EVALUATING LOGISTICS

The development of a method for examining a logistics system and evaluating its performance

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Master Thesis LIU-IEI-TEK-A--08/00331--SE
Department of Management and Engineering
Logistics Management

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FOREWORD

This report is our degree thesis at the Institute of Technology at Linköping University. It concludes our studies at the education program for Industrial Engineering and Management. The work has been conducted between September 2007 and January 2008. The assigner for the thesis is UAE Logistics.

Many people have contributed to this study. First and foremost we would like to thank our supervisor at UAE Logistics, Caroline Raning, for her support and help throughout the work. Furthermore our supervisor Håkan Aronsson and our opponents Lovisa Jonsson and Linda Larsson have given us much valuable input. Finally the workshop participants from UAE Logistics and the case study companies have all provided important contributions to the results.

Stockholm in February 2008

Anna Berg and Konrad von Otter Choroszynski

EXECUTIVE SUMMARY

UAE Logistics is a company who offers consulting, logistics development and logistics administration in Logistics Control Towers (LCT). The consulting services focus both on the LCT customers and on freestanding services for other clients. At the moment the consulting division performs process, supply chain and supplier relationships development and logistics road mapping among other things. However the consulting division at UAE Logistics has recognized a demand for a service where a client can, in a short period of time, have their logistics system analyzed, evaluated and compared against other companies. The purpose of this thesis is therefore to develop a method for examining a logistics system and evaluating its performance so that problem areas can be identified. This method should result in a diagnosis within a week.

The development of the method for logistics evaluation is divided into three parts. A literature review serves as a basis for the first version of the method. Thereafter the first version of the method is evaluated. The first instance of evaluation consists of two workshops with participants from UAE Logistics' Supply chain consulting and Sales & marketing divisions. These workshops result in a second version of the method. The second evaluation type consists of case studies where the method is tested on three different logistics systems. The case studies result in a third and final version of the method.

The developed method is divided into four steps that need to be followed when performing an evaluation of a logistics system. These steps are called System Description, Input and Output, Transformation, and Deeper Analysis and Conclusions.

The first step of the method, System Description, focuses on understanding the logistics system that is to be evaluated. Here the logistics system is mapped and matched against a general representation consisting of procurement, operations and distribution. Thereafter the characteristics and goals of the company and its logistics objectives are examined to be able to relate the results of the evaluation to something. The System Description step is supposed to result in a greater understanding for the logistics system and the characteristics and goals of the company.

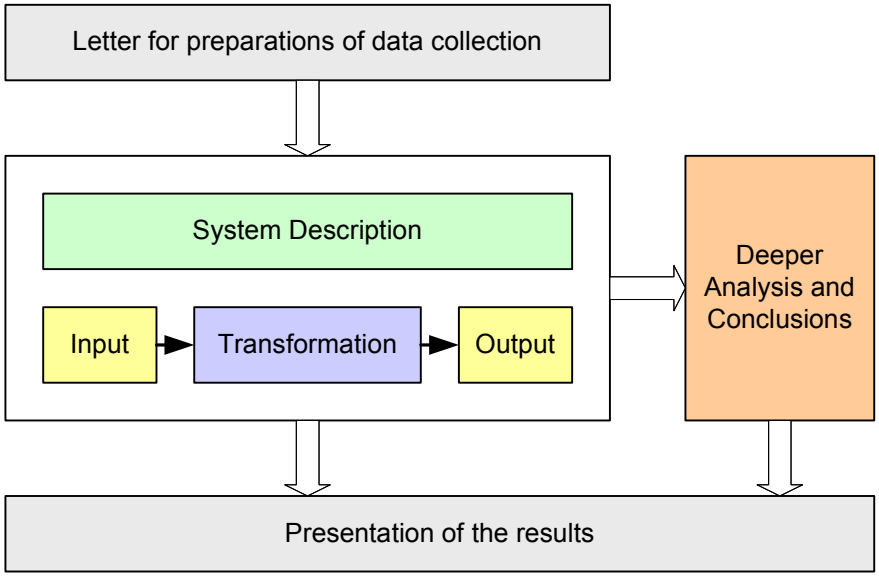
The Input and Output step of the method evaluates the logistics as a whole focusing on the input and the output. The input is considered in terms of the total costs and the output in terms of customer service. To ease the evaluation of these two aspects they are each divided into a number of total cost and customer service elements. The Input and Output step primarily collects quantitative data. The result from the total cost investigation is a total cost breakdown and the customer service examination results in levels for different customer service elements.

The Transformation step focuses on what happens between the input and the output in the logistics system. This part is examined mainly by asking qualitative questions on the three areas, procurement, operations and distribution, that the logistics system is divided into. Moreover the time aspect of the Transformation is evaluated more closely. The qualitative questions in the Transformation step are used to decide the level of control the

company has over its logistics. The time aspect of the Transformation step results in a lead time analysis where bottlenecks and time consuming activities can be visualized.

From the analysis of input, output and transformation deeper analysis is performed in order to draw conclusions. There are no strict guidelines exactly for how the Deeper Analysis and Conclusions step should be carried out. Instead the deeper analysis is meant to concentrate on the parts of the logistics system where problems may occur or already exist. This step increases the flexibility of the method since only relevant or interesting areas are investigated deeper and since the depth of the further analysis can be adapted so that it fills out the time that is available for the evaluation. Once a number of evaluations of logistics systems have been performed it will be possible to compare one company's results with those of other companies to support benchmarking. To start with, however, mostly comparison to the goals of the company is possible.

In addition to the four steps, the method also has two other components. First, a letter for preparations of data collection is included in the method. This letter should be sent to the company, that is to be evaluated, before the first visit at the company. That way the company is able to prepare figures needed in order to execute the investigation. Secondly, a template for the presentation of the results is included in the method. The template consists of the most important headings needed to present the results and a few guidelines on how to structure the presentation. In the figure below an overview of the method is given.



Overview of the method

The first draft of the method is developed rather quickly from a literature review. This report thereafter focuses on evaluating and improving the method. The conclusions of this thesis state that the developed method works well for drawing conclusions about the logistics performance of a company. However it is possible for UAE Logistics to continue evaluating and improving the method when using it.

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1 INTRODUCTION

This chapter describes the background to this thesis and its purpose. Furthermore the directives given from UAE Logistics are discussed.

1.1 Background

Logistics has had its definite breakthrough as a strategically important business area. It is a significant factor in creating competitive and profitable companies. (Aronsson et al., 2004) Many companies have recognized this and realize that they do not have the right logistics competence in-house. Some companies therefore choose to partly or completely outsource their logistics operations so they can focus on their core business areas. Others want help with more specific tasks, such as optimizing goods flows or developing logistics strategies.

UAE Logistics is a potential partner for companies who seek specialist logistics competence. The three main areas that UAE Logistics operate in are logistics consulting, logistics development and logistics administration. The logistics consulting division offers a variety of services where the client's logistics system is examined. Further on they also develop and implements different logistics solutions. (UAE Logistics *Consulting Services*, 2007)

Analyzing a company's logistics requires a special approach, looking at value adding processes and how changes affect total costs and customer value. Traditional performance measuring usually has a different focus, based on individual budget goals for a company's different functions and not the cross functional processes. (Aronsson et al., 2004) Therefore performing an extensive logistics analysis is a time-consuming process that can not easily be shortened.

UAE Logistics consulting division has recognized a demand for a service where a client can, in a short period of time, have their logistics system analyzed, evaluated and compared against other companies. First and foremost this would serve as a free standing service giving the client an indication of how well their logistics system is operating and point out what problem areas there might be. But such a tool could also serve as a starting point for deeper investigations. (Raning, 10-Sep-07)

Today there are no internal instructions or guidelines when the consulting division performs the first analysis of a client's logistics system. Having a standardized approach could make the analysis more efficient and enable proper comparisons between different organizations. It could also minimize variations in what conclusions are drawn from the analysis depending on how it is carried out. Because of these issues UAE Logistics want a standardized method for examining companies' logistics systems in order to identify problem areas. (Raning, 10-Sep-07)

1.2 Purpose

The purpose of this thesis is to develop a method for examining a logistics system and evaluating its performance so that problem areas can be identified.

The method should:

- Consist of guidelines for both collection of data and the initial analysis
- Be a foundation for further analysis
- Enable comparison between different logistics systems

1.3 Directives

In order to give some more guidelines to the development of the method UAE Logistics add three directives to the purpose. These directives follow below.

The method should support the consultants in the first analysis of the client's logistics system which is supposed to give a quick overview. Based on market surveys UAE Logistics have stated that the customers are willing to pay for an investigation taking about 40 hours. Therefore the investigation should, if performed by one consultant, result in a diagnosis within a week.

UAE Logistics' core competence is not production logistics but rather focused on external logistics. Their expertise lies within managing the complete supply chain. Therefore it is desired that also the method should have such a focus.

The method should be general and applicable to various industries. If limitations must be made, companies producing and delivering physical products are high prioritized.

1.4 The composition of the report

In this chapter the composition of the report is given in short in order to give the reader an early insight into how this report is structured. Some aspects that are explained later on in the thesis are only discussed briefly at this stage.

After this first chapter, stating the background, purpose and directives of the investigation, a short description of UAE Logistics is given in chapter *2 UAE Logistics*. This chapter gives an overview of the current situation and the company that is to use the method in the future. Thereafter follows chapter *3 Theoretical review* which serves as a basis for the development of the first draft of the method. The first draft of the method is developed in chapter *4 Specification of the task*. Thereafter this chapter discusses what questions are needed to evaluate the method. Chapter *5 Methodology* concerns how the investigation is carried out; stating that the first literature based draft of the method should be evaluated through first workshops creating a second version of the method and thereafter through case studies resulting in the third and final version of the method. Next follow the results and analysis from both the workshops and the case studies, chapter *6 Results and analysis – Workshops* and chapter *7 Results and analysis – Case studies*. Finally the conclusions from the study and further recommendations are presented in chapter *8 Conclusions and recommendations*. In appendix C the final version of the

developed method can be found. In Figure 1, below, the composition of the study is visualized. This figure is explained more closely in chapter *5 Methodology*.

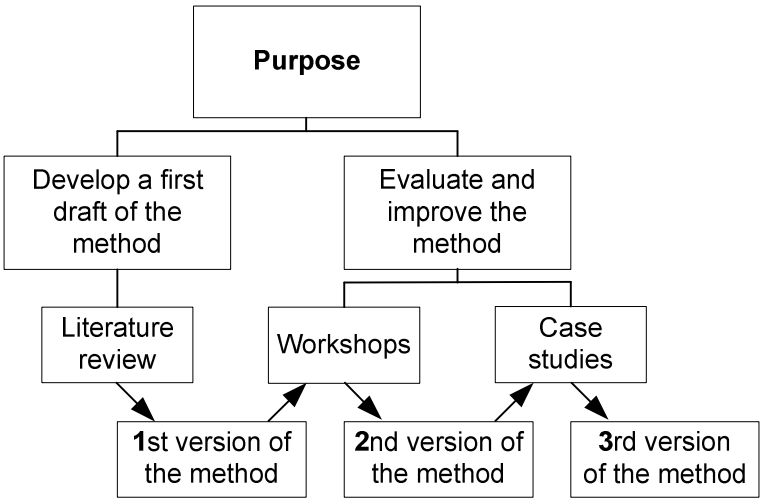

Figure 1. The composition of the study

2 UAE LOGISTICS

In this chapter a short review of the history of UAE Logistics is given along with information about the company's current status, including how it is organized and more detailed descriptions of the Logistics Control Towers and consulting services.

2.1 History

In year 2000 the Swedish telecom company Ericsson experienced problems with high safety stock levels, long lead times and a general lack of control of their logistics. Since they did not consider logistics to be their core competence they decided to outsource the logistics function hoping to solve these problems. Four different logistics companies were chosen to manage Ericsson's logistics, each with their own geographic region. One of the chosen companies was Air Express International. Their Swedish agent Universal Air Express became responsible for distributing Ericsson's products. However Universal Air Express was an air freight company with limited competence in other logistics areas. Therefore the subsidiary UAE Logistics was founded in 2000 to manage Ericsson's distribution flow with only ten employees. Shortly after UAE Logistics started off the ownership of the company changed and Danzas, which is now integrated in DHL, became the major owner (Raning, 10-Sep-07).

Through their business with Ericsson, UAE Logistics developed the concept Logistics Control Towers. With these towers they take full responsibility for their client's logistics which means that UAE Logistics take over the client's logistics setup and continuously develop it. (UAE Logistics *Services*, 2007) Since the startup the company has grown steadily and created its own development unit that offers consulting services.

The current number of employees at UAE Logistics is approximately 130 and the annual revenues are about one billion SEK. The most important customer is still Ericsson but others have followed. Today SAAB, FMC Food Tech, Metso Paper, Alfa Laval and Emhart are all amongst those who use UAE Logistics' services. (*Välkommen till UAE Logistics*, 2007) The headquarters are situated in Stockholm but the company is also represented in Linköping, Helsingborg, Dubai and Dallas (UAE Logistics *The Company*, 2007).

2.2 Organization

UAE Logistics' Control Towers are organized into two different business areas. Ericsson Control Towers (ECT) handles Ericsson's logistics and Logistics Control Towers (LCT) manages the logistics of other customers, such as SAAB and Alfa Laval. Furthermore UAE Logistics has divisions for Human Resources, Sales & Marketing and Development & Consulting. Finally there are functions for Business Controlling and Quality & Environment. Both Human Resources and Business Controlling are shared with DHL. (UAE Logistics *Organization*, 2007)

Since this thesis focuses on the consulting services the Development & Consulting division is especially interesting. Development & Consulting is seen as UAE Logistics' "competence centre" and is supposed to contribute with competence within supply chain management, system solutions, purchasing, process and quality. Moreover the division should work with internal projects as well as external clients. (UAE Logistics *Development and Consulting – Busplan*, 2007) The division is divided into three different parts – Strategic Purchasing, Business Solutions and Supply Chain Consulting. The method for examining a logistics system, that this thesis aims to produce, is to be used by

the Supply Chain Consulting division. Seen below in Figure 2 is an illustration of UAE Logistics' organization.

Figure 2. The organization of UAE Logistics (UAE Logistics *Organization*, 2007)

2.3 Logistics Control Towers

Today UAE Logistics' largest business area is offering logistics administration through their so called Logistics Control Towers. The aim of the Logistics Control Tower is to optimize service and cost efficiency and in doing so the focus is on the whole supply chain. Therefore UAE Logistics work closely with both the client and other parties in the client's supply chain in order to operate and develop the logistics functions. Furthermore the close cooperation helps UAE Logistics provide the client with only one interface to external parties in the supply chain which simplifies operations for the client. (UAE Logistics *Logistics Control Towers*, 2007) In Figure 3 below the concept of Logistics Control Towers is summarized.

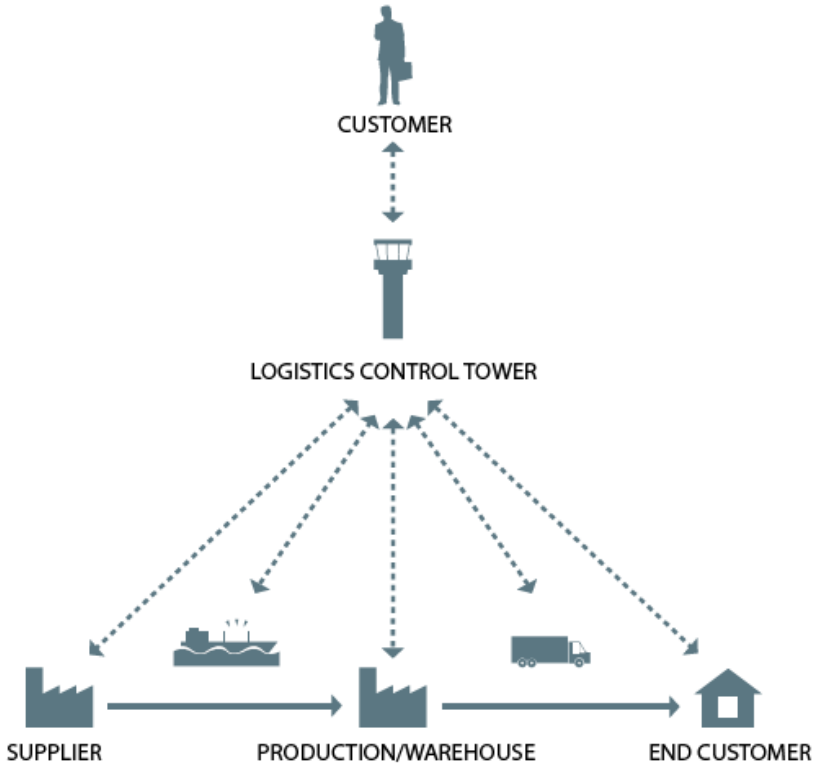

Figure 3. Logistics Control Tower (UAE Logistics *Logistics Control Towers*, 2007)

Instead of having its own warehouses and vehicles the Logistics Control Towers use existing networks of logistics service providers. By doing so UAE Logistics are able to choose the most suitable provider for every specific situation. (UAE Logistics *Logistics Control Towers*, 2007) It should however be emphasized that although being a subsidiary to DHL, UAE Logistics act neutrally and are free to use whatever alternative they consider best fulfills the needs of their client. (Raning, 10-Sep-07)

2.4 Consulting services

UAE Logistics offer consulting services both to support and develop the Logistics Control Towers and as freestanding services for other clients. The consulting division offers a broad spectrum of services. They can help develop processes, supply chains and supplier relationships. Other examples of the type of services they provide are logistics road mapping and supporting logistics outsourcing. (UAE Logistics *Consulting services*, 2007) The method for assessing logistics performance, that this thesis results in, is meant to complement and strengthen the portfolio of services that the supply chain consulting unit offers.

3 THEORETICAL REVIEW

In the theoretical review the literature that serves as a basis in this thesis is reviewed. First theory on how to define logistics is discussed. This is followed by a discussion on how to model a logistics system and difficulties in evaluating logistics. Thereafter an examination on the goals of logistics is performed. Finally the input, output and transformation of a logistics system are addressed.

3.1 Defining logistics

The purpose of this thesis is to develop a method for examining a logistics system and evaluating its performance. To be able to fulfill the purpose it is important to have a clear definition of the meaning of logistics. According to Council of Supply Chain Management Professionals (CSCMP) logistics is defined as following.

"The process of planning, implementing, and controlling procedures for the efficient and effective transportation and storage of goods including services, and related information from the point of origin to the point of consumption for the purpose of conforming to customer requirements. This definition includes inbound, outbound, internal, and external movements." (CSCMP *Supply Chain and Logistics – Terms and Glossary*, 2006)

In literature and articles the word logistics (management) and supply chain management are sometimes used interchangeably. This can cause confusion. Therefore how CSCMP (2006) defines supply chain management is mentioned below.

"Supply Chain Management encompasses the planning and management of all activities involved in sourcing and procurement, conversion, and all logistics management activities. Importantly, it also includes coordination and collaboration with channel partners, which can be suppliers, intermediaries, third-party service providers, and customers. In essence, supply chain management integrates supply and demand management within and across companies. Supply Chain Management is an integrating function with primary responsibility for linking major business functions and business processes within and across companies into a cohesive and high-performing business model. It includes all of the logistics management activities noted above, as well as manufacturing operations, and it drives coordination of processes and activities with and across marketing, sales, product design, finance and information technology." (CSCMP *Supply Chain and Logistics – Terms and Glossary*, 2006)

From the definitions of logistics and supply chain management it is clear that the two concepts have much in common. Lambert & Stock (2001) argue that supply chain management can be seen as the logistics outside the firm, including customers and suppliers. This implies that logistics always has a supply chain orientation, including areas such as materials management and information flows across the supply chain.

The method this thesis produces is meant to be applied on companies or divisions that typically are a part of a greater supply chain. Since the method will focus on their specific part of the supply chain the term logistics is used in this report. However it should be noted that the term supply chain management might be used in the original source even if the word logistics is used in this text.

3.2 Modeling a logistics system

Logistics can be seen as a system. A system approach to logistics suggests that all activities and changes in a system can only be understood by how they affect the big picture. Activities can not be analyzed as isolated events, but instead in terms of how they interact with their surroundings. (Lambert & Stock, 2001)

Below, firstly how a system should be specified is addressed. Thereafter different ways of structuring a logistics system into a general representation are discussed.

3.2.1 Specifying the system

In the method for evaluating a logistics system that this thesis develops it is important that the customer and the consultant have the same picture of what to include and what to exclude in the evaluation. Therefore it is of great importance to carefully describe the system.

According to Bruzelius & Skärvad (2000) an overall picture of an organization and its problems can be obtained through viewing the organization as a system. They further point out that, in all descriptions of open systems, it is important to map the system's input, transformation and output. Depending on the circumstances what is considered to be the input, transformation and output may vary. The input can be regarded as the resources the company puts in to achieve a certain result or output. In this thesis the input is seen as the total costs the company invests to achieve a certain output. The output is considered to be the customer service the company provides for its customers. The transformation explains how the input is converted into output. The concept of an open system is shown in Figure 4 below.

Figure 4. The system's input, transformation and output (Bruzelius & Skärvad, 2000)

To be able to illustrate a system a simplification of the reality needs to be made. Naturally this leads to that some information gets lost in the process. To make sure that most of the important aspects get highlighted a standardized way of illustrating the system can be useful. (Bruzelius & Skärvad, 2000) When specifying and mapping the system Aronsson et al. (2004) emphasizes that it is important to successively refine the parts of the system that are most relevant. The parts that are not that important should instead be kept at a rather general level.

3.2.2 Structuring a logistics system into a general representation

The method for evaluating logistics systems should be applicable to as many different companies as possible. Therefore a general representation for describing a logistics system is needed.

The logistics system spans a company from the management of raw materials through to the delivery of the final product. A common way to structure a company, from a logistics perspective, is in three main functions – procurement, operations and distribution. (Aronsson et al., 2004) Christopher (2005) illustrates the scope of logistics from the management of raw materials through to the delivery of the final product. Included in his model are also suppliers and customers. Furthermore he demonstrates the materials flow

and the requirements information flow in the model. Christopher's (2005) general representation of a logistics system is shown in Figure 5 below.

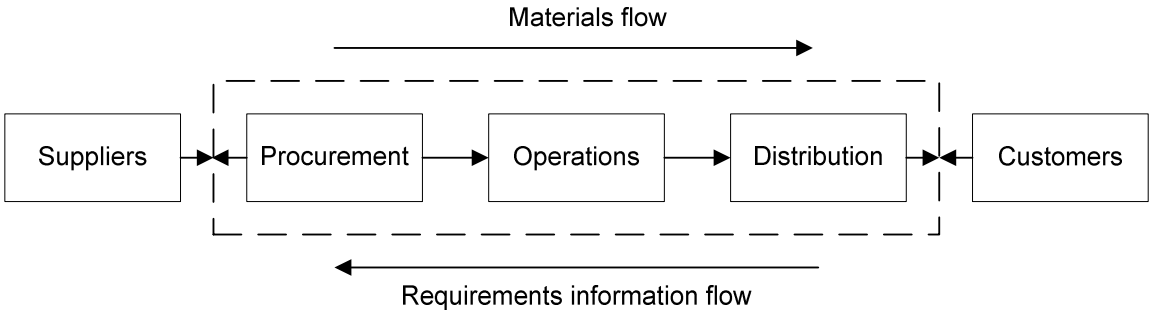

Figure 5. The scope of logistics (Christopher, 2005)

To point out that the focus is on the flow of products Aronsson et al. (2004) describe the logistics system, including its three main functions, as a pipe. This way the length of the different functions and the length of the pipe illustrates the lead time and the inner diameter represents the capacity. Furthermore there are inventories between the different functions, suppliers connected to the procurement and customers connected to the distribution. The logistics pipe of Aronsson et al. (2004) is illustrated in Figure 6 below.

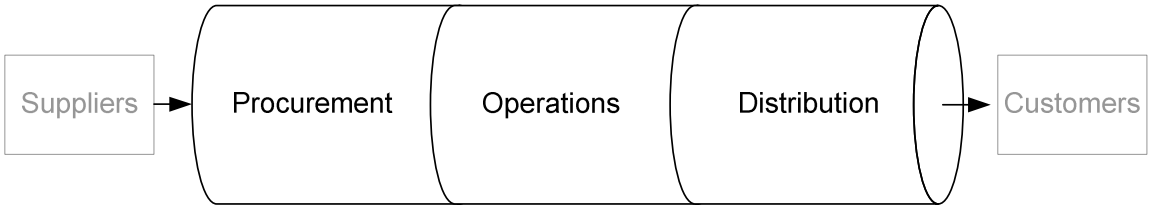

Figure 6. The logistics system (Aronsson et al., 2004)

If there are bottlenecks in the system the logistics pipe will illustrate that in a way that easily can be understood, see Figure 7.

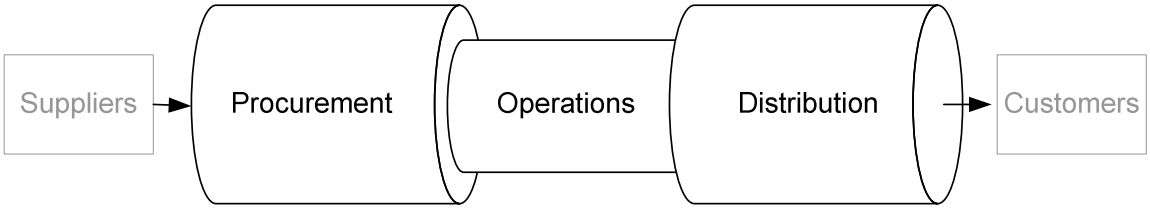

Figure 7. Bottlenecks in the logistics system (Aronsson et al., 2004)

The Supply Chain Council (2007) has developed a model called Supply Chain Operations Reference-model (SCOR) for measuring and evaluating the performance of a logistics system. This model is based on five distinct management processes in an organization; Plan, Source, Make, Deliver and Return which can be used to represent the logistics system. Plan is about management and planning of the supply and demand, while Source focuses on the inventory and the relationships with the suppliers. Make concentrates on the production and Deliver on the distribution. Finally Return handles the return of raw

materials and the reception of returns of finished products. (Supply Chain Council, 2007) The way the SCOR-model structures a logistics system is illustrated in Figure 8 below.

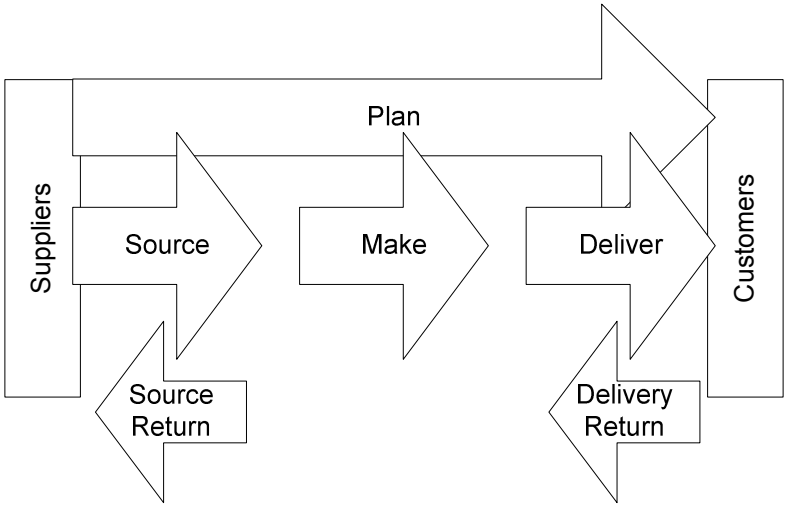

Figure 8. SCOR's structure of a logistics system (Supply Chain Council, 2007)

The models for general representations of logistics systems discussed above are pretty similar. They all have a first instance handling the suppliers and the procurement. The second part is about production or operations and in the latter part of the structure there is a division for distribution or delivery. However they do differ in the view of the after delivery activities. Some of the models point out this perspective while some do not. This aspect is not in focus in this thesis due to the limitations in time the method has. Given that this aspect is not taken into consideration the model that seems most appropriate is the logistics pipe by Aronsson et al. (2004). The reason for this is that it emphasizes the flow of material and throughput times in the specific parts of the logistics system. Therefore the logistics pipe is chosen as a general representation of a logistics system in this thesis. Below the different functions specified in the model; procurement, operations and distribution, are discussed briefly.

Procurement

The procurement concerns order entry and delivery of material needed in the operations. An important part of the procurement is searching for, selecting and contracting of suppliers. (Aronsson et al., 2004)

Operations

In general the word operations refer to a process of creating goods and services by combining material, work and real capital. This definition gives that the term "operations" differs widely. In some organizations it can be the production of a product and in other organizations it might just be the storage of goods. (Jonsson & Mattsson, 2005)

Distribution

The responsibility of the distribution division is to supply the customers with products from the finished goods inventory. Thereafter the customer can either consume the

product or add value to it before selling it to another customer. The goal of distribution is to make the finished products available to the customer at a low cost and with a high customer service level. (Aronsson et al., 2004)

3.3 Difficulties in evaluating a logistics system

To improve a company's logistics, as with any other area, it is important to be able to evaluate its performance. Many companies have realized that supply chains need to be assessed to become efficient and effective. Without measures and metrics it is highly difficult to form a clear direction for improvement so that an organization can achieve its goals. Effective performance measures and metrics are also necessary to test and evaluate different strategies. (Gunasekaran et al., 2001)

Logistics and supply chain management are areas that have gained recognition as key strategic factors for many companies. Much research is done on various aspects of these areas but little attention is paid specifically on performance evaluation of supply chains. (Gunasekaran et al., 2001) This could partially be explained by difficulties experienced when trying to measure logistics performance.

Already when defining what good logistics is, it becomes clear that it is not a trivial task to evaluate it. Some aspects are easy to measure and quantify such as various costs and times. Others are more "fuzzy" values such as information, flexibility and how well customers' needs are adjusted to. (Aronsson et al., 2004) These aspects are certainly very real and appreciated by customers, but difficult to size up.

There are considerable difficulties in analyzing the quantifiable logistics data, such as costs. Traditionally cost accounting methods are based on a company's functions. Shared and indirect costs are often allocated in arbitrary ways. Since the focus is not flow-oriented this can give a quite distorted view of the costs for different customers and markets. This lack of appropriate cost information can obstruct proper analysis of a company's logistics and supply chain management. (Christopher, 2005)

3.4 Logistics' goals

To be able to understand how to evaluate logistics performance the next step is to look deeper into the goals of logistics. This chapter first discusses logistics' goals and then focuses on two aspects of the goals, customer service and total costs, more carefully.

In order to evaluate the logistics performance of a company a basic understanding for that company must be gained. To reach this understanding the primary areas of the company need to be addressed. These areas can for example be found in a business plan. According to Holmström (2004) a business plan should include the following ten areas; History, Business concept, Product, Production, Market, Competitors, Marketing, Distribution and Sales, Organization, and Economy and Risks.

Jonsson & Mattsson (2005) discusses the difference between the levels of the goals in a company. Firstly, there is a comprehensive vision and objectives. Secondly, the company has a business strategy where the different competitive variables are defined. Last, at the

lowest level there are functional strategies for the different functions of the company, for example production, marketing and logistics. This means that the logistics strategy is a part of the business strategy and the comprehensive vision and objectives which is shown in Figure 9 below.

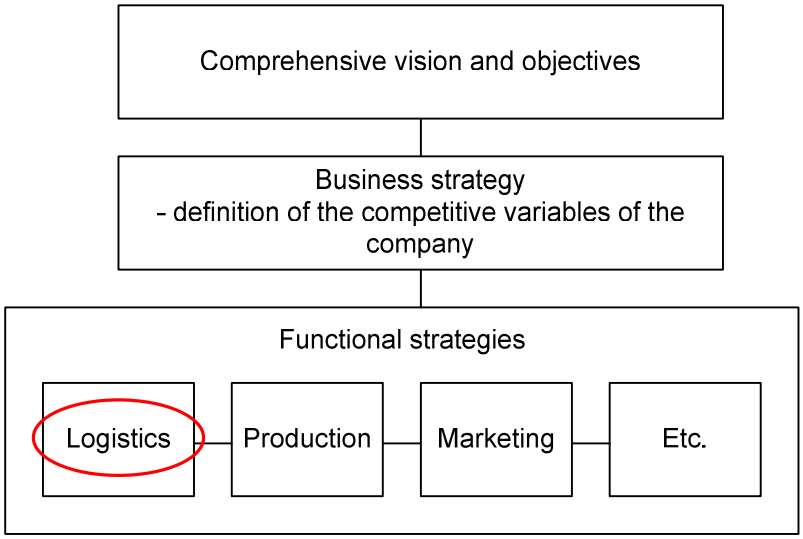

Figure 9. The logistics strategy is a part of the comprehensive goals of the company (Freely translated from Jonsson & Matsson, 2005)

Odette (1999) emphasizes that a goal oriented work is a necessity for an efficient organization. There is a need for documentation regarding the logistics goals to make the logistics efficient. By documenting the strategy it is acknowledged as an important area. Furthermore the logistics strategy should be broken down into goals concerning the logistics performance so that the employees know what to focus on in order to achieve the customer satisfaction the strategy is aiming for.

In logistics the aim is to reach as low total costs as possible while at the same time offering the required level of customer service. (Aronsson et al., 2004) This points out that focus should not be on achieving the highest customer service possible but rather on offering the customers the service level they demand. Since the method this thesis develops is to judge the performance of the logistics system and the performance depends on what the customer requires the method has a high level of complexity.

Lambert & Stock (2001) just like Aronson et al. (2004) suggest that a company should try to offer the demanded customer service level. However they emphasize that there needs to be a balance between the customer service and the total cost to reach the highest benefit. This is because a very high level of customer service will lead to extremely high costs, without a substantial increase in revenues. This characteristic demonstrates one aspect of the conflicting goals that exists within the area of logistics. The concept is shown in Figure 10 below.

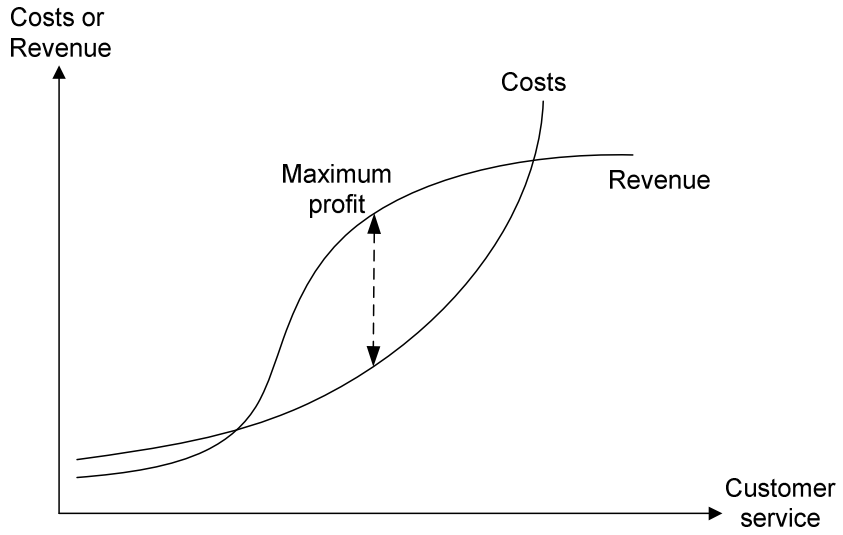

Figure 10. The impact of customer service level on costs and revenue (adapted from Lambert & Stock, 2001)

Christopher (2005) puts another perspective to logistics when he refers to it as a source of competitive advantage. He argues that successful companies have either a cost advantage or a value advantage or both of them. By value advantage the author refers to the idea that a product or service has to be unique for the customer not to choose the cheapest competitor instead. Furthermore logistics can provide a number of different ways to reduce the costs by increasing the efficiency and productivity. The optimal position for a company is to be both a cost and service leader which can be achieved by having both a high value advantage and a high cost advantage. However, having only either a high value advantage, being a service leader, or a high cost advantage, being a cost leader, can be a successful strategy. A problem only occurs when offering both a low value advantage and a low cost advantage since then the company faces the commodity market. This concept is concluded in Figure 11 below. Also Lambert & Stock (2001) suggest that logistics can create a competitive advantage. More specifically they claim that logistics plays an important role in three critical elements of the marketing concept. These elements are customer satisfaction, integrated effort and company profit.

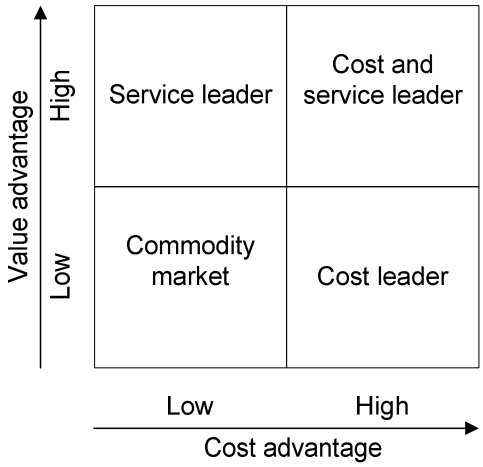

Figure 11. Logistics competitive advantage (Christopher, 2005)

Jonsson & Mattsson (2005) discuss how the level of logistics efficiency and effectiveness influence the company's profit. They also state that this can be expressed in a number of variables that affect the company's revenues, costs, assets and the environment. These variables are customer service, costs, tied up capital, flexibility, time and environment. The problem is, however, that some of these variables of efficiency and effectiveness counteract each other. Therefore the company needs to figure out how the variables should be prioritized to best reflect the overall goals and strategy the company has. The connection between the variables in a logistics system is shown in Figure 12 below.

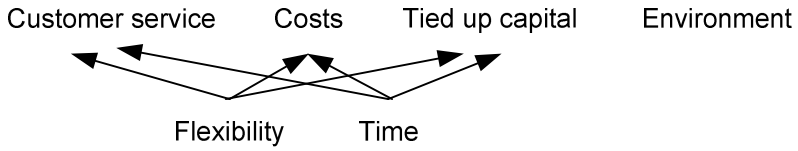

Figure 12. Connection between the variables of efficiency and effectiveness in the logistics system (Jonsson & Mattsson, 2005)

As seen in the discussion above most authors focus on that logistics is about delivering the customer service demanded at the lowest total cost possible. Jonsson & Mattsson (2005) also put focus on tied up capital, environment, flexibility and time. Below only customer service and total costs will be discussed more carefully. However, tied up capital is included in costs and time will be addressed in greater detail later. The environmental aspects are complicated to quantify and measure and due to the time limitation they will not be taken further in this thesis. Flexibility is in some cases considered as a part of the customer service. Also this aspect is delimited at this stage but discussed later on in the thesis.

3.4.1 Total cost

Total cost is an important concept in logistics. It implies that focus shall be on all the costs over the whole company, not just on a specific department. To be able to understand what drives the total cost it can be divided into a number of cost items that

sum up to the total cost for a company's logistics. This can be done with help from different total cost models. These models are mainly used to simulate how the total cost will be affected by a certain decision. (Aronsson et al., 2004) The method that this thesis results in can only compare the total cost to other companies and industry averages since there is no alternative plan of action. However, it is still an important measure which can provide a lot of useful information.

Aronsson et al. (2004) divide the total costs into four main categories, carrying costs, holding costs, transportation costs and administration costs. To this they also add other logistics cost, for example information costs, packaging costs and material costs. The carrying costs are the costs for the products in the inventory, implying the costs connected to tied up capital and risks with keeping inventory. The holding cost, on the other hand, are the costs that occur from running a warehouse, for example the costs connected to ownership and maintenance of the warehouse building, the personnel working at the warehouse and costs for the equipment needed to be able to run the warehouse. The transport costs include all costs for administrating and performing transports. Finally, the administration costs are all costs that relate to the administration of the company's logistics.

In a report concerning evaluations of logistics systems Aronsson (2002) presents, after a thorough literature review, a total cost model which consist of the four main costs discussed above, carrying, holding, transportation and administration costs. To this, apart from other costs, he adds packaging cost to his model.

Lambert & Stock (2001) categorize the total costs into five different cost elements, inventory carrying costs, transportation costs, lot quantity costs, warehousing costs and order processing and information costs. The transport costs have already been described above, inventory carrying costs has been referred to as just carrying costs above and by warehousing costs they address the costs called holding costs above. Furthermore they add lot quantity costs which mainly consist of costs related to production and procurement. The order processing and information costs have been discussed earlier as a part of the other logistics costs. Finally the authors include the costs' connection to the customer service level in the model. The main part of this aspect is the trade-off between customer service level and costs of lost sales. The model by Lambert & Stock (2001) is shown in Figure 13 below.

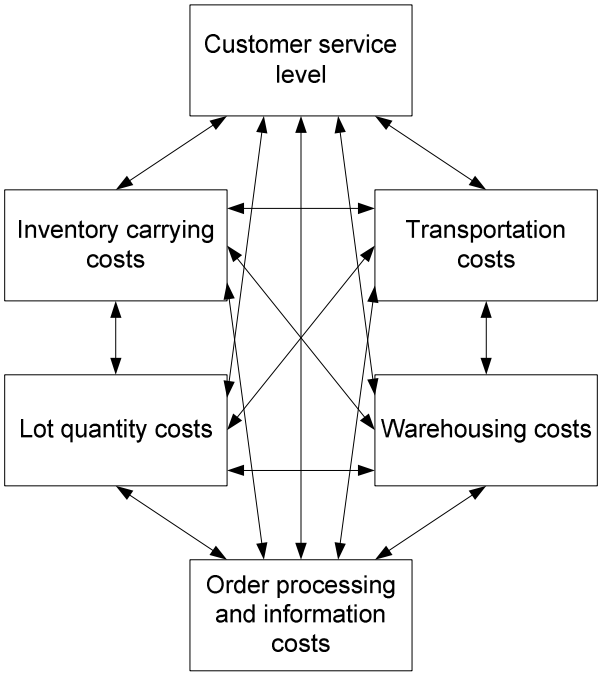

Figure 13. How logistics activities drive total logistics costs (Lambert & Stock, 2001)

Jonsson & Mattsson (2005) structure the total cost into eight different aspects, whereby four of them, holding costs, transportation costs, administration costs and packaging costs, have been discussed before. To this they add order costs which are costs that relate to management of purchasing and production orders. Furthermore capacity related costs in terms of costs connected to service and use of equipment are included in their model, which can be seen as a part of the holding costs. Shortage and delay costs as well as environmental costs are discussed in their model. However, according to the arguments earlier the environmental aspects are not taken into consideration in this thesis. High shortage- and delay costs can also be seen as a sign of a low level of customer service.

Jonsson & Mattsson (2005) point out that the structure of costs above is not complete and many costs can be assigned to more than one cost item. However it is important that the costs do not get counted more than once. Furthermore the type of company, its industry and the perspective for the total cost analysis might affect the structure of the costs. To minimize the problems of costs being assigned to several cost items as few cost items as possible are chosen in this thesis. The ones that are discussed in some form in all the sources are holding, carrying and transportation costs. Therefore these are included in the method. Furthermore administration costs are mentioned by many authors and therefore also this aspect is included in this thesis' method. To give the method a flexible characteristic a cost item called other logistics costs is finally included. Thereby the method can be applied to certain types of companies or industries more properly. The other costs can for example be the ones mentioned above; material costs, packaging costs, lot quantity costs and information costs.

The total cost items used in this thesis are summarized in a list below. Each element is discussed more carefully in chapter *3.5 The input to the logistics system – Total cost.*

- Carrying costs
- Holding costs
- Transportation costs
- Administration costs
- Other logistics costs

3.4.2 Customer service

The idea of customer service is according to Christopher (2005) that a product does not have any value until it is in the hands of the customer. Furthermore he argues that customer service should be examined at three different times – pre-transaction, during transaction and post-transaction. Before delivery the pre-transaction elements are important to examine to be able to give the customer a clear answer concerning what customer service to expect. The transaction elements include the ability to deliver on time, with the right number of products, without any defects and to the right delivery address. Finally the post-transaction elements concern the company's capability to provide spare parts, handle complaints and the return of products. Also Aronsson et al. (2004), Jonsson & Mattsson (2005) and Lambert & Stock (2001) discuss the structuring of customer service into different time aspects.

Aronsson et al. (2004) say that the customer service can be divided into several customer service elements. Together these elements cover the whole concept of customer service. It is important to keep in mind that different elements are of varied importance in diverse situations. Aronsson et al. (2004) present a structure, originated from Persson & Virum (1996), which consists of seven different customer service elements. These elements are customer order lead time, delivery reliability, delivery dependability, stock availability, flexibility, information and customization. Jonsson & Mattsson (2005) presents a similar structure with similar definitions of the elements. However, apart from Persson & Virum (1996) they do not include customization or information in their model. Instead the model only consists of five customer service elements; customer order lead time, delivery reliability, delivery dependability, stock availability and flexibility.

Customer order lead time is described as the time it takes from that an order has been placed until it is delivered. The delivery reliability addresses the reliability in the customer order lead time. Are the goods delivered at the agreed point in time? The delivery dependability, on the other hand, concerns the quality of the delivery in terms of the right product in the right amount. Furthermore the stock availability is defined as the percentage of orders that can be delivered immediately if the customer places an order. The flexibility addresses the ability to adjust to changes in customer demands. (Aronsson et al., 2004 and Jonsson & Mattsson, 2005) The element concerning information handles all kind of information that is needed to make the logistics work, for example information on inventory balance or the supplier's ability to deliver. Finally customization concentrate on the ability the company has to adjust to the specific demands of the customers. (Aronsson et al., 2004)

Christopher (2005) points out a number of key areas where standards for the customer service are of importance. Just like the standards described above the time it takes from

order to delivery is discussed, but here in terms of order cycle time. Furthermore also the delivery reliability and the stock availability are key areas according to the author. When it comes to delivery dependability the concept of order completeness, focusing on the percentage of orders that are delivered complete, is used. Christopher (2005), like both Aronsson et al. (2004) and Mattsson & Jonsson (2005) discuss the importance of information, in terms of order status information and the company's ability to manage differing demands from the customers. Additionally, Christopher (2005) mentions five other key areas; ordering convenience, frequency of delivery, documentation quality, claims procedure and technical support.

To help quantitatively analyze the customer service that a company offers some of the customer service elements will be discussed further in the chapter: *3.6 The output from the logistics system – Customer service.* Due to the difficulties in evaluating and comparing more qualitative customer service elements in a rather short period of time these elements are not discussed further in this thesis. The elements chosen are instead the most commonly mentioned customer service elements of a quantitative nature that are discussed in the literature referred to above. These are listed below.

