Warehouse Analysis and Improvement for Färggrossen

- A Multiple Case Study

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Logistics Management
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ABSTRACT

Färggrossen is a warehousing company that was established in 1976. The company has over 400 customers ranging across mid and south Sweden; it stores 5,000 different types of products such as paints, wallpapers, chemicals and tools which are used for painting.

Since its establishment, the company has not changed how it manages its warehouse. Decisions are based on the warehouse manager’s personal memory and decisions, and this method worked sufficiently well until the company was bought by Mikael Lindgren in September 2008. Lindgren, the CEO, believed that the company had more potential, which is why the company has eagerly started to make changes in order to improve the warehouse operations as well as to reach its full potential. This thesis is to guide the company to reach this goal.

At our first meeting with Färggrossen, improvements regarding different processes as well as the warehouse layout were identified. As a first step, a literature study was conducted in order to gain deeper insight and understanding about warehouse layouts; also we benefited from studying literature regarding different warehouse aspects from a system perspective: inputs, processes and outputs.

Subsequent to the literature study, we identified those thesis research questions which needed to be answered in order to improve the warehouse management at Färggrossen. The next step was to decide which methods should be used in order to answer these questions. After researching different methodology options, a meeting with Färggrossen and our supervisor Bengt Ekdahl took place where we, together, decided to use the multiple case study method.

Färggrossen suggested that we study two other companies, BSAB and ECO; according to them, these companies had similar warehouses. To be able to benchmark three companies, we needed to understand the warehousing management systems of all three companies, which is why we conducted our interviews.

Once we finished gathering the required data, we defined the three companies’ activities in a manner to correspond with the terminology which is used in the literature. In the analysis chapter we compared the three companies, and also used the information from the literature in order to provide Färggrossen with recommendations on how to improve the warehouse processes and layout. These are categorised as main, secondary and future
recommendations; the main recommendations are the most important and inexpensive to implement, which is why we strongly suggest that they are prioritized.

The two most important recommendations to improve the outputs of the warehouse system are implementing a serialized locater addressing system and defining a bulk area to support the replenishment process. These particular modifications will improve the overall efficiency of the warehouse system as well as the product availability and the customer satisfaction.

The overall efficiency of the warehouse system will be further improved by eliminating manual labour as much as possible and combining the inspections which are done in the receiving process with the putaway process.

The product condition will be improved if the following recommendations are implemented; a small shelf solution which is used in ECO, a fixed slot system in the wallpaper area and the implementation of safety precautions in the company.

The purpose of this thesis was to map and analyze Färggrossen in order to improve the inventory, warehouse layout and the methods being used in the warehouse management. With our recommendations, the company will have an improved and new warehouse layout, the processes will be improved and the efficiency will be increased.
PREFACE

Commissioned by Färggrossen AB, this thesis is the final step in our MSc. degree at the Institute of Technology, Linköping’s University and has been carried out between April and October 2009.

Throughout the thesis, different people have supported us and first and foremost we want to thank our families and friends. We also want to thank our supervisor Mikael Lindgren and assistant supervisor Patrick Ledin at Färggrossen for giving us the opportunity to conduct this study; we also want to express our gratitude to our supervisor Bengt Ekdahl, at IEI Linköping’s University, who has given us a great deal of encouragement, valuable feedback and guidance. In conclusion, we also want to thank Jonas Sjöö at ECO AB as well as Thomas Nygren and Sanna Nygren at BSAB for taking time to be interviewed and for sharing essential information which contributed to the results.

Linköping, October 2009

Cara Edgar and Dilek Tanyildiz
# TABLE OF CONTENT

1 Introduction .................................................................................................................. 11  
   1.1 Background ............................................................................................................. 11  
   1.2 Discussion of the Problems .................................................................................... 12  
   1.3 The Purpose of the Thesis ....................................................................................... 14  
   1.4 Research Questions ............................................................................................... 14  
   1.5 The Thesis Outline ................................................................................................. 14  
2 Company Overviews ...................................................................................................... 17  
   2.1 Selected Companies ............................................................................................... 17  
      2.1.1 Färggrossen ....................................................................................................... 17  
      2.1.2 Bengt Sandbergs Byggprodukter AB ............................................................... 18  
      2.1.3 ECO-Boråstapeter ............................................................................................ 19  
3 Theoretical Frame of Reference .................................................................................... 20  
   3.1 Definition and Terminology .................................................................................... 20  
   3.2 Warehouse ............................................................................................................ 21  
      3.2.1 Warehousing Classifications ............................................................................. 23  
      3.2.2 Warehouse Layout .......................................................................................... 25  
      3.2.3 Warehouse System Inputs .............................................................................. 29  
      3.2.4 Man (Personnel) ............................................................................................. 29  
      3.2.5 Money ............................................................................................................. 30  
      3.2.6 Machine (Equipment) .................................................................................... 31  
      3.2.7 Milieu (Environment) ..................................................................................... 36  
      3.2.8 Method ........................................................................................................... 42  
      3.2.9 Material (Goods/Products) ............................................................................. 43  
   3.3 Warehouse Processes .............................................................................................. 43  
      3.3.1 Receiving Process ......................................................................................... 45  
      3.3.2 Putaway Process ............................................................................................. 45  
      3.3.3 Storing (Bulk and Pick) Process ...................................................................... 46  
      3.3.4 Replenishment Process .................................................................................. 48  
      3.3.5 Picking Process ............................................................................................... 49  
      3.3.6 Shipping Process ............................................................................................. 50  
      3.3.7 Cross-docking Process .................................................................................... 50  
      3.3.8 VAL (Value Added Logistics) Process ............................................................... 50  
   3.4 Warehouse System Outputs .................................................................................... 51  
      3.4.1 Product Availability ....................................................................................... 53
3.4.2 Customer Satisfaction ........................................................................................................ 54
3.4.3 Product Condition ............................................................................................................. 54
3.4.4 Efficiency ......................................................................................................................... 54

