terms of total logistics costs. The calculations showed that distribution costs will increase with this kind of distribution set up, mainly because of switching transport modes from rail to the trucks. On the other hand tied up capital costs might decrease by half, because the time when products are in transit is reduced and time for storage in Sweden is eliminated. That results in reduction of total logistics costs. We recommend considering this alternative, but at the same time management should be aware that distribution via stockless platform is more complex solution for physical distribution improvement than DD.

First of all, truck utilization is a big issue in this case. The ability to consolidate the shipments from several customers becomes very complicated, mainly due to rigid delivery time frames. Failing to reach high truck utilization level, transport costs will increase gradually every year. To cross dock goods in cooperation with other manufacturers in Sweden, so called Manufacture Consolidation Centre (MCC), could be an option for this problem. In this case several manufacturers can consolidate their goods at one (outsourced) platform, thus sharing the facility. The reason to this is that the retailers (customers) network (or locations) more or less the same for manufacturers in Nordic countries.

Secondly, it is important to not overlook the frequency of invoicing the customers. The invoicing of the customers has to be increased at the same time as the company increases tied up capital turnover, in other words the inventory turnover and invoicing has to be proportional. Otherwise, even if inventory management is very efficient, finance department might be a bottleneck for overall improvement. That is why the integration of logistics and finance departments is obligatory.

Furthermore, close collaboration with customer is needed. As it was stressed during the interviews with consultants, transport companies, SCA HP managers mutual communication, understanding of processes and win-win solutions finding with customers and business partners is a key to successfully implement this kind of set up.

From the conducted research, we formed a conception that service providers are not mature enough for fast moving consumer goods consolidation, based on interviews that we had. There are no ready solutions for this type of products that SCA HP has. We were told that it can be planned, arranged, and implemented, but we were not provided with the real examples in this industry.

In the analysis part we tried to show the parts where economic savings can be attained. Of course, these are simplified situations and not all variables were included in our research that is why further investigation and more detailed calculations for the proposed solutions are required. In order to implement new distribution set ups, further research on the cost trade-offs for the customer should be conducted.

6.3 Propositions

There is an opportunity for implementing SP/XD at customer' DCs. In our case, ICA, which is the biggest customer for Consumer Goods in Sweden, is a potential partner for such a set up. The decision about location of SP/XD should be made depending on flows and volumes to be shipped, i.e. if the volumes of one customer are big enough and if the retailer sees the benefits of such distribution or if there are other suppliers who have the same type of goods to be consolidated, the SP/XD can be shared with them.

While conducting the research, many ideas were generated and one of them was to create a model for small cross docking platform at DCs in Falkenberg for the whole Consumer Fluff flows (produced in Sweden and Europe) and cross docking platform in Lilla Edet for the whole Consumer Tissue Flow (produced in Sweden and Europe). The idea was rejected due to the fact (as we were informed by managers in the company) that the space in DCs does not allow for that activity. Besides, the cross docking requires professionals in this area or to be outsourced. However, this is not proved empirically (due to time frames of the project) and can be an interesting subject for further research in order to prove if it is feasible or not.

Outsourcing of the whole distribution system to 4PL, who provide IT systems and organisational methods for improving goods distribution, can be one of the trade offs in our case in Cross Docking as well as with Direct Deliveries. Thus, freeing company’s investments on other links in the supply chain.