- Customer order lead time
- Delivery reliability
- Delivery dependability
- Stock availability

3.5 The input to the logistics system – Total cost

Below the total cost items discussed in chapter *3.4.1 Total cost* are described more carefully and ways of measuring them are examined. The total cost elements should together represent all possible logistics costs for the company; costs that do not naturally fall under any other category can be placed under "Other logistics costs". This implies the formula given in Figure 14 below.

Figure 14. The formula for the total cost

In Sweden most companies use a standardized chart of accounts for accounting purposes. The latest version of this is called "kontotabell BAS 2007" and is used by practically all small and medium sized companies and by a growing number of large companies, government agencies and other organizations in Sweden. (Baskontogruppen, 2007) Aronsson (2002) uses an older, but very similar, version of the standardized chart of accounts to help divide a company's logistics costs into different categories. This system is an effective way to quickly collect data regarding a company's logistics costs since it is based on a structure that the company is likely to already use. Still, not all relevant information can be gathered based on the charts of accounts and must therefore be collected from other sources.

For each of the chosen total cost elements the relevant accounts, which are presented in Aronsson (2002), are listed below to support the collection of the data that the method requires. The account names have been translated from Swedish to English and are displayed with their four digit number. The last two digits in this number are 00 for group accounts. These accounts represent a summation of some more specific underlying accounts. A company only uses either a group account or its underlying accounts depending on how detailed information they wish to keep on that area. Both cases are considered in the lists of accounts presented below.

3.5.1 Carrying costs

Carrying costs are the cost for having items in stock. This includes both the cost for tying up capital and the risk associated with keeping products in stock. The cost for tying up capital occurs since the money could always be used in a better way, instead of being invested in items sitting on a shelf in a warehouse. To calculate this cost an alternative interest, that is equivalent to what a "safe" investment would give, is needed. (Aronsson et al., 2004)

The risk part of the carrying costs comes from inventory shrinkage or obsolescence, wastage and costs for insurance. Since these costs to a certain extent are proportional to the size of the inventory, these can also be quantified by multiplying the value of the inventory with a percentage to estimate the annual cost, much like calculating an interest. (Aronsson et al., 2004) Therefore the carrying costs are usually calculated by multiplying the average value of the inventory with an inventory interest. This inventory interest consists of both the alternative interest and an additional part to cover the costs associated with the risk for carrying inventory.

The value of the inventory can be found either in the group account or in its sub accounts which are given in Figure 15 below.

1400 Group account inventory	
or	
1410 Raw materials inventory 1420 Additives and necessities inventory 1430 Semi-finished goods inventory	1440 Work in process 1450 Finished goods inventory 1460 Merchandise inventory

Figure 15. Accounts that can be used to calculate the inventory value

3.5.2 Holding costs

The holding costs are the costs associated with running a warehouse to keep inventory. Included here are the costs for warehouses or storage rooms together with salaries for employees occupied with handling the inventory and the equipment they use, such as

forklifts. (Aronsson et al., 2004) In Figure 16 below relevant accounts that can be used to calculate the holding costs are presented, noteworthy is that the warehouse costs have three alternative accounts that potentially could be used.

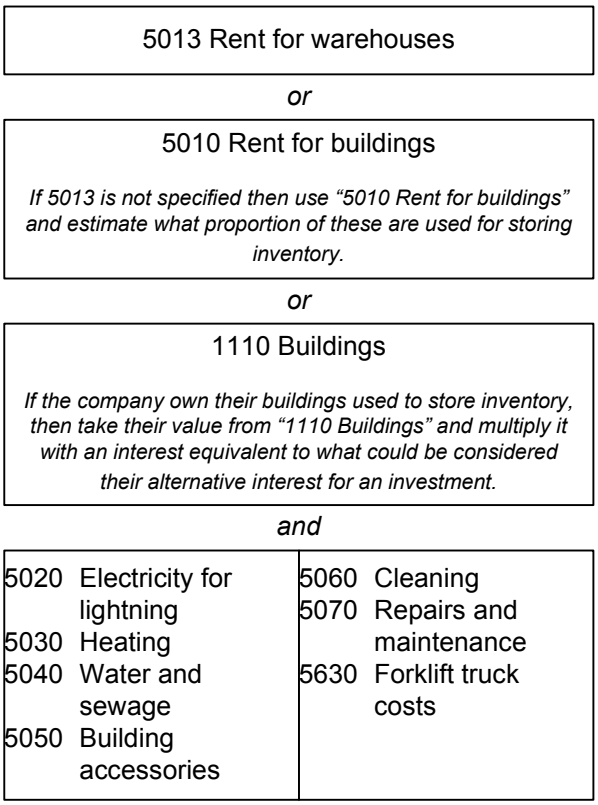

Figure 16. Accounts that can be used to calculate the holding costs

3.5.3 Transportation costs

The transportation costs are all costs associated with transporting goods, both to and from customers and suppliers as well as transports between the company's own facilities. (Jonsson & Mattsson, 2005) The relevant accounts presented in Aronsson (2002) are given in Figure 17 below.

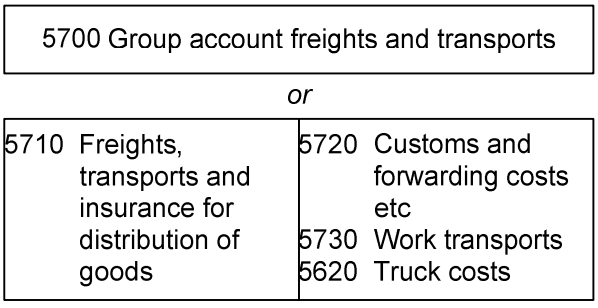

Figure 17. Accounts that can be used to calculate the transport costs

The salary costs for drivers must be added if the company pays these themselves. These can not explicitly be found in any account, but should normally be easy for the company to provide. (Aronsson, 2002)

3.5.4 Administration costs

The logistics administration costs are simply all the costs that occur from the administration of logistics. This can include costs for receiving and sending orders and invoices, various salaries and economic monitoring. (Aronsson et al., 2004) Little information can be gathered about the administration costs based on the chart of accounts. Aronsson (2002) suggests that the administration costs can be estimated as a portion of the total logistics costs, the figure 15 percent is used. However such estimations are of no value for this method, since the very purpose is to judge the administration costs' size, as well as its proportion of the total cost.

The administration costs can be quantified by going through the main logistics processes in the company and identifying what administrative activities occur. Then the actual costs for these activities are quantified by estimations, for example of the proportion of an employee's time spent on logistics administration activities.

3.5.5 Other logistics costs

All logistics related costs that do not fit under any other category should be placed here. Examples of relevant areas to include in other logistics costs are information, packaging, material and lot quantity costs. In different industries different types of costs will be important to include. One example is the beverage industry where packaging costs stand for a large part of the logistics cost. The packaging costs have two relevant accounts that should be included in the other logistics costs; 5430 Transport equipment and 5440 Disposable packaging materials. It is important to note that these two accounts normally only stand for a fraction of the other logistics costs and that another source than the chart of accounts probably is needed to quantify the other logistics costs.

3.6 The output from the logistics system – Customer service

Below the customer service elements discussed in chapter *3.4.2 Customer service* are described more carefully and ways of measuring them are examined.

3.6.1 Customer order lead time

The customer order lead time is the time it takes from that a customer places an order until it has been delivered. (Jonsson & Mattsson, 2005) Christopher (2005) and Lambert & Stock (2001) give another name to the time it takes between order placement and delivery when referring to it as order cycle time. Especially Lambert & Stock (2001) emphasize the importance of monitoring and managing the single components of the order cycle to be able to detect the problems and make the whole order cycle shorter. A short lead time is desired since it increases the flexibility and decreases the tied up

capital. (Jonsson & Mattsson, 2005) In Figure 18 below, the concept of customer order lead time is illustrated.

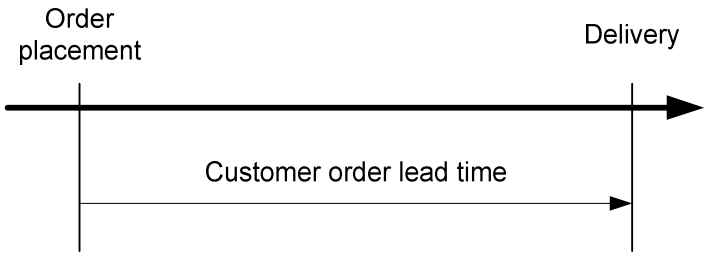

Figure 18. Customer order lead time; from order to delivery (Aronsson et al., 2004)

If a process with a certain lead time is studied carefully it can be divided into several lead times. The customer order lead time in the figure above is actually made up of a number of shorter lead times, for example the time it takes from an order of a transport has been made until the goods have been transported. (Aronsson et al., 2004)

The lead time can be measured by registering the point in time for order placement and the point in time for delivery. Orders as well as deliveries are often automatically registered in a company's Enterprise Resource Planning system which makes it easy to calculate the customer order lead time.

Christopher (2005) emphasizes that short lead times can be a major source of competitive advantage. However, he also points out that the reliability of the customer order lead time is equally important which leads on to the next customer service element.

3.6.2 Delivery reliability

Delivery reliability can also be referred to as the percent of on-time-deliveries which more clearly shows that the element concerns the amount of deliveries that are delivered on time. (Aronsson et al., 2004) Christopher (2005) argues that the delivery reliability reflects the stock availability and the performance of the order processing.

The element of delivery reliability has gained increased importance as many companies have decreased the inventory levels and increased the number of transports. There are even investigations implying that customers prefer a high level of delivery reliability over a short customer order lead time. (Aronsson et al., 2004)

Jonsson & Mattsson (2005) define the delivery reliability as the number of deliveries on promised point in time divided by the total number of deliveries. Below the formula for calculating the delivery reliability in this thesis is given.

$$\text{Delivery reliability} = \frac{\text{Number of deliveries on time}}{\text{Total number of deliveries}}$$

It is important to keep in mind that both a high number of too early and too late deliveries are defined as a low level of delivery reliability (Jonsson & Mattsson, 2005). Aronsson et

al. (2004) puts it that delays are often more painful than too early deliveries. However, too early deliveries should not be accepted without deeper consideration since they might increase the tied up capital and require extra temporary storage space.

3.6.3 Delivery dependability

The delivery dependability concerns the ability of the company in terms of delivering the right product, in the right amount and of the right quality. A high level of delivery dependability is taken for granted by many customers. Inadequate routines for documentation and order management can cause problems with the delivery dependability. (Aronsson et al., 2004)

The delivery dependability is, according to Jonsson & Mattsson (2005), normally defined as the number of orders without any complaints in relation to the total number of delivered orders. The formula for calculating the delivery dependability in this thesis is given below.

$$\text{Delivery dependability} = \frac{\text{Number of deliveries without complaints}}{\text{Total number of deliveries}}$$

The formula above does not take into consideration that there might be problems concerning quality even if there are no complaints. However, to be able to decide the delivery dependability a figure on how many deliveries that has shortages in quality is needed and the number of deliveries with and thereby without complaints is rather easy accessible information. Therefore this formula is used in this thesis.

3.6.4 Stock availability

The stock availability concerns the percentage of goods available in stock when the customer places an order. Thereby this measure is only interesting when the company keeps an inventory. The stock availability can be calculated as the amount of completely delivered orders divided by the total amount of orders. (Aronsson et al., 2004) The stock availability, however, measures the probability that the company is able to deliver directly from the inventory when the customer places an order. There are many different ways of defining stock availability. In some cases companies do not decrease the level of stock availability if the customer is willing to accept a split delivery for example. (Jonsson & Mattsson, 2005) The formula for the stock availability, according to Aronsson et al. (2004) and Jonsson & Mattsson (2005) is given below. This is also the way stock availability is defined in this thesis.

$$\text{Stock availability} = \frac{\text{Number of orders delivered complete}}{\text{Total number of orders}}$$

The stock availability can be measured at different levels, either on an order line level or as in the formula above on an order level. Which is most appropriate to use depends on the demands of the customer. (Aronsson et al., 2004) In order to understand the stock

availability better it can be complemented with the average number of order lines per order. This will give a greater understanding for what the figure signifies.

3.7 The transformation in the logistics system

The transformation in the logistics system focuses on what happens between the input and the output. The transformation can, according to chapter *3.2.2 Structuring a logistics system into a general representation* be divided into three parts; procurement, operations and distribution. To be able to deliver an output a number of logistics activities needs to be performed. These types of activities are discussed more carefully in chapter *3.7.1 Logistics activities* below. Furthermore, time is a useful tool when trying to improve the transformation in a logistics system. Therefore this aspect is addressed in chapter *3.7.2 Time*.

3.7.1 Logistics activities

According to Lambert & Stock (2001) there are thirteen key logistics activities that are involved in the flow of products, from point of origin to point of consumption. They point out that all these activities affect the logistics process even if not all companies consider every activity to be a part of their logistics. The logistics key activities are customer service, demand forecasting, inventory management, logistics communications, material handling, order processing, packaging, parts and service support, plant and warehouse site selection, procurement, reverse logistics, traffic and transportation, warehousing and storage. Below these activities are described briefly.

Customer service has already been discussed both in chapter *3.4.2 Customer service* and in chapter *3.6 The output from the logistics system – Customer service* and is therefore not described further here.

Demand forecasting concerns determining the amount of products and accompanying services that the customers will require at some point in the future.

Inventory management is about maintaining a sufficient supply of products to meet the customers' needs and manufacturing requirements.

Logistics communications concerns the communication system between the organization and its suppliers and its customers, the major functions within the organization, the various aspects of each logistics activity and various members of the supply chain who may not be directly linked to the firm.

Materials handling addresses the movement or flow of raw materials, in-process inventory and finished goods within a plant or warehouse.

Order processing consist of a number of specific activities including order editing, scheduling, order shipping set preparation and invoicing, order modification, order status inquiries, tracing and expediting, error correction and product information requests and credit checking and accounts receivable processing/collecting.

Packaging includes two different aspects, the first one concern the marketing purpose of the packaging and the second the logistics aspect of packaging.

Parts and service support addresses the activities involved in the repair and servicing of products.

Plant and warehouse site selection is about how the strategic placement of plants and warehouses can assist firms in improving customer service levels.

Procurement has already been discussed in chapter *3.2.2 Structuring a logistics system into a general representation* and will therefore not be specified further.

Reverse logistics focuses on the handling of return goods.

Traffic and transportation concerns the movement or flow of goods from point of origin to point of consumption.

Warehousing and storage is the management of the space needed to hold or maintain inventories.

The thirteen key logistics activities are summarized in Figure 19 below.

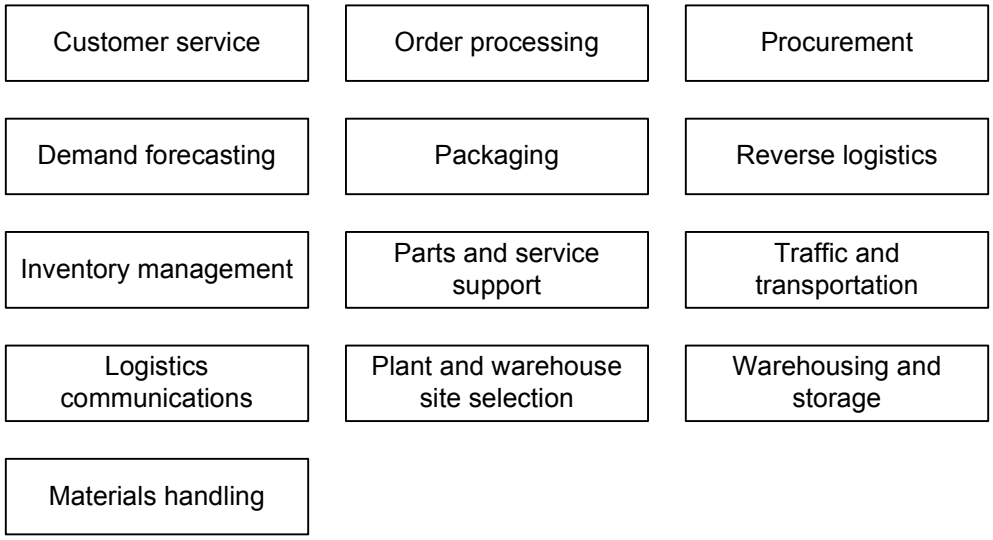

Figure 19. Key logistics activities (Lambert & Stock, 2001)

Odette (1999) has created a logistics evaluation document to support evaluation of companies' logistics. This document is divided into six different assessment areas; customer/supplier relations, work organization, goals, measurement and improvement, procurement process analysis, production process analysis and distribution process analysis. The evaluation is based on documentation of procedures which means that the logistics system is judged based on how well a procedure is documented. Below, in short, the six question areas are discussed in comparison to the key logistics activities according to Lambert & Stock (2001).

The *customer/supplier relations* area is divided into four parts. Firstly logistics agreements with the partners in the supply chain are addressed and followed by if there are any back-up routines to make sure that the deliveries are secured if something unexpected happens in the supply chain. Furthermore logistics assessments of the partners in the supply chain are brought up and finally relationship development with suppliers and customers are discussed. (Odette, 1999) This area can be compared to the

first key activity, customer service, in the model of Lambert & Stock (2001) and also to some extent logistics communications.

In the *work organization* area Odette (1999) first brings up job descriptions that concern how roles and responsibilities within the logistics functions are documented. Furthermore work routines and human resource development are discussed. This area is not specifically mentioned in the key logistics activities by Lambert & Stock (1999).

The *goals, measurement and improvement* area is divided into four parts. The first part addresses whether there is a documented logistics strategy and if there are clearly displayed goals concerning the logistics performance. The second area concerns how the goals within logistics are measured and what action plans exist regarding the logistics goals. The third area addresses continuous improvement and the last one is about how the logistical costs are identified and measured. (Odette, 1999) Lambert & Stock (2001) do not consider the area of goals, measurement and improvement to be one of the key logistics activities.

Odette (1999) starts the question area *procurement process analysis* with a logistics process analysis question which aims to describe the procurement process. Thereafter procedures for data exchange within the company are discussed. Planning of materials requirement in order to meet the customers' demands and to make the materials supply effective is the next part of the procurement area. Also packaging, transports, goods reception and stock management are brought up within the procurement area. (Odette, 1999) When viewing the logistics key activities by Lambert & Stock (2001) several activities can be included in the procurement area, for example logistics communications, materials handling, packaging and warehousing and storage.

The *production process analysis*, just like the previous area, starts with a logistics process analysis in order to describe the production logistics process. This is followed by five areas, production planning, capacity planning and flexibility, production control and production flow, how risks should be handled and finally how launches of new products or technical changes are managed. (Odette, 1999) When comparing the production area with the thirteen key logistics activities to the production process analysis it is hard to find any specific activities that only should be included in the production. However several of the activities can be matched partly.

The *distribution process analysis* starts with a logistics process analysis to describe the distribution process. Thereafter the processing of delivery instructions is handled and followed by warehousing of finished goods, packaging management and dispatch handling. Finally transports and launches of new or modified products are addressed. (Odette, 1999) Just like within the procurement process analysis several activities from the theory of Lambert & Stock (2001) can be included in the distribution area.

The six areas in Odette's (1999) evaluation document are summarized in the bullets below.

- Customer/supplier relations
- Work organization
- Goals, measurement and improvement
- Procurement process analysis
- Production process analysis
- Distribution process analysis

3.7.2 Time

Time can be used as a tool to reach lower costs and better customer service. Keeping the time aspect in mind is becoming more important in order to survive in a competitive market. Furthermore time is an appropriate measurement since it is easy to measure and easy for the people in the organization to understand. (Aronsson et al., 2004) Jonsson & Mattsson (2005) add that it is impossible to reach an overall efficient logistics system if it is not time efficient.

When discussing time related key performance indicators Aronsson et al. (2004) mention three types; customer order lead time, lead time and inventory turnover rate. The customer order lead time has already been discussed in chapter *3.6.1 Customer order lead time* and is therefore not addressed in this chapter. However, both lead time and inventory turnover rate are discussed more carefully below.

Lead time

Lead time can have several different meanings. For the customer the time it takes from order to delivery is the only lead time relevant. For the supplier on the other hand, just as important is the time it takes to convert an order into cash. (Christopher, 2005) However, this thesis, in accordance with Aronsson et al. (2004), refers to lead time as the time it takes for a product or matter to go through any given part of the total flow.

Inventory turnover rate

The inventory turnover rate reflects how many times a year the inventory is replaced. The inventory turnover rate can be calculated from the total time of a year (for example 52 weeks or 365 days) divided by the time the products spend in inventory. This time can for example be the time a “typical” product spends in inventory or the average time for several products. (Aronsson et al., 2004)

4 SPECIFICATION OF THE TASK

Since the purpose of a thesis often is very briefly described there is a need for a further specification in order to plan and perform the investigation accurately. (Lekvall & Wahlbin, 2001) Therefore a specification of the task is done in this chapter. First the emphasis of the thesis needs to be addressed in terms of what results the investigation wants to achieve (Lundahl & Skärvad, 1999). The main part of this study focuses on evaluating and testing a rather rapidly developed literature based method. This implies a hypothesis testing emphasis. Moreover a system description needs to be made. However since the study develops a method for analyzing a logistics system the system that this thesis concerns is any logistics system that the logistics method should be able to analyze. This means that the task of describing the system for this thesis is the same as describing any system that this method will be applied to. Therefore the system description is not looked into any deeper. Instead this chapter, first, focuses on the development of a first draft of the method, based on the literature review. Secondly how this first draft of the method should be evaluated and improved is discussed. Finally the delimitations made so far are summarized.

4.1 Develop a first draft of the method

Developing a method can be done in numerous ways. In this thesis the process of developing the method is divided into two main parts; developing a first draft of the method and evaluating and improving the method, as seen in Figure 20 below. This chapter only concerns the first part, the development of a first draft of the method.

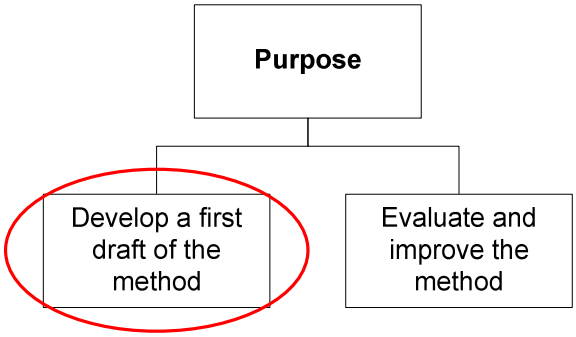

Figure 20. The two parts of the development of the method, focus on the first draft

To develop a method a basic structure for how the investigation should be performed is needed. This structure is chosen based on inspiration from the literature review. It serves as the foundation for how theory can be included so that the structure gradually grows into a first draft of the method. The structure also serves as a basis for how the method is evaluated. As seen in Figure 21 below the structure for the method is divided into four steps; System Description, Input and Output, Transformation and finally Deeper Analysis and Conclusions.

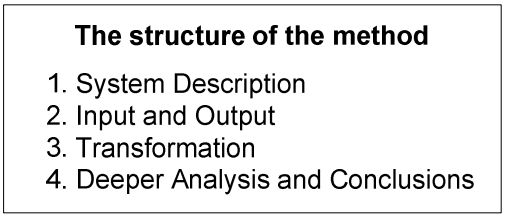

Figure 21. The structure of the method

Below each of the steps are described in greater depth, based on the theoretical review.

4.1.1 System Description (1)

The first step of the method is to define and describe the logistics system that is to be analyzed. It is important to clearly define the study object and to do this a discussion with the client company concerning what should be included in the system needs to be held. The definition of what should be included and excluded in the system is necessary to be able to start the examination and evaluation of the system. The client company plays an important role when defining the system since they have a greater understanding of the system than the investigating consultant. Furthermore it is essential to discuss what the client expects from the analysis to make sure that the expectations are at the right level and that misunderstandings are avoided. To make the investigation as smooth as possible

a contact person at the client company needs to be appointed. This person should preferably have a good overview of the client company's logistics. This way the consultant can focus on only one contact at the client company and in turn this contact person can tell the consultant if contact with other responsible persons is needed in order to perform the analysis with a high quality.

When the study object has been defined it should be matched against a general representation of a logistics system. Different levels or different depths that the system can be analyzed at are used when matching the system against this general representation, as argued in chapter *3.2.1 Specifying the system*. The top level is analyzing the system as a whole, only considering measures that regard the complete system's performance. This means that the top level only focuses on the Input and Output of the system, being the total cost and the customer service. The second level is analyzed using the general representation of the logistics system and focusing on the Transformation in the system. This general representation is divided into three main subsections according to chapter *3.2.2 Structuring a logistics system into a general representation*; procurement, operations and distribution. The system is therefore broken down into these three parts which are analyzed individually at the second level. The method always uses at least these two levels.

To analyze the logistics system at greater depth, than the two first levels, the main parts can in turn be broken down into smaller parts, reaching a third level. Here the consultant operates rather freely and focuses on areas that seem to have some sort of problems or should be questioned. This methodology is used for several reasons. Most importantly it helps tackle the issue of keeping the method applicable to a broad variety of study objects and at the same time letting it reach an interesting depth. Efforts will not be wasted at digging deep into trivial areas; instead only potentially interesting areas will be focused on by "zooming in" on them to a satisfactory level. This way of working also makes the method more flexible time wise, making it easier to adjust the investigation to different circumstances.

In order to perform the investigation, the characteristics of the company need to be examined to be able to get an overview of the company. When characterizing the company a number of key areas should be addressed. These key areas can be found in a business plan, according to chapter *3.4 Logistics' goals*. This gives that firstly questions concerning the company's history and business concept, in terms of what the company offers and in what industry it operates, should be asked. Furthermore questions about the market, competitors and risks should be addressed. Also how marketing, distribution and sales are handled and the company's organization needs to be discussed. Finally the economy and the size of the company should be investigated. The economy is examined in terms of revenue, assets, liabilities, owner's equity and profit. Additionally the size of the company is investigated by addressing the number of employees.

The goals of a company are useful to investigate in order to have something to compare the results of the investigation to. Is the company achieving what it is aiming for? Are the goals appropriate for what the company should be striving for? The goals should be discussed both in terms of the client's overall goals, mission and vision but also in terms

of specific logistics goals. Firstly this gives a hint on whether the different goals point in the same direction or if they contradict each other. Secondly both types of goals are important when performing the evaluation. Sometimes it can be hard to understand exactly what the actual goals are and how they apply to the company's logistics. However just questioning and trying to investigate and map the prioritizations is valuable for the further investigation. According to the model in chapter *3.4 Logistics' goals* there are different levels of goals. All these levels are important and therefore questions on the comprehensive vision and objectives, the business strategy and the logistics strategy should be asked. In the chapter it is also argued that the strategy needs to be broken down into specific logistics goals. For that reason the logistics goals and what the company wants to achieve with these goals needs to be examined. According to another model in chapter *3.4 Logistics' goals* successful companies have either a cost advantage or a value advantage or both of them. Therefore questions concerning the focus of the company in terms of advantages should be asked. According to Odette (1999), see chapter *3.4 Logistics' goals*, there is a need for documentation regarding the logistics objectives of a company to make the logistics efficient. Consequently the documentation of the logistics strategy needs to be examined and further if this documented strategy is followed.

In short the step of describing the system consists of three closely connected parts. The first part is to define the system and match it against the general representation, mapping the system. The second part of the System Description step concerns understanding the characteristics of the company. The last part is about looking into the goals of the company. Each of the steps are summarized in Figure 22

Figure 22. The first version of the System Description step

4.1.2 Input and Output (2)

Once the system has been defined and matched against the general representation and the client's goals have been investigated the initial data collection can begin. How the data collection should be performed should be discussed with the responsible contact person at the client company. He or she helps the consultants to get in touch with the right people for interviews, to get access to annual reports and other financial information and supply the consultants with the needed data from Enterprise Resource Planning systems. Before the first visit at the client company at letter is sent to the company telling what is needed

from the company in terms of quantitative measures. By sending this letter in advance the company can prepare the quantitative measures and thereby the consultant does not have to spend as much time looking for these figures. The final version of the letter can be found in appendix B. Furthermore it is important to keep track of if the needed information is accessible or if it needs to be estimated in this step.

As seen in chapter *3.5 The input to the logistics system – Total cost* the input is looked into by deciding the total costs based on carrying costs, holding costs, transportation costs, administration cost and other logistics costs. Furthermore this chapter gives a standardized chart of accounts that can help divide a company's logistics costs into different categories. This standardized chart serves as a basis when dividing the total costs. These costs can then be compared to the goals of the company, the revenue and how they are related in size to each other. The result from the total cost analysis is visualized in pie charts. Once several analyses have been performed the costs can also be compared to other companies in the same or similar industries. It should be pointed out that in this thesis the term input refers to the total costs spent, not for example the input in terms of incoming materials or the customer service the suppliers offer to the company.

Output is what is extracted from the system or in other words what the company gets in return for their input. The output of the logistics system is as described earlier the customer service which is quantitatively examined in terms of customer order lead time, delivery reliability, delivery dependability and stock availability. Exactly how these elements are defined is described more carefully in chapter *3.6 The output from the logistics system – Customer service*. To better understand the stock availability the number of order lines per order is included in the method. This information is seen as a part of the stock availability. When evaluating the logistics the customer service should be compared to the objectives of the company and also, when several companies have been evaluated the company's customer service can be compared to the customer service of other companies. More qualitative measures for deciding the customer service are delimited in this investigation. The reason for this is mainly the lack of time the carrying out of the method has. Furthermore qualitative customer service elements are hard to compare with each other.

The Input and Output of the logistics system is mainly analyzed by quantitative measures. This implies that it will be easier to compare the results with other companies' performances. The qualitative part of the Input and Output investigation is about comparing the results to the goals and other companies. To get a better understanding for the system and examine it deeper the next step focuses on the Transformation. The measures in that step are mostly qualitative.

In Figure 23 below, the Input and Output step of the method is summarized.

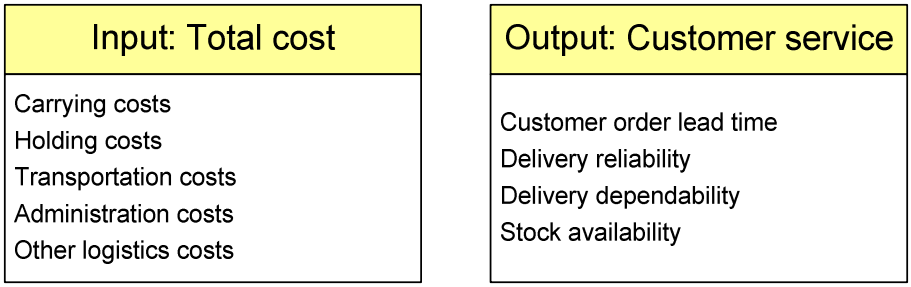

Figure 23. The first version of the Input and Output step

4.1.3 Transformation (3)

Once the Input and Output of the system have been examined it is time to look into the Transformation. This step concerns how the input becomes the output. When analyzing the Transformation the general representation, see chapter *3.2.2 Structuring a logistics system into a general representation*, to which the system has been matched to in the first step of the method serves as a basis. This means that there are three different parts which should be investigated closer, procurement, operations and distribution. Since there are some aspects that concern all three parts there is a need for an all encompassing question area. Furthermore as discussed in chapter *3.7 The transformation in the logistics system* time is a useful tool when trying to improve the transformation in a logistics system. Therefore this area is also investigated in the Transformation step.

In chapter *3.7.1 Logistics activities* thirteen key logistics activities are presented. Three of these activities have overall characteristics; logistics communications, demand forecasting and order processing. Therefore all of these three areas are addressed in the overall question area. These questions should preferably be answered by an overall logistics responsible person at the client company.

After the overall questions have been examined the next step is to look deeper into the procurement of the company. From the logistics activities by Lambert & Stock (2001) in chapter *3.7.1 Logistics activities* three activities are closely related to procurement. The first one is order processing which in this case refers to the processing of the orders to the suppliers. Furthermore the activity of traffic and transportation is essential which in the procurement mostly concern the inbound transports. Finally the warehousing and storage of raw material is an important part of the procurement function. When relating the theory of Odette (1999) to the general representation in this method the relations with suppliers, in terms of selections, evaluations and development, becomes a part of the procurement. Also goods reception is an important area of the procurement which is mentioned in chapter *3.7.1 Logistics activities*. Therefore also these areas should be addressed in the procurement questions.

According to the directives from UAE Logistics the operations should be included in the method but the main focus should be on the procurement and distribution. When viewing the mentioned areas by Odette (1999) concerning operations (or production as it is called in the Odette model) in chapter *3.7.1 Logistics activities* the main focus is on what type of

operations the company has in terms of its characteristics. Also planning of the operations is another important area.

The distribution has a lot in common with the procurement when it comes to trying to place out the key logistics activities mentioned in chapter *3.7.1 Logistics activities*. In the same way as the supplier relations are important in the procurement the customer relations are important in the distribution. Warehousing and storage is just like in the procurement important in the distribution even though it concerns the finished goods instead of the raw material. Furthermore the counterpart of the goods reception in the procurement, the dispatch handling, should be included in the distribution. Finally the outbound transport is an important area to include.

According to Odette (1999) in chapter *3.7.1 Logistics activities* the analysis of the procurement, operations and distribution should start with a logistics process analysis of the specific area in order to understand how the function is planned and performed. For that reason the strategy, planning and implementation of the specific areas need to be investigated in the method. Furthermore Odette (1999) emphasizes that it is important to investigate the goals and measure them. Therefore the area measurement and evaluation of performance is included in the procurement, operations and distribution.

Odette (1999) mentions the importance of documented procedures. By asking for documented procedures on every area within the overall, procurement, operations and distribution questions the level of control the company has over its logistics is examined. By grading the answers to the questions on documented procedures a quantitative perspective is given to the rather qualitative questions and the level of control the company has over its logistics can be determined. Two questions are asked, firstly if the company has any documented procedures on the specific area and secondly if the company follows the documented procedures. There are three levels for the answer on the documented procedures; “yes”, “to some extent” or “no”. Based on these answers the level of control is quantified. If there is a “no” answer to one or both of the documented procedure questions the total score is zero. Two “to some extent” answers give one point. Any combination of one “to some extent” answer and one “yes” answer gives two points. Finally two “yes” answers gives the highest score; three. Based on this control rating system the level of control the company has over each question area of the Transformation can be visualized. This can be seen in the final version of the method in appendix C.

When there is a lack of control in a logistics system there might already be a problem that is not apparent or there might appear a problem without the company noticing it. Therefore the question on documented procedures is an important aspect of the logistics performance of the company. Since some elements are more important than others, the elements might need to be weighted before a conclusion on the total control of the logistics system can be determined. However this is delimited in this thesis since UAE Logistics find it appropriate to complement the method with this feature once it has been used a number of times. Furthermore it should be noted that the return or reverse logistics is not necessarily included in the method but can be if seen as relevant.

As mentioned in chapter *3.7.2 Time*, time can be used as a tool to reach lower costs and better customer service. Furthermore a system needs to be time efficient in order to reach an overall efficient logistics system. When investigating the Transformation of the system the time aspect is therefore essential and should be included in the method. Two types of time measures are discussed in detail in chapter *3.7.2 Time*, lead time and inventory turnover rate. Both these are interesting aspects that should be controlled when performing an analysis supported by the method. Also customer order lead time is mentioned in chapter *3.7.2 Time*. However since this aspect is considered in the output part of step 2, Input and Output, it is not looked any deeper into in this step.

In Figure 24, below, the areas investigated in the Transformation step are summarized.

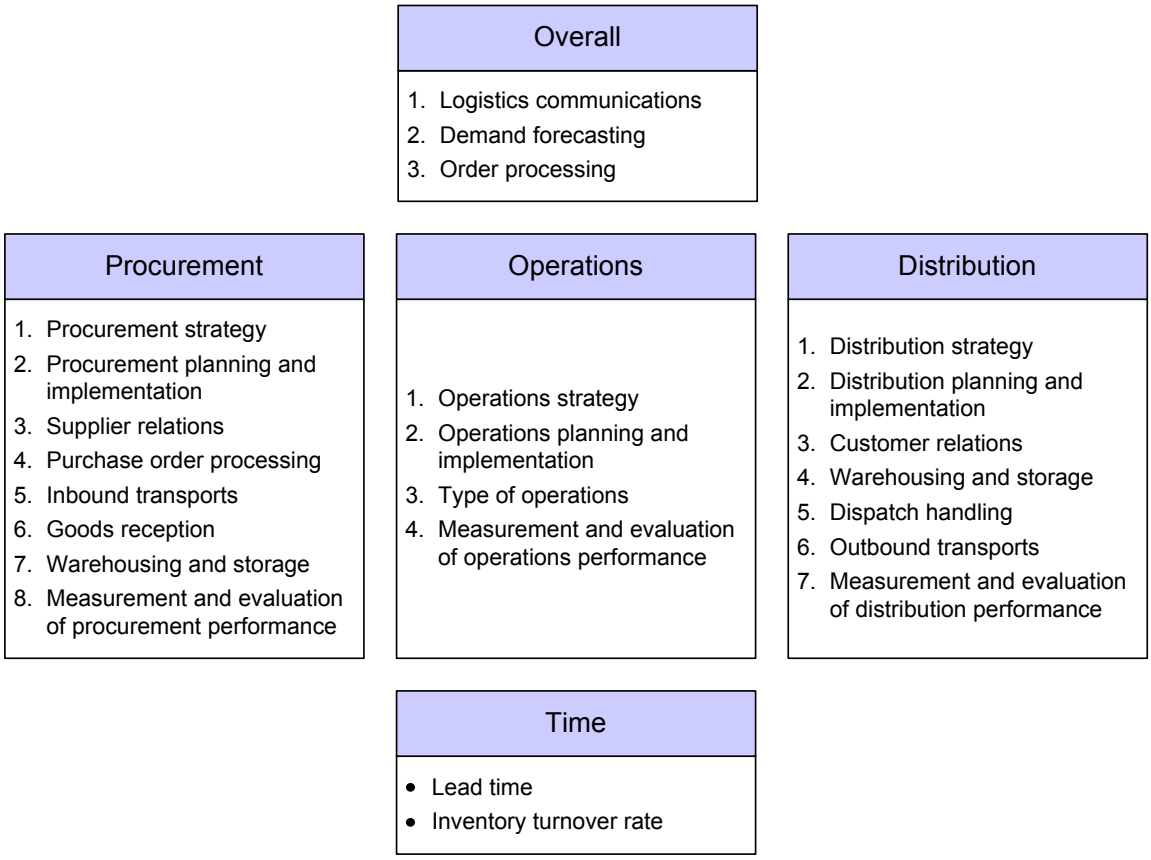

Figure 24. The first version of the Transformation step

4.1.4 Deeper Analysis and Conclusions (4)

From the analysis of Input and Output and Transformation the consultant can try out different hypotheses concerning the logistics systems' problem areas. This is performed by looking deeper into relevant parts of the logistics system. These parts can either be a specific function or part of a function or specific products or services. This step increases the flexibility of the method in two aspects. Firstly instead of following a standardized method only the relevant or interesting areas need to be investigated deeper. Secondly depending on the time left the depth of the further analysis can be adapted.

If needed and if the time frame allows, a follow up visit at the client company can be performed. However if there is not enough time or if there is no need for a follow up visit complementary questions can be asked over the phone or by e-mail contact.

As described earlier the analysis of the input, quantitatively, results in a total cost breakdown and the analysis of the output results in a customer service level. Furthermore the quantitative result of the analysis of the Transformation is an understanding of the level of control the company has over its logistics and the lead time and inventory turnover rate. From the System Description step a greater understanding of the characteristics and goals of the company is reached. By examining the qualitative part of the system in terms of input, transformation and output, an understanding of the logistics system is reached. The quantitative part of the investigation is compared to the performance of other companies. This can easily be done due to the standardized way of collecting data once the method has been used a number of times. The total cost breakdown, the level of control, the time analysis and the customer service level are simply compared to the figures from other companies of the same size in the same or similar industries. From all these findings conclusions can be drawn and potential problem areas identified. It should be pointed out that the way of drawing conclusions based on the analysis may vary widely. Therefore exactly how this step should be carried out can not be standardized. The concept of drawing conclusions based on the deeper analysis is shown in Figure 25 below.

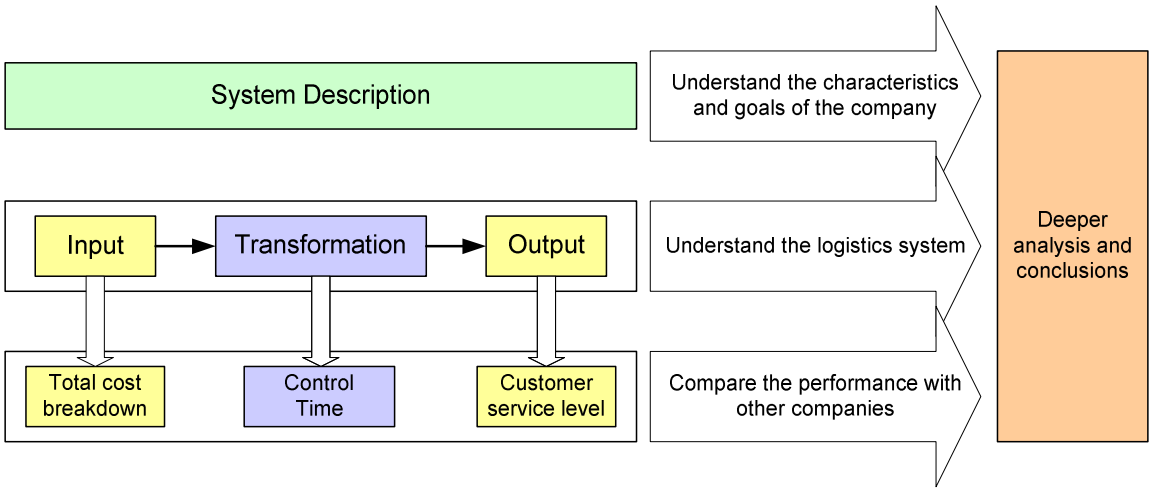

Figure 25. Drawing conclusions supported by the method

After the conclusions have been drawn the results from the evaluation of the system is presented to the company. A basic layout for this presentation can be found in appendix D. The presentation starts with telling the company about the finding of the investigation using the heading “Recommendations”. This is followed by looking deeper into three of the steps of the method; System Description, Input and Output, and Transformation. Finally the conclusions of the investigation are given once again. It should be noted that this layout only serves as a basis and that it can be developed further by UAE Logistics once the method has been used a number of times.

4.1.5 Overview of the first draft of the method

This first part of the specification of the task has focused on developing a first draft of the method for evaluation of logistics performance. The parts of the first draft or the first version of the method are illustrated in Figure 26 below. First a letter for preparations of data collection is sent to the company. The final version of this letter can be found in appendix B. Thereafter the data collection is carried out, consisting of three main parts; System Description, Input and Output, and Transformation. This is followed by the performance of a deeper analysis in order to draw conclusions. Finally the results are presented to the company. The final version of the presentation layout can be found in appendix D.

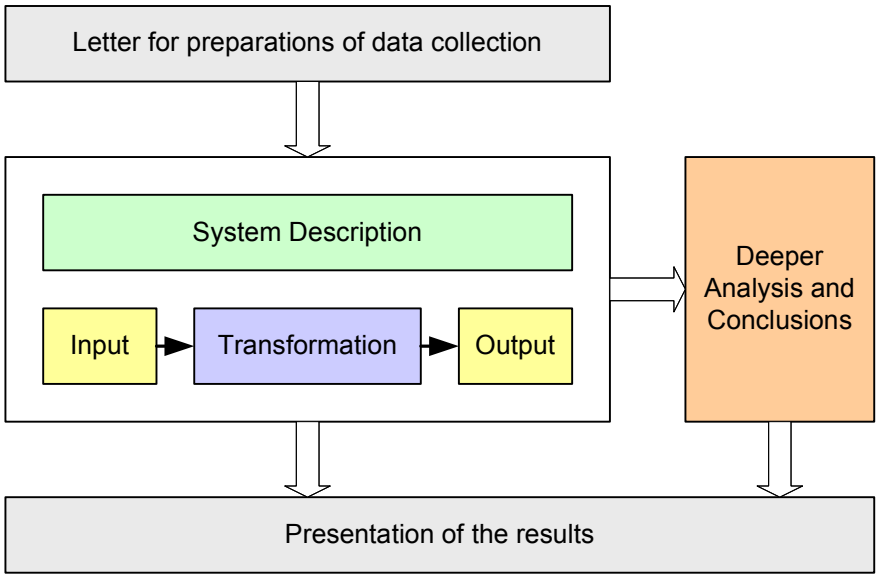

Figure 26. Overview of the first draft or the method

Below, Figure 27 explains the current position in the study, stating that this chapter results in a first version of the method.

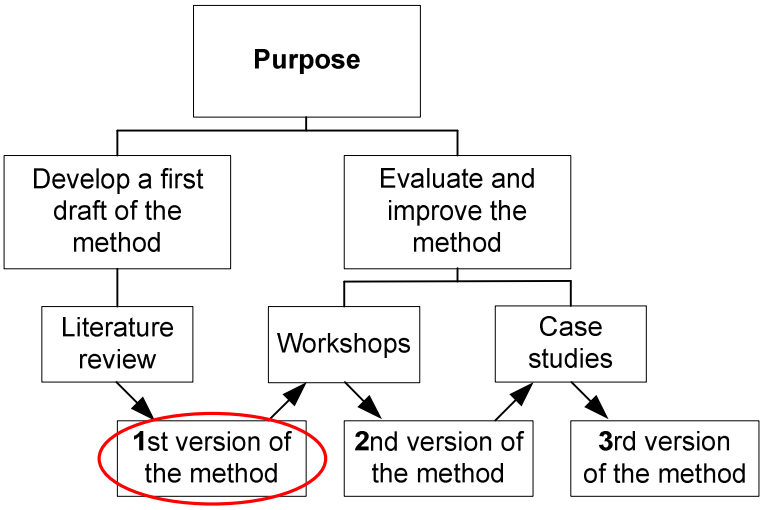

Figure 27. Chapter *4.1 Develop a first draft of the method* results in a first version of the method

Moving on to the next part of the specification of the task the way of conducting evaluation and improvements of the method for development of the second and third versions is described.

4.2 Evaluate and improve the method

How the evaluation and improvements of the method is carried out is addressed in this chapter, as seen in Figure 28.