4 Task Specification .................................................................................................................... 56
4.1 Purpose Clarification ............................................................................................................ 56
4.2 Research Questions ............................................................................................................. 57
   4.2.1 General Questions .......................................................................................................... 58
   4.2.2 Main Questions ............................................................................................................... 59
   4.2.3 Comparison Questions .................................................................................................. 62
4.3 Directives ............................................................................................................................... 63
   4.3.1 Research Strategy .......................................................................................................... 63
   4.3.2 Selection of the Studied Companies .............................................................................. 64

5 Research Design and Methodology .......................................................................................... 65
5.1 Research Design .................................................................................................................. 65
5.2 Research Purposes and Approaches .................................................................................... 65
   5.2.1 Methods and Supportive Theories Used in this Thesis .................................................. 66
   5.2.2 Quantitative versus Qualitative Research ....................................................................... 70
   5.2.3 Common Misunderstandings About Case Study Research ........................................... 72
5.3 Quality Assurance ............................................................................................................... 73
   5.3.1 Construct Validity .......................................................................................................... 74
   5.3.2 Internal Validity ............................................................................................................. 79
   5.3.3 External Validity ............................................................................................................ 79
   5.3.4 Reliability ..................................................................................................................... 80
5.4 Designing the Case Study ...................................................................................................... 82
   5.4.1 The Study’s Research Questions .................................................................................... 82
   5.4.2 The Study’s Propositions ............................................................................................... 82
   5.4.3 The Units of Analysis ..................................................................................................... 82
   5.4.4 Logic Linking the Data to the Propositions and The Criteria for Interpreting the Findings .................................................................................................................. 85
5.5 The Sequence of Work in this Thesis .................................................................................. 86
   5.5.1 Discussions with Färggrossen Regarding the Purpose, etc ............................................ 87
   5.5.2 Literature Study .............................................................................................................. 88
   5.5.3 Planing the Thesis ......................................................................................................... 89
   5.5.4 Literature search and Interview Planing ....................................................................... 89
   5.5.5 Frame of Reference ....................................................................................................... 89
   5.5.6 Thesis Specification ...................................................................................................... 89
   5.5.7 Interviews with Färggrossen, BSAB and ECO ................................................................ 89
LIST OF FIGURES

Figure 1: Thesis Outline. (Source: Our Own) ................................................................. 14
Figure 2: A Warehouse’s Role in Logistics and Supply Chain Management. (Source: Frazelle, E.H. (2001 p.XIV)) 24
Figure 3: Basic System Entity Construct. (Source: Wasson, C.S. (2005 P.22)) .......................... 26
Figure 4: Fishbone Diagram. (Source: http://www.six-sigma-material.com/fishbone-Diagram.html) ......................................................... 27
Figure 5: Inputs in the System Entity Construct. (Source: Our Own) ........................................ 29
Figure 6: Drive-in Rack. (Source: http://www.storageequip.com) .................................................. 33
Figure 7: Live Storage. (Source: http://www.jungheinrich.de) ...................................................... 34
Figure 8: Horizontal Carousel. (Source: http://www.diamondphoenix.com) ................................. 35
Figure 9: Sprinkler Utilization versus Monetary Property Due to Fire Damage. (Source: Tompkins, J. A. et al. (1998 p.412)) ......................................................... 42
Figure 10: Handling of Material Job Flow. (Source: Ackerman, K.B. (1997 p.147)) .......................... 43
Figure 11: Processes in the System Entity Construct. (Source: Our Own) ................................. 44
Figure 12: Activities and Flows in a Distribution Centre. (Source: Van Den Berg, J.P. (2007 p.60)) ............................................................ 45
Figure 13: Input and Process Interpretation. (Source: Our Own) .................................................. 53
Figure 14: Maintaining the Chain of Evidence. (Source: Yin, R.K. (2003 p.106)) ......................... 78
Figure 15: Holistic versus Embedded Units of Analysis. (Source: Yin, R.K. (2003 p.40)) ............... 84
Figure 16: The Sequence of Work in this Thesis. (Source: Our Own) ........................................... 87
Figure 17: Analysis Model. (Source: Our Own) ............................................................................ 115
Figure 18: Organizational Chart. (Source: Our Own) ................................................................. 119
Figure 19: Warehouse Layout. (Source: Our Own) ...................................................................... 124
Figure 20: Customer Location and Corresponding Delivery Lines. (Source: Our Own) ..................... 129
Figure 21: Organizational Chart. (Source: Our Own) ................................................................... 133
Figure 22: Warehouse Layout. (Source: Our Own) ...................................................................... 138
Figure 23: Organizational Chart. (Source: Sjöö, J. at ECO) .......................................................... 148
Figure 24: ECO Finished Goods Warehouse Layout (Source: Our Own) ........................................ 151
Figure 25: Analysis Model. (Source: Our Own) ........................................................................... 167
Figure 26: Recommendation Output Relation (Source: Our Own) .................................................. 218