Appendix I. DDD Volumes

From	Product	Customer	m^3/5months	m^3/week
NL, Hoogezand	Fluff	ICA HANDLARNA ÖST AB	1425.8	71.3
NL, Hoogezand	Fluff	DAGAB NORD AB HANINGE	1049.8	52.5
NL, Hoogezand	Fluff	ICA-HANDLARNA VÄXJÖ	2552	127.6
NL, Hoogezand	Fluff	DAGAB VÄST GBG	1225.2	61.3
NL, Hoogezand	Fluff	ICA ST GÖTEBORG	1766	88.3
NL, Hoogezand	Fluff	ICA KUNGÄLV	1541.8	77.1
NL, Hoogezand	Fluff	JOH-SYSTEM AS, OSLO	1171.7	58.6
NL, Hoogezand	Fluff	COOP TERMINAL OSLO	2101.5	105.1
NL, Hoogezand	Fluff	HAKON, SKÅRER	1063.2	53.2
Total	**Fluff**		**13897**	**694.9**
AT, Ortman	Tissue	ICA-HANDLARNA VÄXJÖ	1311.7	65.6
BE, Stembert	Tissue	JOH-SYSTEM AS, OSLO	1138.4	56.9
DE, Manheim	Tissue	DAGAB VÄST GBG,	1146.1	57.3
Not assigned	Tissue	ICA-HANDLARNA VÄXJÖ	1346.7	67.3
Not assigned	Tissue	ICA HANDLARNA VÄST	1404	70.2
Not assigned	Tissue	ICA PARTIHANDEL, GBG	1650.6	82.5
Not assigned	Tissue	DAGAB VÄST GBG	1537	76.9
Not assigned	Tissue	ICA HANDLARNA SYD, VÄXJÖ	2013.1	100.7
Total	**Tissue**		**11547.6**	**577.4**

Appendix II. Data for facility location

	pall. q-ty	Long.	Latt	Cost/pall			
Demand	Vki	Xki	Yki	Tki	Xki*Tki*Vki	Tki*Vki	Yki*Tki*Vki
Göteborg	1812	58	12	9874	194512152	16249971	937623323
Malmö	76	56	13	537	625001	48040	2669584
Växjö	694	57	15	5351	70632786	4772486	271458979
Stockholm	1132	59	18	6518	127945482	7080547	420018039
Tot./1mon.	**3713**			**22280**	**393715421**	**28151043**	**1631769925**
Supply	Vlj	Xlj	Ylj	Tlj	Xlj*Tlj*Vjl	Tlj*Vjl	Ylj*Tlj*Vjl
FR	275	51	3	10451	8812190	2870420	145530309
NL	1237	53	7	37208	308267243	46010036	2443132926
SK	157	49	20	6703	21372753	1052845	51062981
BE	673	51	6	19759	78482736	13302159	671759014
AT	326	48	16	9864	51070709	3211994	153533327
DE	1046	51	7	24934	172185681	26088739	1325307965
Tot./1 mon.	**3713**				**640191312**	**92536194**	**4790326523**

$$X = \frac{\Sigma(Xlj*Tlj*Vjl) + \Sigma(Xki*Tki*Vki)}{\Sigma(Tlj*Vjl) + \Sigma(Tki*Vki)} = 53° \text{ North of Equator}$$

$$Y = \frac{\Sigma(Ylj*Tlj*Vjl) + \Sigma(Yki*Tki*Vki)}{\Sigma(Tlj*Vjl) + \Sigma(Tki*Vki)} = 8\text{-}9° \text{ East of Prime Meridian}$$

Where, i = 1, …..n (number of customers)

j = 1, ……n (number of supplying DCs)

Appendix III. Glossary

In glossary below are some of the definitions in logistics terminology the authors used in the Master Thesis paper, however not described in theoretical part of the paper. The definitions are taken mainly from the course literature and other available logistics sources referred to in References part.

EDI – Electronic Data interchange implies transmission of data between a firm and its supplier and a tool for transparency between organisations, which need to integrate process in the supply chain.

ERP – Enterprise recourse planning is a logistics information system, which provides the database and the transaction capability to initiate, track, monitor and report on customer and replenishment orders.

Continuous Replenishment – the strategy when the retailer takes the responsibility for setting target inventory levels. The supplier commits to keeping the retailer in stock and to maintaining inventory velocity. Replenishment can involve cross docking and direct delivery distribution designs to eliminate the need for warehousing between the factory and retail store.

4PL - A supply chain integrator that assembles and manages the resources, capabilities and technology of its own organisation with those of complementary service providers to deliver a comprehensive supply chain solution

Supply Chain Management – Channel arrangement based on acknowledged dependency and relationship management and which requires managerial processes that span across functional areas within individual firms and link trading partners and customers across organisational boundaries.

VMI – vendor management inventory involves the strategy when supplier assumes more responsibility and actually manages inventory for the retailer.

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