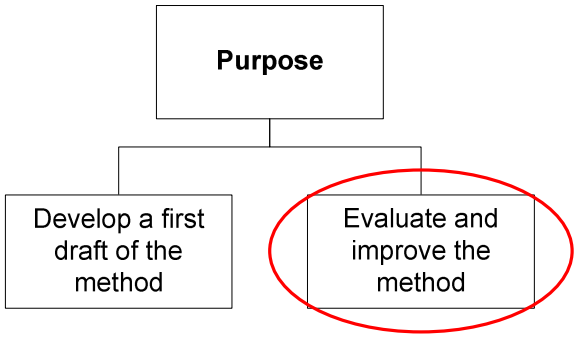

Figure 28. The two parts of the development of the method, focus on the evaluation

When evaluating the method the same four step structure used for developing the method is applied. Additionally a step 0 is added to evaluate the method itself and its composition. Below the evaluation of each step of the method is discussed and broken down into a number of questions that needs to be answered to specify the method.

4.2.1 The composition of the method (0)

Before each step of the method has been described the composition of the method as a whole needs to be discussed. First the method's accordance with the purpose of the project and its directives needs to be evaluated. Thereafter the possibility to carry out the

investigation as described in the method should be discussed. Finally in order to improve the method as a whole, possible improvements of the structure need to be investigated.

There are three questions that need to be answered when analyzing the composition of the method. These questions are summarized below.

0.1. Is the method in accordance with the purpose and directives?
0.2. Is it possible to carry out the investigation as described in the method?
0.3. Can the structure of the method be improved?

4.2.2 System Description (1)

When it comes to evaluating the first step of the method three questions are relevant. Firstly the suitability of mainly using qualitative questions in order to understand the system needs to be questioned. Secondly the chosen question areas and the ability to improve these should be evaluated. Finally the specific questions on each question area need to be evaluated.

The evaluation questions on the first step of the method, System Description, are given below.

1.1. Is it appropriate to describe the system based mainly on qualitative questions?
1.2. Can the question areas be improved?
1.3. Can the questions be improved?

4.2.3 Input and Output (2)

The second step of the method, Input and Output, aims to investigate what resources the company puts in the system and what they result in. In order to evaluate this step three questions need to be answered. First the appropriateness of analyzing the input and the output of the system based on total costs and customer service needs to be questioned since it is the basis of this step. Thereafter the chosen categorization of the total costs and customer service into elements should be investigated and potential improvements discussed. Last the specific total cost and customer service elements need to be evaluated separately in terms of their definitions and the way of determining them.

The questions needed to evaluate the second step of the method, Input and Output, are summarized below.

2.1. Is it appropriate to analyze the input and output based on total costs and customer service?
2.2. Can the categorization of the total costs and customer service into elements be improved?
2.3. Can any of the specific total cost and customer service elements be improved?

4.2.4 Transformation (3)

The evaluation of the Transformation step is divided into four different questions. The appropriateness of mainly using qualitative questions when evaluating the

Transformation step should be discussed before looking any deeper into the area. Also, the usage of time analysis needs to be addressed. When the suitability of the concept of the step has been evaluated each question area and every specific question needs to be tackled and possible improvements discussed. During the evaluation of the question areas and their specific questions also the level of control, based on the documented procedure questions, is considered. Finally the way the time analysis is performed needs to be examined.

The evaluation questions on the Transformation step of the method are given below.

3.1. Is it appropriate to analyze the transformation based on qualitative questions and time analysis?
3.2. Can the question areas be improved?
3.3. Can the questions be improved?
3.4. Can the time analysis be improved?

4.2.5 Deeper Analysis and Conclusions (4)

The last step of the method, Deeper Analysis and Conclusions, is a rather unstructured step. Therefore the evaluation of this step needs to be pretty broad in order to address all potential areas. For that reason only two questions are used in the evaluation of the last step. The first question concerns the appropriateness of the unstructured method for the deeper analysis. The second question addresses the conclusions that are supposed to be drawn based on the analysis the method supports.

The two questions that the Deeper Analysis and Conclusions is evaluated with are given below.

4.1. Is the unstructured method for deeper analysis appropriate?
4.2 Can relevant conclusions be drawn?

4.3 Delimitations in the specification of the task

The main delimitation in the thesis so far concerns the theoretical review that serves as basis for the first draft of the method. Even if this theoretical review is rather thoroughly made it could have been even more extensive taking even more aspects into consideration before the first draft of the method is developed. Nevertheless there is a limitation in time for the development of the method. Therefore the most appropriate way of developing the method is decided to be to rather quickly develop a first draft and thereafter evaluate this draft. This is an important aspect to keep in mind throughout the whole report. In the following sections the delimitations made so far are summarized.

The logistics pipe is chosen to provide a general representation for the method. Making this selection means that other ways of modeling a logistics system are excluded from the investigation, mainly those taking the after delivery activities into account. The reason for this is primary the limitations in time the method has. This delimitation can lead to exclusion of important aspects when conducting an evaluation of a logistics system based on the method. However as mentioned earlier if found relevant and if the time frame

allows it after delivery activities and other interesting aspects can be investigated deeper in the last step of the method. Therefore the consequences of this delimitation should not be that severe.

The second delimitation concerns the way of structuring the method stating that the input should be seen as total costs and the output as customer service. Here environmental aspects are excluded from the investigation. This might affect the result of the investigation but once again the time limit requires this delimitation.

When breaking down the total cost into elements some common elements are included and some are excluded. The argument for including as few elements as possible is that this decreases the risk of counting a specific costs item more than once. Furthermore since the costs item "other logistics costs" is included in the method this still gives some flexibility for the method to improvise if needed.

In the same way as with the total costs elements not all possible customer service elements are included in the method. Only quantitative customer service elements are included due to the difficulties in comparing more qualitative measurements with each other. However since the qualitative aspect of the logistics system and its customer service is looked deeper into in the Transformation step the consequences of this decision should not be too grave. Moreover only some of all available quantitative customer service elements are included in the method. This is done due to the strict time limit of the method. How this affects the results from an evaluation based on the method is hard to tell. Nevertheless according to the theoretical review the most common quantitative customer service elements are included in the method.

The last delimitation so far concerns that it could be very useful to weight the question areas in the Transformation step before drawing conclusions on the total control of the logistics system. However UAE Logistics find it appropriate to complement the method with this feature once it has been used a number of times. They find it more appropriate that this investigation focuses on evaluating other aspects. Therefore this decision is made.

5 METHODOLOGY

The aim of the methodology chapter is to establish the course of action needed to fulfill the purpose of the investigation. Since there almost always is some sort of limitation in the resources, for example time or money, the methodology that best fulfills the purpose, given the available resources, should be chosen. (Björklund & Paulsson, 2003) In this chapter the quality of an investigation is first discussed to support the thesis in reaching a high quality. Next a general model to structure an investigation by is presented and thereafter the model with different phases is applied to this particular investigation. Finally criticism of the used methodology and delimitations are discussed.

5.1 Quality assurance

To support the selection of methodology in this investigation, first the quality of an investigation is discussed. Thereby the quality aspects can be referred to and kept in mind during the entire methodology chapter.

A high quality can be achieved by eliminating sources of errors and their effect on the quality of the study. This can be done by striving for a high validity, reliability and objectivity. (Björklund & Paulsson, 2003) However it is important to keep in mind that the validity, reliability and objectivity always have to be balanced by the resource requirements. (Lekvall & Wahlbin, 2001) Below the quality aspects, in terms of sources of errors, validity, reliability and objectivity, are discussed more carefully.

5.1.1 Sources of errors

Lekvall & Wahlbin (2001) categorizes sources of errors depending on where in an investigation they take place. They point out that it is important to make an effort to, in every part of the investigation, clarify which sources of errors that might appear and as far as possible try to decrease their effect on the quality of the result. It is also important to estimate the effect of the remaining sources of errors on the result of the investigation.

In the planning stage of an investigation sources of errors might occur concerning that an inappropriate purpose has been chosen. The problem can be that the purpose does not mirror what the investigation intends to examine. Furthermore errors can emerge during the specification of the task, addressing either the content or the emphasis. The problems concerning the content might be that the purpose specification does not focus enough on the purpose. Choosing the wrong emphasis is another source of errors. (Lekvall & Wahlbin, 2001)

In the methodology chapter problems concerning choosing the approach of the study and inference errors can appear. Inference errors refer to the problem of applying what has been concluded from the study into the conditions in reality that actually is of interest. Moreover sources of errors can appear in the methodology when choosing a method for collection of data or a measurement method. (Lekvall & Wahlbin, 2001)

Lundahl & Skärvad (1999) points out a few sources of errors that can appear during the collection of data in form of interviews. Mostly these kinds of errors are caused by a lack of agreement between the “true” answer and the answer the respondent leaves.

5.1.2 Validity

The validity considers if a method of measurement actually measures the aspects it intends to measure. The difficulty in measuring validity lies in predicting whether a measurement method is valid or not. To be able to do so the true results of the measurement would be required. (Lekvall & Wahlbin, 2001) Halvorsen (1992) puts it that validity concerns the challenge of collecting data relevant for the problem the investigation addresses.

The validity can be increased by using several perspectives, for example through triangulation. Triangulation implies using several different methods to investigate the same phenomenon in order to gain multiple perspectives on the study object. (Björklund & Paulsson, 2003)

5.1.3 Reliability

According to Lundahl & Skärvad (1999) reliability designates the absence of compulsory measurement errors. Halvorsen (1992) suggests that a high reliability means that several independent measurements will have the same results. Furthermore Björklund & Paulsson (2003) add that the reliability concerns how likely a measurement instrument is to be accurate and provide a correct result. Yin (2003) adds that the goal of reliability is to minimize the errors and biases in a study.

In the same way as validity the reliability can be increased by using triangulation. (Björklund & Paulsson, 2003) However the reliability is easier to measure than the validity. For example repeated measurements on the same individuals can be made. (Lekvall & Wahlbin, 2001)

5.1.4 Objectivity

The objectivity concerns the extent to which different values affect the study and its results. The objectivity can be increased by motivating and clarifying the choices made in the study. That way the reader is able to estimate the result of the study. (Björklund & Paulsson, 2003)

Lundahl & Skärvad (1999) discuss how objectivity can have different meanings in different contexts. However they point out that it is important that an investigator is well aware of in what way the perspective and values control the forming of the problem, the approach and the conclusions both when planning and when performing the investigation. To keep the objectivity at a high level it is therefore important that the process of the investigation is carefully and honestly described.

5.2 The sequence of work in an investigation

Lekvall & Wahlbin (2001) structures an investigation into several different steps which are summarized and connected in a “u”. Their “u-model” is specifically adapted for a market investigation. However it shows a structured way of working which is useful in this study even though it is not a market investigation.

According to the “u-model” the first part of the investigation focuses on the decision situation and the decision problem. It is important that the investigator knows in what context the decision situation lies. That way it is easier for the investigator to understand how he or she is expected to contribute which prevents misunderstandings between the assigner and the investigator. After the decision situation has been addressed the next step of the investigation is to analyze the information need and to specify the purpose of the thesis. The purpose should thereafter be specified further in the specification of the task. This must be done to be able to perform the investigation accurately. Next the approach of the investigation should be decided. The approach concerns how the analysis should

relate to the data. This consequently leads to choosing the method and to planning of the field work and analysis. When this has been specified a plan for the investigation is obtained. (Lekvall & Wahlbin, 2001)

Once the investigation plan is complete the actual investigation can begin. The first step is the field work and compilation of data. The result of that work is a fundamental database which should be analyzed. The analysis then leads to the first results which should be analyzed further and interpreted in order to be able to draw conclusions. The conclusions should be analyzed further in order to connect it to the decision situation. The conclusions are followed by recommendations concerning the decision situation. Finally the study should be reported. (Lekvall & Wahlbin, 2001)

In Figure 29 below the "u-model" divided into three different phases; planning, collection and analysis of data, and results and conclusions is shown. The structure with the three different phases is constructed to support the structure in this thesis' sequence of work which is looked into in the following chapter.

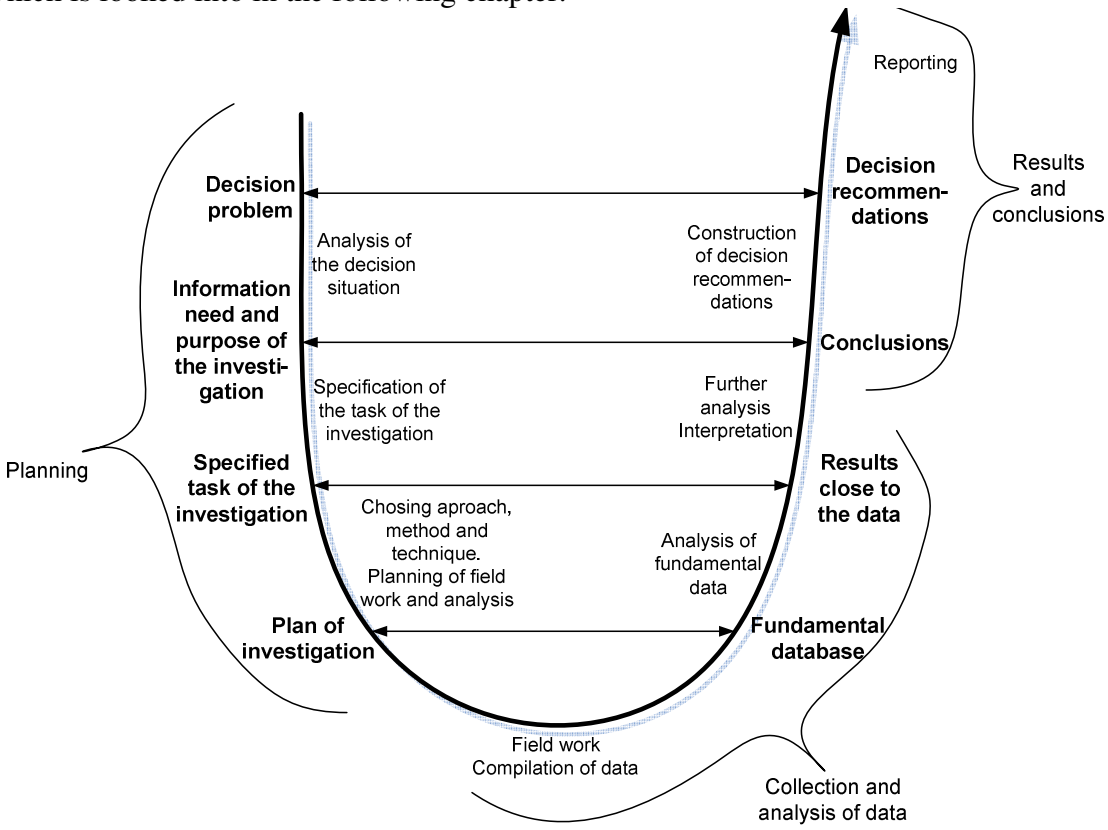

Figure 29. The "u-model" loosely translated and revised from Lekvall & Wahlbin (2001)

5.3 The sequence of work in this investigation

The "u-model" described in chapter *5.2 The sequence of work in an investigation* above is used as a starting point for the sequence of work in this investigation. In Figure 30 below the sequence of work in this investigation is described in three different phases, planning, collection and analysis of data and finally results and conclusions. The work is

divided into empirical, analytical and theoretical in the figure. In the following chapters each part of the investigation is discussed in a more detailed manner.

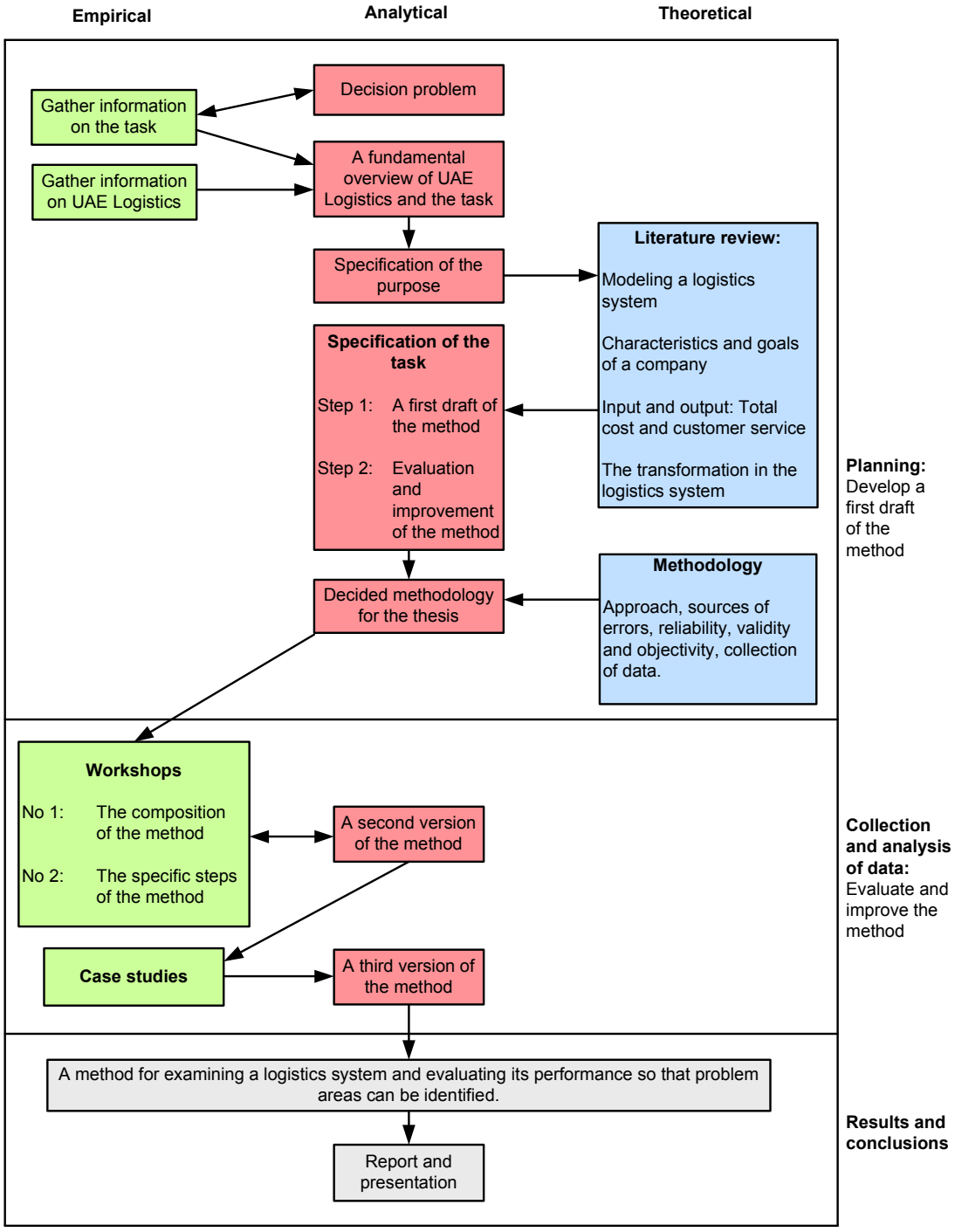

Figure 30. The sequence of work in this investigation

As visualized in the figure above and according to chapter *4.1 Develop a first draft of the method* and chapter *4.2 Evaluate and improve the method* the purpose of the thesis is obtained through two different steps, developing a first draft of the method, and

evaluating and improving the method. The planning phase of this investigation results in the first draft of the method and the phase of collection and analysis of data focuses on evaluating and improving the method. To keep the objectivity high, as described in chapter *5.1.4 Objectivity*, the choices made concerning the methodology are both carefully described, clarified and motivated.

5.3.1 Planning: Develop a first draft of the method

The result of the planning phase is a first draft of the method. However to be able to reach that draft, according to the "u-model" several steps needs to be gone through.

According to the "u-model" the first step in an investigation is to analyze the decision situation and the decision problem. In this investigation the decision problem is carefully discussed through a continuous dialogue with the supervisors at UAE Logistics at least once a week throughout the decision problem stage to decrease the risk of misunderstandings between the assigner and the investigator. Simultaneously, information on the task and the company is collected to be able to understand the problem better. From the information on the task and information on UAE Logistics a fundamental overview of the company and the task is obtained. This is needed to be able to specify the purpose of the investigation. As described in chapter *5.1.1 Sources of errors*, sources of errors can come up due to that an inappropriate purpose is chosen. To prevent that from happening the purpose is carefully discussed both with the supervisor at UAE Logistics and with the academic instructor.

From the specification of the purpose a need for theoretical input appears. The purpose of the thesis, *to develop a method for examining a logistics system and evaluating its performance so that problem areas can be identified*, leads to the question concerning how logistics should be evaluated. From the literature review theories on models for defining and describing systems, characteristics and goals of a company, total costs and customer service and the transformation of the logistics system support the specification of the task. When specifying the task, as mentioned in chapter *5.1.1 Sources of errors*, errors might appear concerning either the content, the emphasis or that the specification does not focus enough on the purpose. To make sure that the specification does not drift away the purpose is constantly kept in mind during the work and the content and emphasis are carefully discussed before being determined.

The specification of the task results in a first draft of the method for evaluating logistics. To be able to reach that method the literature review is of great importance. Furthermore the specification of the task implies that the investigation thereafter focuses on evaluating the first draft of the method to improve it further. How the evaluation and improvement of the method is performed is discussed further in chapter *5.3.2 Collection and analysis of data: Evaluate and improve the method*.

The last step of the planning phase is to decide on a methodology for the investigation. Deciding the methodology starts by determining the approach of the investigation. This is followed by the planning of the field work and the planning of how to analyze the data. In order to keep a high standard of the investigation sources of error, reliability, validity,

objectivity and the method for collection of data needs to be taken into consideration. Since the quality of the investigation already has been discussed, only the approach and the data collection are discussed in detail below. When these two matters have been addressed the planning phase is complete and a plan of investigation is reached.

The approach of the thesis

To be able to decide how the investigation is to proceed, and to be able to draw the intended conclusions, the approach of the thesis needs to be decided. Depending on the wanted type of results different approaches are suitable. (Lekvall & Wahlbin, 2001)

The approach of an investigation is decided based on the number of cases and the type of data that is to be used. If the investigation has a small number of cases which are analyzed more deeply a case study approach is used and if the investigation has many cases more generally studied a cross sectional approach is applied. Furthermore the data used can either have qualitative or more quantitative characteristics. (Lekvall & Wahlbin, 2001)

It is not always possible to classify the approach of a thesis into just one approach. Often an investigation has a mixture of many approaches. In this study a qualitative and case study approach is applied. Since there will not be any numbers or data that can be encoded in numbers in the investigation it is a qualitative approach. To avoid confusion it can be worth to point out that the method includes numbers, but it is the method itself and not the numbers that is investigated in this thesis. Since the aim of the study is to develop a method that is applicable for as many clients as possible an appropriate approach would be a cross sectional. Furthermore Halvorsen (1992) puts it that a cross sectional studies is appropriate when generalizations are wanted. However due to limitations in time only three case studies are carried out, therefore this thesis has a case study approach. This means that it might not be possible to make as many generalizations as wanted concerning the quality and applicability of the developed method.

Collection of data

In the planning phase the method for collection of data should be decided. According to Björklund & Paulsson (2003) the most common methods for collection of data in scientific investigations are literature studies, presentations, interviews, questionnaires, observations and experiments. In this study literature studies, presentations and interviews are relevant for the collection of data and therefore these are described more carefully below. Furthermore case studies are conducted to test the method. In the case studies the method is used in a manner very similar to how it is supposed to be used in the future. This can be seen as a way of testing the method.

Literature studies give information in form of secondary data, which means that the information often has been compiled with another purpose than the purpose of the case in point. Therefore it is important to keep in mind that the information might be biased or not comprehensive. (Björklund & Paulsson, 2003) In this thesis the first collection of data is done through literature studies. This way of collecting data is chosen firstly to get a good overview of the theories known on the area and secondly to develop the first draft of the method. The advantage of this way of collecting data is that it gives results in a

rather economical way. To avoid the problem concerning that only secondary data is obtained through the literature studies, only well known theories from accepted authors are used and avoidance of information specialized on certain companies or industries is strived for.

Presentations can result in information which can be of interest for a study. From a presentation secondary data is obtained. (Björklund & Paulsson, 2003) In this thesis presentations are only used as an information source for the description of UAE Logistics. Therefore the problems that might occur due to the use of secondary data will only have a moderate effect on the result of the investigation.

The advantage of interviews is that they collect primary data, which is data that is collected with the purpose intended for the specific investigation. Furthermore it is easy to gain a better understanding for a certain area since resulting questions easily can be asked and adjusted to earlier answers. (Björklund & Paulsson, 2003) In this thesis a specific type of interviews, so called structured group interviews, are used. During this type of interviews a group of respondents discuss a matter freely but under supervision of an interviewer who leads the discussion into a number of predetermined question areas. The advantage of this type of interviews is that point of views that might not come through in a personal interview can appear due to a favorable group dynamic. This comes from that many people find it easier to discuss a problem area when noticing that it is shared by others. The composition of the group should be rather homogenous so that the question areas can be recognized by many. However different opinions give the discussion more substance but with too many participants the discussion might be hard to pull through. The disadvantage of the focused group interviews is that there is a risk that someone or a number of people in the group dominate the discussion so that their opinions wrongly represent the opinion of the whole group. Therefore it is essential that the interviewer finds a balance between having a free discussion and steering the dialogue so that all participants get the opportunity to speak their opinion. (Lekvall & Wahlbin, 2003) To prevent sources of errors in this investigation in terms of not getting the “true” answer many persons are interviewed at more than one time. Furthermore the result of the interviews are compared to the literature and then further evaluated in case studies.

5.3.2 Collection and analysis of data: Evaluate and improve the method

The collection and analysis of data aims to evaluate and improve the method. This is done in two steps, first through workshops and then through case studies. By choosing to evaluate the method through both workshops and case studies a higher level of reliability is reached since different ways of collecting data is used. Furthermore also an increased level of validity is strived for since by actually testing the method the collected data should be relevant for the investigation.

How the workshops and case studies evaluate and support the improvements of the method is described below. In Figure 31, below, the concept of using workshops and case studies to evaluate and improve the method is shown. From the literature review a first

version of the method is developed. Based on this version the workshops are conducted resulting in a second version of the method. This second version finally serves as a basis for performing the case studies which result in a third and final version of the method.

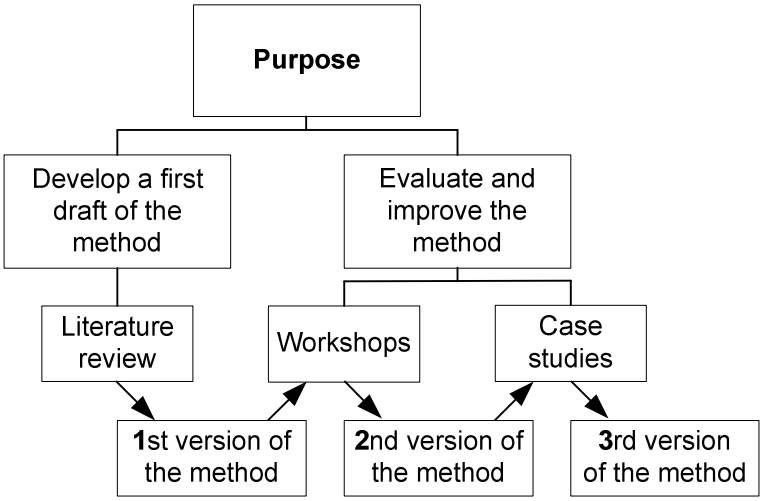

Figure 31. The collection and analysis of data is divided into workshops and case studies

Workshops

To evaluate and improve the method two workshops are held. During the first workshop three of the supply chain consultants who later on intends to use the method (Henrik Höglund, Johan Jönsson and Caroline Raning), one marketing manager (Lars Bäcklund), the sales and marketing director at UAE Logistics (Martin Lennbom) and the two interviewers (the authors of this report), participate. During the second workshop only two consultants (Johan Jönsson and Caroline Raning) and the marketing manager (Lars Bäcklund) participate together with the two interviewers. The workshops are organized as focused group interviews, see chapter *5.3.1 Planning: Develop a first draft of the method*.

The first workshop focuses on the composition of the method as a whole, while the second workshop goes more specifically into the specific steps of the method and evaluates them. Before both workshops letters are sent to the participants in order to give them some insight into the method and to be able to be more focused during the actual workshops.

Two workshops are considered an appropriate scope. If only one workshop is held it is hard find the time to both evaluate the structure and look into each of the steps. Furthermore the opportunity to improve the structure before looking into each step vanishes if only one workshop is held. More than two workshops would have been beneficial. However due to limitations in time for the investigation and due to limitation in access to the participants, two workshops are found more appropriate.

The first workshop focuses solely on general and structural aspects of the method. To get any relevant feedback whatsoever it is vital that all interviewees have a deep understanding of the method. Therefore the first workshop starts with a presentation of the method, followed up by a discussion about the method based on the interviewees'

questions. Also, before the workshop takes place an agenda consisting of information about the method and the workshop has been sent out to the participants. When the group has developed an understanding of the method it is evaluated. The evaluation in the first workshop is based on question area 0, *The composition of the method*, which can be found in chapter *4.2 Evaluate and improve the method.* This area is broken down into discussion topics that are discussed by the group. The results from the first workshop can be found in chapter *6.1 The composition of the method.*

The second workshop starts by, once again, presenting the method and the improvements that have been made as a result of the first workshop. This is followed by a discussion of the potential changes and the method in general. Especially new thoughts that might have occurred since the first workshop are addressed. After that the workshop proceeds with a more detailed evaluation of the method. This is based on question areas one to four in chapter *4.2 Evaluate and improve the method*. An agenda including information about the method is sent to the participants before the second workshop. The information gives an overview of the method and includes all the questions that are part of the method. The second workshop is accounted for in chapter *6.2 System Description* to chapter *6.5 Deeper Analysis and Conclusions*.

Case studies

The workshops result in an improved and revised method, a second version. This method is thereafter evaluated and improved even further based on three case studies at three different companies. The idea of the case studies is to try how well the method works in reality. Based on the experience of using the method changes are made. The improvements and readjustments of the method are done when all the case studies have been performed, not continuously during the case studies. That way, the method will not be affected by characteristics that are distinctive for just one of the cases.

The reason for deciding to perform three case studies mainly depends on the time available for the thesis. More case studies would probably give a higher quality of the result. However due to the limitations in time only three case companies are chosen. The specific case companies are chosen partly based on that they are companies that UAE Logistics have some sort of contact with which makes it easier to get their attention. However all three case companies are potential clients of UAE Logistics which makes them relevant.

Each case is performed according to the directives of the method through examining and evaluating the logistics performance so problem areas can be identified. Since the case companies are potential clients of UAE Logistics it is important that the method can draw conclusions in all three cases. If that is not the case the method needs to be improved. Even though the three case companies are not exactly of the same type they do not span the whole spectra of presumptive clients for UAE Logistics. Therefore the case studies can only guarantee that the method is applicable for these specific companies. However combined with the literature review and the workshops the method is more likely to be applicable for other clients as well.

The evaluation from the case studies is based on the same question areas as the workshops are based on. These can be found in chapter *4.2 Evaluate and improve the method.* Based on the evaluation the method is improved. After these improvements the method reaches its final form, the third version of the method, and serves as a part of the result of this thesis. The results and analysis from the case studies is presented in chapter *7 Results and analysis – Case studies*. In appendix A detailed descriptions of each case study can be found.

5.3.3 Results and conclusions

The last phase of the investigation is results and conclusions. This aspect mainly concerns drawing conclusions from the workshops and the case studies in order to create a complete method. The complete method reflects back at the purpose and the decision problem. This leads to recommendations to UAE Logistics concerning the results and conclusions of the investigation. In these recommendations the impact of delimitations and sources of errors on the conclusion and further studies are discussed. Additionally the contribution of the investigation to UAE Logistics and to science is discussed. At last the investigation is reported and a presentation of the investigation is prepared and performed.

5.4 Criticism of the methodology

The main criticism of the method concerns the collection of data. First the literature review strives to be as all encompassing as possible. However there might be important information or theories, not included in the theoretical review, that could have been used to make the developed method even better. Moreover delimitations made in the theoretical review concerning specific cost or customer service elements may influence the quality of the method.

The workshops might not be as accurate as desired. There are many aspects that affect how a focused group interview turns out. The aim is to get as much and as detailed feedback as possible on the first version of the method but at some points the discussion tends to get stuck on details. In the end, much relevant information was gained but the question is if there was more feedback that did not come through.

The case studies might not exactly mirror how an investigation supported by the method should be carried out. Firstly, the investigation was not carried out by the consultants who will use it in the future. Secondly, the case companies are only three specific companies which may not be representative for the typical company that will be investigated using the method in the future. Finally interpretations and misunderstandings during the case studies may cause insecure results.

An important aspect concerning the methodology is that it starts in a theoretical review. The first draft of the method is developed strictly from theory. This gives that also the final version of the method is strongly influenced by how the first draft turned out. Given that the theoretical review has missed important aspects or that the method has not been optimally structured this affects the final version to a very large extent.

5.5 Delimitations in the methodology

The delimitations in the methodology chapter mostly concern the number of workshops and case studies. Both of these data collection methods are delimited due to the limitations in time this investigation has.

6 RESULTS AND ANALYSIS – Workshops

The results and analysis in this thesis are, as mention in chapter 5 Methodology, divided into two different chapters. The first chapter, this one, addresses the results from the workshops while the second one, chapter 7, discusses the case studies. This division is made since the method evaluated in the case studies is changed based on the improvements made as a consequence of the workshops. In short, different versions of the method are used when performing the workshops and when conducting the case studies. In this chapter the first version is evaluated resulting in a second version of the method, as described earlier.

Two workshops are held, the first one which is about the composition of the method is discussed in 6.1 The composition of the method (0). This is followed by four chapters that are based on the second workshop. In each of these chapters one of the four areas in the method, System Description, Input and Output, Transformation, and Deeper Analysis and Conclusions are discussed. Last the modifications of the method based on the results from the workshops are summarized.

6.1 The composition of the method (0)

During the first workshop the composition of the method is discussed. In order to explain the method and how it has been developed, the workshop starts with describing the sequence of work used in order to create the method. Thereafter the purpose of the workshop and the given task of the investigation are discussed. This is followed by a rather close presentation of the method and finally the specific questions concerning the composition of the method are addressed.

To make the first workshop proceed as smoothly as possible the participants receive a letter including a short description of the method and some questions to consider before the workshop takes place, as mentioned in chapter *5.3.2 Collection and analysis of data: Evaluate and improve the method*. The areas the participants are asked to think about are closely related to the questions that are answered during the workshop.

Below each of the three questions for evaluation of the composition of the method are addressed.

6.1.1 Is the method in accordance with the purpose and directives?

The first question on evaluating the composition of the method concerns the method's accordance with the purpose and directives. As a reminder the purpose of the thesis is given below.

The purpose of this thesis is to develop a method for examining a logistics system and evaluating its performance so that problem areas can be identified.

The method should:

- *Consist of guidelines for both the collection of data and the initial analysis*
- *Be a foundation for further analysis*
- *Enable comparison between different logistics systems*

The participants at the workshop regard the purpose as well fulfilled when looking at the method. However when focusing on the specific parts of the method they agree that it is important that the method is standardized and that the questions are at a "high level" and not too focused on details. That way it will be easy to compare different companies and all areas can be covered without running over the time schedule. This can be solved by asking a rather general and broad questions on every area and thereafter break it down to specific questions that can be used as follow up questions.

Concerning the method's ability to guideline the data collection and the initial analysis the participants at the workshop are positive. Since the focus, according to the directives, should be on the total logistics of the system, not only production logistics, it is important that the method does not focus too much on the operations area. The workshop participants find the current focus on the operations area rather appropriate but discuss if it should be scaled down even further.

The directives state that the method should result in a diagnosis within a week. This is one of the main concerns during the first workshop. All the participants at the workshop agree that there is a big risk that the time given for the analysis is too short. How this issue should be tackled is discussed and after a while the workshop comes to a conclusion. The participants at the workshop recommend that the basic composition of the method should be kept but the consultants performing the evaluation must be flexible and only ask the most relevant questions if time is running out.

The use of the words "logistics system" in the purpose is discussed. One of the participants at the workshop suggests that maybe "logistics set-up" is a better description since "logistics system" may make people think of only IT related aspects of logistics. However the theoretical review motivates the use of the word system and therefore it is kept in the purpose but the use of the word "logistics system" in the questionnaire of the method is changed to "company" or only "logistics" if it is possible and depending on the context.

The comparison between different companies is easier to perform if using quantitative data than if using qualitative questions. On the other hand numbers alone do not say much. Therefore everyone agrees that a balance between qualitative and quantitative data is needed. Though, when possible it would be beneficial if qualitative data could be translated into numbers, by some sort of rating system. For example, having answer alternatives can make qualitative data more quantitative. The level of control part of the method can be seen as a way of translating a qualitative aspect into quantitative data. More qualitative areas could be translated into quantitative data in a similar manner, but caution must be taken because of the subjectivity of such a translation. This is not done at this stage in the development of the method. If UAE Logistics finds it suitable, once the method has been used a number of times, such rating systems can be developed.

6.1.2 Is it possible to carry out the investigation as described in the method?

The workshop participants believe that it will be possible to carry out the investigation as described in the method. However they all agree that the best way to find this out is by testing the method on the case companies.

6.1.3 Can the structure of the method be improved?

Overall the participants at the workshop find the structure of the method appropriate. They believe that it is rather natural and straightforward. The method brings up what needs to be investigated when performing an evaluation and the way of using input, output and transformation is seen as a suitable and accepted method.

6.2 System Description (1)

The second workshop concerns the four steps of the method. Before it takes place the precipitants receive a detailed description of the method to prepare comments about before the workshop. The description amongst other things includes all the questions that are part of the method.

When discussing the first step of the method, System Description, many of the participants at the workshop point out that they think parts of this step should be part of the process of selling the logistics evaluation, based on the method, to the customer. The system of the investigation needs to be mapped out before the investigation is started. It is decided that the mapping of the system should be carried out before the investigation starts and that some of the questions concerning the characteristics and goals of the company also can be answered at an early stage. From this follows that these parts of the first step are not counted as part of the available week's time for conducting the evaluation. This way the available time for performing the rest of the investigation increases slightly.

When the company is mapped out it may occur that some functions, for example purchasing, are joint with other departments which may cause problems when conducting the analysis. This problem could, however, be handled either by estimating the share of the function used by the analyzed company or by excluding that "module" from the analysis. This type of decisions should be taken together with the client, preferably before the investigation is started.

Below the discussion regarding the three evaluation questions of the System Description step are handled.

6.2.1 Is it appropriate to describe the system based mainly on qualitative questions?

The participants at the workshop believe it is important to both use qualitative and quantitative questions. Quantitative questions can help the consultants understand the size and performance of the company rather quickly. However, it might be hard to get hold of quantitative data and sometimes numbers do lie. Therefore also qualitative questions are relevant.

6.2.2 Can the question areas be improved?

As described in chapter *4.1.1 System Description (1)* the question areas in the first step of the method, System Description, are divided into two different areas, "The characteristics of the company" and "The goals of the company and its logistics objectives". The participants at the second workshop find these areas appropriate to use as a basis when trying to describe the system.

6.2.3 Can the questions be improved?

When discussing the specific questions several ideas on how the questions can be improved arise. Starting with the characteristics questions the questions are considered overall well chosen. However the participants believe that they could be improved even further by adding questions of a more quantitative type. After a discussion it is decided that questions on the value the company believe that they add and their capital turnover rate should be added. Furthermore to be able to understand the size of the logistics system better questions on the number of handled stock keeping units, orders and deliveries each year should be added. Finally the location of the company is not answered by the

characteristics questions. This is an important aspect that needs to be included. The result can be seen in appendix A by studying the questions used when conducting the case studies.

The questions on the goals of the company could be expanded according to the participants at the workshop. First it is important to understand what the company means when they are referring to the word “logistics”. Therefore a question concerning their definition of the word “logistics” needs to be added to the questionnaire. Furthermore the importance of logistics, strategically, can be valuable to understand when performing the analysis, according to the participants. They also state that it is interesting if and how the goals are measured and if there are different goals for different products or flows. Finally the customer demands regarding logistics and if the logistics is adapted to the product or vice versa is of interest when examining the logistics objectives.

The topics included in the second version of the System Description step can be seen in Figure 32 below.

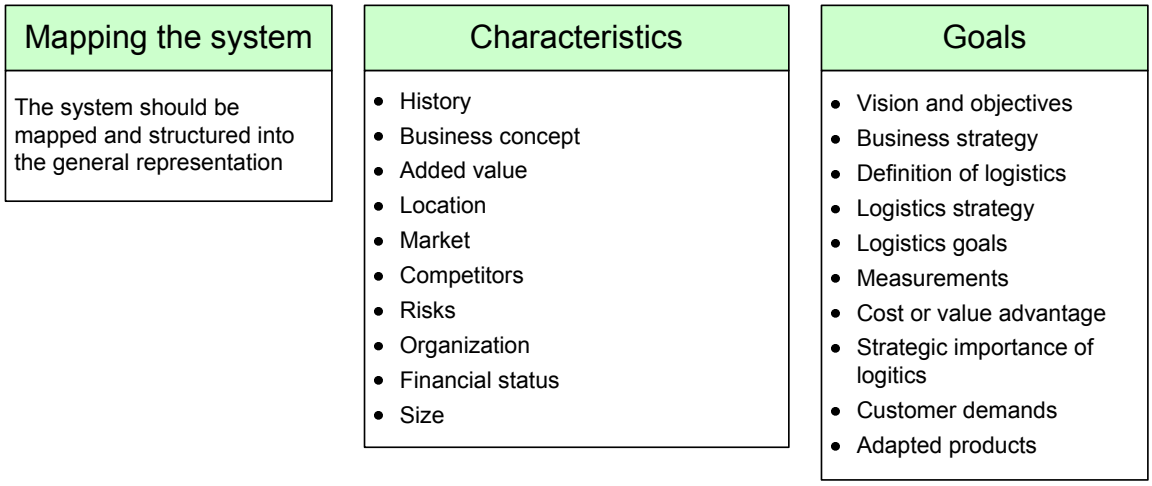

Figure 32. The second version of the System Description step

6.3 Input and Output (2)

The discussion on the Input and Output puts a lot of focus on the possibility to gather relevant quantitative information. It is important that the company, where the logistics system is investigated, is well prepared before the investigation starts. For example the consultants should not have to spend their week trying to get hold of data from the ERP system of the customer. These figures are supposed to be prepared before the investigation starts. Therefore the standard letter, shown in its final version in appendix B, is very useful.

Below the specific evaluation questions on the second step of the method, Input and Output, are addressed based on the discussion on the second workshop.

6.3.1 Is it appropriate to analyze the input and output based on total costs and customer service?

The appropriateness of analyzing the input and the output based on total costs and customer service is considered high by the participants at the workshop. Not only are these areas input and output to the system but they are also very important measures within logistics and therefore the participants find the measures suitable.

6.3.2 Can the categorization of the total costs and customer service into elements be improved?

Overall the workshop participants find the categorization of the total costs and customer service appropriate. A discussion concerning the term "delivery precision" comes up. Delivery precision refers to the percentage of on time deliveries, which is called delivery reliability in this method. The participants at the workshop mean that "delivery precision" might be a more suitable expression since it is more common in the industry and is often used and measured. However even if companies say that they measure the delivery precision and think they mean the exact same measure as everyone else there might be differences in the definition. Therefore the term delivery reliability might be of more value since the definition of the element needs to be made clear before the number is calculated. In the end this leads to more comparable figures between different companies and different logistics systems.

6.3.3 Can any of the specific total cost and customer service elements be improved?

The workshop approves on the specific total cost and customer service elements and their definitions. The only area that is discussed further on this question is internal metrics. Sometimes it might be possible to measure delivery dependability, delivery reliability and stock availability internally, that is for example specifically for the procurement or the operations. However this can only be performed during the deeper analysis or if there is time left at the end of the investigation. Otherwise the investigation will be too time consuming.

Since only small changes are made to the Input and Output step based on the workshops there is no need for a new explanatory figure, Figure 23 is still up to date.

6.4 Transformation (3)

The most thorough discussion during the workshop is on the Transformation area since this area includes many more questions than the others. Below each of the evaluative questions on the Transformation step in the method are addressed.

6.4.1 Is it appropriate to analyze the transformation based on qualitative questions and time analysis?

When discussing the qualitative characteristics of the Transformation questions some of the workshop participants mean that it would be of value to find some way of quantifying

the questions. However when explaining that these questions aim to create a greater understanding of the more quantitative measures the qualitative questions seem more relevant. The time analysis, on the other hand, is seen as a very useful tool that is valuable to include in the method.

6.4.2 Can the question areas be improved?

Below the four question areas in the Transformation are discussed separately starting with the overall questions. However, first an area that is added to three different parts of the Transformation; procurement, operations and distribution, is discussed. Once all the questions have been asked there still might be areas that have been missed or problems that have not been acknowledged enough. Therefore a final question area is added to the procurement, operations and distribution. This area is called "Problems in the…" and is supposed to discover problems in the specific areas.

Overall

The overall questions are before the workshop divided into three different areas, see chapter *4.1.3 Transformation (3)*, logistics communications, demand forecasting and order processing. All these three areas are seen relevant according to the workshop participants. However the participants find it appropriate to include the customer relations, earlier handled in the distribution questions, in the overall questions. The reason for this is mainly that customer relations are important in all parts of the system. Furthermore the workshop finds the order the question areas are presented in inappropriate. They find a more logical order in starting with what comes first, demand forecasting, followed by the next step needed to keep the demand, customer relations. Once the customer relations are in place the order processing becomes relevant and finally the overall covering area logistics communications should be addressed.

Procurement

To start with the term "procurement" is discussed. The workshop participants mean that some of the procurement question areas involve what they would rather call "sourcing" and that this might be a more appropriate term. However procurement is considered a more general term which is also supported by the literature. Therefore the term "procurement" is kept.

Except from adding the question area "Problems in the procurement" the other question areas seem relevant, according to the participants of the workshop. For that reason no other changes are made to the question areas on the procurement.

Operations

The operation questions aim to be rather general and not go very deep into any area. Even so, some of the participants at the workshop feel the questions are too detailed. Therefore it is decided that the question area "Type of operations" should be removed. Thereby the operation questions only focus on the main areas, strategy, planning and implementation, measurement and the new area "Problems in the operations".

Distribution

As mentioned in the overall questions the customer relations do not only relate to the distribution but also to the procurement and operations. Therefore this question area is moved to the overall questions. Furthermore the question area "Problems in the distribution" is added according to earlier discussions.

The revised structure of question areas in the Transformation

According to the discussion above some changes are made concerning the question areas in the Transformation. These changes are summarized in Figure 33 below.