LIST OF TABLES

Table 1: Site-Planning Criteria Hierarchy. (Source: Garcia-Diaz, A. et al. (2007 p. 363)) ................. 37
Table 2: Warehouse Worker Fatalities/Injuries (per 100 Workers). (Source: http://www.bls.gov/iag/tgs/iag493.htm) ................................................................. 41
Table 3: Research Design Strategies. (Source: Yin, R.K. (2003 p.5)) .............................................. 64
Table 4: Research Design Strategies. (Source: Yin, R.K. (2003 p.5)) .............................................. 66
Table 5: Research Strategies. (Source: Ellram (1996)) ................................................................. 69
Table 6: Methodology Approaches. (Source: Halfpenny (1979 p.799, Silverman (2006 p.19) and Ellram (1996 p.98)) ................................................................. 71
Table 7: Multiple Sources of Evidence. (Source: Yin, R.K. (2003 p.86) and Green et al. (2005 p.116)) ....... 75
Table 8: Interview Technique and Their Characteristics. (Source: Lekvall, P. and Wahlbin, C. (2001 p.263)) .... 92
Table 9: Interview Classifications. (Source: Our Own) ................................................................. 93
Table 10: Suppliers with the Greatest Variety/Number in Items. (Source: Our Own) .......................... 121
Table 11: Amount of Customers per Line. (Source: Our Own) ........................................................ 128
Table 12: Case Study Comparison Table. (Source: Our Own) ........................................................ 159
Table 13: Färggrossen's Key Problems. (Source: Our Own) ................................................................. 172
Table 14: Färggrossen's Key Problems Regarding the Warehouse Processes. (Source: Our Own) ........... 181
Table 15: Advantages/Disadvantages of Implementing a Locator Address System. (Source: Our Own) .... 195
Table 16: Advantages/Disadvantages of Implementing Product Family Changes. (Source: Our Own) ........ 196
Table 17: Advantages/Disadvantages of Implementing New Procedures and Looking Into Further Studies. (Source: Our Own) ........................................................................................................... 197
Table 18: Advantages/Disadvantages of Making New Investments. (Source: Our Own) ......................... 199
Table 19: Advantages/Disadvantages of Implementing a Locator Address System Regarding Changes in the Product Flow. (Source: Our Own) ....................................................................................................... 203
Table 20: Advantages/Disadvantages of Implementing Product Families Regarding Changes in the Product Flow. (Source: Our Own) ........................................................................................................... 203
Table 21: Advantages/Disadvantages of Implementing New Procedures and Looking at Further Studies Regarding Changes in the Product Flow. (Source: Our Own) ................................................................. 204
Table 22: Advantages/Disadvantages of Making New Investments Regarding Changes in the Product Flow. (Source: Our Own) ........................................................................................................... 205
Table 23: The Comparison Table of the Process Methods in the Companies. (Source: Our Own) ............ 215
1 INTRODUCTION

This chapter presents an overview of the thesis. The first section presents the thesis background, which is followed by a discussion of the problems and the purpose of the thesis. A brief introduction to the process of identifying the thesis research questions is also presented. In addition, the thesis outline is presented.

1.1 BACKGROUND

Färggrossen is one of mid and south Sweden’s leading wholesale companies with its focus on distributing paint, wallpaper and paint accessories to end customers. With only six employees the workers have a close relationship to each other, but at the same time they also have quite a heavy workload. Färggrossen has over 400 customers and eight different distribution routes in mid to south Sweden; the company has managed to cover a vast customer area, but it is still looking for opportunities to expand its clientele along these existing routes.

Nowadays, a customer does not only have his or her personnel taste in mind when choosing wallpaper or paint, they also have to take the current trends into consideration in order, in the future, to be able to sell their real-estate.

Since trend plays a big role when choosing wallpaper and paint, and due to the fact that it is the customers who decide what is trendy and what is not, the companies must make sure to satisfy every possible customer on the market. This has resulted in the manufacturing paint and wallpaper companies producing larger quantities than in previous years. The increase in the manufacturing of products has increased the supply of products to companies around the world and in particular Färggrossen. This increase in products has lead to an increase of storage area for the products, and Färggrossen has had some excess storage facilities, and this is not an immediate problem. However, the increase in stored products has put a strain on the warehouse management, since there are several different types of brand which all need to be stored, and the different brands only have a certain run-out time, the life expectancy of a brand.

Färggrossen has a long-term vision which is to improve their warehouse management in order to have a warehouse which is managed in the most efficient way. The methods which are used at Färggrossen for warehousing might be considered as old fashioned. At the moment the company are more dependent on the warehouse manager than on a computerized system which puts a strain on the entire company, not only on the warehouse manager. One step in improving the warehouse management is to relieve the workload that
is a consequence of Färggrossen relying on its workers instead of a computer system. In order to achieve this, the warehouse layout and the storage area of the warehouse must be improved and made as efficient as possible.

Today, Färggrossen manages its warehouse in the most efficient way as it can; however, the warehouse management can always be improved. Färggrossen is aware that the system it has can be improved and this is the starting point of our thesis. In order to identify Färggrossen’s present situation and in order to provide the company with suggestions on how to improve their warehouse management, we will look at the theories which are presented in the literature as well as looking at other companies. Färggrossen is therefore interested and eager to learn how other companies are handling the problems which it is experiencing.

Along with our supervisor, Bengt Ekdahl, and Färggrossens’ CEO, Mikael Lindgren, we came to the conclusion that a multiple case study would be the best approach for this thesis, since Färggrossen wants to learn from other companies’ way of managing the warehouse. Together we came to the decision that Lindgren would be the one who would select the companies which should be compared to Färggrossen. The fact that Lindgren has a deeper knowledge and insight into Färggrossen problems and needs, as well as into the market contributed to this decision.

By exploring and comparing Färggrossen to other companies regarding warehouse management, it can help to identify the key problems they are experiencing, how to address these problems and what Färggrossen and the other companies can learn from each other.

Färggrossen is experiencing more than one problem; however, due to time limitations we cannot address all of them. The problem which is being addressed is the warehouse management, i.e., we want to analyse Färggrossen in order to improve the warehouse management.