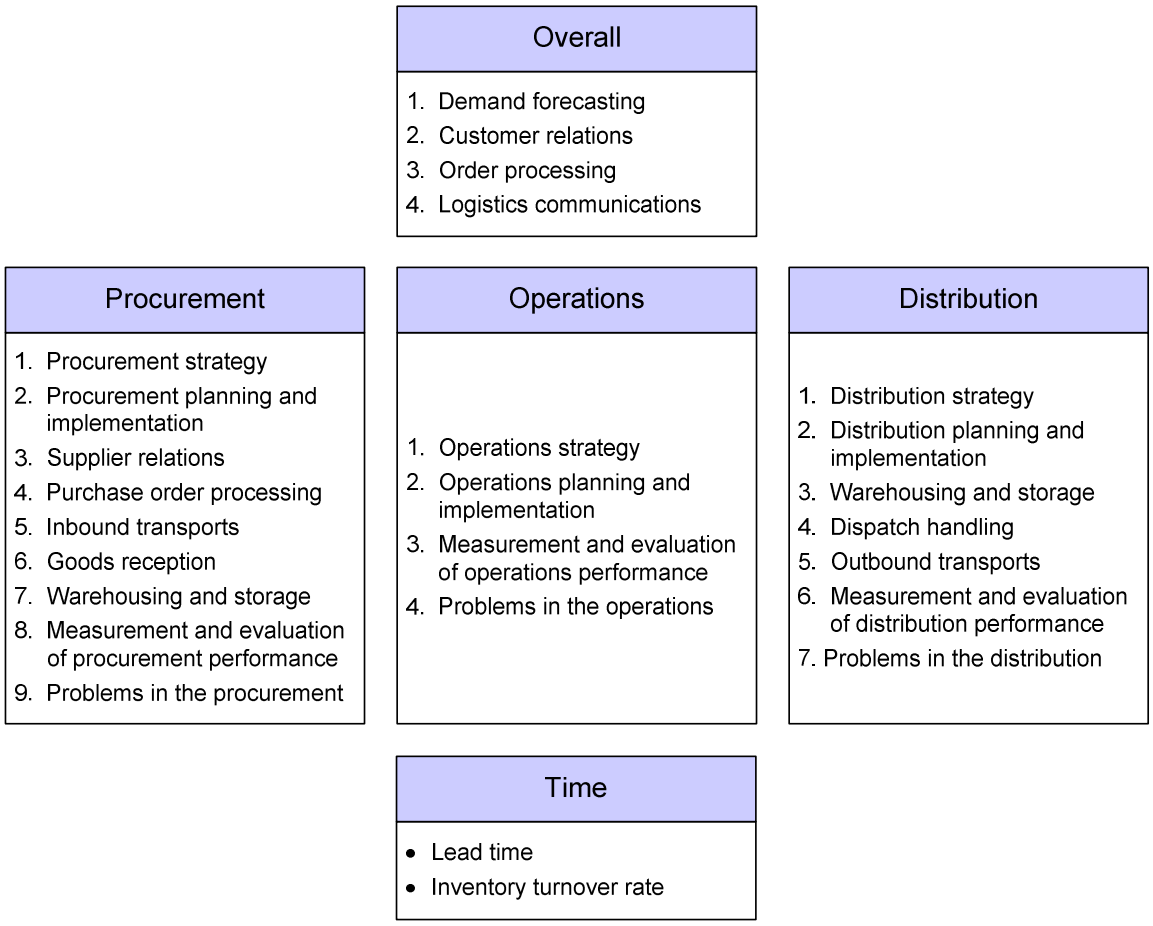

Figure 33. The second version of the Transformation step

6.4.3 Can the questions be improved?

Once the question areas have been discussed the workshop moves on to discussing the specific question within each area. Since the Transformation step contains approximately 180 questions not every question is discussed in detail. Rather the participants have been asked to study the questions in advance and thereby they are well prepared when the discussion starts. This leads to that focus is on the questions that need improvement while the ones that the participants of the workshop are satisfied with are not brought up.

Since every specific question in the method only is presented in the appendixes the description of the evaluation is given at a very general level in the thesis. The result of the workshops can be seen in the case studies in appendix A where all the questions are reported.

The first issue brought up concerning the questions is that the participants at the workshop are looking for a very distinct division of the questions. They wish that the question areas start with a broad question representing the whole area and thereafter a number of key points within the overall area should be mentioned. For example the main question can be followed by a number of bullets typing out what needs to be answered when looking into the area as a whole. It is decided that the bullets with key areas also should be written out as questions which follow after the main question. This way the consultant will not be forced to formulate a question of his or her own when performing the interview. The main question asks how the specific question area is managed, for example "How is the demand forecasting managed?". This question is thereafter followed by a number of specific questions making sure the relevant key areas within demand forecasting are addressed. Furthermore the participants of the second workshop mean that it is valuable if the bullet questions follow the products flow to the specific question area. That way it is easy to discover if questions are irrelevant or missing for a specific case.

For every question area the participants at the workshop are missing some sort of conclusive question. They mean it is important that every question area can lead to some interesting insight, even if the insight is that the company is not able to answer the question. The workshop decides that by asking questions on how a specific area is working, what happens if it is not working and if things could be done better, these insights can be attained. Therefore every question area is ended by the questions "What are the *consequences* of how the specific area is managed? What *problems* are there? How can this area be *improved*?".

6.4.4 Can the time analysis be improved?

When discussing the time analysis the participants at the workshop find it suitable. They agree it is important to put some focus on the time aspect and that lead time and inventory turnover rate are suitable measures. However they point out that this aspect is much easier to evaluate through the case studies.

6.5 Deeper Analysis and Conclusions (4)

When discussing the fourth step of the structure of the method, first, the question on how the results and conclusions of the analysis will be presented is brought up. Some of the participants at the workshops are looking for more specified guidelines on how the results should be presented. They believe a suitable way of presenting the results is through a presentation and thereafter in a short report. Since the conclusions may differ widely between different cases it is hard to create a standardized way of structuring a report. However, as mentioned earlier, a suggestion of a structure for the presentation can be seen in appendix D. This is meant to be a basic structure that UAE Logistics can develop further once the method has been used a number of times.

Below the two evaluation questions on the Deeper Analysis and Conclusions are discussed.

6.5.1 Is the unstructured method for deeper analysis appropriate?

There are different opinions on the unstructured method for deeper analysis among the participants at the workshop. Someone thinks this step can be completely dropped since it will take too much time to reach any conclusions from this analysis and since the method should be as standardized as possible. Someone else opposes to this and argues that this is an important part of the method for the findings of problem areas. However the majority agrees that there might not be much time for the deeper analysis but that it should remain as a part of the method since it increases its flexibility.

6.5.2 Can relevant conclusions be drawn?

The participants at the workshop believe the method for logistics evaluation is rather comprehensive and therefore it should be possible to draw relevant conclusions. However since the method has a quite strict time limit it might be hard to find all problem areas of a logistics system. Although the workshop is positive to the ability to find the major problems a logistics system has by using the method.

6.6 Modifications

In conclusion the workshops lead to minor revisions of the method. The overall structure is kept and changes are mainly made to specific questions on the System Description and Transformation step. Furthermore some question areas are changed in the Transformation step.

Below, Figure 34 explains the current position in the study, stating that chapter *6 Results and analysis – Workshops* results in a second version of the method.

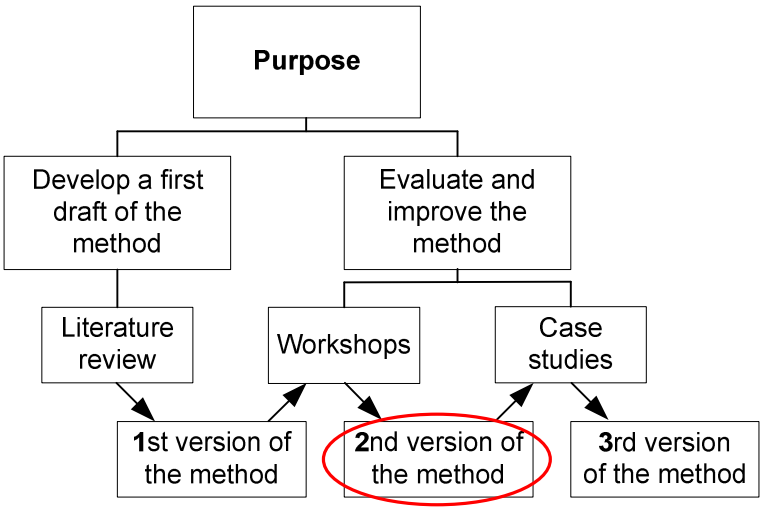

Figure 34. Chapter *6 Results and analysis – Workshops* results in a second version of the method

7 RESULTS AND ANALYSIS – Case Studies

In this chapter the second part of the results and analysis is presented. The results and analysis in this chapter comes from the evaluation of the second version of the method, which is presented in chapter 6 Results and analysis – Workshops, and results in a third version of the method. As mentioned in chapter 5 Methodology three case studies are performed when executing the second part of the evaluation of the method. The results from the case studies can be found in appendix A. In this chapter only the evaluation and improvements of the method are discussed. The structure of this chapter, just like the previous chapter, follows the structure of the evaluation of the method. Consequently the chapter starts with a discussion on the composition of the method. Thereafter the System Description, Input and Output, Transformation, and Deeper Analysis and Conclusions are dealt with. Finally the modifications of the method based on the results from the case studies are summarized.

7.1 The composition of the method (0)

When performing the evaluations of the case companies the composition of the method is always kept in focus since it is what the evaluations are based on. At the end of each case study the contact person at the case company is asked if he or she finds the method appropriate and if there are any obvious improvements that can be made. At all three case companies the contact persons find the questions relevant and they do not feel that any important areas have been overlooked. Furthermore no particular suggestions of improvements are given from the contact persons. One contact person expresses that the evaluation based on the method was very valuable since it made him start thinking about aspects of the logistics that he does not usually question.

In one of the case studies it becomes clear that the smart format of the questions makes it possible to work through half of the questions very swiftly. This of course affects the depth of the answers but they are still at an acceptable level and it is possible to draw conclusions about the logistics system based on them. For this reason the format of the questions with one primary question and a number of secondary questions for each question area is kept.

Below the three questions for evaluation of the composition of the method are discussed closer.

7.1.1 Is the method in accordance with the purpose and directives?

The question concerning whether the method is in accordance with the purpose and the directives of the thesis is mainly discussed during the workshops while it is harder to evaluate this aspect during the case studies. Therefore this question is not discussed any further in this chapter.

7.1.2 Is it possible to carry out the investigation as described in the method?

Especially the time frame for using the method is disbelieved during the workshops. Therefore this aspect is evaluated closely during the case studies. In order to get all data needed in time the case companies are asked to collect most of the quantitative data in advance before the visit at the company. Thereafter one day is spent for collecting the qualitative data and discussing possible obscurities concerning the quantitative data. After this day the gathered information is documented and summarized so that the need for complements is made clear. This complementing data is collected through contact by phone and e-mail. Next the analysis starts which may need further contact with the case company before any conclusions can be drawn.

There are some differences in how the usage of the method is carried out in this study compared to how it will be carried out in the future. The first difference concerns the people carrying out the evaluation. Instead of one consultant it is executed by two people with less experience in the logistics consultancy area. This means it is easier to quickly work through the questionnaire since one person can ask the questions while the other

person can type down the answers. However this also means that the analysis of the companies is not based on that much experience as it will be in the future. The second difference is that the focus during the testing of the method is mainly on how well the questions can be answered. The exact answers to the questions and how these answers are used in the analysis is also important but is subordinated.

During the one day spent per company collecting data at their offices it is possible to work through the questions and get them properly answered. There is also time to discuss some questions regarding how to collect the quantitative data. This is an indication that the time needed to collect data should not exceed two days for a solitary consultant. Given that the data collection takes a maximum of two days, which naturally will include a certain amount of analysis. There will be three days left to finish the analysis and present the results. This is seen as sufficient and therefore it should be fully possible to complete the investigation within the required time frame.

7.1.3 Can the structure of the method be improved?

The contact person at one case company is looking for more questions concerning how the logistics should be managed and how the system applies the principles of the company on the logistics. However these questions are already considered to be handled under the questions about "The goals of the company and its logistics objectives" which is a part of the System Description step. Here the following five questions are regarded as taking care of this aspect and therefore no changes are made to the method as a cause of this comment.

G.1 What are the comprehensive ***vision and objectives*** of the company?
G.2 What is the ***business strategy***?
G.3 How does the company ***define logistics***?
G.4 What is the ***logistics strategy***?
G.5 What are the ***logistics goals***? What does the company want to achieve with its logistics?

One of the case companies appears to have a very high level of control over their logistics and therefore it is hard to draw conclusions concerning problem areas. This could lead to questioning the type of companies the method is suitable for. On the other hand it must be a valid result that the logistics system is very good. Furthermore the system can serve as a role model for other systems, both regarding their quantitative data and management.

When there are several distinct product groups as in two of the cases the answers can get a bit mixed up and confused. Afterwards it can be hard to interpret the notes from the data collection and therefore confusion can be caused concerning which type of products that are referred to. How this problem should be solved is hard to decide. Probably the easiest way is to have this in mind when typing in the data and try to make it as clear as possible. No solution for improving the method to prevent this problem is found. Another problem that also comes from the documentation of the qualitative data is that sometimes the answers from the contact person or persons are inconsistent with each other. This is difficult to detect during the first interview occasion when the amount of information is overwhelming. A follow up interview after the material has been worked through can

help raise the quality of the data. This is already suggested in the method and this finding only makes the suggestion more important.

7.2 System Description (1)

The System Description is the first step when performing the evaluations at the case companies. When visiting the companies the contact persons start with a standard presentation of the company. This is a good way to start and to get to understand the company, both because it is convenient for the interviewee to start in a familiar way and because it gives the company a chance to describe their business without being steered by any questions. Many of the questions in "The characteristics of the company" are then already answered and the questions in this step can instead quickly be worked through as a checklist, so nothing important is forgotten. Therefore these types of presentations are recommended for future usage of the method. Moreover it is valuable to take a quick look at the company before the first visit, for example at the homepage of the company. This quick look can spare a lot of confusion during the first visit.

The mapping of the system and the matching of it to the general representation works very well at all three case companies. All the case companies have some sort of system description in their presentation of the company which easily can serve as a basis for the mapping of the system. Furthermore since the general representation has a very common composition it is easy to translate the composition of the system descriptions of the companies to the general representation.

In all three case companies the products can be divided into a limited number of homogenous flows with similar characteristics. This is a crucial factor when applying this method. A good balance must be struck between the benefits and drawbacks of generalizing products into groups. The products in a group must be similar enough to make average measurements of different metrics within the group meaningful. On the other hand each extra group complicates the investigation and requires extra time. The investigations at the case companies require at the most three different flows to be considered within one logistics system. This is an acceptable number but any more could be difficult to manage, especially under the same time frame as for an investigation of a company with only one product flow to consider. This problem can be alleviated since the mapping of the system is part of the sales process. If it becomes apparent that the logistics system is much differentiated and requires many different flows to be considered, then extra time can perhaps be granted for the investigation.

Based on the three case studies the evaluation of the System Description step of the method is discussed below.

7.2.1 Is it appropriate to describe the system based mainly on qualitative questions?

The qualitative questions on the System Description are appropriate and give a good overview of the company, its goals and logistics objectives. The problems rather concern the small number of quantitative questions which are included in the "Characteristics and goals" questions. In all three cases the respondents have problems answering these

questions and in one case the interviewee wrote a list of questions that she would e-mail later. Therefore it is decided that this quantitative data should be specified and asked for together with the Input and Output data which is asked for in advance in the specific letter to the company. The final version of this letter can be found in appendix B.

7.2.2 Can the question areas be improved?

The question areas on the System Description are considered appropriate and therefore no modifications are made on these based on the case studies.

7.2.3 Can the questions be improved?

When it comes to the specific questions on the "Characteristics and goals" part of the System Description the main problems concern the quantitative questions as discussed above. Moreover when asking one of the case companies about documented procedures on the logistics strategy confusion arises since the contact person at the case company means that a strategy does not have any procedures. This is kept in mind during the evaluation of all the case companies and later on it is discovered that the words "documented procedures" are not very suitable. This is mainly since the word "procedures" and its close relative "process" are both words that have different meaning for different persons and are interpreted rather differently. Therefore the words "documented procedures" are changed to the word "documentation".

Since only small changes are made to the System Description step based on the case studies there is no need for a new explanatory figure, Figure 32 is still up to date.

7.3 Input and Output (2)

The main issue concerning the Input and Output step of the method is the difficulties in the data collection. It is hard to decide if the difficulties in collecting the data come from the case companies not having the figures the method seeks, the contact person at the company not knowing where the figures can be found or the contact person just not being able to find the time to look for the figures. However it can be stated that it is hard to collect the data needed for the evaluation of the Input and Output in the case studies. When looking closer into the problem it becomes obvious that as long as the contact person tries the best he or she can to get the information needed it is sufficient for making the evaluation. If the needed information can not be found when the contact person makes a strong effort it means the information is not as easily accessible as desired and therefore the level of control the company has over its logistics can be considered limited. However the case where the contact person does not put as much effort as desired in looking for the needed figures will hopefully not occur once the company pays for the evaluation instead of seeing it as a contribution to a study as in this case.

Below each of the questions for evaluating the Input and Output step of the method are discussed based on the findings from the case studies.

7.3.1 Is it appropriate to analyze the input and output based on total costs and customer service?

When discussing the appropriateness of analyzing the Input and Output based on total costs and customer service mainly the appropriateness in terms of the possibility to execute the analysis and collection of data in a rather simple manner is evaluated in this chapter.

The cost information is initially considered difficult to collect for all the case companies. Nevertheless when discussing the data closer two case companies find it much easier while one still finds it hard. It was anticipated that it would be difficult for the companies to collect the cost data. Therefore instructions that were meant to make the collection easier were sent to the company, in the data collection preparation letter, before the data collection started. The instructions give guidance to how the cost elements can be collected and clarify that exact figures are not expected. However the attached total cost collection help sheets did not have such an effect on all the companies. Instead they gave the impression that the costs needed to be very detailed and specified, which would be very tedious. Therefore it is decided that the information and need for data that is sent to the company before the first visit should state out exactly what is needed from the company very clearly. It must be made clear that the total cost collection help sheets only are inspiring help and that they are not meant to be followed down to the last detail. This letter of explanation can be found in appendix B, as mentioned earlier.

7.3.2 Can the categorization of the total costs and customer service into elements be improved?

Since it was found rather difficult to collect the total cost data and categorize it into five elements the number of total cost elements should not be expanded any further. However the number could hardly be decreased since the elements are all very relevant according to the theoretical review. Therefore the five cost elements, carrying costs, holding costs, transportation costs, administration costs and other logistics costs, are kept in the method.

In some cases it is rather confusing when it comes to the used terms for the customer service elements. For example, what is called delivery reliability in this study is in many companies called delivery precision, as discussed during the workshops. Furthermore this figure is measured differently in all companies, some companies accept a delay of one day without making the delivery reliability decrease while other companies do not even accept if the products are one minute too late or one day too early. However it is exactly these differences in measurements that can be avoided when using another term than the one the company uses since then the company is more interested in the exact definition and fewer misunderstandings occur. Therefore the used terms for the customer service elements are kept.

Since not all companies measure their customer service in the same way and since they have different limits when it comes to what is accepted it might be hard to collect comparable data. Somehow this must be marked when an evaluation of a specific

logistics system is made, for example an asterisk can be used to leave a comment on how a specific figure is calculated.

7.3.3 Can any of the specific total cost and customer service elements be improved?

The specific total cost and customer service elements all works well during the case studies and therefore no changes are made to these.

Since only small changes are made to the Input and Output step based on the case studies there is no need for a new explanatory figure, Figure 23 is still up to date.

7.4 Transformation (3)

The evaluation of the Transformation step is the main focus during the case company visits since these questions take up most of the time. Overall the questions are found relevant and very appropriate. Nonetheless some improvements are made which are discussed under the specific questions below.

7.4.1 Is it appropriate to analyze the transformation based on qualitative questions and time analysis?

Based on the questions used in the Transformation step of the method it is easy to quickly gain insight into the company. Therefore it is considered appropriate to analyze the Transformation based on qualitative questions. The time analysis gives another perspective to the Transformation than the qualitative questions. Even if the aspect does not give as much understanding of the system as the qualitative questions it still increases the understanding of the logistics system further. For that reason also the time analysis is seen as an appropriate way of analyzing the Transformation.

7.4.2 Can the question areas be improved?

Based on the results from the case study evaluations of the method mainly two types of question areas are discussed. These question areas are parts of the procurement, operations and distribution; the strategy for the specific area and the planning and implementation for the specific area. Once the strategy questions have been asked it is found in all three case studies that the planning and implementation questions are rather closely related. Therefore these two question areas are merged together to one question area called management. The three new question areas are thereby called procurement management, operations management and distribution management. The third version of the question area structure of the Transformation step can be seen in Figure 35 below.

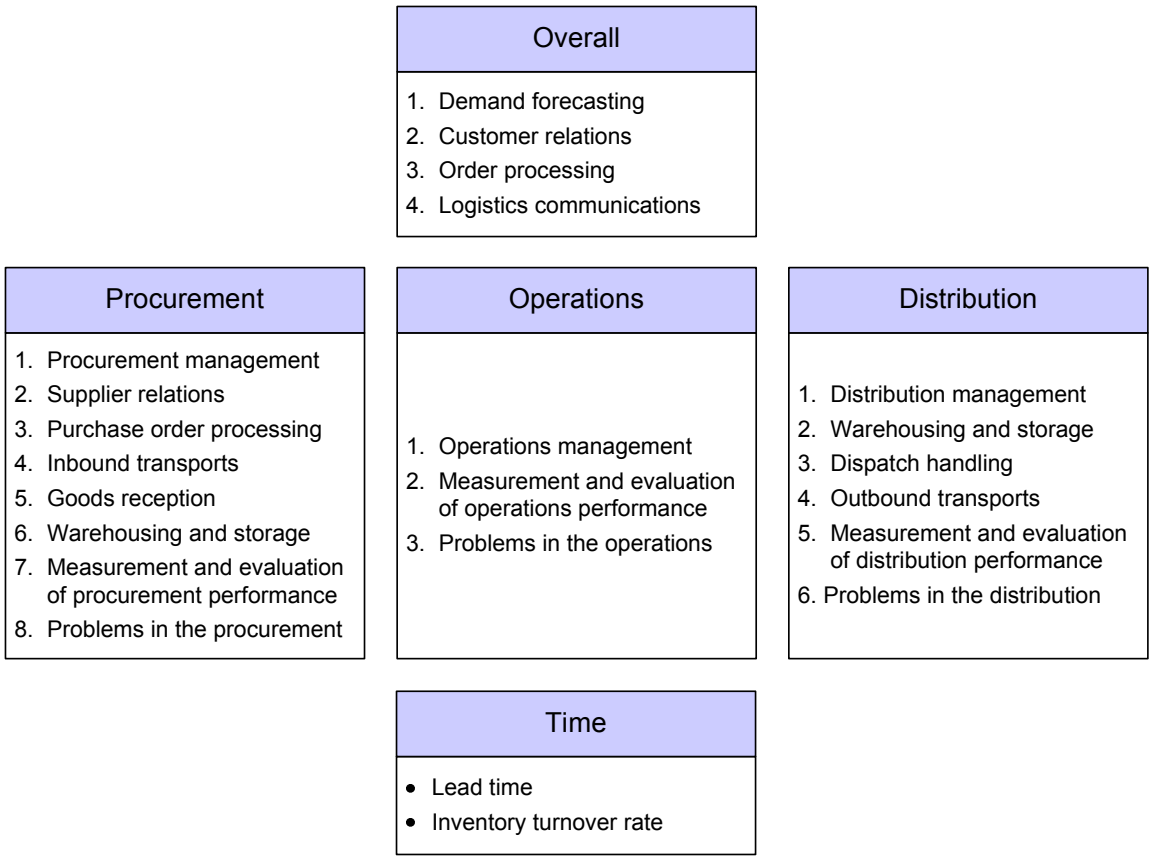

Figure 35. The third and final version of the Transformation step

7.4.3 Can the questions be improved?

As discussed in chapter *7.2.3 Can the questions be improved?* concerning the System Description the questions on "documentation of procedures" were found inappropriate. When working through the Transformation questions this formulation is not considered suitable either and therefore it is changed to "documentation" on the rest of the questions as well.

The question following after "Are there any documented procedures on…?" concerns if the documented procedures are followed. This question is a bit demeaning since it is hard for the company to leave a no as an answer to the question. However it still feels necessary to keep the question in the questionnaire to show the importance of this aspect. Instead the formulation of the question is changed to "Are these instructions used in satisfactory manner?". That way it is easier to get an honest answer.

Each question area ends with a question concerning the consequences of how the specific area is managed. The question aims to discover any types of problems or improvements that can be made on the area. However the use of the word consequences tends to confuse the respondents. Therefore it is decided that this part of the question should be removed. This means that for example the question on the supplier relations will be changed from "What are the consequences on how the supplier relations are managed? What problems

are there? How can this area be improved?" to only "What problems are there concerning the supplier relations? How can this area be improved?".

7.4.4 Can the time analysis be improved?

As mentioned before the time analysis is seen as relevant when performing the evaluations of the case companies. It is important that the flows that are investigated in the time analysis are so homogeneous that the average times that are associated with different activities are representative for the product group. If they are not, the time analysis will not be a very useful tool for understanding the logistics system.

A problem in the time analysis lies in the confusion about the terms. The term "lead time" is mixed together with "customer order lead time". In this thesis "lead time" is seen as the time for any unspecified activity, like the word "throughput time". Discussions are held whether "throughput time" is a better word but it is strongly associated with "total throughput time", which is not exactly what is meant when referring to "total lead time". Therefore the term "lead time" is kept in the method but it should be kept in mind that it is very important to make a strong distinction between the types of lead times.

7.5 Deeper Analysis and Conclusions (4)

Since the Deeper Analysis and Conclusions further on will be performed and drawn by experienced consultants it is hard to deem exactly how they will turn out in the future. Furthermore neither the deeper analysis nor the conclusions are steered to a larger extent by the method. This means the characteristics of the Deeper Analysis and Conclusions may vary between the different cases. However based on the case studies some observations concerning the Deeper Analysis and Conclusions are made. These aspects are discussed below.

7.5.1 Is the unstructured method for deeper analysis appropriate?

When it comes to evaluating the unstructured method for deeper analysis it is found to be an appropriate way of performing the deeper analysis. However it would also be very relevant with an even deeper follow up data collection so hypotheses can be further investigated. For example one case has rather high administration costs that might be due to a misconception of what should be included in this specific cost element. If a further follow up data collection is performed it can be controlled whether this is due to a misunderstanding or if the costs actually are that high.

7.5.2 Can relevant conclusions be drawn?

From the case studies it is found that relevant conclusions can be drawn based on an evaluation of a logistics system according to the method. These conclusions, which can be found in Appendix A for each case company, are not drawn by experienced supply chain consultants but by the authors of this thesis. Although these conclusions are considered satisfactory it is not unreasonable to assume that when the method is used by the consultants at UAE Logistics the quality of the conclusions will rise. Another factor that affects the quality of the conclusions is the time constraint. A lot deeper and more

specific conclusions could be drawn if the needed time was given for the deeper analysis. Nevertheless the time frame, which is a directive from UAE Logistics, limits the further data collection based on hypothesis testing.

As the method is used a database of quantitative data will be built. This will in time make it possible to, based on the quantitative data, draw conclusions if a company in some area deviates from what is normal or considered good for a company in that industry. This will be an effective tool that reasonably should strengthen the conclusions additionally.

7.6 Modifications

On the whole the case studies only lead to minor modifications of the method. Firstly some changes are made to the letter sent out to the company. In this letter it is made very clear what quantitative data is needed from the company before the evaluation can be executed. Secondly two question areas in the Transformation step are merged into one. These modifications are made on the procurement, operations and distribution questions. Finally some minor changes are made to the specific questions in order to make them easier to understand.

Below, Figure 36 explains the current position in the study, stating that chapter *7 Results and analysis – Case studies* results in a third and final version of the method.

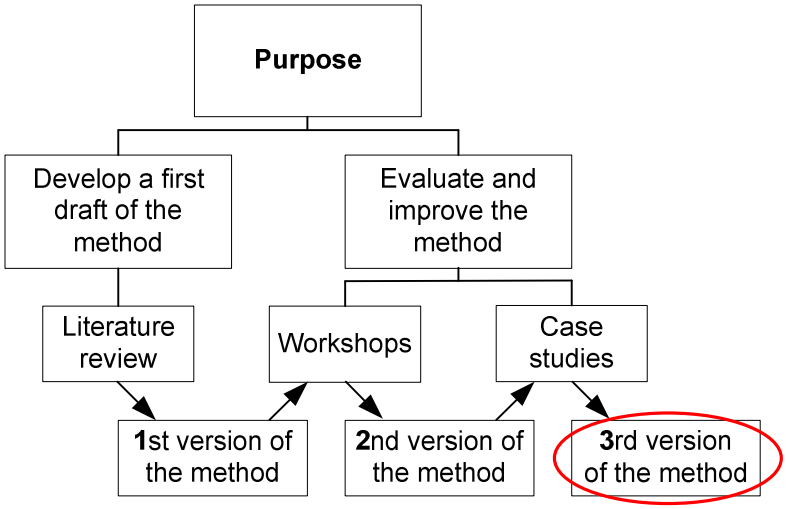

Figure 36. Chapter *7 Results and analysis - Case studies* results in a third version of the method

8 CONCLUSIONS AND RECOMMENDATIONS

In this last chapter of the thesis the conclusions from the study are presented. Thereafter reflections from the authors followed by recommendations to UAE Logistics concerning the method and its further development are given. Finally the investigation's generalness and contribution both to UAE Logistics and to science is discussed.

8.1 Conclusions

According to the purpose of this thesis a method for examining a logistics system and evaluating its performance is developed. The method is based on theoretical studies and improved in two different stages, through both workshops and case studies. The case studies show that conclusions can be drawn concerning a logistics system's performance based on an evaluation supported by the method. Guidelines for usage of the third and final version of the method can be found in appendix C.

8.2 The authors' reflections

It is interesting to discuss how delimitations and choices throughout an investigation affect the final result. In this chapter reflections from the authors on these aspects are given. The first issue concern that the methodology used to develop the method is rather special. After a quite thorough literature review a first draft of the method is developed rather quickly. Even though changes are made based on the evaluations through workshops and case studies the final version of the method is highly influenced by the first version. The question is if a more comprehensive development of the first draft and less focus on evaluation would have given the method an even higher quality. Whether this is the case or not is uncertain. It could be argued that the evaluation should be left to UAE Logistics while the thesis should focus on more theoretical studies. However since UAE Logistics is looking for a method that has been tested the given methodology is chosen.

One of the main issues discussed during this investigation is the proportion between qualitative and quantitative data. To create a method that can be used to compare a company's logistics performance with industry averages requires completely standardized quantitative data. But such common data can be difficult to choose because different companies measure different things. To complicate things further companies can have different definitions of the same measurements, making comparisons difficult even when the "same" metrics are used. Therefore the method is complemented with a great deal qualitative data, both to better understand the quantitative data and as important information on its own. The downside of the qualitative data is that it can not be used to the same extent for comparisons. Striking a balance between how much standardized quantitative data and how much customized quantitative data should be used has been one of the main challenges faced during this investigation.

A number of delimitations have affected the results of the thesis. First in the theoretical review, which serves as a basis for the first version of the method, a number of cost elements and customer service elements are excluded. The main reasons for these exclusions are that the elements are not seen as important enough, are too hard to evaluate or too hard and too time consuming to measure. These delimitations are forced due to the strict time limit of the method and also due to the time limit of this investigation. Since relevant conclusions can be drawn from an evaluation supported by the method the consequences of the delimitations should not be too severe. However it is impossible to know if other more relevant conclusions could have been drawn if additional elements were included in the method. During the workshops and case studies

the main delimitation relates to how many of these were performed. Of course the result from the investigation would have been even more reliable and the method would have been even better if a larger number of workshops with a larger number of participants and a larger number of case studies had been conducted. Due to the limitations in time in this study this was not possible. Nevertheless, once again referring to the relevant conclusions drawn in the case studies, the consequences probably are not that grave. Besides, both the workshops and the case studies gave much relevant input which enabled important improvements of the method.

8.3 Recommendations

The most difficult problem during the development of the method is the time aspect. Is it possible to come to meaningful conclusions in only a week's time of work? It can be concluded that this is the case and that the developed method fulfills the purpose of the thesis. However as discussed in chapter *7.5.2 Can relevant conclusions be drawn?*, deeper and more specific conclusions could be draw if there was more time available. That way it would be possible to try out different hypotheses developed from the first analysis to a larger extent. This would both raise the quality of the conclusions and increase the chance of understanding the causes of problem areas.

Should UAE Logistics have the opportunity to modify the service when selling it to a client company it is recommended that the method maybe should be expanded with some extra hours. That way a more thorough analysis can be made and thereby more relevant conclusions could be drawn. Not many extra hours are needed for this extra analysis.

When working with the method in the future UAE Logistics will be able to gradually improve the specific questions of the method and the way of using it. For example question areas may be found irrelevant and can be excluded or new question areas may be added. Furthermore specific questions can be added, excluded or just rephrased. When trying to improve the Transformation step it should be kept in mind that even if quantitative data enables comparison to greater extent important information might get lost when trying to quantify qualitative data.

It should be pointed out that the third version of the method should not be seen as the final version of the method in the long run. UAE Logistics should continue developing the method based on experiences from using it, as shown in Figure 37 below.

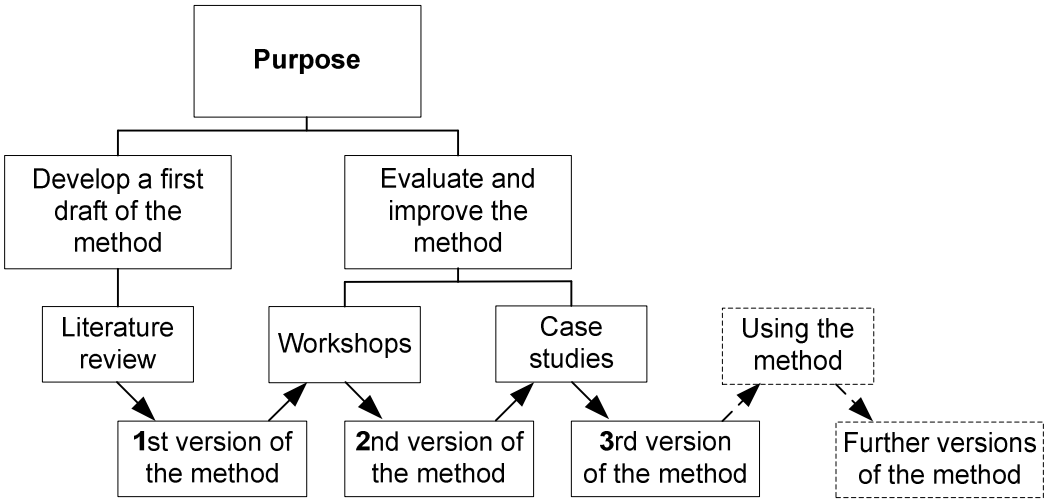

Figure 37. Further development of the method

For each time the method is used the database, consisting of the quantitative results from the evaluations, will grow. This will improve the opportunity to compare logistics systems with each other and therefore sharpen the method. This combined with improvements made by UAE Logistics gives the method the potential to grow into an even more useful tool.

8.4 Generalness and contributions

Generalness is an important aspect to discuss. How applicable the method is on different types of companies is hard to tell based on this study alone. It has been tested on three different types of companies and has turned out well in all three cases. Also the method is based on a theoretical review which strives to be as general as possible. However there is no guarantee that this indicates that the method works well on all types of companies. How valid the method is for other types of companies than the ones in the case studies UAE Logistics will have to discover when using the method in the future. Anyhow based on the time available for this investigation it is considered valuable that the three case companies are rather similar. Since there is only time for three case studies it would have been hard to come to any consistent conclusions concerning the quality of the method if the case companies were too different.

The first and main contribution of this study is to UAE Logistics. It presents UAE Logistics with a method for examining and evaluating the performance of a company's logistics system. Moreover the thesis presents the main areas and questions that need to be asked when analyzing a logistics system.

To science this thesis offers a review of basic logistics literature needed to develop a method for logistics evaluation. Furthermore a method for examining logistics systems and evaluating their performance resulting in a conclusion within a week is contributed.

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APPENDIXES

This thesis has four appendixes that in a more detailed way describe different aspects of the developed method. The first appendix (A) consists of the three conducted case studies. By studying the questions used in the case studies the second version of the method can be seen. In appendix B the letter that should be sent to a company before evaluating its performance is presented. This appendix is called "Data collection preparations". The following appendix (C) presents the guidelines for using the method. Finally appendix D shows the basic structure for presentation of the results.

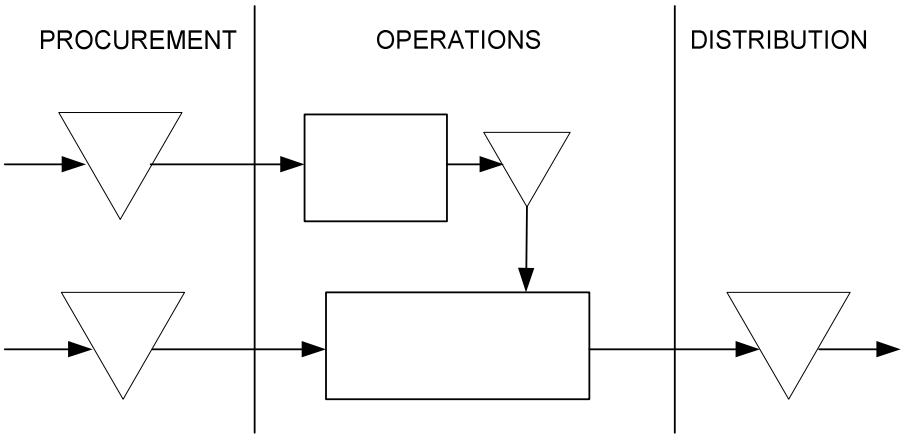
Appendix A: Case Company 1

The visit at Case Company 1 is held on December 4 2007. The data collection also includes telephone interviews and questions answered in written form by e-mail. Unfortunately only about half of the qualitative questions were addressed in the face-to-face interview at the company. A second interview was scheduled but was not possible to perform because of the interviewees' busy itineraries. The second half of the questions was handled during telephone interviews and over e-mail.

System Description

Before the discussion on the system starts the contact person at the company gives a short presentation on the company and its background. This presentation is very useful since it gives a broad understanding of the system. There is a minor problem when applying the method to this logistics system. The factory has just been moved from one city to another and testing is done on the new factory where not everything is up and running yet. However when there are numbers missing the contact person takes data from the old factory or make estimations.

Mapping the system



Characteristics and goals

Much of the information concerning the characteristics and goals of the company was obtained during the presentation of the company.

The characteristics of the company

C.1 What is the ***history*** of the company?
As described earlier the history of the company (or the part of the company that is analyzed) is rather short since the factory has moved from one city to another.

C.2 What ***type of company*** is it, what does the company offer?
The analyzed system produces three similar types of products which are parts of bigger products. The products the system produces are delivered to another part of the company.

C.3 What ***value*** does the company add before selling the finished products?
The value is mostly the customer service the company offers where the customer gets the products delivered in sequence and in 99.9 percent of the time exactly in the right time. Furthermore, the company offers a high quality.

C.4 In what ***industry*** does the company operate?
-

C.5 Where is the company ***located***?
In central Sweden

C.6 Which ***markets*** does the company focus on?
The system's customer is mainly another division of the company.

C.7 Who are the ***competitors*** of the company?
There is not a very big competition in the industry since the system delivers its products to another part of the company. However, they try to achieve a competitive production and stay updated on how other companies in the same industry works, by benchmarking.

C.8 What ***risks*** does the company face?
At the moment a big risk is that it is hard to order enough raw material since the demand is large. Furthermore, there are risks concerning the quality of the products. Finally, only having one customer, and this customer being the own company is a big risk which forces the system to be able to adapt to changes.

C.9 How is the company ***organized*** in general and regarding logistics?
The company is divided into the following divisions;

- In-flow/raw material storage
- Internal flow
- Out-flow
- Material management
- Material steering (including call-offs, controlling of quality, inventory levels, stock-taking, material planning, transport coordinator)
- Production planning (makes plans on how the production should be carried out)
- Logistics development
- IS/IT coordination

C.10 What has the ***revenue*** been during the last years?
Approximately 2 000-2 500 MSEK

C.11 What have the ***assets***, ***liabilities*** and ***owner's equity*** been during the last years?
Since the system is a part of a larger company they do not have these figures.

C.12 What has the ***profit*** been during the last years?
The company tries to reach a zero result every year.

C.13 What has the ***capital turnover rate*** been during the last years?
The company does not measure this.

C.14 What has the ***number of full time employees*** been during the last years?
Approximately 650 employees

C.15 What is the ***full time equivalent*** of the employees ***working with logistics***?
Approximately 125 employees

C.16 How many ***stock keeping units*** are handled annually? Inbound/outbound?
1 200 inbound stock keeping units and several hundreds variations of the three outbound stock keeping units.

C.17 How many ***orders*** are handled annually? Inbound/outbound?
Every component is an order, this means that there are approximately 150 000 orders per year.

C.18 How many ***deliveries*** are handled annually? Inbound/outbound?
Every day approximately 40 trucks delivers to the system and approximately 25 trucks leaves the system.

The goals of the company and its logistics objectives

G.1 What are the comprehensive ***vision and objectives*** of the company?
The goal is to provide the customers with high quality products, a 100 percent delivery precision both in and out from the system and to a low cost. Furthermore, it should be a safe workplace where it is stimulating to work.

G.2 What is the ***business strategy***?
See question G1 above.

G.3 How does the company ***define logistics***?
According to the company logistics include delivery of products from suppliers to the assembly line, both concerning the actual products and information on them, and to with a high precision deliver the finished products to the customer, both physically and administratively.

G.4 What is the ***logistics strategy***?
The company focuses much on equalizing. A part of the company should be able to adapt the work as it wishes without letting it affect the suppliers or the customers.

G.5 What are the ***logistics goals***? What does the company want to achieve with its logistics?
See question G1 above.

G.6 Are the goals ***measured***? How?
There are measurements on a number of areas.

Customers: Customer complaints, green buffer to customer, delivery dependability, sequence reorganization at the customer, lack of material in the production, lack of material in the storage

Process: Slot times, delivery precision in in-flow, total cover time, cover time in storage, incorrect balance in production, incorrect balance in storage

Co-worker: Discussions on personal development, improvement per co-worker and year, incidents/accidents, healthy presence

Economy: Express transports out-flow, express transports in-flow, cost per component (personnel and other)

Development: Production system, personal efficiency program

G.7 Does the company focus on a ***cost*** or ***value advantage*** or both?
A high value is more important than low costs

G.8 How ***important*** is ***logistics*** for the company, strategically?
The logistics is an important part of the whole; however, it has to work in harmony with the rest of the company

G.9 What are the ***customer demands*** regarding logistics?
The customer demands a 100 percent level on the delivery precision but also on the information the customer gets. The customers are not interested in what products they are going to get but in which products they will not get.

G.10 Are there ***different logistics goals*** for different products or flows?
No, there are not any different logistics goal since there are not many variations in products and a very few customers.

G.11 Is the logistics ***adapted*** to the products or vice versa?
Neither the products nor the logistics is able to make the definite decision. It is rather a mutual agreement between the two of them, it is important to understand the whole. However, the contact person means that the company can improve the product development in order to adapt the products to the logistics in a better manner.

Documented procedures on the logistics strategy

The company works with a strategic plan from a number of given parameters. They point out that a strategy does not have any value until it has been broken down to an operative level. They both have and follow a logistics strategy.

Input and Output

Total cost

	Procurement	Operations	Distribution	Total
Carrying costs	70 000 000	20 000 000	20 000 000	110 000 000
Holding costs	9 885 000	52 720 000	3 295 000	65 900 000
Transportation costs	95 000 000	0	0	95 000 000
Administration costs	340 000	1 360 000	0	1 700 000
Other logistics costs	3 150 000	6 300 000	1 050 000	10 500 000

Customer service

Total number of orders	150 000
Total number of deliveries	5 244
Number of complete orders delivered	149 950
Number of deliveries on time	5 192
Number of deliveries without complaints	5 200
Time from customer order placement to complete delivery (customer order lead time)	7 days
Average number of order lines per order	1

Transformation

Overall

1. Demand forecasting

A.1.1 How is the demand forecasting managed?

The company knows exactly how the production will be two weeks in advance. The time before these two weeks is in turn filled gradually with orders. One year in advance the whole demand is just a prognosis. Every month a planning meeting is held where it is decided if the pace should be increased or decreased. The planning meeting decides what the pace will look like in three months. This means that the planning meeting in November decided the pace for the production in March.

A.1.2 How are prognoses made?
See question A.1.1 above.

A.1.3 Are the prognoses usually accurate?
Yes

A.1.4 Are the prognoses followed?
Yes

A.1.5 Where is the ***order penetration point*** situated?
The customer production starts four days before the product is finished. However there are a number of extra days which need to be included since the suppliers need a number of days to deliver. Therefore the order penetration point is situated 7 days before the product is delivered. However, since this product is a part of a greater product there are other parameters steering the ability to change the product. The end user of the total product can change the specification of the total products up until 21 days before delivery.

A.1.6 What are the ***consequences*** of how the demand forecasting is managed? What ***problems*** are there? How can this area be ***improved***?
There are not any exact problems. However, the company needs to focus more on equalizing in order to be even better on planning and prognosticating the production

Documented procedures on demand forecasting

Yes there are documented procedures which are followed.

2. Customer relations

A.2.1 How are the customer relations managed?
The company tries to work as customer-supplier related as possible. However, since the customer is a part of the own company it is sometimes hard to keep a strict relationship.

A.2.2 What is the ***number of customers*** the company has? What is that number based on? Is that the desired number?
The system has three customers, all parts of the company.

A.2.3 What is the ***percentage of the annual sales value*** that the three biggest customers stand for each?
The three customers stand for 50 %, 25 % and 25 % each.

A.2.4 Where are the customers ***located***? What is the ***lead time*** to the customers?
The customers are located in Holland, France and Sweden. The lead time in Sweden is just a couple of minutes. To Holland and France it is approximately three days.

A.2.5 How are the ***contracts*** with the customers formed? (time conditions, price, order entry, payment conditions, etc.)
-

A.2.6 What are the ***consequences*** of how the customer relations are managed? What ***problems*** are there? How can this area be ***improved***?
Since the customers are a part of the own company the relations are rather good. Transport optimization and equalizing of the flows could be improved.

Documented procedures on customer relations

Yes there are logistics agreements that decide how the relations should work and how meetings should be held. These documentations are followed.

3. Order processing

A.3.1 How is the order processing managed?
The company receives an order batch from its customers once a week. It tells when the customer wants the products and what type of products that should be produced. The specification of the products is presented in terms of a code string which tells the information system which components are needed etc. The demand of components is then sent on to the suppliers.

A.3.2 How is the ***order entry*** (order editing/call off) performed?
Se question A.3.1 above.

A.3.3 How are ***order modifications*** or ***error corrections*** handled?
-

A.3.4 Are the customers given answers to ***order status inquiries***? How?
The company focuses on leaving information on deviations but not very much on leaving information when everything is working alright. Furthermore, the company is at the moment working with an implementation of a tracking system that will be available to the customers.

A.3.5 How is ***invoicing*** managed?
This question is not relevant in this case since the customer is a part of the company.

A.3.6 What are the ***consequences*** of how the order processing is managed? What ***problems*** are there? How can this area be ***improved***?
It would improve the order processing even further if the order batch had a sequence which was more adapted to the production.

Documented procedures on order processing

Yes, there are documented procedures on the order processing which also are followed. However, a system to support the documentation of outbound deliveries is missing.

4. Logistics communications

A.4.1 How are data and information exchange managed

The delivery planners have contact with the customer several times per day, mainly by phone or e-mail. Information exchange is handled by Excel files and to some extent through the ERP system of the company. This ERP system will be used even more in the future.

A.4.2 What ***type of ERP system*** is used to support the logistics communications?
A common ERP system is used within the whole company.

A.4.3 What method is used for information exchange between the major functions ***within the organization***? Is the same ERP system used within the whole logistics system?
Yes, the same ERP system is used for information exchange within the whole system

A.4.4 What method is used for information exchange between the organization, its ***suppliers*** and its ***customers***?
When communicating with the suppliers orders are sent by EDI. Then the information is automatically transformed to the mode the supplier wants the information in, for example e-mail, into their ERP system or sometimes by fax.

A.4.5 What method is used for information exchange between ***other members of the supply chain*** who may not be directly linked to the firm? (second tier suppliers and customers' customer)
There is not much communication with the 2 tier suppliers. When it comes to the customer of the customer the main company has that contact.

A.4.6 What are the ***consequences*** of how the logistics communications are managed? What ***problems*** are there? How can this area be ***improved***?
There are a lot of documentation on what should be done if the logistics communications do not work as they should and different levels of measures.

Documented procedures on logistics communications

Yes, as mentioned above, there are documented procedures on the logistics communications and these are followed.

Procurement

1. Procurement strategy

P.1.1 What is the procurement strategy? (single/multiple sourcing)

The procurement strategy differs widely and depends on the type of article and its supplier structure. However there is a carefully documented process for how this should be handled within the procurement division.

P.1.2 Why is this strategy chosen?
-

P.1.3 What are the ***consequences*** of how the procurement strategy is managed? What ***problems*** are there? How can this area be ***improved***?
-

Documented procedures on procurement strategy

Yes, there are documented procedures on the procurement strategy and these are followed.

2. Procurement planning and implementation

P.2.1 How is the procurement planned and implemented?
The procurement division is responsible for the overall strategy and structure of suppliers while the logistics division handles the daily contact and home taking of material.

P.2.2 How are the ***inventories managed***? (inventory levels, safety stock, cycle stock, etc.?)
-

P.2.3 How is the raw material ***demand prognosticated***?
-

P.2.4 What is the ***capacity utilization*** level in the procurement? Is this the desired level?
-

P.2.5 How is ***flexibility*** in the procurement taken in to account?
-

P.2.6 Are there any ***bottlenecks*** in the procurement? How do they impact the procurement? How are they avoided?
-

P.2.7 How are the ***risks*** in the procurement managed? Is there a contingency plan?
-

P.2.8 Are there any ***custom*** issues that effect how the procurement is managed?
-

P.2.9 What are the ***consequences*** of how the procurement planning and implementation is managed? What ***problems*** are there? How can this area be ***improved***?
-

Documented procedures on procurement planning and implementation

Yes, there are documented procedures on this area and they are followed.

3. Supplier relations

P.3.1 How are the supplier relations managed?
A centralized procurement division is responsible for the supplier relations and therefore this aspect is not completely in the company's control.

P.3.2 How are logistics related parameters used when ***selecting*** the suppliers?
-

P.3.3 How are the ***contracts*** with the suppliers formed? (time conditions, price, order entry, payment conditions etc.)
-

P.3.4 How are logistics related parameters used when ***evaluating*** the suppliers?
-

P.3.5 How is the work with ***supplier relations development*** performed?
-

P.3.6 What is the ***number of suppliers*** the company has? What is that number based on?
-

P.3.7 What is the ***percentage of the annual costs value*** that the three biggest suppliers stand for each?
-

P.3.8 Where are the suppliers ***located***?
-

P.3.9 What is the ***lead time***, from order to delivery, from the suppliers?
-

P.3.10 What are the ***consequences*** of how the supplier relations are managed? What ***problems*** are there? How can this area be ***improved***?
-

Documented procedures on supplier relations

Yes, there are documented procedures on this area and they are followed.

4. Purchase order processing

P.4.1 How is the purchase order processing managed?
The procurement division has a main agreement which the logistics division follows when they make call offs.

P.4.2 How is the ***order entry*** (order editing/call off) performed?
-

P.4.3 How are ***order modifications*** or ***error corrections*** handled?
-

P.4.4 Do the suppliers give answers to ***order status inquiries***? How?
-

P.4.5 How is ***invoicing*** managed?
-

P.4.6 What are the ***consequences*** of how the purchase order processing is managed? What ***problems*** are there? How can this area be ***improved***?
-

Documented procedures on purchase order processing

Yes, there are documented procedures on this area and they are followed.

5. Inbound transports

P.5.1 How are the inbound transports managed?
The company cooperates with a third part logistics company that plans the specific transport paths. The transports are followed in a certain web based system that visualizes the flow from booking of transports to delivery.

P.5.2 How are the ***Inco terms*** for the inbound transports formed?
-

P.5.3 How is the ***method of shipment*** selected? (boat, air, truck, rail, etc.) What method is normally used?
-

P.5.4 How is the ***specific path*** the shipment takes decided?
-

P.5.5 How are different ***transport regulations*** taken into account?
-

P.5.6 How are the deliveries ***supervised***?
-

P.5.7 What are the ***consequences*** of how the inbound transports are managed? What ***problems*** are there? How can this area be ***improved***?
-

Documented procedures on inbound transports

Yes, there are documented procedures on this area and they are followed.

6. Goods reception

P.6.1 How is the goods reception managed?

-

P.6.2 How is the ***capacity level*** (in terms of personnel available at different times) in the goods reception decided?

-

P.6.3 How are ***deviations*** in the shipments managed? (amount, quality, time, etc)

-

P.6.4 What are the ***consequences*** of how the goods reception is managed? What ***problems*** are there? How can this area be ***improved***?

-

Documented procedures on goods reception

Yes, there are documented procedures on this area and they are followed.

7. Warehousing and storage

P.7.1 How is the warehousing and storage managed?

The inventory is managed by the material planning division. The inventory levels are decided by a number of parameters which are chosen by the material planning division. Furthermore a certain system is used in order to decide the exact inventory levels based on the specific parameters, including transport lead time, internal handling time and volume.

P.7.2 How is the ***warehouse site*** selected?

-

P.7.3 How is ***picking, staging*** and ***loading*** performed?

-

P.7.4 How is the ***packaging*** managed?

-

P.7.5 Is the storage facility ***owned***, ***leased*** or ***rented***? What is that decision based on?

-

P.7.6 How is the ***layout*** and ***design*** of the storage facilities decided?

-

P.7.7 How is the ***product mix*** in the storage considered?

-

P.7.8 What are the ***consequences*** of how the warehousing and storage is managed? What ***problems*** are there? How can this area be ***improved***?

-

Documented procedures on warehousing and storage

Yes, there are documented procedures on this area and they are followed.

8. Measurement and evaluation of procurement performance

P.8.1 How is measurement and evaluation of the procurement performance, both internally and externally, managed?

The delivery precision and quality deviations on the suppliers and the transport company are followed up. Furthermore, the purchasing division also follows up the costs. Some problems may occur in this area since the company sometimes puts too much focus on the price and too little focus on the total cost.

P.8.2 ***What*** is measured?

-

P.8.3 ***How*** is it measured?

-

P.8.4 How is it ***evaluated***?

-

P.8.5 How are ***improvements*** made?

-

P.8.6 What are the ***consequences*** of how the measurement and evaluation of procurement performance is managed? What ***problems*** are there? How can this area be ***improved***?

-

Documented procedures on measurement and evaluation of the procurement

Yes, there are documented procedures on the area and they are followed.

9. Problems in the procurement

P.9.1 What problems are there in the procurement?

There are problems concerning the coordination, standardizing and communication within the procurement area.

P.9.2 Is the procurement ***method appropriate***? Does it work well?

-

P.9.3 How are ***deviations*** handled? What are the consequences of the deviations?

-

P.9.4 How can the procurement be ***improved***?

-

Operations

1. Operations strategy

O.1.1 What is the operations strategy?
The strategy is to produce in an even pace each day. Safety and environment are cornerstones.

O.1.2 Why is this strategy chosen?
-

O.1.3 What are the ***consequences*** of how the operations strategy is managed? What ***problems*** are there? How can this area be ***improved***?
-

Documented procedures on operations strategy

Yes, and they are used.

2. Operations planning and implementation

O.2.1 How are the operations planned and implemented?
The aim is that everything should be documented in processes and standards. For this to be possible they want everything paced, equalized and a good visibility so that measures can be taken immediately. There is a constant will to improve this and break down irregularities and build a system that works well when operating.

O.2.2 What are the ***characteristics of the operations***? (Nonstop, line, customized, project, etc.)
Paced production line

O.2.3 How is the operations ***demand prognosticated***?
-

O.2.4 What is the ***capacity utilization*** level in the operations? Is this the desired level?
-

O.2.5 How is ***flexibility*** in the operations taken in to account?
-

O.2.6 Are there any ***bottlenecks*** in the operations? How do they impact operations? How are they avoided?
-

O.2.7 How are the ***risks*** in the operations managed? Is there a contingency plan?
-

O.2.8 What are the ***consequences*** of how the operations planning and implementation is managed? What ***problems*** are there? How can this area be ***improved***?

-

Documented procedures on operations planning and implementation

Yes, there are documented procedures on this area and they are followed.

3. Measurement and evaluation of operations strategy

O.3.1 How is measurement and evaluation of the operations performance managed?

They are divided into different areas:

- Safety and work environment, accidents
- Efficiency, downtime, quality deviations
- Lead time, delivery precision, energy usage
- Transport cost per unit, total cost per unit

O.3.2 What is measured?

-

O.3.3 How is it measured?

-

O.3.4 How is it ***evaluated***?

-

O.3.5 How are ***improvements*** made?

-

O.3.6 What are the ***consequences*** of how the measurement and evaluation of operations performance is managed? What ***problems*** are there? How can this area be ***improved***?

There are no problems and it is a very important area. One issue is that it is easy to start measuring too much. It should be about finding the right measurements and not too many. Not many can explain what they actually measure, in such cases it is more about noting changes and development and not evaluating the figures themselves.

Documented procedures on measurement and evaluation of the operations

Yes and they are followed.

4. Problems in the operations

O.4.1 What problems are there in the operations?

The material supply has been a bottleneck. External suppliers have had a hard time considering the high volumes. Different parts of the operation process have developed to different stages.

O.4.2 Is the operations ***method appropriate***? Does it work well?
-

O.4.3 How are ***deviations*** handled? What are the consequences of the deviations?
-

O.4.4 How can the operations be ***improved***?
-

Distribution

1. Distribution strategy

D.1.1 What is the distribution strategy?
The distribution is planned at a central level but there is a local delivery planning unit that handles the details. The transports are paid for by the customer but the company do not completely ignore what happens outside their gates since the customer is internal.

D.1.2 Why is this strategy chosen?
-

D.1.3 What are the ***consequences*** of how the distribution strategy is managed? What ***problems*** are there? How can this area be ***improved***?
There were problems with the previous location regarding its location that now are solved. Of course there will always be disturbances, for example due to weather conditions, which can not be handled.

Documented procedures on distribution strategy

Yes on several levels and they are followed.

2. Distribution planning and implementation

D.2.1 How is the distribution planned and implemented?
For the outflow lead time and delivery precision go before a high capacity usage. But on the other hand there is a limit to that as well; high capacity usage is a good thing.

D.2.2 How are the ***inventories managed***? (inventory levels, safety stock, cycle stock, etc.?)
-

D.2.3 How is the distribution capacity ***demand prognosticated***?
-

D.2.4 What is the ***capacity utilization*** level in the distribution? Is this the desired level?
-

D.2.5 How is ***flexibility*** in the distribution taken in to account?
-

D.2.6 Are there any ***bottlenecks*** in the distribution? How do they impact distribution? How are they avoided?
Recently there has been a general lack of trucks all over Europe which can be seen as a bottleneck.

D.2.7 How are the ***risks*** in the distribution managed? Is there a contingency plan?
One risk is if a truck would drive into a ditch it would cause big problems since they deliver in sequence. There are no contingency plans for this kind of events.

D.2.8 Are there any ***custom*** issues that effect how the distribution is managed?
Not really, almost all trucks stay within Europe. A few go to South America but they can be neglected because they are so unusual.

D.2.9 What are the ***consequences*** of how the distribution planning and implementation is managed? What ***problems*** are there? How can this area be ***improved***?
-

Documented procedures on distribution planning and implementation

Yes, there are documented procedures on this area and they are followed.

3. Warehousing and storage

D.3.1 How is the warehousing and storage managed?
Outdoors, under roof without heating. There is a 24 hour buffer. It is all stored according to a plan so that it can be loaded into the truck in sequence.

D.3.2 How is the ***warehouse site*** selected?
Right by the factory

D.3.3 How is ***picking, staging*** and ***loading*** performed?
-

D.3.4 How is the ***packaging*** managed?
-

D.3.5 Is the storage facility ***owned***, ***leased*** or ***rented***? What is that decision based on?
-

D.3.6 How is the ***layout*** and ***design*** of the storage facilities decided?
-

D.3.7 How is the ***product mix*** in the storage considered?
-

D.3.8 What are the ***consequences*** of how the warehousing and storage is managed? What ***problems*** are there? How can this area be ***improved***?
-

Documented procedures on warehousing and storage

Yes it is controlled by documentation. Today it is a fairly manual procedure but in about six months there will be implemented systems to help plan and administrate the area.

4. Dispatch handling

D.4.1 How is the dispatch handling managed?
This is controlled by slot times, generally fifteen minutes according to the paced flow. The day before dispatch the transport is booked in the companies one web-based system. Then the agent gets the bookings through a system and fits them in.

D.4.2 How is the ***capacity level*** in the dispatch handling decided?
If there is chaotic weather or some other situation a problem arises because trucks start missing there slot times. This is extra sensitive because of the paced system.

D.4.3 How are ***deviations*** in the dispatch handling managed?
-

D.4.4 How is the ***quality*** of the dispatch handling controlled?
-

D.4.5 What are the ***consequences*** of how the dispatch handling is managed? What ***problems*** are there? How can this area be ***improved***?
-

Documented procedures on dispatch handling

Yes and they are followed

5. Outbound transports

D.5.1 How are the outbound transports managed?
They are handled by an agent.

D.5.2 How are the ***Inco terms*** for the outbound transports formed?
-

D.5.3 How is the ***method of shipment*** selected? (boat, air, truck, rail, etc.) What method is normally used?
Everything goes by truck

D.5.4 How is the ***specific path*** the shipment takes decided?
-

D.5.5 How are different ***transport regulations*** taken into account?
The weight limits the number of products that can be transported in each truck.

D.5.6 How are the deliveries ***supervised***?
There is no tracking, just simply a pickup and arrive time. It is possible to call and ask where things are.

D.5.7 What are the ***consequences*** of how the outbound transports are managed? What ***problems*** are there? How can this area be ***improved***?
The weather causes problems.

Documented procedures on outbound transports

Yes and they are followed.

6. Measurement and evaluation of distribution performance

D.6.1 How is measurement and evaluation of the distribution performance, both internally and externally, managed?
Delivery precision and the transport cost per unit. The deviation handling system of the transporters.

D.6.2 What is measured?
-

D.6.3 How is it measured?
-

D.6.4 How is it ***evaluated***?
-

D.6.5 How are ***improvements*** made?
-

D.6.6 What are the ***consequences*** of how the measurement and evaluation of distribution performance are managed? What ***problems*** are there? How can this area be ***improved***?
It would be nice to be able to measure times and such by tracking the transports. This could help identify problems.

Documented procedures on measurement and evaluation of the distribution

The central transport function has two regular surveys that identify what the customers think.

7. Problems in the distribution

D.7.1 What problems are there in the distribution?
There are some language difficulties when the drivers speak neither Swedish nor English. This could probably not be helped by better documentation

because the problems only arise in the first place when something irregular happens.

D.7.2 Is the distribution ***method appropriate***? Does it work well?
-

D.7.3 How are ***deviations*** handled? What are the consequences of the deviations?
-

D.7.4 How can the distribution be ***improved***?
-

Time

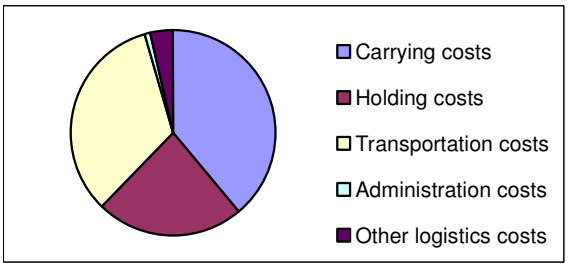
	Procurement	**Operations**	**Distribution**
Lead time	7 days	2 days	1 day
Time in inventory	5 days	0 days	1 day

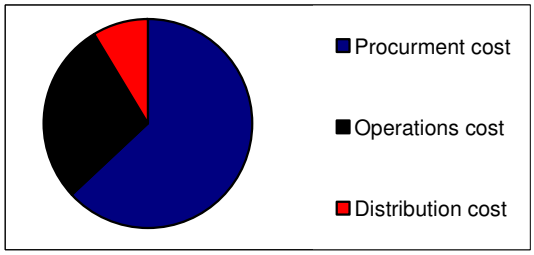
Analysis and Conclusions

Below the quantitative results from the analysis are presented and after that follows a brief analysis of the results. First the total costs are presented followed by the customer service. Thereafter the level of control is presented and finally the time analysis is shown. The control of each section is graded on a scale of zero to three, three being the highest, based on the documentation on that area and how it is used. These levels are also summarized for the three main parts of the company's logistics system and the complete system.

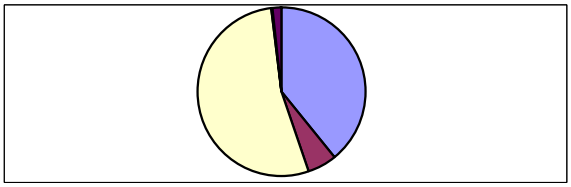
Total Cost Results

Total cost	**283 100 000 kr**	
Carrying costs	110 000 000 kr	39%
Holding costs	65 900 000 kr	23%
Transportation costs	95 000 000 kr	34%
Administration costs	1 700 000 kr	1%
Other logistics costs	10 500 000 kr	4%

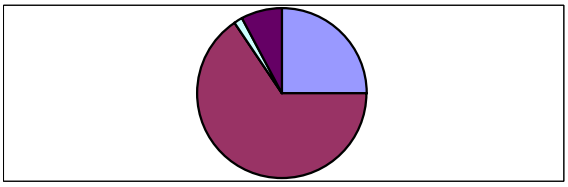




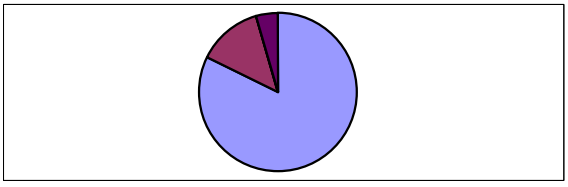
Procurment cost	**178 375 000 kr**	**63%**
Carrying costs	70 000 000 kr	39%
Holding costs	9 885 000 kr	6%
Transportation costs	95 000 000 kr	53%
Administration costs	340 000 kr	0%
Other logistics costs	3 150 000 kr	2%



Operations cost	**80 380 000 kr**	**28%**
Carrying costs	20 000 000 kr	25%
Holding costs	52 720 000 kr	66%
Transportation costs	- kr	0%
Administration costs	1 360 000 kr	2%
Other logistics costs	6 300 000 kr	8%



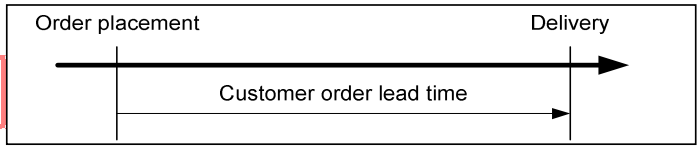
Distribution cost	**24 345 000 kr**	**9%**
Carrying costs	20 000 000 kr	82%
Holding costs	3 295 000 kr	14%
Transportation costs	- kr	0%
Administration costs	- kr	0%
Other logistics costs	1 050 000 kr	4%



Customer Service

Total number of orders	150 000
Total number of deliveries	5 244
Number of complete orders delivered	149 950
Number of deliveries on time	5 192
Number of deliveries without complaints	5 200

Customer order lead time 7 days



Delivery reliability **99,01%**

$$\text{Delivery reliability} = \frac{\text{Number of deliveries on time}}{\text{Total number of deliveries}}$$

Delivery dependability **99,16%**

$$\text{Delivery dependability} = \frac{\text{Number of deliveries without complaints}}{\text{Total number of deliveries}}$$

Stock availability **99,97%**

$$\text{Stock availability} = \frac{\text{Number of orders delivered complete}}{\text{Total number of orders}}$$

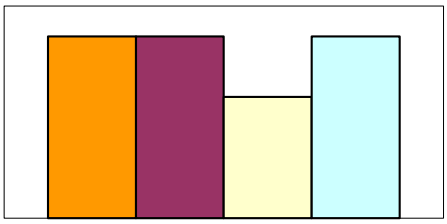
Average number of order lines per order 1

The average number of order lines per order affects the customer service level. A high number of order lines per order may make it harder to achieve a high customer service level.

Control	2,90

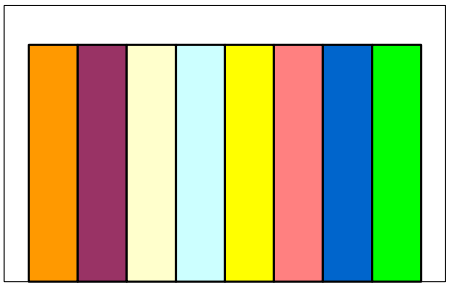
Overall	2,75

1. Demand forecasting	3
2. Customer relations	3
3. Order processing	2
4. Logistics communications	3



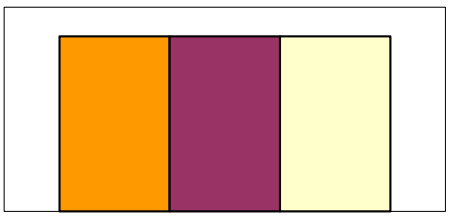
Procurement	3

1. Strategy	3
2. Planning and implementation	3
3. Supplier relations	3
4. Purchase order processing	3
5. Inbound transports	3
6. Goods reception	3
7. Warehousing and storage	3
8. Measurement and evaluation	3



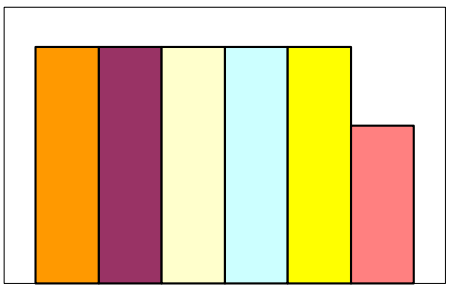
Operations	3

1. Strategy	3
2. Planning and implementation	3
3. Measurement and evaluation	3



Distribution	2,83

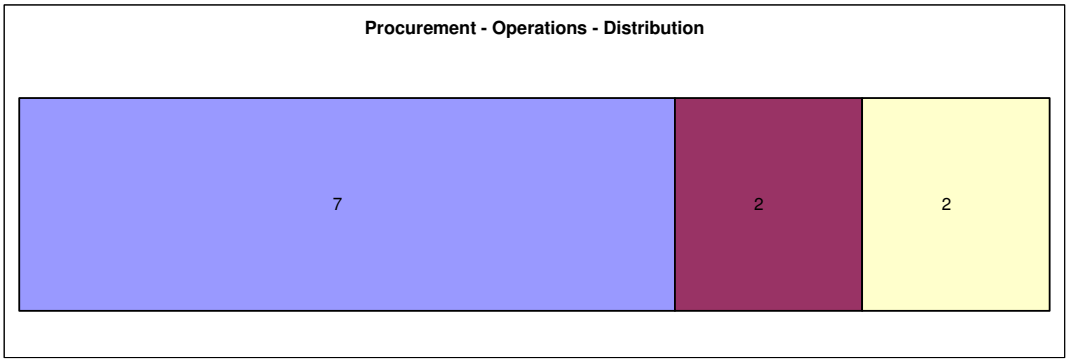
1. Strategy	3
2. Planning and implementation	3
3. Warehousing and storage	3
4. Dispatch handling	3
5. Outbound transports	3
6. Measurement and evaluation	2



Time

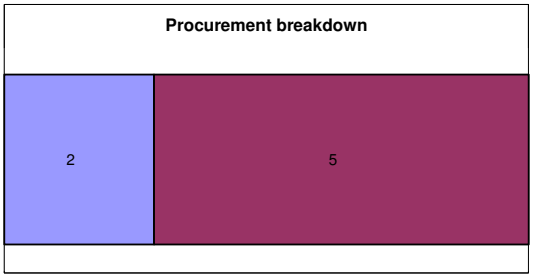
Lead time breakdown

Total lead time	11	days

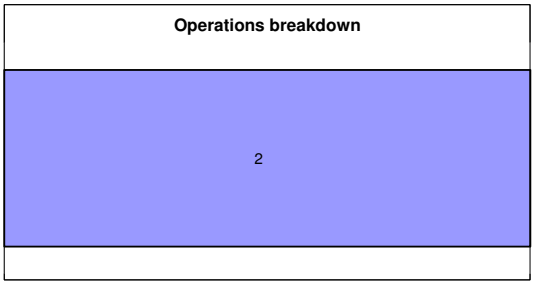


Procurement	7	Operations	2	Distribution	2

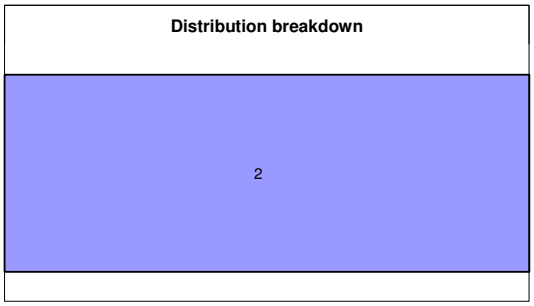
Procurement	Lead time	Inventory?(yes)	Turnover rate
Activity breakdown			**73**
Order lead time from suppliers	2	no	-
Raw material inventory	5	yes	73
			-
			-
			-
			-
			-
			-
			-
			-
			-



Operations	Lead time	Inventory?(yes)	Turnover rate
Activity breakdown			**#DIV/0!**
Production	2	no	-
			-
			-
			-
			-
			-
			-
			-
			-
			-



Distribution	Lead time	Inventory?(yes)	Turnover rate
Activity breakdown			**183**
Finished goods inventory	2	yes	183
			-
			-
			-
			-
			-
			-
			-
			-
			-



Inventory turnover rate			
Total turnover rate	#DIV/0!	/year	

Procurment	73,00	Operations	#DIV/0!	Distribution	182,50

Comments

The results above indicate that the company has a very good logistics system and it is difficult to identify major problem areas without investigating further. The company has a high level of control through documented procedures that seem well balanced and focus on the big picture, avoiding sub-optimization. Since the company is relatively big and spends a lot of money on logistics even smaller improvements can generate large savings. Therefore some minor issues are mentioned below that if looked into could potentially result in improvements.

The fact that the customer is another division of the same company has both positive and negative consequences. One negative aspect is that there is never a real customer-supplier relationship with the positive effects that competition brings. It could be investigated further how to develop this relationship in a manner that uses the benefits of a competitive environment without deteriorating the benefits of close interaction and common objectives.

Transport optimization and equalizing of the flows could be improved. This is an area that the company already is conscious of and actively tries to improve.

High demand has made it difficult to order the needed amount of raw material. If such problems would escalate it could have devastating consequences. It could be further investigated if the company could work more proactively in securing future supply needs.

As with most companies logistics is neglected in the product design stage. A more integrated effort including not only production but also logistics expertise at an early design stage could be beneficial. This is of course a very long term project but it has potential to make a good logistics system even better.

There is always a trade off between planning production for longer or shorter periods. Larger quantities will allow a more even flow of unusual products but makes the system less flexible for late changes. Looking over how this decision can be optimized and “fine tuned” could result in a slight improvement.

The purchasing division is responsible for following up on the procurement performance and they might focus too much on the component price and not on the total cost. Proper information about how purchasing decisions affect the total costs would enable purchasing to make smarter choices that can improve the bottom line.

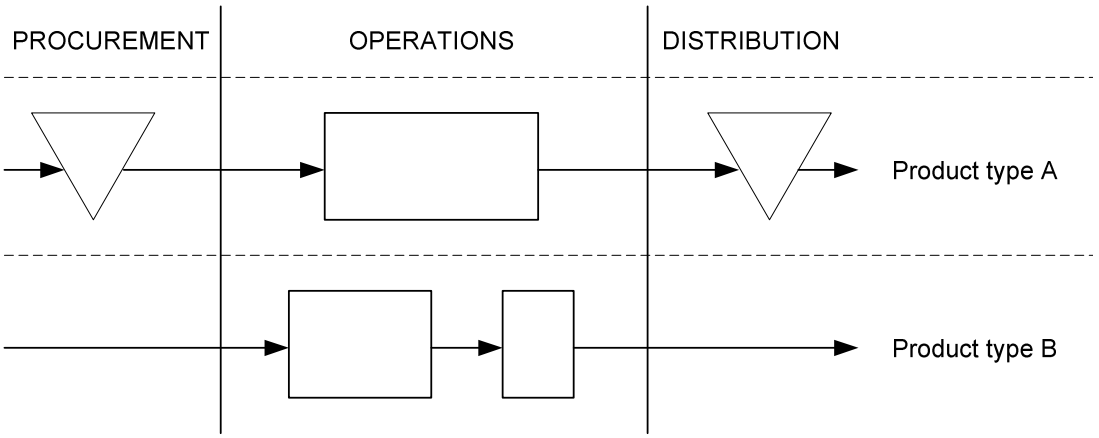
Appendix A: Case Company 2

The visit at Case Company 2 is performed during one day, December 11 2007. The meeting is about six hours long, excluding breaks. Furthermore contact is held through e-mail to complete the investigation.

System Description

Before the discussion on the system starts the contact person at the company gives a short presentation on the company and its background. This presentation is very useful since it gives a broad understanding of the system.

Mapping the system



Characteristics and goals

During the presentation of the company many relevant areas concerning the characteristics and goals of the company are discussed. Therefore some of the questions below have been answered indirectly through the presentation.

The characteristics of the company

C.1 What is the ***history*** of the company?
The company was established in the mid eighties and is now owned by a foreign company. The system in this investigation is situated in Sweden.

C.2 What ***type of company*** is it, what does the company offer?
The company produces two types of products, type A and type B. For both type of products the company mainly works with assembly and the amount of own production is rather low. Furthermore the company only delivers to other companies, not to end consumers.

C.3 What ***value*** does the company add before selling the finished products?
They mainly assembly the products

C.4 In what ***industry*** does the company operate?
-

C.5 Where is the company ***located***?
The company is located in central Sweden.

C.6 Which ***markets*** does the company focus on?
Not relevant

C.7 Who are the ***competitors*** of the company?
When it comes to product type B, their customer has several other suppliers of that product as well. However, the company is ranked as one of the three world class manufacturers among the suppliers according to the customer. The other products, product type A, are also in a competitive environment where there are several competitors.

C.8 What ***risks*** does the company face?
The biggest risk the company faces is if the mechanical way that is used in product type A industry is replaced by a more high tech solution.

C.9 How is the company ***organized*** in general and regarding logistics?
Below the president of the company there are six different divisions; Finance & Admin, Market & Technique, Production, Marketing & Sales, Production development & Projects and finally Material administration. The logistics function is a part of the Material administration which is divided into three different parts; Purchasing, SQA and Logistics.

C.10 What has the ***revenue*** been during the last years?
Approximately 500 MSEK

C.11 What have the ***assets***, ***liabilities*** and ***owner's equity*** been during the last years?
- Assets: 215 MSEK (2006-12-31)
- Liabilities: 173 MSEK (2006-12-31)
- Owner's equity: 42 MSEK (2006-12-31)

C.12 What has the ***profit*** been during the last years?
20 MSEK 2006 and -8 MSEK 2005

C.13 What has the ***capital turnover rate*** been during the last years?
3.2 times per year

C.14 What has the ***number of full time employees*** been during the last years?
286

C.15 What is the ***full time equivalent*** of the employees ***working with logistics***?
13

C.16 How many ***stock keeping units*** are handled annually? Inbound/outbound?
Inbound 4 950 and outbound 850

C.17 How many ***orders*** are handled annually? Inbound/outbound?
Approximately 4 200

C.18 How many ***deliveries*** are handled annually? Inbound/outbound?
Approximately 4 200

The goals of the company and its logistics objectives

G.1 What are the comprehensive ***vision and objectives*** of the company?
The vision of the company is to work step by step to implement world class manufacturing throughout the whole company with focus on a number of areas including quality and environment, production and cost effectiveness, delivery precision, innovative design and development, long term partnership, working environment for employees and finally a dedicated personnel.

G.2 What is the ***business strategy***?
The logistics division does not work actively with the business strategy.

G.3 How does the company ***define logistics***?
Logistics is seen as the control of the total flow. The logistics does not focus on production planning but rather on having the right things in the right places.

G.4 What is the ***logistics strategy***?
The strategy focuses on keeping a high level of service and delivery precision.

G.5 What are the ***logistics goals***? What does the company want to achieve with its logistics?
The goals are closely related to the strategy above.

G.6 Are the goals ***measured***? How?
The number of errors in inventory is measured and followed up and the goal is to not have any errors in the inventory. The delivery precision is measured in two ways, both to and from the company. Deliveries to the company have acceptable delivery precision if the goods arrive less than five days early and zero days to late compared to the delivery date in the order. Deliveries from the company have tougher demands; they are not allowed to be as early. Finally, the quality is also measured in terms of number of errors in amount or quality.

G.7 Does the company focus on a ***cost*** or ***value advantage*** or both?
The main focus is on a high service and trying to achieve a value advantage. The customers have very high demands and the company wants to meet these demands. They spend a lot of money on express transports in order to offer a high service level.

G.8 How ***important*** is ***logistics*** for the company, strategically?
Delivery precision and quality are very important to the company since the customers have high demands on these aspects.

G.9 What are the ***customer demands*** regarding logistics?
There are a lot of demands from the customers regarding the logistics, for example how the packaging is performed, how transports should be ordered, how the goods should be marked and that the goods are announced when they leave the factory.

G.10 Are there ***different logistics goals*** for different products or flows?
Yes, the demands from the product type A customer concerning delivery precision and quality are much higher than the demands from the customer buying product type B.

G.11 Is the logistics ***adapted*** to the products or vice versa?
Mostly the logistics has to adapt to the production.

Documented procedures on the logistics strategy

Partially, and they are followed.

Input and Output

Total cost

	Procurement	Operations	Distribution	Total
Carrying costs	4 725 000	2 250 000	525 000	7 500 000
Holding costs	3 100 000	0	775 000	3 875 000
Transportation costs	6 660 000	0	740 000	7 400 000
Administration costs	6 858 000	2 921 000	2 921 000	12 700 000
Other logistics costs	2 016 000	0	1 184 000	3 200 000

Customer service

Product type B

As seen below the number of deliveries without complaints is seen as irrelevant since the products are installed at the end customer and it is made sure that it is working before the final delivery is made.

Total number of orders	152
Total number of deliveries	152
Number of complete orders delivered	152
Number of deliveries on time	130
Number of deliveries without complaints	Irrelevant
Time from customer order placement to complete delivery (customer order lead time)	9-21 weeks
Average number of order lines per order	1

Product type A

Total number of orders	4 280
Total number of deliveries	4 280
Number of complete orders delivered	4 240
Number of deliveries on time	4 240
Number of deliveries without complaints	4 168
Time from customer order placement to complete delivery (customer order lead time)	2-5 days
Average number of order lines per order	1

Transformation

Overall

1. Demand forecasting

A.1.1 How is the demand forecasting managed?

The demand forecasting is based on the prognoses from the customers. There are different types of prognoses for product type B and product type A. Some of the type B products are produced according to a pace schedule which is decided together with the customer. On the other type B products the company is following a prognosis. However, no orders to the suppliers are made until the company is certain that a type B product will be produced. The production of the type A products is based on prognoses from the customers which are regularly transferred into the ERP system. The prognoses are used to calculate the need of raw material. The fixed order is then placed at a minimum 48 hours before the customer wants the products delivered.

The prognoses are usually for the following 12 months. Once the company gets the prognosis from the customer it is reformed and sent on to the suppliers so that they are able to plan their needs.

At the moment, the company is changing its ERP system. After the system switch the company is hoping to work with a paced production to a greater extent. Thereby, a smaller buffer will be built in order to handle changes in prognoses better.

A.1.2 How are prognoses made?
The prognoses are based on the prognoses from the customers.

A.1.3 Are the prognoses usually accurate?
The product type A prognoses are usually correct but for the type B products the prognoses are not as reliable.

A.1.4 Are the prognoses followed?
The product type A prognoses are followed, but the prognoses for the production of product type B are not always followed.

A.1.5 Where is the ***order penetration point*** situated?
-

A.1.6 What are the ***consequences*** of how the demand forecasting is managed? What ***problems*** are there? How can this area be ***improved***?
Yes they are experiencing problems with the type B products customer's prognoses. Today they can solve some of the capacity irregularities by having the type B products assemblers work with the type A products, however this is not popular since that is less qualified work. The two week freeze time on the type B products is too late since they have to order components before that. This could be helped by having more flexible suppliers that keep inventory for them if all the supplies are not needed. Some of the suppliers already do this.

Documented procedures on demand forecasting

Do not know.

2. Customer relations

A.2.1 How are the customer relations managed?
Both the type A and type B customers are demanding of the company. The customers are big companies and therefore the company does not have much leverage when it comes to negotiations. This leads to disadvantaged terms of payment with long payment times, approximately 90 to 120 days. The result of this is that the company has put great demands on long payment times to their suppliers. Furthermore, the customers demand low prices and that the prices shall decrease gradually as the company improves its production techniques.

A.2.2 What is the ***number of customers*** the company has? What is that number based on? Is that the desired number?
Seven customers stand for 98 percent of the total sales.

A.2.3 What is the ***percentage of the annual sales value*** that the three biggest customers stand for each?
The biggest customer, who buys the type B products, stands for approximately 50 percent of the total annual sales value. Both the second and third biggest customer stands for approximately 10 percent of the annual sales value each.

A.2.4 Where are the customers ***located***? What is the ***lead time*** to the customers?
The customers are located all over the world, for example in North America, Iran, Australia, France, Germany, Turkey and Sweden. The lead time to the customers of the type A products are approximately two to five days.

A.2.5 How are the ***contracts*** with the customers formed? (time conditions, price, order entry, payment conditions, etc.)
The product type A customers have very high demands on the company.

A.2.6 What are the ***consequences*** of how the customer relations are managed? What ***problems*** are there? How can this area be ***improved***?
There is a tough pressure from the product type A customers concerning their demands. Furthermore, the prognoses concerning the product type B are rather uncertain which can cause problems and make it hard to plan the production and staffing requirement. This leads to that the employees who are educated to assembly the type B products sometimes have to work with the type A products instead which is a waste of resources.

Documented procedures on customer relations

Only for returns, they are followed.

3. Order processing

A.3.1 How is the order processing managed?
There are different systems for order processing for the different customers. The type A products follow a delivery plan with a freeze time, minimum deadline for order changes, of 48 hours before delivery. The type B products on the other hand use a prognosis and pace schedule.

A.3.2 How is the ***order entry*** (order editing/call off) performed?
The orders from the customers are transferred by EDI to the ERP system of the company.

A.3.3 How are ***order modifications*** or ***error corrections*** handled?
The customer can change the order before the freeze time but not after.

A.3.4 Are the customers given answers to ***order status inquiries***? How?
The main order status inquiries concern the dispatch from the company. Once the goods have left the company this is typed into the ERP system. Some customers also wish the company to send a fax or e-mail once the goods have left.

A.3.5 How is ***invoicing*** managed?
The invoicing to the customers is performed when the delivery is set.

A.3.6 What are the ***consequences*** of how the order processing is managed? What ***problems*** are there? How can this area be ***improved***?
-

Documented procedures on order processing

Yes, and they are followed.

4. Logistics communications

A.4.1 How are data and information exchange managed?
The providing of components to the production is handled rather manually today. However, the company is hoping to use the new ERP system to support a more standardized and automatic way of providing the production. The providing of components in the type A products production is based on that the line of a specific product take out a picking list of what is needed in the line. This picking list is thereafter brought to a picking inventory spot where the products the line needs are placed. There should always be enough products in the picking inventory which is the responsibility of the line itself.

A.4.2 What ***type of ERP system*** is used to support the logistics communications?
GudaX is used today but it will soon be replaced with a Microsoft based system called Accapta.

A.4.3 What method is used for information exchange between the major functions ***within the organization***? Is the same ERP system used within the whole logistics system?
Yes, the same ERP system is used within the whole logistics system.

A.4.4 What method is used for information exchange between the organization, its ***suppliers*** and its ***customers***?
The communication with the customers is mainly through the ERP system. When it comes to the suppliers the information exchange is handled through a number of different systems, also via e-mail and fax. The company has tried to build a web based system where the suppliers receive an e-mail once an order has been placed. However, there have been some problems with this system since it is hard to communicate changes in orders. The company is hoping that the new ERP system will solve this problem better since there is another concept with a supplier portal. Through this portal the suppliers can enter the ERP system of the company but only see the data they need and nothing else.

However, it depends on the size of the suppliers if they should be connected to the web based system.

A.4.5 What method is used for information exchange between ***other members of the supply chain*** who may not be directly linked to the firm? (second tier suppliers and customers' customer)
There is no contact between the company and its second tier suppliers. However, to some extent the company is connected to its customers' customers since the prognoses of the customers are based on their customers' prognoses.

A.4.6 What are the ***consequences*** of how the logistics communications are managed? What ***problems*** are there? How can this area be ***improved***?
One of the biggest problems concerning the logistics communications is that the supplier portal, mentioned above, is not working as well as the company had hoped. Another problem concerns the labeling of the goods from the suppliers. The company has asked their suppliers to label the goods in a certain way. Unfortunately this is not working as well as desired. One problem is that the labels sometimes are too big for the packages.

The company works a lot with trying to get the suppliers to use the same packaging. However this area could be improved.

Documented procedures on logistics communications

Yes, and they are followed.

Procurement

1. Procurement strategy

P.1.1 What is the procurement strategy? (single/multiple sourcing)
At the moment the company applies a single sourcing strategy with one supplier per component. Sometimes one supplier even delivers several components. When it comes to components with a low value the company strives for as few suppliers as possible. However, supported by the new ERP system the strategy will probably change so that for example 70 percent is bought from one supplier and 30 from another. The company is limited in their choice of suppliers due to the high demands from the customers. If the company wants to change from one supplier to another it must be approved by the customer concerning the type A products. The product type B customer wants to choose the suppliers on their own and therefore the company has little ability to affect the decision. This strategy is based on that the customer is a large purchaser and thereby are able to get low prices. However, since the customer is not located close to the company sometimes the suppliers are not as close to the company as would be optimal. At the moment the company is trying to convince the customer that a change of suppliers would help keep the costs lower.

P.1.2 Why is this strategy chosen?
See the question above.

P.1.3 What are the ***consequences*** of how the procurement strategy is managed? What ***problems*** are there? How can this area be ***improved***?
At the moment the procurement division is looking for suppliers abroad. This can cause problems concerning the securing of quality. Furthermore, the decision of new suppliers from China or India has to be made jointly between the logistics and procurement division.

The procurement needs to improve their purchasing activities by looking at the total flow and the total cost instead of just the price per piece. The logistics function and purchasing function are already integrated to some extent since they are organized into the same part; procurement. However, the cooperation could be improved further.

Documented procedures on procurement strategy

Yes, and they are followed.

2. Procurement planning and implementation

P.2.1 How is the procurement planned and implemented?
The need of type A products is transferred into the ERP system and from these figures a material need is created which is used to place orders to the suppliers. These suppliers are already given so it is mostly about making call offs. The components needed in order to produce the type B products are ordered once the need is decided. These components are supposed to arrive when they are needed.

P.2.2 How are the ***inventories managed***? (inventory levels, safety stock, cycle stock, etc.?)
The company has rather high levels of safety stock. This is mainly since the suppliers offer a rather low level of delivery precision while the company offers their customers a rather high level of delivery precision. The safety stock is calculated in the ERP system based on for how long time it will last.

The inventory levels are, among other things, based on economic order quantity and the lead time from the suppliers. The company does not want to have too high inventory levels. However, at the moment there are some problems in the incoming goods and inventory since the company has a number of vacant positions in the planning function. The problem in this area has also become apparent since there are no longer any calculations of the inventory turnover rate which there used to be.

The company only controls certain components when they arrive. Which articles that should be controlled are decided based on the control code they have.

P.2.3 How is the raw material ***demand prognosticated***?
This has already been discussed earlier.

P.2.4 What is the ***capacity utilization*** level in the procurement? Is this the desired level?
-

P.2.5 How is ***flexibility*** in the procurement taken in to account?
When it comes to the type A products it is rather hard to be flexible in changing suppliers since the customers have high demands on the company. Since the lead time from the suppliers is rather short it is quite easy to keep a high level of flexibility.