1.2 Discussion of the Problems

Färggrossen is a company which has grown internally in many different ways, such as the introduction of computers within the company. The company has also grown on the Swedish market as a wholesale company within the paint and wallpaper industry, selling leading paint brands such as Demi Dekk and Jotun, and wallpaper brands such as Eco Wallpaper. Since Färggrossen is one of the leading wholesale companies for paint/wallpaper, especially in the Nybro area, this has required an increase of products and an increase in the warehouse
management. This has in turn resulted in certain inefficient practices: for instance articles are located and stored in a way that does not contribute to their efficient flow in the warehouse. Since the articles are not always stored at what we believe is the optimal location, in the warehouse storage area, this leads to unnecessary internal transports. Even though Färggrossen is a small scale company and it does not have to transport articles over large distances, the efficiency of internal transportation is still affected when articles are stored at the wrong location. After observing how Färggrossen’s warehouse was managed we decided that the first step in the study was to identify its key problems. This in turn, led us to consider how the warehouse management - more specifically how the inefficient practices - will be affected by future expansions. However, this is not the main problem which Färggrossen is experiencing it is part of the bigger problem: namely the inefficiency in the warehouse management. This is the main problem which we will be focusing on within this study. When studying the warehouse management on location we observed a number of specific deficiencies such as the lack of proper article coding, the lack of knowledge concerning the inventory and the lack of a proper computerized inventory system. This raised the question as to how we could help Färggrossen tackle these problems. Could we observe and research how other companies managed their warehouses in order to provide Färggrossen with some recommendations? By not managing the warehouse, in particular the storage area of the warehouse, in a favourable way, contributes to an unnecessary increase in the workload for the warehouse workers, unnecessary delays in deliveries, and the inventory being either overstocked or Färggrossen experiencing stock outs. Therefore, we decided to help Färggrossen to decrease the workload for the warehouse workers by finding alternative ways of conducting some of the work tasks in order to improve the warehouse management.

In order to find answers for the problems, and in order to carry out this study in a satisfactory way, we need to broaden our knowledge using all available sources. It is very important to have a strong base of information with which to start. First and foremost, it is important to map the storage area in order to find the exact locations of the articles. Secondly, it is also very important to take the warehouse employees, opinions into consideration, since the warehouse needs their cooperation to function. The final step is to consider possible improvements that can be applicable for the company, and also what kind of recommendations we can provide the company with in order to make the right changes. This will in turn contribute to improving the warehouse management in such a way that the warehouse storage will be improved as much as possible.
1.3 **The Purpose of the Thesis**
The purpose of the thesis is to map and to analyse the company in order to improve the inventory, warehouse layout and the methods being used in warehouse management. The result should in part be based on benchmarking with other companies.

1.4 **Research Questions**
In order to achieve the purpose there are several research questions which need to be presented. By conducting interviews at the three companies, which resulted in many different sub questions being answered, and researching theory, these questions were identified. The research questions will be addressed and discussed in detail in Chapter 4 *Task Specification*.

1.5 **The Thesis Outline**
Figure 1 below presents a brief overview of the thesis outline. An introduction to what each chapter consists of is also presented subsequent to the outline.

![Figure 1: Thesis Outline. (Source: Our Own)](image-url)

*Chapter 1, Introduction:*
This chapter presents an overview of the thesis, starting with the background to the subject of the thesis. After this a discussion of the problems derives from the background which is followed by the purpose, a brief introduction to the thesis research questions and ending with the thesis outline.

Chapter 2, Company Overviews:
The study’s primary case, Färggrossen, is presented in this chapter along with overviews of the two benchmark companies. These cases will be compared against literature, in a within-analysis, and each other, in a cross-case synthesis, in the analysis chapter.

Chapter 3, Theoretical Frame of Reference:
The chapter presents the theoretical framework along with central terms which are used in the thesis. The theoretical frame of reference discusses the different theories which have been excluded and the ones which have been applied to this thesis.

Chapter 4, Task Specification:
Firstly, this chapter presents a clarification of the purpose, where the purpose is broken down and analyzed into smaller sections. Finally, the thesis research questions are identified and discussed in detail.

Chapter 5, Research Design and Methodology:
This chapter presents the research design which has been used in this thesis. It discusses the different approaches, strategies, techniques and methods which have been excluded and the ones that have been applied to this thesis. Furthermore, the chapter presents the different criteria for judging the quality assurance of the study. Moreover, the study’s steps, data collection methods and discussion to support our different choices are presented. Lastly, the chapter presents the thesis interview questions and a brief explanation to why each question was chosen for the interview guide as well as presenting the thesis analysis model.

Chapter 6, The Case Studies:
In this chapter the three studied companies and their characteristics are presented in a similar manner. First the case study of Färggrossen is presented followed by the second and third case description.
Chapter 7, Analysis and Recommendations:
In this chapter the empirical finding of Färggrossen are compared to the literature and the benchmarking companies. The similarities, differences and other relevant and interesting finding are identified by using cross-case synthesis and within-case analysis. Recommendations on how to address the issues at Färggrossen are also presented in this chapter.

Chapter 8, Conclusions and Further Work:
This chapter presents the most relevant and interesting findings which we believe will help Färggrossen improve their warehouse management. These findings and recommendations and further work suggestions are presented to Färggrossen so they know what is required of them in order to handle the key problems they are experiencing.
2 Company Overviews

This chapter briefly presents an overview of Färggrossen and the benchmark companies Bengt Sandbergs Byggprodukter AB (BSAB) and ECO-Bordstapeter (ECO). The chapter is meant to give the reader a brief introduction to the companies which are presented in Chapter 6 The Case Studies. All information is taken from interviews at Färggrossen, BSAB and ECO if nothing else is stated.

This following section briefly presents an overview of the studied companies which are included in this thesis and which are used in the Chapter 6 The Case Studies. The information gathered from these companies is analysed and compared and presented in Chapter 7 Analysis and Recommendations and in Chapter 8 Conclusions and Further Work.