P.2.6 Are there any ***bottlenecks*** in the procurement? How do they impact the procurement? How are they avoided?
One bottleneck within the procurement may be the trucks. This has become apparent during the last months since there has been a high activity in the industry as a total. The suppliers order the transports which the company pays for. Sometimes is the transportation company not able to come and pick up the goods since they are already fully booked. When the goods arrive to the company another bottleneck appears when it comes to receiving and unloading the goods. More forklift trucks are needed in order to avoid this bottleneck. However, the number one prioritization is that lack of goods must not stop the line. This is kept in mind when deciding the order of unloading trucks.

If material is needed to the line there is no specific way to go. The needs are just written down and thereafter a, so called, milk car goes and get the material. Here, problems and bottlenecks can appear if the car does not notice the needs in time.

The last bottleneck is the limited number of truck computers. Since there is just a limited number of truck computers there is sometimes a need for a greater amount. Furthermore, the line personnel can not go into the ERP system to check if certain components are missing or if they need to be reordered.

P.2.7 How are the ***risks*** in the procurement managed? Is there a contingency plan?
The main risk the procurement faces is errors in quality. For example there might be a big problem if it is discovered that all the products in stock do not have the quality needed. However, there are routines to handle these problems. If the quality level is not high enough the quality division in the company discusses the problem with the supplier and together they will find a solution.

P.2.8 Are there any ***custom*** issues that effect how the procurement is managed?
Since the company does not order any goods from abroad there are no custom issues that affect the procurement management at the moment. However the

company has discussed how custom issues will be working in the future if the company decides to use suppliers from India or China.

P.2.9 What are the ***consequences*** of how the procurement planning and implementation is managed? What ***problems*** are there? How can this area be ***improved***?
The main problems or risks at the moment are defects concerning the quality or problems in the production since the company only has one supplier of each component.

The execution of the procurement could be improved by avoiding shortages in the inventory through more reliable information in the ERP system. Furthermore, it is important to improve the delivery precision from the suppliers.

The level of control over the cold storage is not as high as it could be. It is important to remember to register changes in the inventory which is not always done today. Moreover, there are too many manual steps in the usage of the information system. This may cause unnecessary errors. For example the company has been looking into using scanners instead of typing information manually into the system. Also, the picking man could get a picking assignment directly into his or her computer instead of using paper picking lists. That way the picking man only has to confirm that he or she has performed the assignment instead of typing into the computer what has been done. However, this has not been implemented into the organization yet.

Documented procedures on procurement planning and implementation

Yes, and they are followed.

3. Supplier relations

P.3.1 How are the supplier relations managed?
The procurement division supervises how the suppliers are acting. There is a meeting once a month where the delivery precision the suppliers have offered is presented and suppliers that have performed poorly are followed up.

P.3.2 How are logistics related parameters used when ***selecting*** the suppliers?
Before a supplier is chosen a careful control of the supplier is carried out. The purchasers have a certain questionnaire which they use when evaluating the suppliers before selecting one. This questionnaire has been used during approximately one year and is based on eleven criterions which are broken down into 37 parameters. The criterions are company profile, management, environment, quality, logistics, after market, competence, product development, finance, productivity and sourcing. Finally the suppliers have to be ISO certified in order to qualify as an alternative to the company.

P.3.3 How are the ***contracts*** with the suppliers formed? (time conditions, price, order entry, payment conditions etc.)
Deliveries from suppliers are acceptable as on time if they arrive between five days early and the agreed time of delivery. If the company causes stops in their product type A customers' production the company has to pay a penalty fee. If the stop can be referred to a certain supplier to the company the supplier should pay the penalty fee instead. However the company has problems when trying to make some suppliers to pay the penalty fee. This is mainly since the suppliers sometimes are rather small and do not have the capacity to pay these large amounts.

P.3.4 How are logistics related parameters used when ***evaluating*** the suppliers?
The same parameters used when selecting new suppliers, see above, are used when evaluating present suppliers. Furthermore, the suppliers are ranked according to their performance and if they do not offer as high quality as demanded they are followed up.

P.3.5 How is the work with ***supplier relations development*** performed?
The company works a lot with supplier relations development, especially when there are problems with a certain supplier. The goal is to achieve a suitable solution without trying to change suppliers. However, this might take time; sometimes the company keeps a bad performing supplier for approximately a year before the problems are sorted out.

P.3.6 What is the ***number of suppliers*** the company has? What is that number based on?
When it comes to the type A products the number of suppliers is limited. However, concerning the type B products the number of suppliers is much higher. The total number of suppliers is approximately 660.

P.3.7 What is the ***percentage of the annual costs value*** that the three biggest suppliers stand for each?
-

P.3.8 Where are the suppliers ***located***?
Most of the suppliers are located in Sweden. Furthermore, some of the suppliers are located in Europe and USA. Also the company has been investigating if there are any suitable suppliers in China or India.

P.3.9 What is the ***lead time***, from order to delivery, from the suppliers?
The type A products have rather high demands on lead times. Therefore the lead time from suppliers in Sweden is approximately five days and the lead time from suppliers in Europe approximately ten days. If suitable suppliers are found in China or India there will of course be a longer lead time. Finally, there are a number of deliveries from the parent company abroad and then the lead time is approximately 40 days.

The goal concerning payment conditions is that the suppliers should get paid within 60 days. However, this is sometimes hard to negotiate and therefore the payment conditions are sometimes shorter.

P.3.10 What are the ***consequences*** of how the supplier relations are managed? What ***problems*** are there? How can this area be ***improved***?
The main problem concerning the suppliers is that they do not reach the delivery precision that the company demands. Furthermore, the company whishes that they were able to be more flexible concerning change of suppliers. However, since the demands, from especially the product type A customers, are very high it is hard to make fast changes.

Documented procedures on supplier relations

Yes, and they are followed.

4. Purchase order processing

P.4.1 How is the purchase order processing managed?
Orders to the suppliers of the company are based on a skeleton agreement which is put together by the purchasing division. Thereafter orders are placed based on this skeleton agreement. Before the skeleton agreement can be followed the company makes a number of tests and controls that the supplier is able to follow the agreement.

P.4.2 How is the ***order entry*** (order editing/call off) performed?
The order entry to the suppliers are typed into the ERP system or in some specific cases sent by e-mail or fax.

P.4.3 How are ***order modifications*** or ***error corrections*** handled?
-

P.4.4 Do the suppliers give answers to ***order status inquiries***? How?
-

P.4.5 How is ***invoicing*** managed?
-

P.4.6 What are the ***consequences*** of how the purchase order processing is managed? What ***problems*** are there? How can this area be ***improved***?
-

Documented procedures on purchase order processing

Yes, and they are followed.

5. Inbound transports

P.5.1 How are the inbound transports managed?
The transport company Schenker is used for inbound transports. The company has an agreement with Schenker and the suppliers concerning what transport

company the suppliers are supposed to use. When the supplier wants to send products to the company the supplier books a transport and leaves the customer number of the company to Schenker. That way the transport comes when the supplier needs it and the company pays for the transport.

P.5.2 How are the ***Inco terms*** for the inbound transports formed?
The supplier is responsible for the goods until they are loaded on the truck.

P.5.3 How is the ***method of shipment*** selected? (boat, air, truck, rail, etc.) What method is normally used?
Within Sweden and also most often within Europe trucks are used for transports. If goods are sent from Asia they are usually sent by boat to Gothenburg and from there by car to the company.

P.5.4 How is the ***specific path*** the shipment takes decided?
The company only pays for the weight and volume. Thereafter the transport company is free to choose the specific path the transport will take. When it comes to product type B the transports can be rather expensive since the products have a big volume.

P.5.5 How are different ***transport regulations*** taken into account?
These are handled by Schenker.

P.5.6 How are the deliveries ***supervised***?
They are not supervised by the company but rather by the transport company.

P.5.7 What are the ***consequences*** of how the inbound transports are managed? What ***problems*** are there? How can this area be ***improved***?
There are always examples of problems that have occurred during transports. However, keeping in mind the large number of transports from suppliers to the company each year, there is a very small number accidents or problems.

The pricing from the large transport firms is a problem. The company is not able to affect the transport company very much. For example, now there has been a high demand on transports and therefore transport companies have added an additional charge to their prices called capacity charge. This is something that upsets the company. However, overall the company is pleased with the service Schenker offers.

Documented procedures on inbound transports

There are no documented procedures concerning inbound transports since the company does not find this necessary due to that there are no bookings made by the company.

6. Goods reception

P.6.1 How is the goods reception managed?
Once the trucks with type A products arrive to the company they are unloaded under a roof and the goods are placed on an in-place. Thereafter it is controlled

that the right number of products has arrived and the goods are compared to the delivery note before letting the transport leave again. This is followed by an announcement in the information system saying that the goods have arrived. Finally the goods are moved to the inventory.

Concerning product type B the arriving goods are controlled and announced into the system. Thereafter the goods are placed directly into a picking inventory.

P.6.2 How is the ***capacity level*** (in terms of personnel available at different times) in the goods reception decided?
The employees working with goods reception are able to do other tasks when there are no incoming goods to take care of. There are rather big changes in the amount of goods arriving each day. The outbound and inbound transports leave and arrive at the same place.

P.6.3 How are ***deviations*** in the shipments managed? (amount, quality, time, etc)
If there are deviations in the shipments this is discussed with the suppliers.

P.6.4 What are the ***consequences*** of how the goods reception is managed? What ***problems*** are there? How can this area be ***improved***?
There are some problems concerning the trucks since there is not always enough space for both loading and unloading. The consequence of this is mainly irritation among the truck drivers while the customers, suppliers or production is not affected.

Sometimes documents, like delivery notes, are missing when the goods arrive. This causes confusion and extra work. When documents are missing it is reported and investigated. However, the arriving goods are not sent back but the company rather tries to unravel what has happened and solve the problem.

Documented procedures on goods reception

Yes, and they are followed.

7. Warehousing and storage

P.7.1 How is the warehousing and storage managed?
Once the product type A goods have arrived to the inventory they are placed in a certain spot. The inventory has floating palling spots and therefore it is registered into the system where the goods are placed. As mentioned above, the product type B components are directly placed into a picking inventory.

P.7.2 How is the ***warehouse site*** selected?
Components that are used on a daily basis are placed right next to the production. Some more bulky products, on the other hand, are place in a warehouse a few kilometers away. For this inventory the company pays a monthly rent per square meter they use in the warehouse.

P.7.3 How is ***picking, staging*** and ***loading*** performed?
A floating inventory system is used and if very bulky products arrive they are freely piled in a cold inventory on the yard outside the company's buildings.

P.7.4 How is the ***packaging*** managed?
-

P.7.5 Is the storage facility ***owned***, ***leased*** or ***rented***? What is that decision based on?
Leased

P.7.6 How is the ***layout*** and ***design*** of the storage facilities decided?
See above

P.7.7 How is the ***product mix*** in the storage considered?
-

P.7.8 What are the ***consequences*** of how the warehousing and storage is managed? What ***problems*** are there? How can this area be ***improved***?
There are problems when some suppliers are on vacation. This is since the suppliers then have to deliver extra material and there might not be enough space in the inventory.

Improvements could be made concerning using truck computers in a more suitable manner. This way the company would not have to do as much manual editing into the system.

Documented procedures on warehousing and storage

Yes, and they are followed to some extent.

8. Measurement and evaluation of procurement performance

P.8.1 ***How is measurement and evaluation of the procurement performance, both internally and externally, managed?***
The delivery precision is followed up. Furthermore the error frequency in inventory is compared to the number of pickings. The company would appreciate more measurements concerning the procurement performance but it is hard to find appropriate ones. Moreover in order to make the measurements appropriate they have to be able to affect them and the people working with the measurement have to understand them.

P.8.2 ***What*** is measured?
-

P.8.3 ***How*** is it measured?
-

P.8.4 How is it ***evaluated***?
-

P.8.5 How are ***improvements*** made?
-

P.8.6 What are the ***consequences*** of how the measurement and evaluation of procurement performance is managed? What ***problems*** are there? How can this area be ***improved***?
-

Documented procedures on measurement and evaluation of the procurement

Yes, and they are followed.

9. Problems in the procurement

P.9.1 What problems are there in the procurement?
There are some articles that can be questioned concerning their order volume. Furthermore the planning division is unwilling to look deeper into and change their order volume. For example there are some articles that have a much higher inventory level than needed. This may lead to unnecessary work for the employees in the inventory.

P.9.2 Is the procurement ***method appropriate***? Does it work well?
-

P.9.3 How are ***deviations*** handled? What are the consequences of the deviations?
-

P.9.4 How can the procurement be ***improved***?
It is not always as focused on the logistics as it should be.

Operations

1. Operations strategy

O.1.1 What is the operations strategy?
The company mainly focuses on assembly but they also have some welding. However, in a long term they only want to work with assembly. The type B products are, after assembly, also tested a number of times in order to check that they are working. There are influences from lean production and kaizen in their production. For example, this can be seen in the production where there is a certain kaizen corner where problems that occur in the operations are discussed.

O.1.2 Why is this strategy chosen?
-

O.1.3 What are the ***consequences*** of how the operations strategy is managed? What ***problems*** are there? How can this area be ***improved***?
-

Documented procedures on operations strategy

Yes, and they are followed.

2. Operations planning and implementation

O.2.1 How are the operations planned and implemented?

-

O.2.2 What are the ***characteristics of the operations***? (Nonstop, line, customized, project, etc.)

The operations are characterized as line production. The type B products already have an end customer when they are produced. Therefore these products are not stored after they are finished. Instead they are transported directly to the end customer. The type A products are produced against a buffer inventory where a week's use is stored.

O.2.3 How is the operations ***demand prognosticated***?

-

O.2.4 What is the ***capacity utilization*** level in the operations? Is this the desired level?

The company has the capacity to produce more type B products but the demand is not that high. When it comes to the type A products the company is rather fully booked at the moment. The company has quite cramped premises and therefore space is a capacity problem.

O.2.5 How is ***flexibility*** in the operations taken in to account?

By having two different types of products in two different types of industries the company increases its flexibility. If one industry is not performing very well at the moment the company can focus on the other one. However the parent company is questioning the production of product type B since the group as a whole is much more focused on the product type A industry.

O.2.6 Are there any ***bottlenecks*** in the operations? How do they impact operations? How are they avoided?

There are definitely bottlenecks in the operations. For example, the lathing and welding performed at the company has caused a lot of problems. However, parts of these areas are now outsourced which has solved some of the problems. The company tries to avoid the bottleneck by using it in five shifts.

O.2.7 How are the ***risks*** in the operations managed? Is there a contingency plan?

There are risks in the operations concerning severe problems in the production, for example if a vital product type B would crash.

O.2.8 What are the ***consequences*** of how the operations planning and implementation is managed? What ***problems*** are there? How can this area be ***improved***?
Since there is a rather high tempo in the production the assemblers suffers from different types of wears. The company works a lot with ergonomics in order to sort this problem out.

Documented procedures on operations planning and implementation

Yes, and they are followed.

3. Measurement and evaluation of operations strategy

O.3.1 How is measurement and evaluation of the operations performance managed?
The main key performance indicators used in the operations are a quality index, total defect cost, delivery precision to customer, delivery from supplier, supplier claims, sickness rate, inventory days, productivity type A products and productivity type B products.

O.3.2 ***What*** is measured?
-

O.3.3 ***How*** is it measured?
-

O.3.4 How is it ***evaluated***?
-

O.3.5 How are ***improvements*** made?
-

O.3.6 What are the ***consequences*** of how the measurement and evaluation of operations performance is managed? What ***problems*** are there? How can this area be ***improved***?
-

Documented procedures on measurement and evaluation of the operations

Partially, but those that exist are followed.

4. Problems in the operations

O.4.1 What problems are there in the operations?
All the problems in the operations have been discussed above.

O.4.2 Is the operations ***method appropriate***? Does it work well?
-

O.4.3 How are ***deviations*** handled? What are the consequences of the deviations?
-

O.4.4 How can the operations be ***improved***?

-

Distribution

1. Distribution strategy

D.1.1 What is the distribution strategy?

The product type A customers have decided that they want to stand for the distribution. This is mainly since they are able to get much better contracts with the transportation companies than the company can. The product type B distribution is also handled by the customer. This is mainly since distribution is not a core competence of the company.

D.1.2 Why is this strategy chosen?

-

D.1.3 What are the ***consequences*** of how the distribution strategy is managed? What ***problems*** are there? How can this area be ***improved***?

-

Documented procedures on distribution strategy

No.

2. Distribution planning and implementation

D.2.1 How is the distribution planned and implemented?

Since the main part of the distribution is not handled by the company a lot of the questions on this area become irrelevant.

D.2.2 How are the ***inventories managed***? (inventory levels, safety stock, cycle stock, etc.?)

There is a safety stock level representing one week's usage according to the demands from the product type A customers. The type B products are dispatch directly when finished.

D.2.3 How is the distribution capacity ***demand prognosticated***?

-

D.2.4 What is the ***capacity utilization*** level in the distribution? Is this the desired level?

-

D.2.5 How is ***flexibility*** in the distribution taken in to account?

-

D.2.6 Are there any ***bottlenecks*** in the distribution? How do they impact distribution? How are they avoided?

-

D.2.7 How are the ***risks*** in the distribution managed? Is there a contingency plan?
-

D.2.8 Are there any ***custom*** issues that effect how the distribution is managed?
-

D.2.9 What are the ***consequences*** of how the distribution planning and implementation is managed? What ***problems*** are there? How can this area be ***improved***?
-

Documented procedures on distribution planning and implementation

No.

3. Warehousing and storage

D.3.1 How is the warehousing and storage managed?
Once the products are produced in line they are packed according to the instructions given by the product type A customer. Thereafter the products are marked with article numbers, both the number of the company and the number of the customer. This is followed by a transport of the products from the line to the inventory. The finished type A products are stored in a tent on the yard outside the premises of the company. Every customer has a certain spot where their products are stored. The goods in this inventory are not announced into the ERP system. However, the company tries to work after the FIFO principle.

D.3.2 How is the ***warehouse site*** selected?
All inventories of finished goods are placed on the premises of the company or on the yard outside.

D.3.3 How is ***picking, staging*** and ***loading*** performed?
The goods are freely piled in the inventory.

D.3.4 How is the ***packaging*** managed?
-

D.3.5 Is the storage facility ***owned***, ***leased*** or ***rented***? What is that decision based on?
Rented

D.3.6 How is the ***layout*** and ***design*** of the storage facilities decided?
The finished goods are stored either in a tent or in a cold storage.

D.3.7 How is the ***product mix*** in the storage considered?
The product mix in the storage depends on the available space. However, each and every one of the products is stored on a specific spot.

D.3.8 What are the ***consequences*** of how the warehousing and storage is managed? What ***problems*** are there? How can this area be ***improved***?
It is hard to follow the FIFO principle fully out since the goods enters and leaves the storage from the same side. This problem could be solved through putting the goods in storage from one way and picking from the other. However, this is an expensive solution that would need more space.

Documented procedures on warehousing and storage

Yes, and they are followed.

4. Dispatch handling

D.4.1 How is the dispatch handling managed?
As mentioned earlier the dispatch handling and goods reception is handled in the same place and by the same personnel. The dispatch handling starts when the company gets data on what should be delivered the following day. Thereafter the company books a transport that will come and pick up the goods. This is followed by a change of flags, from the internal flag to the flag of the customer. After that the products are scanned in order to control that the right things are sent away.

D.4.2 How is the ***capacity level*** in the dispatch handling decided?
-

D.4.3 How are ***deviations*** in the dispatch handling managed?
-

D.4.4 How is the ***quality*** of the dispatch handling controlled?
-

D.4.5 What are the ***consequences*** of how the dispatch handling is managed? What ***problems*** are there? How can this area be ***improved***?
The main problem within the dispatch handling concerns the limited space. Furthermore, there might be problems during the winter if snow gets into the storage or truck since this might damage the goods.

The traceability is very important in the dispatch handling. The company is trying to secure this area by scanning the products. Also, it is important to announce the customer once the truck has left the company.

Documented procedures on dispatch handling

Yes, and they are followed.

5. Outbound transports

D.5.1 How are the outbound transports managed?
The outbound transports are handled by the customers and therefore this area is not relevant in this analysis.

D.5.2 How are the ***Inco terms*** for the outbound transports formed?
-

D.5.3 How is the ***method of shipment*** selected? (boat, air, truck, rail, etc.) What method is normally used?
-

D.5.4 How is the ***specific path*** the shipment takes decided?
-

D.5.5 How are different ***transport regulations*** taken into account?
-

D.5.6 How are the deliveries ***supervised***?
-

D.5.7 What are the ***consequences*** of how the outbound transports are managed? What ***problems*** are there? How can this area be ***improved***?
-

Documented procedures on outbound transports

-

6. Measurement and evaluation of distribution performance

D.6.1 How is measurement and evaluation of the distribution performance, both internally and externally, managed?
The delivery precision to customer is measured by the company. Furthermore the customers do evaluations of the company on their delivery precision and quality. By delivery precision the company mainly refers to the time aspect concerning delivering the goods on time.

D.6.2 What is measured?
-

D.6.3 How is it measured?
-

D.6.4 How is it ***evaluated***?
-

D.6.5 How are ***improvements*** made?
-

D.6.6 What are the ***consequences*** of how the measurement and evaluation of distribution performance are managed? What ***problems*** are there? How can this area be ***improved***?
The company is rather content with this area.

Documented procedures on measurement and evaluation of the distribution

To some extent, and they are followed.

7. Problems in the distribution

D.7.1 What problems are there in the distribution?

Some of the customers use, in order to lower the prices, different transport firms very often. This causes problems for the company since they do not know what transport firm they should turn to if there are any problems or changes. Also, it sometimes feels unsafe to leave the goods with a new transport company when the customer has not given any notice concerning the changes.

D.7.2 Is the distribution ***method appropriate***? Does it work well?

-

D.7.3 How are ***deviations*** handled? What are the consequences of the deviations?

-

D.7.4 How can the distribution be ***improved***?

-

Time

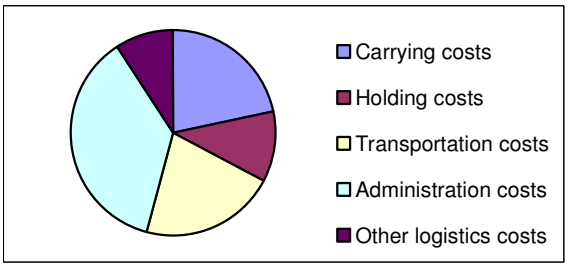
	Procurement	**Operations**	**Distribution**
Lead time (product type B)	12 weeks	6-18 weeks	0 weeks
Time in inventory (product type B)	9 weeks	0 weeks	0 weeks
Lead time (product type A)	35-40 days	2-5 days	5 days
Time in inventory (product type A)	30 days	0 days	5 days

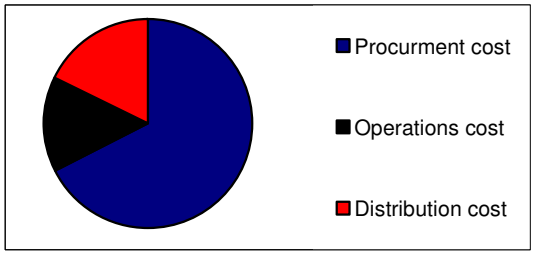
Analysis and Conclusions

Below the quantitative results from the analysis are presented and after that follows a brief analysis of the results. First the total costs are presented followed by the customer service. Thereafter the level of control is presented and finally the time analysis is shown. The control of each section is graded on a scale of zero to three, three being the highest, based on the documentation on that area and how it is used. These levels are also summarized for the three main parts of the company's logistics system and the complete system.

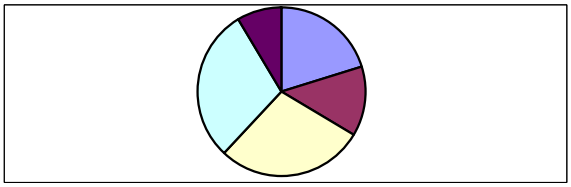
Total Cost Results

Total cost	**34 675 000 kr**	
Carrying costs	7 500 000 kr	22%
Holding costs	3 875 000 kr	11%
Transportation costs	7 400 000 kr	21%
Administration costs	12 700 000 kr	37%
Other logistics costs	3 200 000 kr	9%

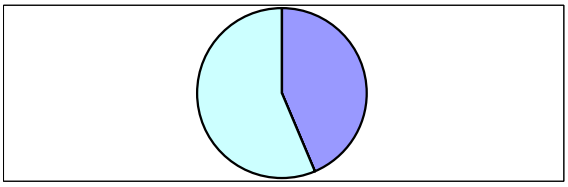




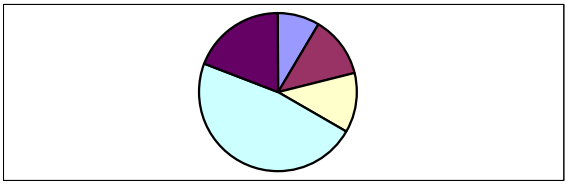
Procurment cost	**23 359 000 kr**	**67%**
Carrying costs	4 725 000 kr	20%
Holding costs	3 100 000 kr	13%
Transportation costs	6 660 000 kr	29%
Administration costs	6 858 000 kr	29%
Other logistics costs	2 016 000 kr	9%



Operations cost	**5 171 000 kr**	**15%**
Carrying costs	2 250 000 kr	44%
Holding costs	- kr	0%
Transportation costs	- kr	0%
Administration costs	2 921 000 kr	56%
Other logistics costs	- kr	0%



Distribution cost	**6 145 000 kr**	**18%**
Carrying costs	525 000 kr	9%
Holding costs	775 000 kr	13%
Transportation costs	740 000 kr	12%
Administration costs	2 921 000 kr	48%
Other logistics costs	1 184 000 kr	19%

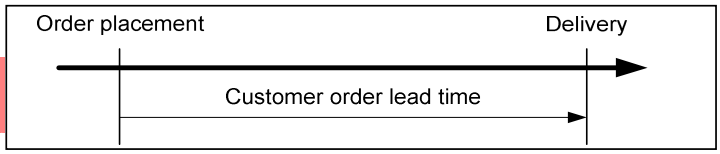


Customer Service

Product type B

Total number of orders	152
Total number of deliveries	152
Number of complete orders delivered	152
Number of deliveries on time	130
Number of deliveries without complaints	Irrelevant

Customer order lead time 9-21 weeks



Delivery reliability **85,53%**

$$\text{Delivery reliability} = \frac{\text{Number of deliveries on time}}{\text{Total number of deliveries}}$$

Delivery dependability **Irrelevant**

$$\text{Delivery dependability} = \frac{\text{Number of deliveries without complaints}}{\text{Total number of deliveries}}$$

Stock availability **100,00%**

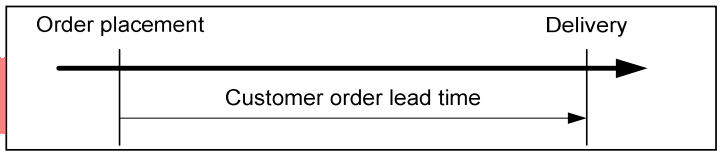
$$\text{Stock availability} = \frac{\text{Number of orders delivered complete}}{\text{Total number of orders}}$$

Average number of order lines per order 1

The average number of order lines per order affects the customer service level. A high number of order lines per order may make it harder to achieve a high customer service level.

Product type A

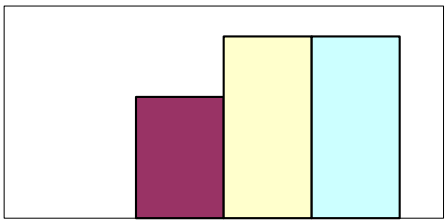
Total number of orders	4 280
Total number of deliveries	4 280
Number of complete orders delivered	4 240
Number of deliveries on time	4 240
Number of deliveries without complaints	4 168

Customer order lead time	2-5 days	
Delivery reliability	**99,07%**	Delivery reliability = $\frac{\text{Number of deliveries on time}}{\text{Total number of deliveries}}$
Delivery dependability	**97,38%**	Delivery dependability = $\frac{\text{Number of deliveries without complaints}}{\text{Total number of deliveries}}$
Stock availability	**99,07%**	Stock availability = $\frac{\text{Number of orders delivered complete}}{\text{Total number of orders}}$
Average number of order lines per order	1	The average number of order lines per order affects the customer service level. A high number of order lines per order may make it harder to achieve a high customer service level.

Control	2,13

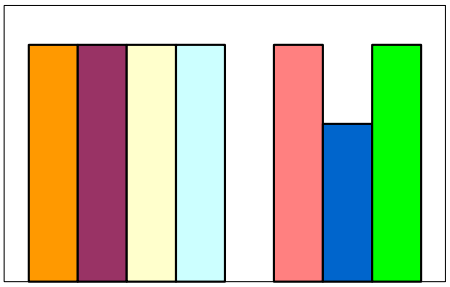
Overall	2

1. Demand forecasting	0
2. Customer relations	2
3. Order processing	3
4. Logistics communications	3



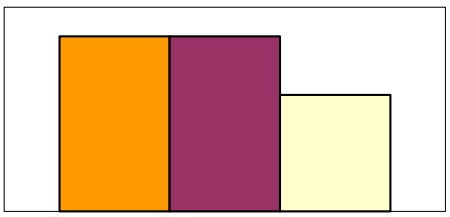
Procurement	2,5

1. Strategy	3
2. Planning and implementation	3
3. Supplier relations	3
4. Purchase order processing	3
5. Inbound transports	0
6. Goods reception	3
7. Warehousing and storage	2
8. Measurement and evaluation	3



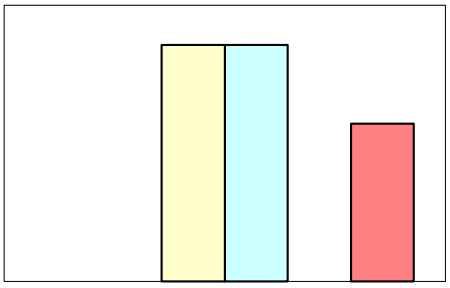
Operations	2,67

1. Strategy	3
2. Planning and implementation	3
3. Measurement and evaluation	2



Distribution	1,33

1. Strategy	0
2. Planning and implementation	0
3. Warehousing and storage	3
4. Dispatch handling	3
5. Outbound transports	0
6. Measurement and evaluation	2

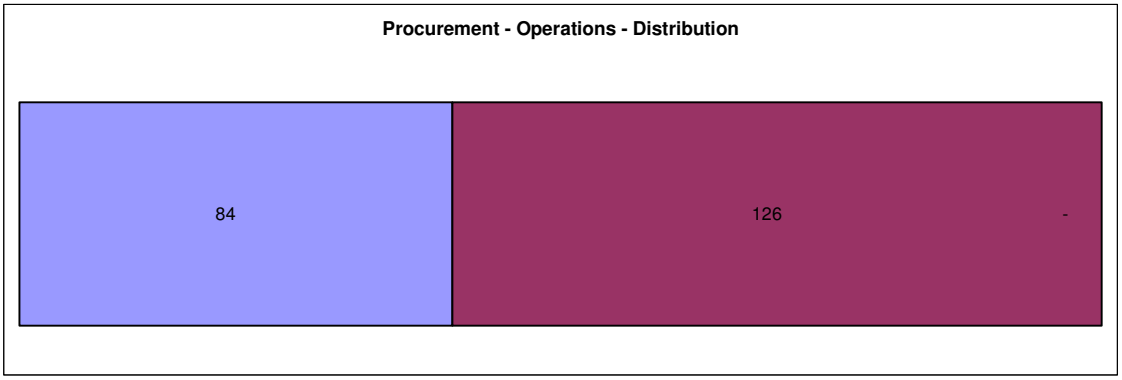


Time

Lead time breakdown

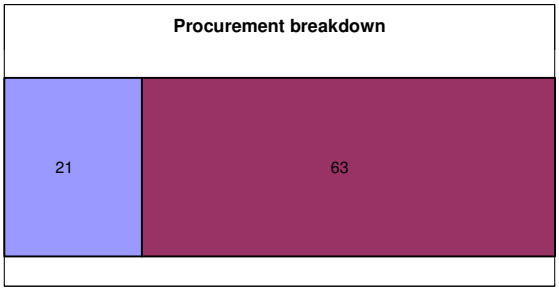
Product type B

Total lead time	210	days

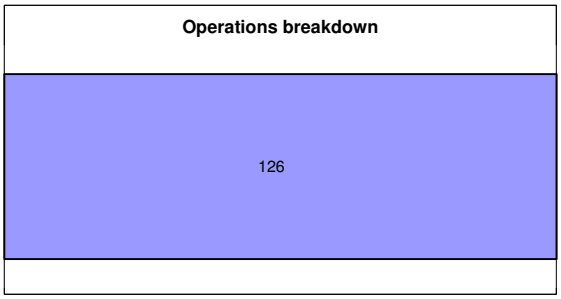


Procurement	84	Operations	126	Distribution	-

Procurement	Lead time	Inventory?(yes)	Turnover rate
Activity breakdown			**6**
Order lead time from suppliers	21	no	-
Raw material inventory	63	yes	6
			-
			-
			-
			-
			-
			-
			-
			-
			-



Operations	Lead time	Inventory?(yes)	Turnover rate
Activity breakdown			**#DIV/0!**
Production	126	no	-
(6-18 weeks)			-
			-
			-
			-
			-
			-
			-
			-
			-
			-



Distribution	Lead time	Inventory?(yes)	Turnover rate
Activity breakdown			#DIV/0!
Delivered directly	-	no	-
from production			-
			-
			-
			-
			-
			-
			-
			-
			-
			-

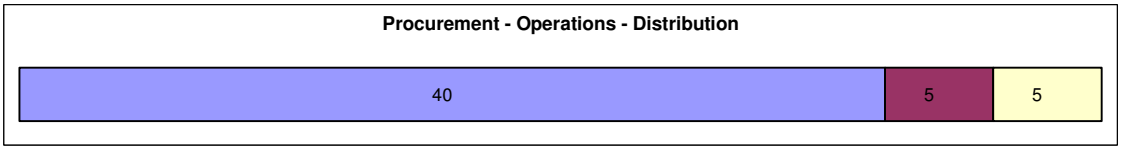
Inventory turnover rate

Total turnover rate	#DIV/0!	/year

Procurment	5,79	Operations	#DIV/0!	Distribution	#DIV/0!

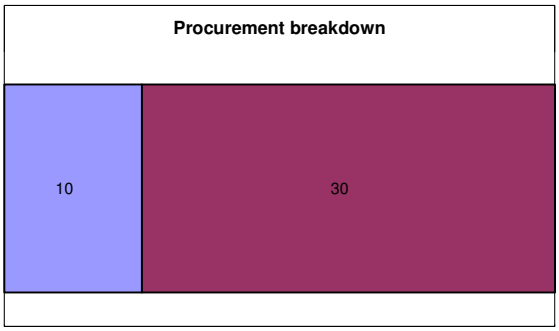
Product type A

Total lead time	50	days

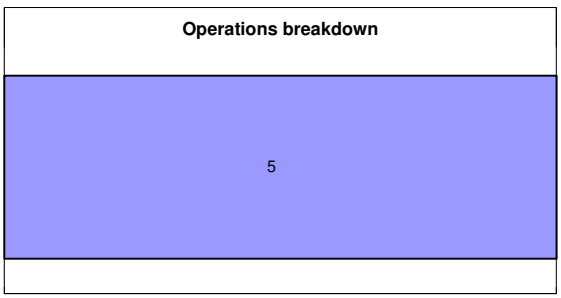


Procurement	40	Operations	5	Distribution	5

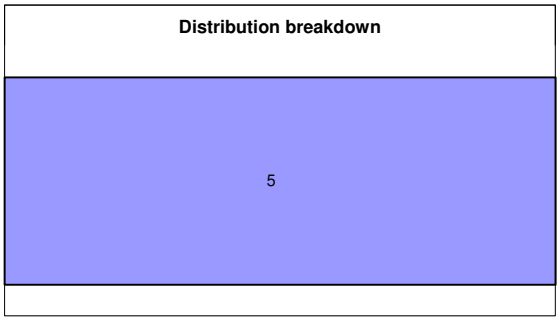
Procurement	Lead time	Inventory?(yes)	Turnover rate
Activity breakdown			12
Order lead time from suppliers (5-10 days)	10	no	-
Raw material inventory	30	yes	12
			-
			-
			-
			-
			-
			-
			-
			-
			-



Operations	Lead time	Inventory?(yes)	Turnover rate
Activity breakdown			#DIV/0!
Production	5	no	-
(2-5 days)			-
			-
			-
			-
			-
			-
			-
			-
			-
			-



Distribution	Lead time	Inventory?(yes)	Turnover rate
Activity breakdown			73
Finished goods inventory	5	yes	73
			-
			-
			-
			-
			-
			-
			-
			-
			-
			-



Inventory turnover rate		
Total turnover rate	#DIV/0!	/year

Procurment	12,17	Operations	#DIV/0!	Distribution	73,00

Comments

Some areas that could be investigated further have been identified. These are listed below.

Administration Costs

The company has very high administration costs. The data might look worse than it is because of difficulties in separating the logistics administration costs from the other administration costs. If this is not the case (and probably even if it is) the company definitely has to look over cutting these expenses.

Undersized facilities

Their operations are crammed into a too small area. This causes problems. The first in/ first out principle is sometimes difficult to live up to today but could easily be maintained if there was more room in the finished goods storage. The problems are also evident in the component storage with problems before vacations when the company needs to stock up on items. In the production the lack of space hinders the flow and temporary storage of products resulting in lowered efficiency.

Strong customers

The company relies on few and strong customers making them very dependent. This results in hard requirements from the customers that the company must live up to. Amongst those tough demands are the long terms of payment and the late freeze times on the type B products, regardless of their unreliable prognoses. Another area that the high demands affect is that they limit the company's flexibility in choosing suppliers, which in turn effects the procurement negatively.

Procurement issues

A problem in the procurement is that the company probably does not have the optimal set of suppliers. This is partially because of restrictions from the customer but also because they do not have the correct information to make any decisions. A proper total cost analysis of all aspects is necessary, considering how the choice of suppliers affect everything, not only the price per unit.

One effect of the bad supplier performance is that a large inventory is built up to protect the production from variances in deliveries. This is certainly costly but a further problem is that there is no control of how costly it actually is since there are no measurements of for example the turnover rate in the component inventory.

Another issue is that there are bottlenecks causing disturbances in the procurement. Trucks transporting components from suppliers is one such area, although that has been a general problem for all companies in Sweden during the last year because of the strong economy. There are also problems with the capacity of the forklift trucks that receive the goods. This is further complicated by the fact that there are problems with registering material handling activities into the system. The problems have consisted of both a lack of computers and getting employees to register activities correctly.

A final issue in the procurement is that some components are not ordered in an optimal amount but rather in way too big quantities; this must be looked over, especially considering the lack of space for storage.

Appendix A: Case Company 3

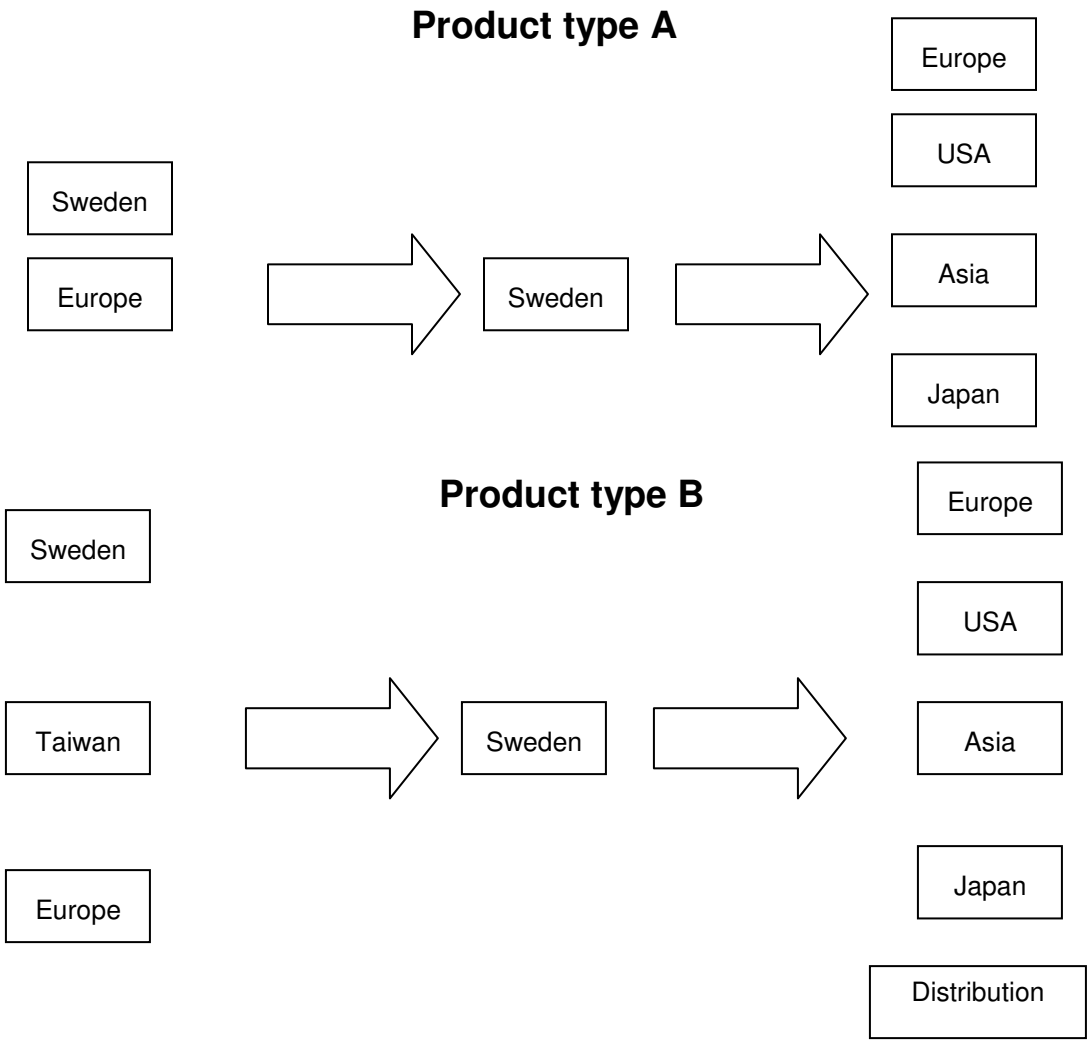
The visit at Case Company 3 is held on December 17 2007. The data collection also includes information acquired by e-mail.

System Description

The interview starts with a presentation about the company held by the interviewee. The analyzed logistics system is the Swedish part of the organization. All data regards this part of the organization specifically and it is referred to as Case Company 3 or simply the company, even though it is only a section of a bigger company.

Mapping the system

In the figures below the system is divided into its two main products. Since the company does not have any own production and lets the suppliers handle a great amount of the distribution the mapping is simplified.



Characteristics and goals

The characteristics of the company

C.1 What is the ***history*** of the company?
The company was founded sixty years ago, based on innovations in medical equipment.

C.2 What ***type of company*** is it, what does the company offer?
The company sells medical equipment to hospitals around the world. The company has two main product types.

The first one will be referred to as product type A and is a very expensive (approximately 30 million SEK) and heavy product that they annually sell about 25 of. The delivery of this product is a project in itself requiring preparations both of the room the equipment should be installed in and how it should be transported and installed. Product type A is sold in four different models and stands for approximately 90 % of the company's revenues. There are approximately 250 of these products operational in hospitals around the world today.

Product type B is also specialized hospital equipment that is rather expensive, but in a much lower price range than type A. The products are not particularly large or heavy, so "normal" delivery channels can be used, unlike product type A. The products are sold in kits in different variations. About 100 kits are sold annually.

C.3 What ***value*** does the company add before selling the finished products?
The company doesn't have any production of there own, the only operations they have are quality control and repacking components into different kits before sending them to their customers.

The value the company gives their customers is the clinical result. To achieve this they give the customer the product itself, the delivery and installation know-how, competence regarding the operations of the machinery and service that sometimes includes guaranteed up-time. It is not the technical specification but the results that are important.

For the products of type A the usage competence is transferred through a five day course in using the equipment. This includes seminars with different doctors and technicians. During a start up period the equipment is also operated by a specialist from the company, until the local doctors learn how to use it properly.

Product type B is more common and does not require specific training.

C.4 In what ***industry*** does the company operate?
The medical equipment industry

C.5 Where is the company ***located***?
The head office and "operations" are located in Sweden. The company has market divisions all over the world and suppliers are located in Europe and Asia.

C.6 Which ***markets*** does the company focus on?
The products are sold to hospitals all over the world through market divisions. The USA and Japan are especially big markets.

There is an important secondhand market for the products of type A. They need to be serviced thoroughly after 5-7 years. This requires special heavy equipment and requires much planning. Hospitals usually upgrade their product at the same time. It is important to have the latest model for marketing purposes, especially in the USA. The upgrade can either involve replacing parts of the equipment or the entire machine. The used machines can be sold on to other hospitals, often in rural areas were the procedures are done less often.

Another important issue in the hospital equipment market is the high requirement regarding service and spare parts. If a machine breaks down they required spare part should be delivered the next day. Therefore the logistics system for the spare parts is designed for very different requirements than the complete products.

C.7 Who are the ***competitors*** of the company?
For product type A there are no competitors offering an equivalent product. However there are other alternative techniques to treat the same patients that are treated with such a product. There are clear competitive advantages for this company's products.

Product type B has more direct competitors offering similar products. However they are the market leader and have one main competitor. There competitors alternative is newer but more difficult to produce.

Hospitals are generally under hard pressure in choosing the best investments and in a sense all hospital expenses "compete" with the case company's products since they are alternative investments.

C.8 What ***risks*** does the company face?
There is a lot of research in the field of medicine and a new technical innovation could replace one of the company's product types.

Other risks involve changes in the market, political and regulatory factors can affect both suppliers and customers. Health legislation can also change. The company also has financial risks specifically from dealing in different currencies and having an unbalance in the currencies used to pay suppliers and received from customers.

C.9 How is the company ***organized*** in general and regarding logistics?
The company has one legal and another functional organization. Only the functional one is relevant for this logistics analysis, since it is the one that governs the daily operations.

Operations have the following subdivisions: Global Customer Order Management, Manufacturing, Purchasing, Logistics, Controller and HR.

The purchasing unit only deals with strategic purchasing while logistics handle the operative purchasing.

Logistics is divided in to a Spare Logistics Centre and one unit each for the two product groups. There is also a Logistics Development unit with two employees that are evaluating how to improve and better measure the logistics. The Global Customer Order Management unit used to be a part of the Logistics unit but is now free standing.