2.1 Selected Companies

Alongside Färggrossen the two companies which were chosen by Färggrossen’s CEO, Mikael Lindgren, for the benchmarking were BSAB and ECO.

BSAB is a company that deals with building products. It could be considered a SME (Small Medium Enterprise) just as Färggrossen, and this is why the company is part of our benchmarking study. Even though BSAB and Färggrossen do not deal with the same kind of products, BSAB could still provide Färggrossen and this thesis with valuable information concerning efficient warehouse management. The insight gained by studying BSAB will be used as a complement to the theory, and will help identify key issues along with interesting and relevant areas on which to focus, in order to improve the efficiency of Färggrossen’s warehouse management.

ECO is a company which has several decades of experience in handling wallpaper and distributing their products to their end customers; these are major wallpaper/paint companies such as Colorama and wholesale companies such as Färggrossen. We believe that this company provides us with insight into how a major company’s warehouse is managed in order to provide Färggrossen with some suggestions which could contribute to improving the efficiency in its warehouse. ECO was also able to provide us with enough time and resources in order for us to be able to conduct our study.

2.1.1 Färggrossen

Färggrossen was founded in 1976 and is one of Sweden’s leading wholesale companies within the paint and wallpaper industry. With six employees and over 400 customers, Färggrossen supplies paint stores and painters with paint, wallpaper and paint accessories from the Stockholm area and down to the most southern parts of Sweden. The company has
eight different distribution lines, whereof one of the lines, line 3, is a line which the company has considered expanding.

The company has recently purchased their first computers and a database system for the warehouse, however, the Lindgren has discovered that the database system is not really suited for the company like Färggrossen. This has resulted in the system not being used to its full capacity.

The company warehouse can roughly be divided into three sections; the main, the wallpaper and chemical area. In the main area goods are stored on pallets, both on shelves and on the floor, euro pallets are stacked on each other and similar products are in general stored at different locations. This area can be considered to be eligible for major improvements.

The warehouse manager is the only person who knows exactly where all the products are stored and can be seen as a bottleneck in the system based on the fact that the warehouse would not function properly if the manager is absent. The yearly net turnover for 2007/2008 was 22 million SEK.\(^1\)

2.1.2 Bengt Sandbergs Byggprodukter AB

BSAB was founded in 1985 by Bengt Sandberg. The company has since it was founded in 1985 grown rapidly on the Swedish market and expanding its deliveries to neighbouring countries. Though the company’s clientele has expanded, the size of the company’s organizations has remained the same throughout the years. With only five employees, the company is considered, as mentioned earlier, a small scale company or a SME. In spite of the company’s size, it is one of the leading distributors of building products in Sweden. Some of BSAB’s major customers in Sweden are Byggmax and Beijer; however, they also distributes to other companies including Byggmax in Norway and Finland.

As a result of BSAB’s clientele expanding, which meant keeping higher inventory in order to serve all the demands, and the fact that BSAB hold Byggmax’s stock, the warehouse was expanded on three different occasions, the latest expansion occurred earlier this year (2009). The different storage areas are categorised, according to us authors, into an indoor, an outdoor and a loading/unloading area, all areas storing different types of products. Some of the products which BSAB distributes are nails, screws, drainage pipes, etc. The yearly gross turnover for 2008 was approximately 53 million SEK.\(^2\)

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\(^1\) Färggrossen internal sources
\(^2\) BSAB internal sources
2.1.3 ECO-Boråstapeter

ECO has two different histories since the company once was two different companies which merged together and became ECO-Boråstapeter. While Eco Wallpaper was founded in 1880 by Johan Alfred Hedenström, originally the company was named Norrköpings Tapetfabrik and was not named Eco Wallpaper until 1986 after many different companies had merged together; Boråstapeter was founded in 1905 by Waldemar Andrén. In 2002 Eco Wallpaper was acquired by Boråstapeter and this is when ECO-Boråstapeter was ‘founded’. Today ECO has approximately 115 employees working for them and the company manufactures and distributes wallpaper to their estimated 300 customers within Sweden. ECO’s entire warehouse can be categorized into a raw material area, finished goods area, manufacturing area and loading/unloading area. We will however only be focusing on the finished goods area as well as the loading/unloading area since these are the relevant areas of our study.

ECO has a good reputation internationally and they also distribute to the rest of Scandinavia, Russia, China and all together 45 different countries worldwide. The company constantly seeks good business opportunities to expand even more internationally than they already have. The approximate yearly gross turnover in 2007 was 352 million SEK.³

³ ECO’s internal sources
3 Theoretical Frame of Reference

Different organizations have different ways of managing their warehouse. As a part of this thesis the theoretical view from appropriate literature will be taken as a base point for comparison. This chapter starts with definitions of some central terms, and will be followed by a summary of the theoretical work.

3.1 Definition and Terminology

Some topic related terms and definitions will be covered in this section. The reason behind this section is to avoid misunderstandings, as well as to make clear the point of view of this thesis.

There are a variety of formal definitions for logistics in the literature, some of, which are quoted below:

- Logistics is the flow of material, information and money between consumers and suppliers.\(^4\)
- Handling an operation that involves providing labour and materials as required.\(^5\)
- The planning, execution and control of the movement and placement of people and/or goods and of the supporting activities related to such movement and placement within a system organized to achieve specific objectives.\(^6\)
- The process of transporting, supplying and supporting a field project.\(^7\)
- The total process of moving goods from a manufacturer to a customer in the most timely and cost-efficient manner possible.\(^8\)

However, at the simplest and at the operational level logistics can simply be considered as planning of operations, labour, and material to support the system.