The organization is a result of the merger of two companies and can not be considered optimal yet.

C.10 What has the ***revenue*** been during the last years?
Approximately 1.1 billion SEK for the last two years

C.11 What have the ***assets***, ***liabilities*** and ***owner's equity*** been during the last years?
Since the company is part of a bigger organization this can not be specified.

C.12 What has the ***profit*** been during the last years?
The profit is well over 10 %.

C.13 What has the ***capital turnover rate*** been during the last years?
This can not be answered, for the same reasons as in question C.11.

C.14 What has the ***number of full time employees*** been during the last years?
There are 240 employees.

C.15 What is the ***full time equivalent*** of the employees ***working with logistics***?
10 people work with logistics. Of these three work in the warehouse, two with planning and one with developing the logistics.

C.16 How many ***stock keeping units*** are handled annually? Inbound/outbound?
2 500 unique articles are procured and kept in inventory. Most of these are for product type B and many of them are small parts. About 40 unique products are sold.

C.17 How many ***orders*** are handled annually? Inbound/outbound?
Yearly about 11 200 order rows are ordered from suppliers. About 125 products are sold annually, each representing its own order.

C.18 How many ***deliveries*** are handled annually? Inbound/outbound?
Outbound: 1 690, inbound: -

The goals of the company and its logistics objectives

G.1 What are the comprehensive ***vision and objectives*** of the company?
-

G.2 What is the ***business strategy***?
The goals and measures have been worked through and a common logistics strategy was formulated for the whole company. This includes using the same performance measures.

The goals and visions are tied to the TTM (time to market), TTC (time to customer) and Install Base Management Processes.

G.3 How does the company ***define logistics***?
This has previously differed in different parts of the organization. Some have considered it "box moving", but now it has grown in stature and is perceived to be important to make the company competitive.

The company believes that logistics involves the whole supply chain from the procurement out to the customers, including quality and precision.

The purchasing division is responsible for supplier relationships, evaluation and contracts. The logistics division is responsible for the actual operative purchasing.

G.4 What is the ***logistics strategy***?
The strategy is to be a world class function for supply of all of the company's products with focus on customer satisfaction and cost efficiency.

G.5 What are the ***logistics goals***? What does the company want to achieve with its logistics?
For spare parts the goal is to in an as cost effective manner as possible be able to deliver to the customer the next day at least 98 % of the time.

For the main products the challenges are different. The time frame is not as rushed. Visibility is important through the supply chain.

G.6 Are the goals ***measured***? How?
Today the goals are not measured properly.

The measurements include:

- Delivery precision: For type A, type B and spare parts. For type B products it is measured at an order line level and the average product has about 20 order lines. The spare parts are also measured at an order line level; however this measure ends when the parts leave the warehouse and

not when they arrive at the customer, which would be aspired. They would like their logistics partner to provide such information.

- Inventory turnover: For type B and spare parts
- Shipment Completeness
- Returns form customers regarding spare parts
- The value of the inventory for outdated goods

The company would like to measure the logistics effectiveness but have not decided on an appropriate way to measure it.

G.7 Does the company focus on a ***cost*** or ***value advantage*** or both?
The value advantage is more important

G.8 How ***important*** is ***logistics*** for the company, strategically?
It is considered important, especially for the spare parts where it is a top priority.

G.9 What are the ***customer demands*** regarding logistics?
To get the right products delivered at the right time. Extra important for spare parts since the customer usually is eagerly waiting for them. The customer order lead time of one day is a demand from the customers.

For the main products the timing is not as important. Good communication can create an understanding of possible delays.

G.10 Are there ***different logistics goals*** for different products or flows?
See question G.9 above.

G.11 Is the logistics ***adapted*** to the products or vice versa?
Previously the logistics was completely adapted to the production but this is starting to change. The latest model of the type A product is an example of this. It is built in modules so the logistics flows should be as smooth as possible.

Documented procedures on the logistics strategy

Yes, every three years a plan is formulated at the top of the company and thereafter broken down into concrete plans applicable at lower levels. The top level strategy is broken into tactics and that in turn is broken into activity plans that are a foundation for job descriptions.

So yes, there are documented procedures and these are followed.

Input and Output

Total cost

-

Customer service

-

Transformation

Overall

1. Demand forecasting

A.1.1 How is the demand forecasting managed?

At the top level a sales prognosis is made that is interpreted and serves as a basis for a budget and the production. The prognosis is broken down into production plans. The suppliers receive a prognosis twice per year.

A.1.2 How are prognoses made?

-

A.1.3 Are the prognoses usually accurate?

The company is trying to develop better tools for the prognosis since they are not completely satisfied with how they work so far.

A.1.4 Are the prognoses followed?

Yes

A.1.5 Where is the ***order penetration point*** situated?

The maximum total throughput time for products of type A is nine months so the company must produce based on a prognosis. If there are no orders waiting then they produce unassigned products that are put in the finished goods inventory.

For product type A the minimum time between a customer ordering a product and receiving it is four months. However there is usually other aspects that constrain this time, such as the preparations the hospital must make for the installation. So the sales cycle is usually one year.

For type B products there is a 30 day customer order lead time and therefore they build up an inventory of unassigned products. Bigger more expensive parts are mainly kept in the central inventory in Sweden while smaller parts are kept closer to the market.

A.1.6 What are the ***consequences*** of how the demand forecasting is managed? What ***problems*** are there? How can this area be ***improved***?
The prognosis is not considered great and the planning is not organized properly. They will ABC-classify the products to lower the tied up capital and maintain high service levels.

The prognosis is based on the whole year production and it is therefore difficult to estimate demand variations between seasons during the year. Experience and information on variation previous years helps to a certain extent.

Using the enterprise resource planning systems better could improve the prognosis. An important factor is that the products are registered correctly so the right components are associated with the product, otherwise the inventory levels will be incorrect.

The problems derive from the company's transition from a small entrepreneur company to a quite big organization. The processes need time to catch up.

Documented procedures on demand forecasting

There is something but it is being redone since it has not been working well. Therefore they have not been used.

2. Customer relations

A.2.1 How are the customer relations managed?
The type A products have a dedicated sales team with a responsible salesman for each client. They negotiate and write the contracts. After that a project manager becomes responsible for the delivery and start up period. There are also networks for the customers with conferences where they can share their experiences.

There is a ambition to have the same type of deep client relations with the type B product customers but today they are not as developed.

A.2.2 What is the ***number of customers*** the company has? What is that number based on? Is that the desired number?
About 1 000 hospitals use the company's products today

A.2.3 What is the ***percentage of the annual sales value*** that the three biggest customers stand for each?
There is no single big customer that accounts for a large part of the revenues.

A.2.4 Where are the customers ***located***? What is the ***lead time*** to the customers?
The customers are located all over the world, the US and Japanese markets are especially big.

For product type B there is a 30 day customer order lead time. In the USA the hospitals would like a shorter customer order lead time.

Product type A has a minimum customer order lead time of four months but the hospitals usually want the product in about one year.

A.2.5 How are the ***contracts*** with the customers formed? (time conditions, price, order entry, payment conditions, etc.)
For type A products the purchase always includes the equipment, installation, education and one years guarantee. The customers often add some form of service contract and uptime guarantee.

The payment is divided into a down payment (30 %), second payment (30%), delivery payment (30 %) and the final acceptance payment (10 %). The terms of payment are usually 30-60 days. The service contracts are paid for continuously, typically 800 000 SEK annually. The hospitals usually have an external financier for the investment.

A.2.6 What are the ***consequences*** of how the customer relations are managed? What ***problems*** are there? How can this area be ***improved***?
No real problems are experienced, generally good relations to the customers. The customer focus is high. Through a logistics perspective the work with distributors could be more proactive.

Delivery precision on spare parts is crucial for the customers. They are ordered against inventory that is kept in USA, Holland and Sweden. The visibility should be improved regarding the spare parts all over the world. The goal of one day customer order lead time is sometimes hard since things often must be transported from Europe to the US. There is a hub in the USA from which express transports are sent off to the hospitals.

Documented procedures on customer relations

Of course!

3. Order processing

A.3.1 How is the order processing managed?
The order is either received directly here in Sweden or at one of the market units around the world. The recipient checks when the order can be delivered and informs the customer. There is a responsible employee designated for each customer order. That person is responsible for all the order lines until the product is delivered. The order is picked and transport is arranged and sent off with the traveler and invoice.

A.3.2 How is the ***order entry*** (order editing/call off) performed?
It is entered into the system by an order handler.

A.3.3 How are ***order modifications*** or ***error corrections*** handled?
There is no system for customers to change things. There was but it was problematic since the orders need clinical approving and therefore must be tested specifically before being sent off and these tests can not be changed on a short notice. But other customizations can be made, like having a certain laptop for operating the equipment.

A.3.4 Are the customers given answers to ***order status inquiries***? How?
For product type A there is a continuous contact since the delivery is something of a project.

For product type B any exceptions from the plan are communicated.

A.3.5 How is ***invoicing*** managed?
See A.2.5

A.3.6 What are the ***consequences*** of how the order processing is managed? What ***problems*** are there? How can this area be ***improved***?
There have been problems with how the Enterprise Resource Planning system supports the order processing.

Documented procedures on order processing

Yes, there is a 40 pages long "Order Fulfillment process".

4. Logistics communications

A.4.1 How are data and information exchange managed?
Movex is used and fully implemented in Sweden, some of the market units are still in transition. All deliveries that leave Sweden are reported through the system and half of the orders are registered using it. The other half are registered using a fax machine. When Movex is fully implemented globally it will simplify things, today it can be difficult to get accurate reports from the system.

A.4.2 What ***type of ERP system*** is used to support the logistics communications?
Movex. No other ERP systems are used only fax, telephone and e-mail.

A.4.3 What method is used for information exchange between the major functions ***within the organization***? Is the same ERP system used within the whole logistics system?
See A.4.1 and A.4.2

A.4.4 What method is used for information exchange between the organization, its ***suppliers*** and its ***customers***?
With customers the telephone, e-mail and fax is used.

With suppliers there is a prognosis that is supported by the system and serves as a frame for what will be ordered. The call-off is often done through Movex.

For some components they use production plans in Excel, a way to get the phone calls on paper.

A.4.5 What method is used for information exchange between ***other members of the supply chain*** who may not be directly linked to the firm? (second tier suppliers and customers' customer)
It is very seldom that they have contact with their suppliers' suppliers and never their customers' customers.

A.4.6 What are the ***consequences*** of how the logistics communications are managed? What ***problems*** are there? How can this area be ***improved***?
Communicating the prognosis in an understandable way to the suppliers is challenging. They have monthly meetings with the biggest suppliers where they discuss the prognosis, this helps. But there are always suppliers that say one thing and do another, perhaps because they do not understand.

Documented procedures on logistics communications

There is no procedure on communication specifically but it is covered partially in other processes. The information to the customers is covered in a process and the supplier communication in the purchasing process.

Procurement

1. Procurement strategy

P.1.1 What is the procurement strategy? (single/multiple sourcing)
There is a Swedish and other global purchasing units responsible for the strategic procurement. The interviewee does not work specifically with these questions but will answer them as well as possible.

The goals are to buy faster, cheaper and at an as "high level" as possible meaning buying components rather the raw materials. Other goals are to minimize currency risks by purchasing mainly in USD. The number of suppliers should be minimized without single sourcing any vital component.

They company puts it that the goal is to: Create a competitive advantage for the company through sourcing of new and current products...

P.1.2 Why is this strategy chosen?
See above.

P.1.3 What are the ***consequences*** of how the procurement strategy is managed? What ***problems*** are there? How can this area be ***improved***?
No specific problems regarding the procurement strategy. They are evaluating using suppliers in low cost countries.

Documented procedures on procurement strategy

Yes, and they are followed.

2. Procurement planning and implementation

P.2.1 How is the procurement planned and implemented?

For some components long term contracts are necessary and these are handled by purchasing. Besides these the planning is usually done on a yearly basis by the logistics unit. Movex is used but not as much as possible. The interviewee is unsure if the right resources are put into procurement and thinks there is a need for better measurements.

Practically the planning is performed through a breakdown of the prognosis of the annual sales in an Excel file. The estimated sales figures are broken down to monthly estimates and translated into the demand for components. The interviewee believes there is a lot of potential in improving this planning procedure.

P.2.2 How are the ***inventories managed***? (inventory levels, safety stock, cycle stock, etc.?)

There is hardly any raw material inventory, the components are directly stored in the finished goods inventory after being controlled and sometimes repacked. Problems with managing inventory have contributed to the decision to buy as finished components as possible.

P.2.3 How is the raw material ***demand prognosticated***?

See above.

P.2.4 What is the ***capacity utilization*** level in the procurement? Is this the desired level?

There are problems with room for storing products. Therefore they try to get the suppliers to keep inventory, this also helps lower the tied capital. There is almost unnecessary capacity regarding personnel.

P.2.5 How is ***flexibility*** in the procurement taken in to account?

-

P.2.6 Are there any ***bottlenecks*** in the procurement? How do they impact the procurement? How are they avoided?

Space is a bottleneck

P.2.7 How are the ***risks*** in the procurement managed? Is there a contingency plan?

The fluctuation in demand is demanding for the suppliers. The suppliers need to be able to handle the variations or build up a finished goods inventory.

The long lead times are also demanding so the planning must be done far ahead.

Another risk is that the ERP system gives faulty information or breaks down.

P.2.8 Are there any ***custom*** issues that effect how the procurement is managed?
Yes, due to import from China and Switzerland. But these issues are usually handled by the transporter. Although some tax issues might be handled poorly.

P.2.9 What are the ***consequences*** of how the procurement planning and implementation is managed? What ***problems*** are there? How can this area be ***improved***?
This area might have the biggest potential for improvement in the whole company right now. The communication with suppliers must be improved; they could work more proactively and efficiently.

Documented procedures on procurement planning and implementation

There are but they are outdated and therefore not used.

3. Supplier relations

P.3.1 How are the supplier relations managed?
The supplier relations are managed on an operative level through the planners handling the procurement. The suppliers are categorized into three classes. The first and second class suppliers deliver the critical components and these are the ones which they have monthly meetings with.

They work to improve quality and press costs together. It is important that the company's suppliers make money since it is hard to switch suppliers. By understanding what is easy and difficult for the suppliers they can press costs together.

P.3.2 How are logistics related parameters used when ***selecting*** the suppliers?
There are specific parameters for evaluating suppliers. When selecting a new one they look deeper into the financial health of the company and at how good they are technically and how they work with quality issues and such.

P.3.3 How are the ***contracts*** with the suppliers formed? (time conditions, price, order entry, payment conditions etc.)
-

P.3.4 How are logistics related parameters used when ***evaluating*** the suppliers?
Every quarter a formal evaluation is done rendering in a total score. Based on this an improvement plan is formed.

P.3.5 How is the work with ***supplier relations development*** performed?
Differently on different levels. The every day contact is on an operative level, while the managers meet quarterly.

P.3.6 What is the ***number of suppliers*** the company has? What is that number based on?
Around twenty

P.3.7 What is the ***percentage of the annual costs value*** that the three biggest suppliers stand for each?
There used to be one pretty big one but now their share has dropped and there are three fairly big ones.

P.3.8 Where are the suppliers ***located***?
Many in Europe, Sweden dominant and secondly England. Some Chinese suppliers are used. They are considering using more Asian suppliers.

P.3.9 What is the ***lead time***, from order to delivery, from the suppliers?
This varies much. One component has a nine month lead time, but working with accurate prognosis makes it as practically as if it was only three months. Most components have about one month lead time. They try to get the same lead times from the suppliers that they promise their customers, so they would especially like shorter lead times on spare parts. Some parts are not ordered from suppliers until they get a customer order, this requires a short lead time from the suppliers.

P.3.10 What are the ***consequences*** of how the supplier relations are managed? What ***problems*** are there? How can this area be ***improved***?
Sometimes the company is bad at making reclaims and is too nice to suppliers that repeatedly do not live up to their contracts. Tighter communication internally and then to the suppliers would help, it might be due to lack of resources that this is not already handled this way.

Documented procedures on supplier relations

Not sure, but there are formal evaluation forms.

4. Purchase order processing

P.4.1 How is the purchase order processing managed?
The demand comes from either a real customer order or a prognosis. The order is entered into the system and printed, attested by the appropriate person depending on its value. Then it is sent to the supplier by e-mail and the original is sent by mail. The supplier has a five day confirm time.

They measure the suppliers on the confirmed date and the date of delivery regarding delivery precision. Some suppliers are watched more carefully depending on how well they usually perform, although the company would like a better way to pick which suppliers this should be.

P.4.2 How is the ***order entry*** (order editing/call off) performed?
-

P.4.3 How are ***order modifications*** or ***error corrections*** handled?
Most requests can be solved with some giving and taking.

P.4.4 Do the suppliers give answers to ***order status inquiries***? How?
-

P.4.5 How is ***invoicing*** managed?
The company would like as long payment terms as possible but 30 days is currently the most common terms of payment. The invoicing is handled through Movex.

P.4.6 What are the ***consequences*** of how the purchase order processing is managed? What ***problems*** are there? How can this area be ***improved***?
Some problems are experienced in following up performance and keeping track of the deliveries that should be expected next week.

Documented procedures on purchase order processing

Yes and they are followed.

5. Inbound transports

P.5.1 How are the inbound transports managed?
The company pays for the incoming transports and the goods are the transport company's responsibility as soon as the goods are on the truck. Many transports are over a short distance. In some unusual cases the supplier plans the transports but this is generally avoided. One special component is and must be completely handled by the supplier.

P.5.2 How are the ***Inco terms*** for the inbound transports formed?
-

P.5.3 How is the ***method of shipment*** selected? (boat, air, truck, rail, etc.) What method is normally used?
Trucks are used within Europe, otherwise plane or ship. Courier if a problem has occurred. Sometimes a taxi cab is used for short local transports. From Asia mostly by plane but some heavy parts go by boat.

P.5.4 How is the ***specific path*** the shipment takes decided?
The actual route is decided by the transporter given that it satisfies the company's requirements.

P.5.5 How are different ***transport regulations*** taken into account?
The heavy components cause problems in some parts of the world, as they can be slightly too heavy according to regulations.

P.5.6 How are the deliveries ***supervised***?
No, only if there is some special urgency.

P.5.7 What are the ***consequences*** of how the inbound transports are managed? What ***problems*** are there? How can this area be ***improved***?

One problem is that when the company arranges transport it takes more time. But the supplies are not motivated to get a good deal since they are not paying. The company is moving towards using the same transporter for everything which is practical since they only have to deal with one contact point for follow up and to set demands. They believe that giving the transporter more responsibility will improve things.

Documented procedures on inbound transports

No. It is only briefly mentioned in a process that the transport demands must be written on the order.

6. Goods reception

P.6.1 How is the goods reception managed?

The goods arrive, are inspected for transport damage and then the transporter registers the goods as arrived in the system. Then further controls are performed depending on the requirements, for example a visual inspection may be done, then they are stored in the inventory. Two employees work with goods reception, inventory and picking and packaging. One employee works with the goods control.

P.6.2 How is the ***capacity level*** (in terms of personnel available at different times) in the goods reception decided?

No problems. 90 % of the received goods are reported in the same day.

P.6.3 How are ***deviations*** in the shipments managed? (amount, quality, time, etc)

If something is wrong when they receive it they put it on a special shelf for investigation. Then they contact the supplier. Usually this means sending back the goods and then they send a new delivery. Focus is on keeping this procedure as fast as possible.

P.6.4 What are the ***consequences*** of how the goods reception is managed? What ***problems*** are there? How can this area be ***improved***?

Since there are so many different types of components all articles are handled in their on special way, this makes it a bit complicated.

The capacity might be a little too high because of the uneven workload; a steadier workload would be beneficial.

Documented procedures on goods reception

Yes there is an instruction that is followed.

7. Warehousing and storage

P.7.1 How is the warehousing and storage managed?

Since the component and finished goods inventory is the same inventory this is a bit special. The product types A and B have inventories in separate locations in Sweden and the spare parts are in Holland. The average inventory value for

the type A inventory is around ten million SEK. For the spare parts in Holland the average value is approximately five million SEK.

The type A and spare part inventories are outsourced and paid for based on space and pick orders. There is a quality representative from the company at the type A inventory.

P.7.2 How is the ***warehouse site*** selected?
There are two warehouses in Sweden, one for each product type and the spare parts are kept in Holland to keep the lead times shorter.

P.7.3 How is ***picking, staging*** and ***loading*** performed?
-

P.7.4 How is the ***packaging*** managed?
-

P.7.5 Is the storage facility ***owned***, ***leased*** or ***rented***? What is that decision based on?
They are rented (or outsourced), as is the offices to keep things flexible.

P.7.6 How is the ***layout*** and ***design*** of the storage facilities decided?
Principles are not to mix ingoing and outgoing or single and consolidated articles.

P.7.7 How is the ***product mix*** in the storage considered?
-

P.7.8 What are the ***consequences*** of how the warehousing and storage is managed? What ***problems*** are there? How can this area be ***improved***?
The problems that occur are human mistakes. These are not a big problem, a difference of about 60 000 SEK when inventory is checked.

There might be potential for improvement by moving the type B inventory to Holland and outsourcing it. The upside is that it is closer to the customers and would have better open hours. This would also mean that the cost would be variable instead of fixed. The problem would be that the kitting and controlling might be difficult to outsource. This move might be done within the next year.

Documented procedures on warehousing and storage

Yes and they are followed.

8. Measurement and evaluation of procurement performance

P.8.1 How is measurement and evaluation of the procurement performance, both internally and externally, managed?
The following is measured:

- Delivery precision from the supplies
- Service degree from the suppliers

- Delivery deviations from the suppliers

Delivery precision is the time measurement but if they are late then there is a three days margin so that the suppliers will not be punished if the fault is in the companies own reception and registration.

P.8.2 ***What*** is measured?
See above.

P.8.3 ***How*** is it measured?
See above.

P.8.4 How is it ***evaluated***?
The measurements are discussed in the monthly meetings with the suppliers.

P.8.5 How are ***improvements*** made?
-

P.8.6 What are the ***consequences*** of how the measurement and evaluation of procurement performance is managed? What ***problems*** are there? How can this area be ***improved***?
There is uncertainty about how correct the measurements are. The reports from the system could be a lot more clear and improved in general.

Documented procedures on measurement and evaluation of the procurement

No not exclusively about measurements and evaluation of the procurement but some things are mentioned in other processes.

9. Problems in the procurement

P.9.1 ***What problems are there in the procurement?***
Nothing that has not already been discussed.

P.9.2 Is the procurement ***method appropriate***? Does it work well?
-

P.9.3 How are ***deviations*** handled? What are the consequences of the deviations?
-

P.9.4 How can the procurement be ***improved***?
-

Operations

1. Operations strategy

O.1.1 ***What is the operations strategy?***

The strategy is to have no production at all by outsourcing it to the suppliers. Buy components at an as high level as possible, repack and deliver to the customers.

The kitting the company does today could also be avoided in the future, they are trying to find a supplier to deliver the finished component. They are currently evaluating one located in Taiwan.

O.1.2 Why is this strategy chosen?
-

O.1.3 What are the ***consequences*** of how the operations strategy is managed? What ***problems*** are there? How can this area be ***improved***?
Not being able to affect the actual production is a problem. If something is wrong they have to deal with their suppliers. Therefore it is important to choose suppliers that they can influence.

The strategy might not be the most cost effective, but it avoids tying the company and its capital down.

The areas for potential improvement are communication and control. Staying updated on what is happening at the suppliers so adjustments can be made.

A lot of work goes into explaining to the suppliers how they should manufacture.

Documented procedures on operations strategy

Yes and they are followed.

2. Operations planning and implementation

O.2.1 How are the operations planned and implemented?
There is as previously mentioned no production. The components are received from the suppliers, controlled and then put in inventory. Some of the items are the kitted into different combinations and put as finished goods in inventory. The kitting is the only task that can be considered as operations.

O.2.2 What are the ***characteristics of the operations***? (Nonstop, line, customized, project, etc.)
-

O.2.3 How is the operations ***demand prognosticated***?
-

O.2.4 What is the ***capacity utilization*** level in the operations? Is this the desired level?
-

O.2.5 How is ***flexibility*** in the operations taken in to account?
-

O.2.6 Are there any ***bottlenecks*** in the operations? How do they impact operations? How are they avoided?
-

O.2.7 How are the ***risks*** in the operations managed? Is there a contingency plan?
-

O.2.8 What are the ***consequences*** of how the operations planning and implementation is managed? What ***problems*** are there? How can this area be ***improved***?
-

Documented procedures on operations planning and implementation

Yes and they are followed.

3. Measurement and evaluation of operations strategy

O.3.1 How is measurement and evaluation of the operations performance managed?
No measurements are done since the gap between receiving deliveries and sending out products is so small.

O.3.2 ***What*** is measured?
-

O.3.3 ***How*** is it measured?
-

O.3.4 How is it ***evaluated***?
-

O.3.5 How are ***improvements*** made?
-

O.3.6 What are the ***consequences*** of how the measurement and evaluation of operations performance is managed? What ***problems*** are there? How can this area be ***improved***?
-

Documented procedures on measurement and evaluation of the operations

-

4. Problems in the operations

O.4.1 What problems are there in the operations?
-

O.4.2 Is the operations ***method appropriate***? Does it work well?
-

O.4.3 How are ***deviations*** handled? What are the consequences of the deviations?
-

O.4.4 How can the operations be ***improved***?
-

Distribution

1. Distribution strategy

D.1.1 What is the distribution strategy?

The company pays for the transport and insurance but the customer stands for any other risks. The company takes responsibility until the product is delivered.

For spare parts the customer pays for the transport unless they have a service contract.

For product type A the customer pays for the installation and preparations of the operating room. The company assists with instructions of how everything should be done.

The overall goal is a cost effective distribution.

D.1.2 Why is this strategy chosen?
-

D.1.3 What are the ***consequences*** of how the distribution strategy is managed? What ***problems*** are there? How can this area be ***improved***?
Treating the spare parts in a very different way is the right thing to do. There are no real problems and consolidating the transports to one distributor should be a good move. They will not supervise the deliveries, only be notified of any irregularities.

Documented procedures on distribution strategy

Yes, the tasks are broken down in procedures and these are followed.

2. Distribution planning and implementation

D.2.1 How is the distribution planned and implemented?

The distributors keep as little inventory as possible, most is kept in Sweden.

D.2.2 How are the ***inventories managed***? (inventory levels, safety stock, cycle stock, etc.?)
They are working towards having an inventory of strictly finished goods. Eliminating the kitting and giving more control to suppliers at third party logistics operators.

The spare parts inventory is managed to have a high service level.

D.2.3 How is the distribution capacity ***demand prognosticated***?
-

D.2.4 What is the ***capacity utilization*** level in the distribution? Is this the desired level?
They try to level out the deliveries over the year. This makes the flows more regular and they can specifically only deliver so many of product type A at a time, since the start-up needs special training.

D.2.5 How is ***flexibility*** in the distribution taken in to account?
-

D.2.6 Are there any ***bottlenecks*** in the distribution? How do they impact distribution? How are they avoided?
No bottlenecks except that mentioned in D.2.4.

D.2.7 How are the ***risks*** in the distribution managed? Is there a contingency plan?
Using only one transporter may be a risk. But it is considered to be worth it since it gives better quality at a not much higher price.

D.2.8 Are there any ***custom*** issues that effect how the distribution is managed?
Yes, to China and India there have been some issues.

D.2.9 What are the ***consequences*** of how the distribution planning and implementation is managed? What ***problems*** are there? How can this area be ***improved***?
Making all the business units work in the same direction is difficult, many prefer their local alternative and want to sub optimize. The centralized decision to use one common transporter is best for the company as a whole.

The cost measurements for transports could be improved. They often use a fast and costly method even when there is no hurry, just because they are used to it.

Documented procedures on distribution planning and implementation

Yes as a part of the order process.

3. Warehousing and storage

D.3.1 How is the warehousing and storage managed?
-

D.3.2 How is the ***warehouse site*** selected?
-

D.3.3 How is ***picking, staging*** and ***loading*** performed?
-

D.3.4 How is the ***packaging*** managed?
-

D.3.5 Is the storage facility ***owned***, ***leased*** or ***rented***? What is that decision based on?
-

D.3.6 How is the ***layout*** and ***design*** of the storage facilities decided?
-

D.3.7 How is the ***product mix*** in the storage considered?
-

D.3.8 What are the ***consequences*** of how the warehousing and storage is managed? What ***problems*** are there? How can this area be ***improved***?
-

Documented procedures on warehousing and storage

-

4. Dispatch handling

D.4.1 How is the dispatch handling managed?

Customer orders, distribution orders and requisition orders go to the order planner to be prioritized. The orders are allocated and if possible consolidated before they are released for picking and packing. After this it is entered into Movex that they have left the inventory. Then the transport specification and pack list are withdrawn and the transporter is contacted.

For spare parts the description above happens very fast. For product type B the items are picked two days before the shipment. The time constraint is usually that some part is out of stock, if that is the case.

D.4.2 How is the ***capacity level*** in the dispatch handling decided?
There are no problems with the capacity levels. As previously mentioned there is an overcapacity in the type B inventory and the others are outsourced.

D.4.3 How are ***deviations*** in the dispatch handling managed?
-

D.4.4 How is the ***quality*** of the dispatch handling controlled?
-

D.4.5 What are the ***consequences*** of how the dispatch handling is managed? What ***problems*** are there? How can this area be ***improved***?
-

Documented procedures on dispatch handling

Yes, and they are followed.

5. Outbound transports

D.5.1 How are the outbound transports managed?
-

D.5.2 How are the ***Incoterms*** for the outbound transports formed?
-

D.5.3 How is the ***method of shipment*** selected? (boat, air, truck, rail, etc.) What method is normally used?
- Type A is by truck in Europe and by ship otherwise
- Type B is by truck or plane
- Spare parts are mostly transported by plane or with a courier

D.5.4 How is the ***specific path*** the shipment takes decided?
That is up to the transporter.

D.5.5 How are different ***transport regulations*** taken into account?
The high weight can cause trouble. One component for the type A product weighs 18 tons and there are several other very heavy parts. There are also some hazardous goods. This must be kept in mind when ordering transports.

D.5.6 How are the deliveries ***supervised***?
They are starting to implement and evaluate a track-and-trace system with their new sole transporter. Urgent or critical transports are usually supervised with status reports from the transporter.

D.5.7 What are the ***consequences*** of how the outbound transports are managed? What ***problems*** are there? How can this area be ***improved***?
They are very satisfied with their transporter.

Documented procedures on outbound transports

Nothing besides the order process as earlier described and that does not deal with transports.

6. Measurement and evaluation of distribution performance

D.6.1 How is measurement and evaluation of the distribution performance, both internally and externally, managed?
They get statistics from the transporter regarding delivery precision. It is divided into the delivery precision that the customer experiences and the part that is the transporters fault.

D.6.2 ***What*** is measured?
See above.

D.6.3 ***How*** is it measured?
See above.

D.6.4 How is it ***evaluated***?
-

D.6.5 How are ***improvements*** made?
There are operative monthly meetings with the transporter during which problems are discussed. Eventually they will start having meetings at a higher level.

D.6.6 What are the ***consequences*** of how the measurement and evaluation of distribution performance are managed? What ***problems*** are there? How can this area be ***improved***?
They are not satisfied with the measurements in this area. One thing they have discussed is how to deal with deviations. They would like to develop a classification of how serious different deviations are and how they can be dealt with. They need to understand the problems better; today the actions are too blunt.

Documented procedures on measurement and evaluation of the distribution

Yes and they are used.

7. Problems in the distribution

D.7.1 ***What problems are there in the distribution?***
-

D.7.2 Is the distribution ***method appropriate***? Does it work well?
-

D.7.3 How are ***deviations*** handled? What are the consequences of the deviations?
-

D.7.4 How can the distribution be ***improved***?
-

Time

	Type A	**Type B**	**Spare parts**
Lead time	~ 3 months	210 days	~ 13 months
Inventory turnover rate	-	2	1.1

Analysis and conclusions

Below the quantitative results from the analysis are presented and after that follows a brief analysis of the results. The level of control is presented followed by the time analysis. The control of each section is graded on a scale of zero to three, three being the highest, based on the documentation on that area and how it is used. These levels are also summarized for the three main parts of the company's logistics system and the complete system.

Total Cost Results

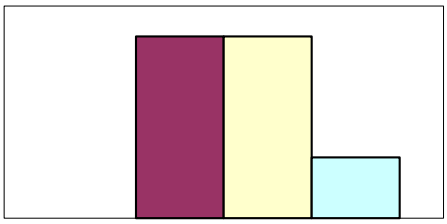
The company was not able to provide the requested total cost information. This indicates a low level of control over their logistics costs.

Customer Service

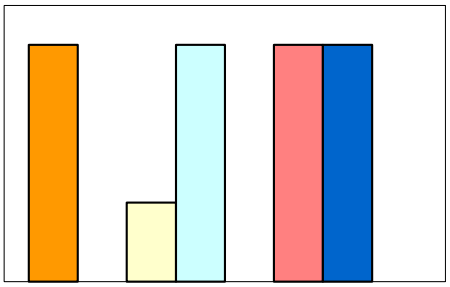
The company has some given statistics regarding their customer service levels. However, this information is not complete and can therefore not be used for any comparisons.

Control	1,97

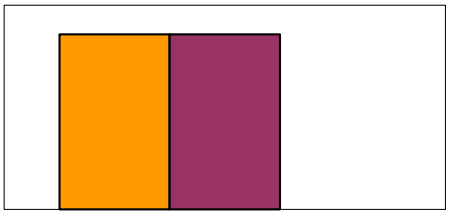
Overall	1,75
1. Demand forecasting	0
2. Customer relations	3
3. Order processing	3
4. Logistics communications	1



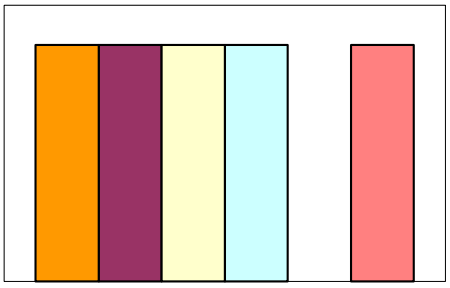
Procurement	1,63
1. Strategy	3
2. Planning and implementation	0
3. Supplier relations	1
4. Purchase order processing	3
5. Inbound transports	0
6. Goods reception	3
7. Warehousing and storage	3
8. Measurement and evaluation	0



Operations	2
1. Strategy	3
2. Planning and implementation	3
3. Measurement and evaluation	0



Distribution	2,5
1. Strategy	3
2. Planning and implementation	3
3. Warehousing and storage	3
4. Dispatch handling	3
5. Outbound transports	0
6. Measurement and evaluation	3



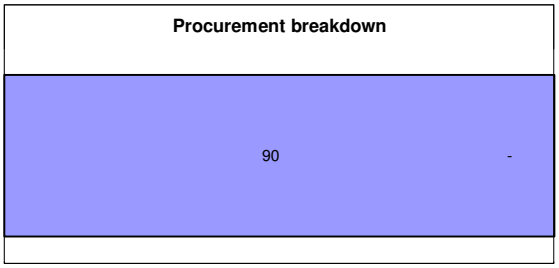
Below the acquired time information is presented. Because of the special nature of the logistics system of Case Company 3 only the procurement lead times are relevant.

Time

Lead time breakdown

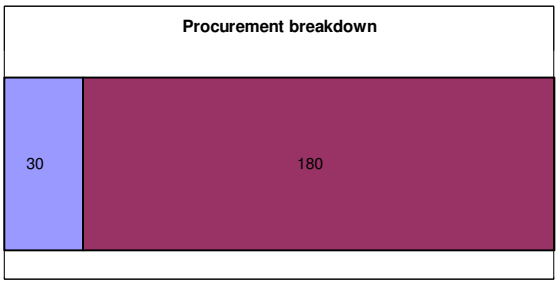
Product type A

Procurement	Lead time	Inventory?(yes)	Turnover rate
Activity breakdown			#DIV/0!
Order lead time from suppliers	90	no	-
Inventory	?	yes	#VALUE!
			-
			-
			-
			-
			-
			-
			-
			-
			-



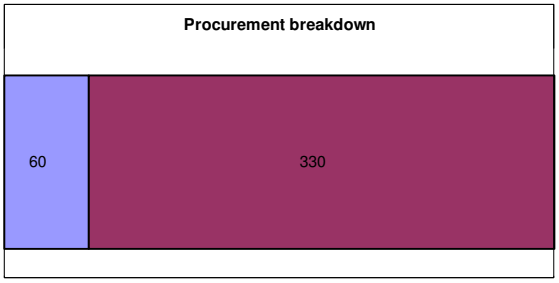
Product type B

Procurement	Lead time	Inventory?(yes)	Turnover rate
Activity breakdown			2,03
Order lead time from suppliers	30	no	-
Inventory	180	yes	2,03
			-
			-
			-
			-
			-
			-
			-
			-
			-



Spare parts

Procurement	Lead time	Inventory?(yes)	Turnover rate
Activity breakdown			1,11
Order lead time from suppliers	60	no	-
Inventory	330	yes	1,11
			-
			-
			-
			-
			-
			-
			-
			-
			-



Comments

The analysis of the company's logistics system is affected by not being able to collect all the required quantitative data. Some potential areas to investigate further have been identified but the quality of these conclusions is uncertain, because of the lack of quantitative data to back them up.

Regarding the logistics set up of product type A some rather big changes could be made. A deeper investigation on the effects of such a change must of course be made first, but the area seems to have big potential.

Type A products

Only 25 type A products are sold per year and they are very expensive, approximately 30 million SEK. These should be managed rigorously to avoid tying down any capital. Preferably no inventory should be kept and the cash to cash time minimized. This would besides lowering the carrying costs eliminate the holding costs and a lot of unnecessary transportation costs. This could also make it less of a problem logistically to use suppliers in any part of the world, which the company is already interested in, since the components will be delivered to the hospital directly anyway. Since the delivery is a project in itself anyway it should not be more complicated to manage the deliveries direct to the hospital and there is a time window allowing a less than perfect delivery precision, making the thought of delivering directly from the suppliers even more viable.

The increase in costs from having less consolidated transports should be acceptable and certainly smaller than the lowered costs in other areas. For the 18 ton component such consolidation gains are probably questionable anyway.

Spare Parts

For the spare parts and service of type A products there are completely different demands on the customer order lead time and delivery precision. For these products a logistics evaluation comparing the alternative of having closer inventories or relying on more costly transport methods must be performed. The nature of the service repairs will be important in this decision. If a specialized technician must be flown in to the hospital then there is not much point in getting the spare part there any faster then the technician can be available.

Other areas of improvement

There seams to be unused potential in the ERP system. Better reports based on data that can be trusted are necessary. This also affects how well the company can plan ahead. The company needs better techniques for making prognoses since they are poor today. The procurement planning is another area that has been neglected and needs attention. But as long as the data that procurement planning and prognoses are based on is not satisfactory then even the most refined techniques for planning will not do any good.

Appendix B: Data collection preparations

To perform a logistics evaluation a certain amount of information must be collected. On this page the quantitative data needed from you before the evaluation takes place is summarized. On the following pages how and why the data should be collected is explained more carefully. Please fill out the following tables before the first interview at your company takes place.

Customer service

Total number of orders	
Total number of deliveries	
Number of complete orders delivered	
Number of deliveries on time	
Number of deliveries without complaints	
Average number of order lines per order	
Time from customer order placement to complete delivery (customer order lead time)	

Total costs

	Procurement	**Operations**	**Distribution**
Carrying costs			
Holding costs			
Transportation cost			
Administration costs			
Other logistics costs			

Time

	Procurement	**Operations**	**Distribution**
Lead time			
Time in inventory			

Other quantitative data

Company revenue		Number of orders per year (Inbound and outbound)	
Company assets, liabilities and owner's equity		Number of deliveries per year (Inbound and outbound)	
Company profit		Number of customers	
Capital turnover rate		Three largest customers percentage of the annual sales	
Number of full time employees		Number of suppliers	
Full time equivalent working with logistics		Three largest suppliers percentage of annual costs value	
Number of stock keeping units per year (Inbound and outbound)		Lead time from suppliers	

Introduction

The greater part of the information that will be collected at your company will be gathered through interviews with employees. Other information of a more quantitative nature can be found in your Enterprise Resource Planning system and in financial reports. This quantitative data can be somewhat difficult to collect and therefore it would be helpful if you could prepare as much of this information as possible before the interviews take place, as seen on the previous page.

This document will guide you through the necessary preparations by explaining what data is required. Since different companies can work very differently, regarding what measurements they use and what data they collect, it is not a completely simple task to collect this information. Therefore guidelines for how it can be gathered are given, together with definitions of measurements and cost elements. It is important that these definitions are properly understood so all collected data is as correct as possible.

After this document has been worked through it is likely that you have questions or other concerns about the data collection. Especially if you have not been able to gather all the required data it is very important that you contact us as soon as possible so we can discuss how to handle the situation.

The system parts

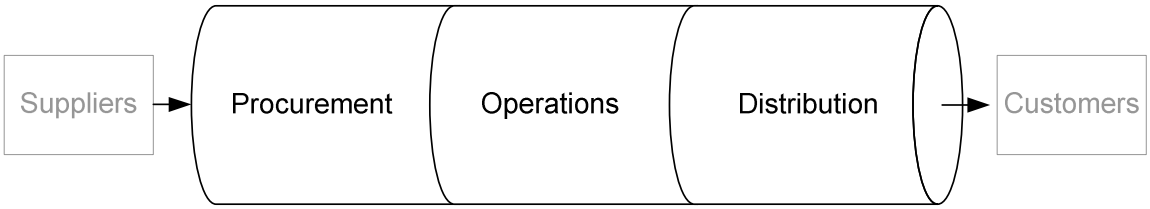
During this logistics evaluation the logistics system will be examined from two different aspects, Input and Output, and Transformation, which are described more carefully below. The term "logistics system" refers to the part of your company's logistics that is included in this analysis.

Input and Output

The first aspect is looking at the system as a whole. All the measurements regard the performance and cost of the complete system. The input to the system is the total cost the system pays for being able to deliver an output, a certain level of customer service.

Transformation

The second aspect is looking into what happens between the input and the output, the Transformation. At this stage the system as divided into three areas, procurement, operations and distribution, which are all investigated more closely.



Below the three areas, procurement, operations and distribution, are described more carefully.

Procurement refers to the sourcing of material in order to support the operations with the raw material needed. The raw material inventory should be seen as a part of the procurement area.

Operations refer to the process of creating goods and services by combining material, work and real capital. It should be noted that neither the raw material inventory nor the finished goods inventory is included in the operations.

The *distribution* division's responsibility is to supply the customers with products from the finished goods inventory. The finished goods inventory should be seen as a part of the distribution area.

The logistics evaluation is meant to analyze your company's logistics system using a minimal amount of required data. For this to be effective the data is standardized in a manner that makes it comparable with databases of other company's performance. Therefore the collected data will be limited to describing the system in these two aspects and be based on mean values for all products when necessary.

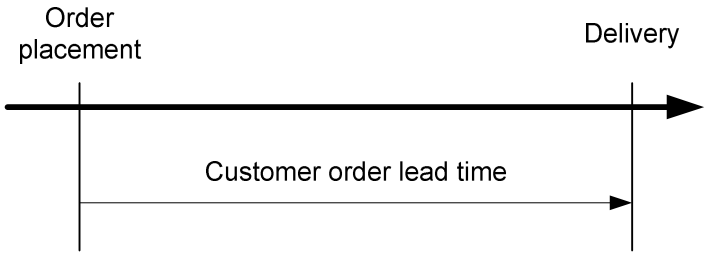
What is needed from you?

To be able to perform the analysis it is essential that the logistics system is clearly defined regarding what should be included in the system and what should not be included. Furthermore your system should be matched against the logistics pipe consisting of procurement, operations and distribution before the investigation starts. There might be some problems when matching the system if, for example, there is a central procurement function meaning that your system does not have a procurement of its own. In that case the method will simply disregard the specific area.

Before you can continue with the data collection you need to decide exactly what parts of your logistics system can be included in each of the three areas; procurement, operations and distribution. This also implies deciding exactly what part of your company will be included in the system as a whole, and thereby in the analysis.

Customer service

The customer service will be evaluated in two different manners, both with quantitative and qualitative data. The qualitative data will be collected during the visit at your company while the quantitative data should be prepared in advance. There are four quantitative customer service elements that the diagnosis evaluates; customer order lead time, delivery reliability, delivery dependability and stock availability. The average number of order lines per order is also required to better understand the stock availability. Different companies might have different definitions of the elements. Therefore the definitions used in this evaluation are given below.



$$\text{Delivery reliability} = \frac{\text{Number of deliveries on time}}{\text{Total number of deliveries}}$$

$$\text{Delivery dependability} = \frac{\text{Number of deliveries without complaints}}{\text{Total number of deliveries}}$$

$$\text{Stock availability} = \frac{\text{Number of orders delivered complete}}{\text{Total number of orders}}$$

What is needed from you?

In order to decide the performance level of the customer service elements mentioned above, the data specified under the heading “Customer service” at the first page is needed. The data should cover all products relevant in the logistics system so that the customer service reflects the total performance of the system.

Total Cost

To be able to assemble the total cost data you need to understand the definitions of the different cost elements. Therefore these are briefly described below.

Carrying costs

Carrying costs are the cost for having items in stock. This includes both the cost for tying up capital and the risk associated with keeping products in stock. To be able to calculate the carrying costs the value of the products in stock must be estimated and multiplied by the inventory interest. The inventory interest consists of the interest an alternative "risk free" investment would give plus a premium for the risks involved with holding inventory.

Holding costs

Holding costs are the costs associated with running a warehouse to keep inventory. Included here are the costs for warehouses or storage rooms together with salaries for employees occupied with handling the inventory and the equipment they use, such as forklifts.

Transportation costs

Transportation costs are all the costs associated with transporting goods, both to and from customers and suppliers as well as transports between the company's own facilities.

Administration costs

Administration costs are all the costs that occur from the administration of logistics. This can include costs for receiving and sending orders and invoices, various salaries and economic monitoring.

Other logistics costs

Other logistics costs are all logistics related costs that do not fit under any other category. Examples of relevant areas are information, packaging and material costs. In different industries different types of costs will be important to include.

What is needed from you?

The data regarding costs that is necessary for the analysis is simply to divide all the logistics costs the company has into the five different elements discussed above. The only other complication is that these costs should each be divided into the three parts of the logistics system; procurement, operations and distribution. Consequently the costs we are interested in are the fifteen described on first page.

If these costs are difficult for you to collect based on the accounting used at your company, some guidance is given in the appendix.[*] Observe that this is only meant to support the collection of data and are not necessary to use if ill-suited to the data you have access to.