The warehouse is a cornerstone in the logistics system. There are also a variety of formal definitions for warehouse, in the literature, which are quoted below:

- Warehousing is simply defined as the holding of goods until they are required.\(^9\)

\(^5\) wordnetweb.princeton.edu
\(^6\) www.shipping.francoudi.com
\(^7\) www.farahsouth.cgu.edu
\(^8\) www.prenahall.com
\(^9\) Kulviec, R. A. et al. (1985) p. 654
• Places of transition where a company will, manage a lot of logistic flows, create added value, and realize physical and administrative operations.\(^\text{10}\)

• A storehouse for goods and merchandise.\(^\text{11}\)

However, at the simplest and at the operational level a warehouse can simply be considered a building where products are stored.

Handling of materials is one of the most important inputs of the warehouse layout especially from the view of planning. There are also a variety of formal definitions for handling of materials in the literature, which are quoted below:

• Handling of material is a system of interrelated handling activities.\(^\text{12}\)

• The activities of loading, unloading placing and manipulating material and of in-process movement.\(^\text{13}\)

• The physical handling of products and materials between procurement and shipping.\(^\text{14}\)

3.2 Warehouse

From the definitions of warehouse in the previous section we noted that the main element of a warehouse is simply a building where products are stored. Warehouses are needed and used not only by manufacturers, but also distributors, retailers, importers and exporters. The functions, which a warehouse fulfils, are described by Ackerman (1997) as followed:\(^\text{15}\)

Stockpiling, which is the situation where there is a need to handle overflow products. This can occur in two situations: either there is a seasonal production and level sales, or level production and seasonal sales. Either way, the warehouse is the place to balance the supply and demand. For Färggrosen high season is during the summer time.

Product mixing is the process to assemble half finished goods into customer ordered goods. In our case special ordered colours fits this situation.

Consolidation is the process to gathering different products due to the customer order. The customer might need products, which are located in different location or being produced by different producers. This is again an issue that needs to be balanced in the warehouse.

\(^{10}\) www.free-logistics.com

\(^{11}\) wordnetweb.princeton.edu

\(^{12}\) Kulviec, R. A. et al. (1985) p. 8

\(^{13}\) www.shipping.francoudi.com

\(^{14}\) en.logisticsplatform.com.

\(^{15}\) Ackerman, K. B. (1997) p. 13
Distribution is the opposite of consolidation, both consolidation and distribution is important for customer satisfaction. Färggrossen distributes its orders not only by using transportation companies but with also their own trucks.

Additional to these functions, Van Den Berg (2007) also recommends some value adding warehouse functions such as, break-bulk, storage and customization, which he describes as follows: 16

Break-bulk, this is the function where bulk orders are delivered to the warehouse and are broken into smaller units for delivery to individual customers. This benefits the production and transportation.

Storage helps the company to compensate for the delays between supply and demand. This serves many purposes, such as instant availability, lot sizes, seasonal supply, demand anticipation, speculation and strategic products.

Customisation is when the customer might demand some specific brand, brochures or special packaging. At Färggrossen there is a special section, which includes brochures related to the products, which serves to this purpose.

According to Tompkins et al. (1998) the functions that has been explained by Ackerman (1997) and Van Den Berg (2007) is not enough and there are more functions of a warehouse. Warehouse functions that are needed to be added are receiving, inspection, inventory control, replenishment, order picking, checking, packing and marking. 17

Receiving, is the first step the materials go through when entering the warehouse. The material is received and controlled. It is important to report data such as the date, supplier, item coding etc. regarding the receiving process.

Inspection, this is the function to control if the purchased order is fulfilled and if the received items are meeting the standard quality requirements that are demanded by the customers. The main goal of inspection is to keep the data communication alive so the data about stock levels and stocking positions of the goods in warehouse are up to date

Inventory control, after receiving the products they are moved to their positions in the warehouse. It is important to keep track of, which product is being stored where, to control the locations and the quantities of the products on hand.

16 Van Den Berg, J. P. (2007) p.31
17 Tompkins, J. A. et al. (1998) p. 256
Replenishment, some of the material can be stocked in a secondary area as bulk storage. Replenishment is moving the items from that secondary area to the primary area.

Order picking, is when a customer’s order that consists of products is being picked together. Here the most crucial part is the document where the customer order is printed; the document has to be clear and valid.

Checking, after the order has been picked the order should be checked to assure that it fulfils the customer order regarding quantity and quality. Damaged goods should be thrown away.

Packing and marking, after checking the picked orders, they have to be packed for shipment. The orders can be marked depending on customer requests or as a firm policy.

### 3.2.1 Warehousing Classifications

Variety is something we see every day in our life. People are different from each other. Some people to live a peaceful calm life, on the other hand some people like to rush from one meeting to another and work as an accountant for example. Just like variety being a part of everything, it is a part of warehousing as well. Warehouses can be classified depending on the ownership or functions. According to their functions, warehouses can be classified in following main categories:

**Raw material and component warehouses:** This is the warehouse type where the raw materials for manufacturing are held.

**Work-in-process warehouses:** In a manufacturing company it can be needed to keep a stock for partially completed products and a work-in-process warehouse is used for this purpose.

**Finished goods warehouses:** This is where the finished goods are stored.

**Distribution warehouse and centres:** This is where finished products are accumulated from many different manufacturing points to be delivered as combined shipment to the customers.

**Fulfilment warehouses and centres:** This is where items are received picked and shipped in small orders for individual customers.

**Local warehouses:** In some circumstances it will be useful to have local warehouses to supply strictly local demands.

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18 Ackerman, K. B. (1997) p. 15
*Value-added service warehouses.* This is where the value-adding process, such as labelling, marking, pricing and/or return pricing occurs. Return price is the cost when some item needs to be returned back to the supplier because of various reasons.

An overview of the different warehouse types is shown in the Figure 2 below. As it can be seen from Figure 2’s Raw material and Work in process warehouses is related to the manufacturing facility. Finished goods warehouse is where the manufactured goods are kept. Distribution centre is where many different products are gathered from different manufacturers. Frazelle (2001) has similar definitions with Ackerman (1997) for the different types of warehouses.

![Figure 2: A Warehouse’s Role in Logistics and Supply Chain Management. (Source: Frazelle, E.H. (2001 p.XIV))](image)

As mentioned before, the classifications are decided based on the functions of the warehouse. As Ackerman (1997) mentions there are three different types of warehouses that can be used by a company:¹⁹

- Private
- Public
- Contract or Dedicated

A private warehouse is operated by the company itself, which allows it to have total control. If the storage volume is high and handling volume is constant, this type of warehouse is the most economical. On the other hand private warehousing suffers from fixed costs; and the choice of personnel is very important and there needs to be good management.²⁰

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¹⁹ Ackerman, Kenneth B. (1997) p.15
²⁰ Ackerman, K. B. (1997p.15)
A public warehouse is managed by an independent contractor who serves a number of different companies at the same time. The warehouse owner does not own the products and has the freedom to vary the types and amounts of the products; he also has more freedom in employing labour depending on the variation in customer orders, and this brings cost efficiency.\(^{21}\)

Such warehousing often focuses on short term commodity type of storage.\(^{22}\)

Contract or dedicated warehousing uses a combination of private and public warehouses. In particular, an independent contractor’s warehousing service is bought for a period of time according to a contract.\(^{23}\) This type of warehousing has a long term agreement, and risks are shared between the warehouse and the company.\(^{24}\)

The main advantage of private warehouses is that they are aimed to serve internal needs of their own organization and in this way they differ from public and contract warehouses.\(^{25}\) Many companies use a combination of three types of warehouses.

### 3.2.2 Warehouse Layout

Even though there might be different types of warehousing, all of the warehouses have a common point; layout. The warehouse layout has been defined as:

> The design and implementation of a warehousing strategy; to use the space, equipment, labour, accessibility and protections of the items with maximum efficiency and flexibility as possible...\(^{26}\)

‘System’ is a word originated from the Greek term ‘systema: place together’ and one of the best examples to system is a company, which consists of many sub systems. There are multiple descriptions for systems by business and engineering domains.

There are many other descriptions of system that can be found in the literature, more or less expressing same idea, system as it is described by Wasson (2005) is ‘an integrated elements of interoperable elements, each with explicitly specified and bounded capabilities, working synergistically to perform value-added processing to enable a user to satisfy mission oriented operational needs in a prescribed operating environment with a specified outcome and probability of success.’\(^{27}\), while Kerzner (2009) defines a system as ‘a group of elements, either human or nonhuman, that is organized and arranged in such a way that the elements can act as a whole toward achieving some

\(^{21}\) Ackerman, K. B. (1997) p.15  
\(^{22}\) Tompkins, J. A. et al. (1998) p.65  
\(^{23}\) Ackerman, K. B. (1997) p. 15  
\(^{24}\) Tompkins, J. A. et al. (1998) p.65  
\(^{25}\) Tompkins, J. A. et al. (1998) p.65  
\(^{26}\) Salvendy, G. (2001) p. 1538  
\(^{27}\) Wasson, C. S. (2005) p.18
As we can observe from both definitions, system is a group of elements being organised for achieving a common goal. In Figure 3, a basic system construct can be seen; there are inputs, which enter the system, they are then processed to create outputs, which can be a product or service.

The warehouse is a sub system of the company system where products or raw materials are being stored, mixed and transferred. First of all we need to understand the inputs, processes and outputs to be able to understand the warehouse system as a whole.

To understand the whole system, we will take a deeper look to the inputs, processes and outputs. For that we will base our inputs, on a basic analysis technique in the ‘six sigma’, which is used for understanding the source of the problems. Brussee (2004) defines the ‘Six sigma’ methodology as a data-driven technique, which uses a specific problem-solving approach and some specific tools. The main goal of the ‘Six sigma’ methodology is to reduce process variations, which are more than three defects per million parts. As mentioned previously, the ‘Six sigma’ has many tools, which are statistic based, mathematical and complicated to understand and solve problems, but we will benefit from one of the simplest tools of the ‘Six sigma’, Fishbone diagram.

The Fishbone diagram is a tool that is used to identify the entire input variables in a system that could be the reason of a problem. The main problem is placed at the head of the fishbone and there are six bones on the fishbone; we then assign an input variable for each. This tool gives the advantage of not missing any inputs and related causes for the main problem. After completion of listing the inputs, each input variable and their effects on the main problem are discussed. Sometimes just the process of preparing the fishbone diagram leads to the solution. Figure 4 shows the principle of a Fishbone diagram.

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In our project we use the input variables of the fishbone diagram with the warehouse point of view, which will be discussed under the Section 3.3 Warehouse System Inputs. The Fishbone input variables are:\(^{31}\):

- Man (Personnel)
- Money
- Machine (Equipment)
- Milieu (Environment)
- Method
- Material (Goods/Products)

Every input can be detailed and investigated; since our topic is the warehouse layout we will focus on the warehouse views of those inputs. Knowing about those inputs will let us see the problem’s solution with a clear view in Chapter 7 Analysis and Recommendations. None of those inputs can be considered without considering the other inputs; each of them affects the bigger system (company system) and other inputs as well. It is very important to have an efficient and customer satisfying logistics, which requires optimizing the warehouse layout. The objectives of layout optimization planning are:\(^{32}\)

- Space efficiency
- Efficient material handling
- Cost efficiency
- Flexibility
- Good housekeeping

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In addition to the objectives that Salvendy (2001) has defined, Mulcahy (1993) brings forward more objectives. Warehouse layout objectives according to Mulcahy (1993) are as follows:

- Maximizing the space utilization
- Efficient product flow
- Ease of access to positions and inventory rotation
- Reducing annual operation costs
- Improve employee productivity
- Maintain philosophy and direction of the corporate
- Protecting the inventory
- Providing expansion
- Providing safe work environment
- Customer Satisfaction

The objectives of the layout optimization planning that were mentioned above are influenced by the limitations of the warehouse. In a warehouse: space, material handling, costs, ability to serve and the quality of working space are the limitations.