Time

In order to understand the transformation between the input and the output of the system procurement, operations and distribution will be investigated more closely. This will mainly be done through interviews and collection of qualitative data. However, the total lead time of the system is an important area of a more quantitative kind that increases the understanding for the transformation. The term "total lead time" refers to the time it takes for a certain product to go through the whole system, from procurement, through operations and finally leaving the distribution.

What is needed from you?

Information about the total lead time is needed before the investigation starts. You should breakdown the total lead time into the three main areas discussed earlier, procurement, operations and distribution. If you find it relevant and if it is possible it can also be of

[*] This guidance appendix is not included here since the total cost guidance is the same as the one that can be seen in the method.

value to breakdown the lead time even further in the specific areas. Particularly interesting is the time the products spend in inventories. From this information the inventory turnover rate can be calculated. If you have several products with varying lead times a mean of the products' lead times or the lead time for a "typical" product should be chosen. The table that needs to be filled out can be found on the first page of this compendium.

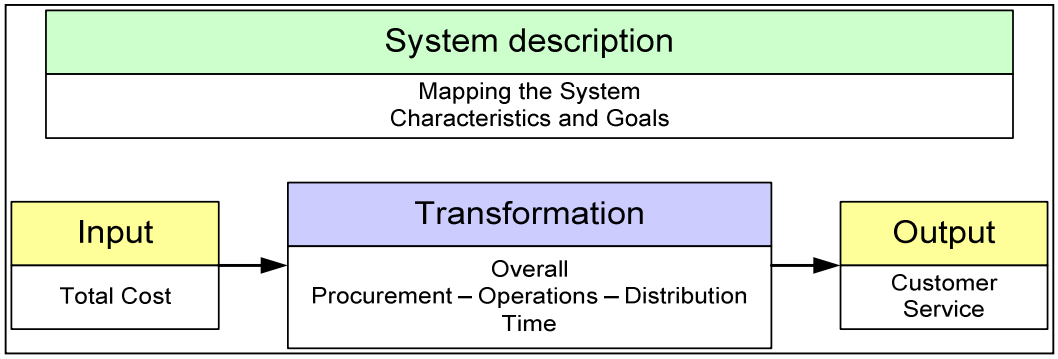
Appendix C: Method guidelines*

Instructions for the main data collection

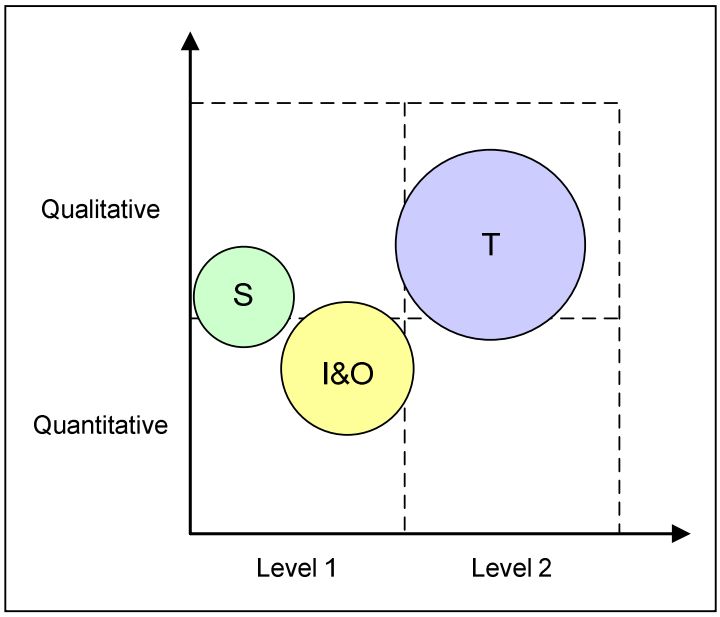
The method focuses on two different levels of the logistics system. On Level 1 the system is seen as a black box and the main focus is on the Input and Output (I&O) of the system. On Level 2 the system is matched against a general representation, consisting of procurement, operations and distribution, and the Transformation (T) is zoomed in.

The main data collection is divided into three parts. The first part is called System Description (S). The data in this part is both qualitative and quantitative. The second part focuses on more quantitative data in form of total costs, the input to the system, and customer service, the output from the system. The last part has more qualitative characteristics and consists of a number of questions focused four different areas; overall, procurement, operations and distribution, and an area called time.

Below, an overview of the data collection is given, first in terms of the three different parts of the data collection and after that in terms of the type of data and level of each part. Thereafter the three parts of the main data collection are described more closely.



* In some places throughout the guidelines examples of figures and other data is filled out. It should be noted that these figures are fictional and only filled out in order to show how the charts work.



System description (S)
The study object must be carefully defined so that it can be investigated in a consistent manner. In the sheet called “S Mapping the System” the study object should be illustrated to clarify exactly what is included in it. Sometimes the system has to be divided into several homogeneous flows. The other part of describing the system involves gaining a basic understanding of the system and its purpose. This is addressed in the sheet called "S Characteristics and Goals". In this section there are a number of questions that should be discussed in order to increase the understanding for the company, its goals and logistics objectives.

Input and Output - Total Cost and Customer Service (I&O)
The total cost is handled in two different sheets. The first sheet is called "I&O Total Cost Collection" which addresses the collection of the cost items and the second sheet, "I&O Total Cost Results" presents the results of the collection.

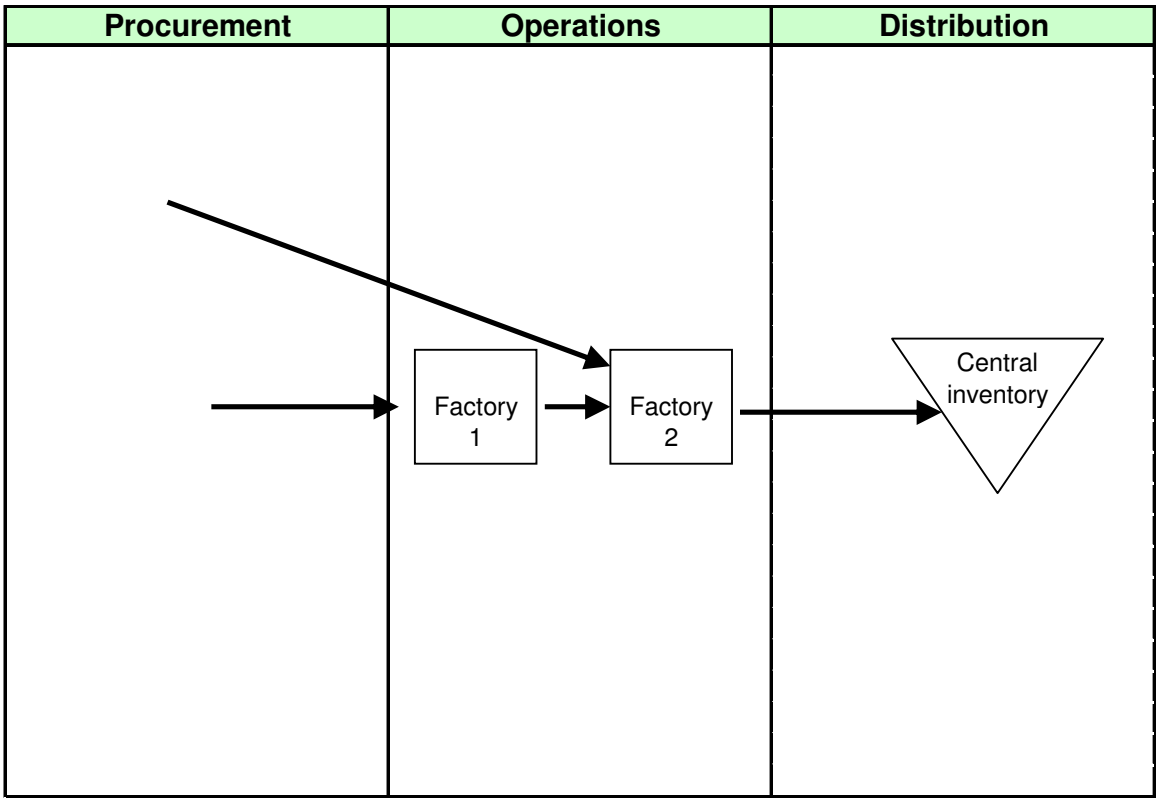
The customer service is dealt with in the sheet called "I&O Customer Service".

Transformation - Overall, Procurement - Operations - Distribution, Time (T)
Specific questions on procurement, operations and distribution are addressed under the sheets named "T Procurement", "T Operations" and "T Distribution". Furthermore questions that concern all the three areas and the links between them are handled in the sheet called "T Overall". From questions concerning the documentation on different areas the level of control over the logistics system is estimated. This is presented in the sheet called "T Control". Finally time is an important aspect that helps understanding the Transformation, therefore the total lead time, inventory turnover rate and other time aspects are handled in the sheet called "T Time".

Throughout the whole method some boxes are marked with a red border. This indicates that they should be filled out with some sort of information.

Mapping the System (S)

It is important to clearly define the study object. The definition of what should be included and excluded in the system is essential to be able to start the examination and evaluation of the system. When the study object has been defined it should be matched against a general representation of a logistics system. This means that it should be divided into three parts; Procurement, Operations and Distribution. The system should be mapped to clarify where the border between the system and its environment is situated and also to show what is included in each part system.



Characteristics and Goals (S)

To be able to draw any conclusions regarding a company's logistics a basic understanding of the company must be gained. Therefore a number of questions to gain this understanding are listed below in "The characteristics of the company". These questions should be worked through very quickly, some of them the consultant might even be able to answer before the first interview by reviewing the company's webpage and annual report.

The company's logistics must be evaluated by relating its performance to what it is trying to achieve. Therefore the company's goals, both in general and regarding its logistics, are examined closer under "The goals of the company and its logistics objectives".

The characteristics of the company	
C.1	What is the ***history*** of the company?
C.2	What ***type of company*** is it, what does the company offer?
C.3	What ***value*** does the company add before selling the finished products?
C.4	In what ***industry*** does the company operate?
C.5	Where is the company ***located***?
C.6	Which ***markets*** does the company focus on?
C.7	Who are the ***competitors*** of the company?
C.8	What ***risks*** does the company face?
C.9	How is the company ***organized*** in general and regarding logistics?
C.10	What has the ***revenue*** been during the last years?
C.11	What have the ***assets***, ***liabilities*** and ***owner's equity*** been during the last years?
C.12	What has the ***profit*** been during the last years?
C.13	What has the ***capital turnover rate*** been during the last years?
C.14	What has the ***number of full time employees*** been during the last years?
C.15	What is the ***full time equivalent*** of the employees ***working with logistics***?
C.16	How many ***stock keeping units*** are handled annually? Inbound/outbound?
C.17	How many ***orders*** are handled annually? Inbound/outbound?
C.18	How many ***deliveries*** are handled annually? Inbound/outbound?

The goals of the company and its logistics objectives	
G.1	What are the comprehensive ***vision and objectives*** of the company?
G.2	What is the ***business strategy***?
G.3	How does the company ***define logistics***?
G.4	What is the **logistics strategy**?
G.5	What are the ***logistics goals***? What does the company want to achieve with its logistics?
G.6	Are the goals ***measured***? How?
G.7	Does the company focus on a ***cost*** or ***value advantage*** or both?
G.8	How ***important*** is ***logistics*** for the company, strategically?
G.9	What are the ***customer demands*** regarding logistics?
G.10	Are there ***different logistics goals*** for different products or flows?
G.11	Is the logistics ***adapted*** to the products or vice versa?

Documentation	***Yes***	***To some extent***	***No***
Is there any documentation on the logistics strategy?			
Are these instructions used in a satisfactory manner?			

Total Cost Collection (I&O)

Below explanations of each of the five cost elements can be found together with charts that breakdown the different cost elements based on the "kontotabell BAS 2007". The breakdown is not necessary to use and should be seen as an optional aid to assemble the cost data. This is a good starting point to gather all the cost elements, but additional posts should be added where deemed necessary.

The costs under the column "Total" are not interesting as a final result for the method but can be used if you happen to have such data. In those cases the proportion of that cost that can be attributed to each of "Procurement", "Operations" and "Distribution" should be estimated and filled out in the three boxes right of the "Total" cost box.

Carrying costs

Carrying costs are the cost for having items in stock. This includes both the cost for tying up capital and the risk associated with keeping products in stock. To be able to calculate the carrying costs the value of the products in stock must be estimated and multiplied by the inventory interest. The inventory interest consists of the interest an alternative "risk free" investment would give plus a premium for the risks involved with holding inventory.

	Total	Procurement	Operations	Distribution
Inventory interest				
1400 Group account inventory				
or				
1410 Raw materials inventory				
1420 Additives and necessities inventory				
1430 Semi-finished goods inventory				
1440 Work in process				
1450 Finished goods inventory				
1460 Merchandise inventory				
More carrying cost values:				
Inventory value				
Carrying costs				

Holding costs

The holding costs are the costs associated with running a warehouse to keep inventory. Included here are the costs for warehouses or storage rooms together with salaries for employees occupied with handling the inventory and the equipment they use, such as forklifts. It should be noted that work costs for warehouse personnel also must be added even though they are not specified in any account below.

	Total	Procurement	Operations	Distribution
5013 Rent for warehouses				
or				
5010 Rent for buildings				
Proportion of buildings for storage				
Calculated rent for storage buildings				
or				
1110 Buildings				
Alternative interest				
Calculated storage building costs				
Storage building costs				
5020 Electricity for lighting				
5030 Heating				
5040 Water and sewage				
5050 Building accessories				
5060 Cleaning				
5070 Repairs and maintenance of buildings				
5630 Forklift truck costs				
Labor costs for holding				
More holding costs:				
Other holding costs				
Holding costs				

Transportation costs

The transportation costs are all costs associated with transporting goods, both to and from customers and suppliers as well as transports between the companies own facilities. The salary costs for drivers must be added if they pay these themselves. These can not explicitly be found in any account, but should normally be easy for the company to provide.

	Total	Procurement	Operations	Distribution
5700 Group account freights and transports				
or				
5710 Freights, transports and insurance for distribution of goods				
5720 Customs and forwarding costs etc				
5730 Work transports				
5620 Truck costs				
Freights and transports accounts cost				
Labor costs for transports				
More transportation costs:				
Other transportation costs				
Transportation costs				

Administration costs

The logistics administration costs are all the costs that occur from the administration of logistics. This can include costs for receiving and sending orders and invoices, various salaries and economic monitoring. Little information can be gathered based on the chart of accounts concerning the administrative costs.

The administrative costs should be quantified by going through the main logistics processes in the company and identifying what administrative activities occur. Then the actual costs for these activities are quantified by estimations, for example of the proportion of an employee's time that is spent on logistics administration activities.

	Total	Procurement	Operations	Distribution
More administration costs:				
Administration costs				

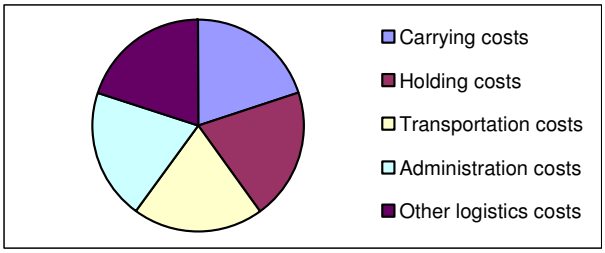
Other logistics costs

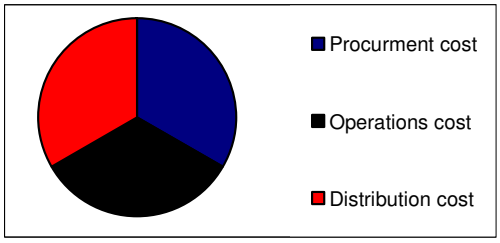
All logistics related costs that do not fit under any other category should be placed here. Examples of relevant areas are information and packaging material costs. In different industries different types of costs will be important to include.

	Total	Procurement	Operations	Distribution
5430 Transport equipment				
5440 Disposable packaging materials				
More other logistics costs:				
Other logistics costs				

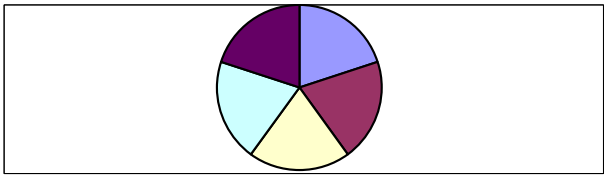
Total Cost Results (I&O)

Total cost	15 000 000 kr	
Carrying costs	3 000 000 kr	20%
Holding costs	3 000 000 kr	20%
Transportation costs	3 000 000 kr	20%
Administration costs	3 000 000 kr	20%
Other logistics costs	3 000 000 kr	20%

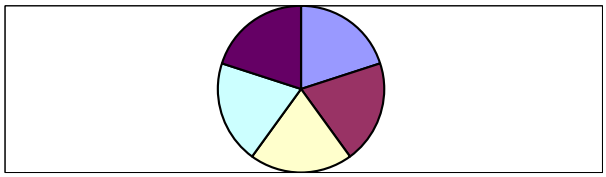




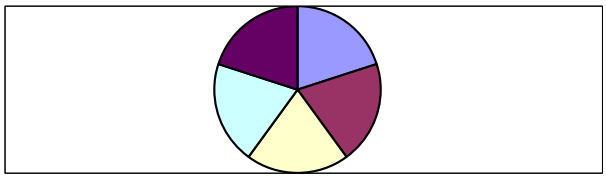
Procurment cost	5 000 000 kr	33%
Carrying costs	1 000 000 kr	20%
Holding costs	1 000 000 kr	20%
Transportation costs	1 000 000 kr	20%
Administration costs	1 000 000 kr	20%
Other logistics costs	1 000 000 kr	20%



Operations cost	5 000 000 kr	33%
Carrying costs	1 000 000 kr	20%
Holding costs	1 000 000 kr	20%
Transportation costs	1 000 000 kr	20%
Administration costs	1 000 000 kr	20%
Other logistics costs	1 000 000 kr	20%



Distribution cost	5 000 000 kr	33%
Carrying costs	1 000 000 kr	20%
Holding costs	1 000 000 kr	20%
Transportation costs	1 000 000 kr	20%
Administration costs	1 000 000 kr	20%
Other logistics costs	1 000 000 kr	20%

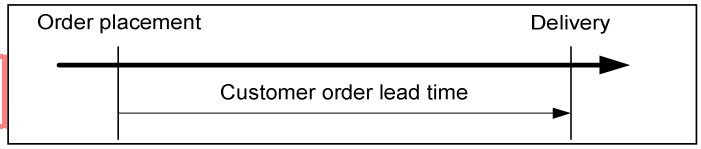


Customer Service (I&O)

The quantitative part of customer service is divided into four different elements in this method. These elements are customer order lead time, delivery reliability, delivery dependability and stock availability. The average number of order lines per order is also included to complement the stock availability.

The customer order lead time is defined below as the time it takes from customer order placement to complete delivery. As the red border indicates the customer order lead time should be filled out directly. The other three customer service elements can be calculated from the data that should be filled out in the table below. Exactly how the data from the table is used can be seen in the formulas below. Before calculating the customer service the specific company's definition of the data should be discussed since these definitions may vary.

Total number of orders	10 000
Total number of deliveries	11 000
Number of complete orders delivered	9 000
Number of deliveries on time	8 000
Number of deliveries without complaints	8 000

Customer order lead time	5 days	
Delivery reliability	**72,73%**	Delivery reliability = $\frac{\text{Number of deliveries on time}}{\text{Total number of deliveries}}$
Delivery dependability	**72,73%**	Delivery dependability = $\frac{\text{Number of deliveries without complaints}}{\text{Total number of deliveries}}$
Stock availability	**90,00%**	Stock availability = $\frac{\text{Number of orders delivered complete}}{\text{Total number of orders}}$
Average number of order lines per order	1	The average number of order lines per order affects the customer service level. A high number of order lines per order may make it harder to achieve a high customer service level.

Overall (T)

The questions below address issues that span across all of the three main functions of the logistics system - procurement, operations and distribution. Therefore these areas are handled in this separate part called "overall". Preferably these questions are answered by an overall logistics responsible person at the company.

In every question area the first question concerns the area as a whole. The answer to this should always include a description of exactly what this area includes, responsibilities for and within the area and the number of employees working with it. The questions that come afterwards could be answered indirectly through the overall question or may need to be addressed specifically depending on the level of detail in the respondent's answer to the overall question. At the end of most question areas the documentation of the procedures are considered. These questions are used to determine the level of control the company has over its logistics.

1. Demand forecasting	
A.1.1	***How is the demand forecasting managed?***
A.1.2	How are prognoses made?
A.1.3	Are the prognoses usually accurate?
A.1.4	Are the prognoses followed?
A.1.5	Where is the ***order penetration point*** situated?
A.1.6	What ***problems*** are there concerning the demand forecasting? How can this area be ***improved***?

Demand forecasting:
Forecasting and prognosticating the customer demand

Documentation	***Yes***	***To some extent***	***No***
Is there any documentation on management of demand forecasting?		x	
Are these instructions used in a satisfactory manner?	x		

2. Customer relations	
A.2.1	***How are the customer relations managed?***
A.2.2	What is the ***number of customers*** the company has? What is that number based on? Is that the desired number?
A.2.3	What is the ***percentage of the annual sales value*** that the three biggest customers stand for each?
A.2.4	Where are the customers ***located***? What is the ***lead time*** to the customers?
A.2.5	How are the ***contracts*** with the customers formed? (time conditions, price, order entry, payment conditions, etc.)
A.2.6	What ***problems*** are there concerning the customer relations? How can this area be ***improved***?

Customer relations:
Management of the customer relations, for instance the number of customers and their importance

Documentation	***Yes***	***To some extent***	***No***
Is there any documentation on management of customer relations?		x	
Are these instructions used in a satisfactory manner?			x

3. Order processing	
A.3.1	***How is the order processing managed?***
A.3.2	How is the ***order entry*** (order editing/call off) performed?
A.3.3	How are ***order modifications*** or ***error corrections*** handled?
A.3.4	Are the customers given answers to ***order status inquiries***? How?
A.3.5	How is ***invoicing*** managed?
A.3.6	What ***problems*** are there concerning the order processing? How can this area be ***improved***?

Order processing:
Processing orders from the customers

Documentation	***Yes***	***To some extent***	***No***
Is there any documentation on management of order processing?		x	
Are these instructions used in a satisfactory manner?	x		

4. Logistics communications	
A.4.1	***How are data and information exchange managed?***
A.4.2	What ***type of ERP system*** is used to support the logistics communications?
A.4.3	What method is used for information exchange between the major functions ***within the organization***? Is the same ERP system used within the whole logistics system?
A.4.4	What method is used for information exchange between the organization, its ***suppliers*** and its ***customers***?
A.4.5	What method is used for information exchange between ***other members of the supply chain*** who may not be directly linked to the firm? (second tier suppliers and customers' customer)
A.4.6	What ***problems*** are there concerning the logistics communications? How can this area be ***improved***?

Logistics communications: Data and information exchange concerning the logistics of the company

Documentation	***Yes***	***To some extent***	***No***
Is there any documentation on management of data and information exchange?	x		
Are these instructions used in a satisfactory manner?	x		

Procurement (T)

The questions below aim to give a greater understanding of the procurement activities in the company. The answers serve as a basis for the analysis and will be used to be able to explain certain circumstances and quantitative results and to identify problem areas.

In every question area that follows the first question concerns the area as a whole. The answer to this should always include a description of exactly what this area includes, responsibilities for and within the area and the number of employees working with it. The questions that come afterwards could be answered indirectly through the overall question or may need to be addressed specifically depending on the level of detail in the respondent's answer to the overall question. At the end of most question areas the documentation of the procedures are considered. These questions are used to determine the level of control the company has over its logistics.

1. Procurement management	
P.1.1	***How is the procurement managed?***
P.1.2	What is the procurement strategy? (single/multiple sourcing) Why is this strategy chosen?
P.1.3	How are the ***inventories managed***? (inventory levels, safety stock, cycle stock, etc.?)
P.1.4	How is the raw material ***demand prognosticated***?
P.1.5	What is the ***capacity utilization*** level in the procurement? Is this the desired level?
P.1.6	How is ***flexibility*** in the procurement taken in to account?
P.1.7	Are there any ***bottlenecks*** in the procurement? How do they impact the procurement? How are they avoided?
P.1.8	How are the ***risks*** in the procurement managed? Is there a contingency plan?
P.1.9	Are there any ***custom*** issues that effect how the procurement is managed?
P.1.10	What ***problems*** are there concerning the procurement management? How can this area be ***improved***?

Procurement management: Management of the procurement in terms of strategy, planning and execution

Documentation	*Yes*	*To some extent*	*No*
Is there any documentation on the management of procurement?	x		
Are these instructions used in a satisfactory manner?		x	

2. Supplier relations	
P.2.1	***How are the supplier relations managed?***
P.2.2	How are logistics related parameters used when ***selecting*** the suppliers?
P.2.3	How are the ***contracts*** with the suppliers formed? (time conditions, price, order entry, payment conditions etc.)
P.2.4	How are logistics related parameters used when ***evaluating*** the suppliers?
P.2.5	How is the work with ***supplier relations development*** performed?
P.2.6	What is the ***number of suppliers*** the company has? What is that number based on?
P.2.7	What is the ***percentage of the annual costs value*** that the three biggest suppliers stand for each?
P.2.8	Where are the suppliers ***located***?
P.2.9	What is the ***lead time***, from order to delivery, from the suppliers?
P.2.10	What ***problems*** are there concerning the supplier relations? How can this area be ***improved***?

Supplier relations: Management of the supplier selections, evaluations, development and relations

Documentation	*Yes*	*To some extent*	*No*
Is there any documentation on management of supplier relations?	x		
Are these instructions used in a satisfactory manner?	x		

3. Purchase order processing	
P.3.1	***How is the purchase order processing managed?***
P.3.2	How is the ***order entry*** (order editing/call off) performed?
P.3.3	How are ***order modifications*** or ***error corrections*** handled?
P.3.4	Do the suppliers give answers to ***order status inquiries***? How?
P.3.5	How is ***invoicing*** managed?
P.3.6	What ***problems*** are there concerning the purchase order processing? How can this area be ***improved***?

Purchase order processing: Processing of orders to suppliers

Documentation	*Yes*	*To some extent*	*No*
Is there any documentation on management of purchase order processing?		x	
Are these instructions used in a satisfactory manner?		x	

4. Inbound transports	
P.4.1	***How are the inbound transports managed?***
P.4.2	How are the ***Inco terms*** for the inbound transports formed?
P.4.3	How is the ***method of shipment*** selected? (boat, air, truck, rail, etc.) What method is normally used?
P.4.4	How is the ***specific path*** the shipment takes decided?
P.4.5	How are different ***transport regulations*** taken into account?
P.4.6	How are the deliveries ***supervised***?
P.4.7	What ***problems*** are there concerning the inbound transports? How can this area be ***improved***?

Inbound transports:
Management of transports from the suppliers to the company

Documentation	*Yes*	*To some extent*	*No*
Is there any documentation on management of inbound transports?	x		
Are these instructions used in a satisfactory manner?			x

5. Goods reception	
P.5.1	***How is the goods reception managed?***
P.5.2	How is the ***capacity level*** (in terms of personnel available at different times) in the goods reception decided?
P.5.3	How are ***deviations*** in the shipments managed? (amount, quality, time, etc)
P.5.4	What ***problems*** are there concerning the goods reception? How can this area be ***improved***?

Goods reception:
Management of reception of goods from the suppliers

Documentation	*Yes*	*To some extent*	*No*
Is there any documentation on management of goods reception?	x		
Are these instructions used in a satisfactory manner?	x		

6. Warehousing and storage	
P.6.1	***How is the warehousing and storage managed?***
P.6.2	How is the ***warehouse site*** selected?
P.6.3	How is ***picking, staging*** and ***loading*** performed?
P.6.4	How is the ***packaging*** managed?
P.6.5	Is the storage facility ***owned***, ***leased*** or ***rented***? What is that decision based on?
P.6.6	How is the ***layout*** and ***design*** of the storage facilities decided?
P.6.7	How is the ***product mix*** in the storage considered?
P.6.8	What ***problems*** are there concerning warehousing and storage? How can this area be ***improved***?

Warehousing and storage:
Management of warehousing and storage of raw material

Documentation	*Yes*	*To some extent*	*No*
Is there any documentation on management of warehousing and storage?		x	
Are these instructions used in a satisfactory manner?	x		

7. Measurement and evaluation of procurement performance	
P.7.1	***How is measurement and evaluation of the procurement performance, both internally and externally, managed?***
P.7.2	***What*** is measured?
P.7.3	***How*** is it measured?
P.7.4	How is it ***evaluated***?
P.7.5	How are ***improvements*** made?
P.7.6	What ***problems*** are there concerning measurement and evaluation of procurement performance? How can this area be ***improved***?

Documentation	*Yes*	*To some extent*	*No*
Is there any documentation on management of measurement and evaluation of the procurement?		x	
Are these instructions used in a satisfactory manner?	x		

8. Problems in the procurement	
P.8.1	***What problems are there in the procurement?***
P.8.2	Is the procurement ***method appropriate***? Does it work well?
P.8.3	How are ***deviations*** handled? What are the consequences of the deviations?
P.8.4	How can the procurement be ***improved***?

Operations (T)

The questions below aim to give a greater understanding of the operations activities in the company. The answers serve as a basis for the analysis and will be used to be able to explain certain circumstances and quantitative results and to identify problem areas.

In every question area that follows the first question concerns the area as a whole. The answer to this should always include a description of exactly what this area includes, responsibilities for and within the area and the number of employees working with it. The questions that come afterwards could be answered indirectly through the overall question or may need to be addressed specifically depending on the level of detail in the respondent's answer to the overall question. At the end of most question areas the documentation of the procedures are considered. These questions are used to determine the level of control the company has over its logistics.

1. Operations management	
O.1.1	***How are the operations managed?***
O.1.2	What is the operations strategy? Why is this strategy chosen?
O.1.3	What are the ***characteristics of the operations***? (Nonstop, line, customized, project, etc.)
O.1.4	How is the operations ***demand prognosticated***?
O.1.5	What is the ***capacity utilization*** level in the operations? Is this the desired level?
O.1.6	How is ***flexibility*** in the operations taken in to account?
O.1.7	Are there any ***bottlenecks*** in the operations? How do they impact operations? How are they avoided?
O.1.8	How are the ***risks*** in the operations managed? Is there a contingency plan?
O.1.9	What ***problems*** are there concerning the operations management? How can this area be ***improved***?

Operations management:
Management of the operations in terms of strategy, planning and execution

Documentation	***Yes***	***To some extent***	***No***
Is there any documentation on management of operations?		x	
Are these instructions used in a satisfactory manner?	x		

2. Measurement and evaluation of operations performance	
O.2.1	***How is measurement and evaluation of the operations performance managed?***
O.2.2	***What*** is measured?
O.2.3	***How*** is it measured?
O.2.4	How is it ***evaluated***?
O.2.5	How are ***improvements*** made?
O.2.6	What ***problems*** are there concerning the measurement and evaluation of operations performance? How can this area be ***improved***?

Documentation	***Yes***	***To some extent***	***No***
Is there any documentation on management of measurement and evaluation of the operations?		x	
Are these instructions used in a satisfactory manner?		x	

3. Problems in the operations	
O.3.1	***What problems are there in the operations?***
O.3.2	Is the operations ***method appropriate***? Does it work well?
O.3.3	How are ***deviations*** handled? What are the consequences of the deviations?
O.3.4	How can the operations be ***improved***?

Distribution (T)

The questions below aim to give a greater understanding of the distribution activities in the company. The answers serve as a basis for the analysis and will be used to be able to explain certain circumstances and quantitative results and to identify problem areas.

In every question area that follows the first question concerns the area as a whole. The answer to this should always include a description of exactly what this area includes, responsibilities for and within the area and the number of employees working with it. The questions that come afterwards could be answered indirectly through the overall question or may need to be addressed specifically depending on the level of detail in the respondent's answer to the overall question. At the end of most question areas the documentation of the procedures are considered. These questions are used to determine the level of control the company has over its logistics.

1. Distribution management	
D.1.1	***How is the distribution managed?***
D.1.2	What is the distribution strategy? Why is this strategy chosen?
D.1.3	How are the ***inventories managed***? (inventory levels, safety stock, cycle stock, etc.?)
D.1.4	How is the distribution capacity ***demand prognosticated***?
D.1.5	What is the ***capacity utilization*** level in the distribution? Is this the desired level?
D.1.6	How is ***flexibility*** in the distribution taken in to account?
D.1.7	Are there any ***bottlenecks*** in the distribution? How do they impact distribution? How are they avoided?
D.1.8	How are the ***risks*** in the distribution managed? Is there a contingency plan?
D.1.9	Are there any ***custom*** issues that effect how the distribution is managed?
D.1.10	What ***problems*** are there concerning the distribution management? How can this area be ***improved***?

Distribution strategy:
Management of the distribution in terms of strategy, planning and execution

Documentation	***Yes***	***To some extent***	***No***
Is there any documentation on management of distribution?	x		
Are these instructions used in a satisfactory manner?	x		

2. Warehousing and storage	
D.2.1	***How is the warehousing and storage managed?***
D.2.2	How is the ***warehouse site*** selected?
D.2.3	How is ***picking, staging*** and ***loading*** performed?
D.2.4	How is the ***packaging*** managed?
D.2.5	Is the storage facility ***owned***, ***leased*** or ***rented***? What is that decision based on?
D.2.6	How is the ***layout*** and ***design*** of the storage facilities decided?
D.2.7	How is the ***product mix*** in the storage considered?
D.2.8	What ***problems*** are there concerning warehousing and storage? How can this area be ***improved***?

Warehousing and storage:
Management of warehousing and storage of finished goods

Documentation	***Yes***	***To some extent***	***No***
Is there any documentation on management of warehousing and storage?		x	
Are these instructions used in a satisfactory manner?		x	

3. Dispatch handling	
D.3.1	***How is the dispatch handling managed?***
D.3.2	How is the ***capacity level*** in the dispatch handling decided?
D.3.3	How are ***deviations*** in the dispatch handling managed?
D.3.4	How is the ***quality*** of the dispatch handling controlled?
D.3.5	What ***problems*** are there concerning the dispatch handling? How can this area be ***improved***?

Dispatch handling:
Handling of shipments from the company to the customers

Documentation	***Yes***	***To some extent***	***No***
Is there any documentation on management of dispatch handling?		x	
Are these instructions used in a satisfactory manner?	x		

4. Outbound transports	
D.4.1	***How are the outbound transports managed?***
D.4.2	How are the ***Inco terms*** for the outbound transports formed?
D.4.3	How is the ***method of shipment*** selected? (boat, air, truck, rail, etc.) What method is normally used?
D.4.4	How is the ***specific path*** the shipment takes decided?
D.4.5	How are different ***transport regulations*** taken into account?
D.4.6	How are the deliveries ***supervised***?
D.4.7	What ***problems*** are there concerning the outbound transports? How can this area be ***improved***?

Outbound transports: Management of transports from the company to the customers

Documentation	***Yes***	***To some extent***	***No***
Is there any documentation on management of outbound transports?		x	
Are these instructions used in a satisfactory manner?	x		

5. Measurement and evaluation of distribution performance	
D.5.1	***How is measurement and evaluation of the distribution performance, both internally and externally, managed?***
D.5.2	***What*** is measured?
D.5.3	***How*** is it measured?
D.5.4	How is it ***evaluated***?
D.5.5	How are ***improvements*** made?
D.5.6	What ***problems*** are there concerning the measurement and evaluation of distribution performance? How can this area be ***improved***?

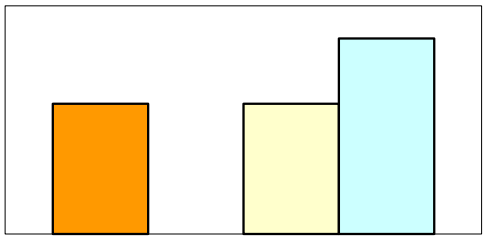
Documentation	***Yes***	***To some extent***	***No***
Is there any documentation on management of measurement and evaluation of the distribution?		x	
Are these instructions used in a satisfactory manner?		x	

6. Problems in the distribution	
D.6.1	***What problems are there in the distribution?***
D.6.2	Is the distribution ***method appropriate***? Does it work well?
D.6.3	How are ***deviations*** handled? What are the consequences of the deviations?
D.6.4	How can the distribution be ***improved***?

Control (T)	1,73

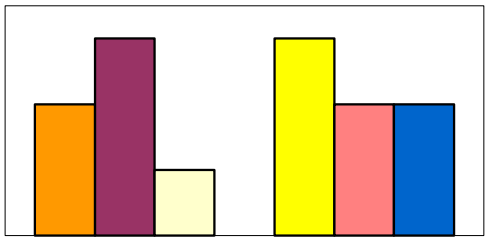
Overall	1,75

1. Demand forecasting	2
2. Customer relations	0
3. Order processing	2
4. Logistics communications	3



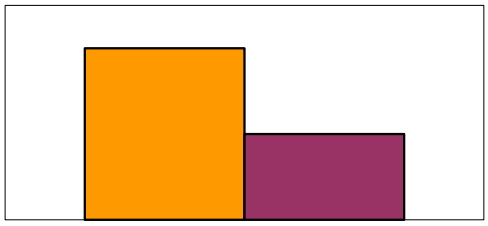
Procurement	1,86

1. Procurement management	2
2. Supplier relations	3
3. Purchase order processing	1
4. Inbound transports	0
5. Goods reception	3
6. Warehousing and storage	2
7. Measurement and evaluation	2



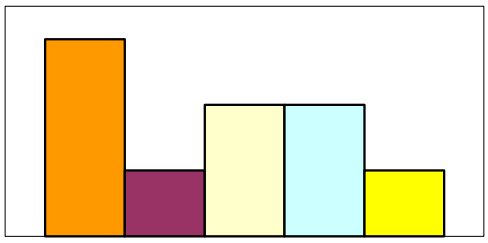
Operations	1,5

1. Operations management	2
2. Measurement and evaluation	1



Distribution	1,8

1. Distribution management	3
2. Warehousing and storage	1
3. Dispatch handling	2
4. Outbound transports	2
5. Measurement and evaluation	1



Time (T)

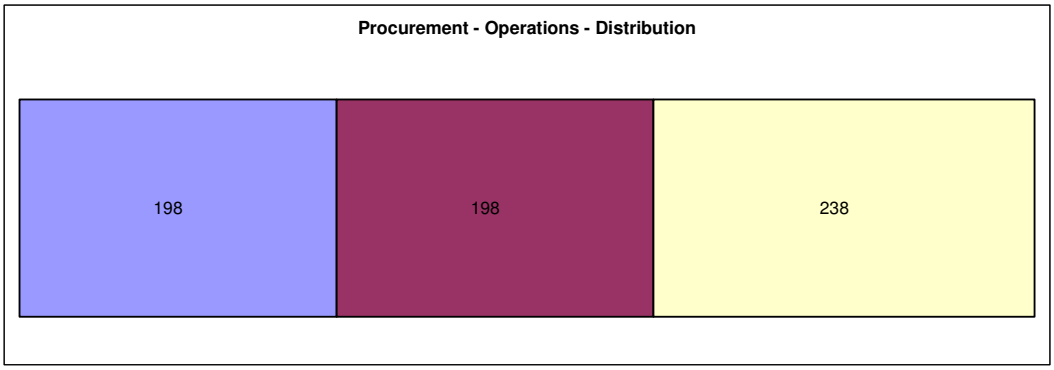
A lead time for an activity is the time it takes for an item to pass through that activity. If the lead times for all the activities in the logistics system are added together the total lead time for that system is calculated. Here the average lead time for the products should be inserted for at least the three main parts of the logistics system; Procurement, Operations and Distribution. Preferably these can be broken down further into activities. In each of the three red boxes below you can either fill in the complete lead time for that main part **or** break it down into activities by writing the name of each activity and the time beside it.

Since the time items are in inventory is of extra interest it is possible to look at these specifically. Simply write "yes" under the "Inventory?" column besides those activities that can be classified as an item being in inventory. If this data is entered then the inventory turnover time will be calculated both for that activity and accumulated for the main parts and the total system.

Another extra interesting lead time is the picking time in the distribution. If available this should preferably be specified as an individual activity under the "Distribution" column.

Lead time breakdown

Total lead time	634	days

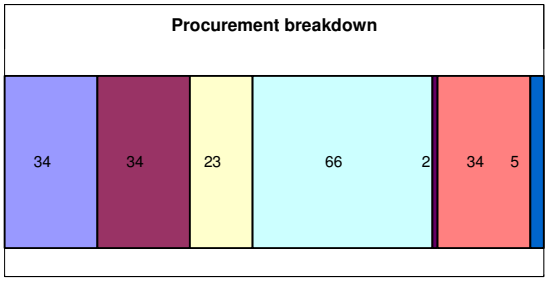


Procurement	198

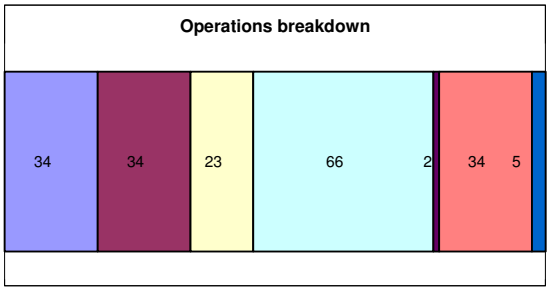
Operations	198

Distribution	238

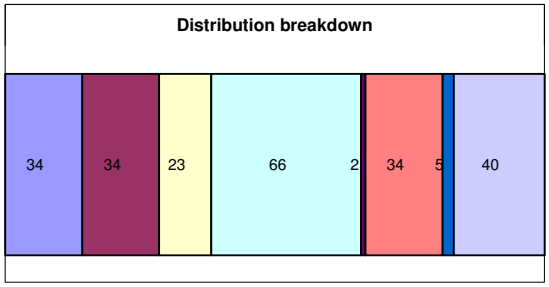
Procurement	Lead time	Inventory?(yes)	Turnover rate
Activity breakdown			**3,48**
	34	yes	10,74
	34	no	-
Inbound transport	23	no	-
Raw material inv.	66	yes	5,53
	2	no	-
	34	no	-
	5	yes	73,00
			-
			-
			-
			-



Operations	Lead time	Inventory?(yes)	Turnover rate
Activity breakdown			**3,48**
	34	yes	10,74
	34	no	-
Welding	23	no	-
Buffert inventory	66	yes	5,53
	2	no	-
Painting	34	no	-
	5	yes	73,00
			-
			-
			-
			-



Distribution	Lead time	Inventory?(yes)	Turnover rate
Activity breakdown			**10,74**
	34	no	-
Transport	34	no	-
	23	no	-
	66	no	-
	2	no	-
Finished goods inv.	34	yes	10,74
	5	no	-
Outbound transport	40	no	-
			-
			-
			-



Inventory turnover rate		
Total turnover rate	**1,50**	**/year**

Procurment	**3,48**

Operations	**3,48**

Distribution	10,74

Appendix D: Presentation of the results

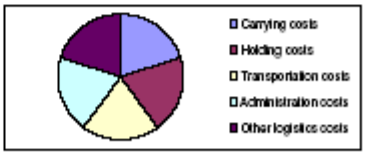
System description

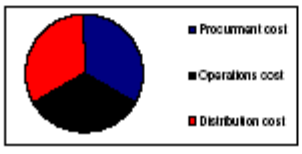
The analyzed system is described briefly, especially for those who have not been involved in the evaluation process.

Input – total costs

The main findings concerning the total cost and its statistics are presented

Total cost	15 000 000 kr	
Carrying costs	3 000 000 kr	20%
Holding costs	3 000 000 kr	20%
Transportation costs	3 000 000 kr	20%
Administration costs	3 000 000 kr	20%
Other logistics costs	3 000 000 kr	20%

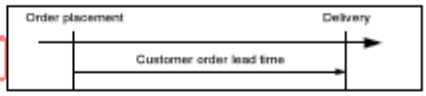




Output – customer service

The main findings concerning the customer service level and its statistics are presented

Customer order lead time	5 days
Delivery reliability	72,73%
Delivery dependability	72,73%
Stock availability	90,00%
Average number of order lines per order	1



Delivery reliability = Number of deliveries on time / Total number of deliveries

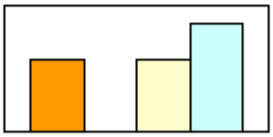
Delivery dependability = Number of deliveries without complaints / Total number of deliveries

Stock availability = Number of orders delivered complete / Total number of orders

The average number of order lines per order affects the customer service level. A high number of order lines per order may make it harder to achieve a high customer service level.

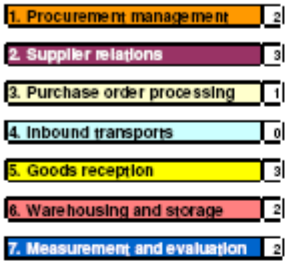
Transformation: Overall

1. Demand forecasting	2
2. Customer relations	0
3. Order processing	2
4. Logistics communications	3



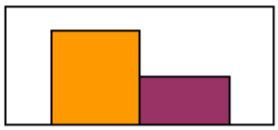
The main findings concerning the overall area are presented together with the statistics of the level of control

Transformation: Procurement



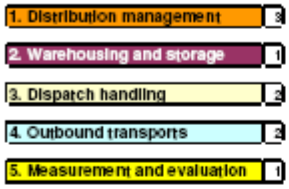
The main findings concerning the procurement area are presented together with the statistics of the level of control

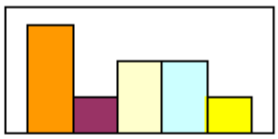
Transformation: Operations



The main findings concerning the operations area are presented together with the statistics of the level of control

Transformation: Distribution

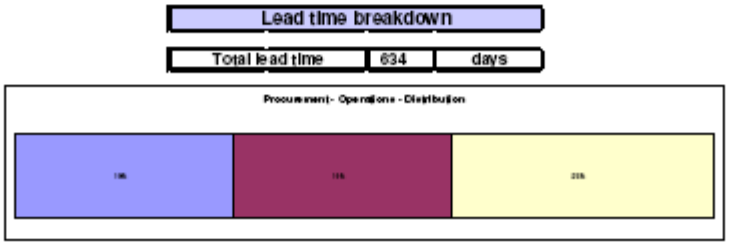




The main findings concerning the distribution area are presented together with the statistics of the level of control

Transformation: Time

The main findings concerning the time analysis are presented together with the statistics



Conclusions

The main findings of the evaluation are presented once again