The warehouse layout planning is a specialised version of facility planning, which has its own limitations and it begins with finding out the amount of space required for each and every process in the warehouse.

In normal facility planning the system input is taken into consideration. In the warehouse planning we are also supposed to have the basic elements of the warehouse layout in mind, in order to be able to succeed in the planning process, since beyond the complete system, the warehouse system is restricted by:

- The need for flexibility
- Accessibility and location of materials
- Customer response requirement
- Safety
- Rising space and labour costs

To be able to work on warehouse layout we should know more about warehouse inputs, which will be explained in the following Section 3.3 Warehouse System Inputs.

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33 Mulcahy, D. E. (1993) p. 3.4
35 Ackerman, K. B. (1997) p.13
3.2.3 **Ware House System Inputs**

Previously mentioned was that the warehouse is a system on its own and every system has its own inputs. Either inputs are effected or/and are effecting other inputs of the warehouse system or the bigger system. Warehouse system inputs can be seen in the Figure 5, which will be detailed in the upcoming sections.

![Diagram of Warehouse System Inputs](image)

**Figure 5: Inputs in the System Entity Construct. (Source: Our Own)**

3.2.4 **Man (Personnel)**

Even though technology has developed is at a very advanced level, there are warehouses where almost every process is handled by automated systems, still there is no such work that is not managed by a human. The latest technology is automated systems, which does not require any labour involved; and yet they need to be prepared or programmed by a human. This creates the understanding that technology at the moment cannot support itself without a human starting and/or controlling it. The human is the most important element in a system.

A human, has its own strength and endurance, which are limited by four variables:\(^{36}\)

- **Age**: A human’s strength is at its maximum level by the late twenties and then slowly degenerates.
- **Sex**: Men are the stronger sex; however, women have 2/3 of men’s strength.
- **Body build**: This variable is dependent on strength and endurance, even though an athletic-looking person is stronger than others, a weaker person might be more efficient due to fatigue.
- **Exercise**: it is a known fact that exercising on a regular basis has a positive effect on keeping strong and healthy.

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Other governing variables about humans beside strength and endurance are: speed, accuracy and senses. These variables affect the efficiency of a warehouse system due to the dependency on labour, which was explained at the beginning of this section. John W. Langford (2006) bases labour efficiency on age, sex and the previous explained variables while. Ackerman (1997) bases labour efficiency on the usage of the labour time.

In a warehouse system, the human is the key factor to assign the placements and order pickings. Just like every input of the system, ‘Man’ input need to be planned. Planning starts with time planning, prioritizing and scheduling. To be able to do planning some points are need to be taken under consideration like identifying and defining the basic warehousing activities, time requirements and benchmarks for time usage, forecast of work. In organizations it is suggested that a warehouse supervisor has control of the acts and improvement on utilization. 37

Planning on its own might not be enough for efficiency. Efficiency is described as work done in an assigned-limited time. Efficiency can be lower if there is time that is being lost. There are two kinds of lost time in a warehouse system, which are obvious and hidden time loss,38

Obvious time loss is when a worker is not doing his job while hidden time loss is a bit more difficult to notice and crucial to figure out. Hidden time loss can be waiting for order lists, looking for equipments, or time lost because of items being stored in the wrong place, fast moving items stocked behind slow moving items or stacked high up on racks.39

3.2.5 Money
In logistics, goods change hands in the supply chain and the aim of the system is to deliver the goods to the end customers with a profit. From basic economics we know that profit is equal to the difference between sales and costs.

In a warehouse the main income comes from the sales while costs are considered to be costs such as: Building costs: (ground and building), utilities, maintenance, safety, insurance property taxes etc.; Fixture costs: racking and other storage devices, labels and signs; Equipment costs: forklift trucks and other vehicles, sorting devices and office equipments; Material cost: pallets, roller cages and other carriers packaging materials and labels; Staff costs: salaries, outsourced services (catering, cleaning etc.), other expenses such as education and celebrations; IT costs: information systems, data communication, hardware (servers,

37 Tompkins, J. A. et al. (1998) p. 255
38 Ackerman, K. B. (1997) p. 267
39 Ackerman, K. B. (1997) p. 267
computers, terminals etc.), maintenance, support and other services; Inventory holding cost: cost of damaged or missing products and Overhead costs are partial charges for senior management, financial services, human resources and other support functions.\textsuperscript{40}

Even though Van Den Berg (2007) classifies the costs as mentioned above, Tompkins et al. (1998) have three different classifications of costs: first costs, annual operating and maintenance costs and other costs. First costs is described as the depreciable property and onetime costs, which can be identified as buildings, racks, machines, hardware, controls and land. The second type of cost is annual operating and maintenance, which is the cost of keeping the warehouse working. This includes costs such as labour, energy, etc. The third type of cost: taxes, price escalations, discounts, inflation rate and cost of capital.\textsuperscript{41}

In every capital commitment there are some risks, which can be classified according to Ackerman (1997):\textsuperscript{42}

- The business environment might change
- Operating situations might change
- Project estimates might be wrong

A very important cost, which should not be forgotten, is the loss of value of goods at rest. In a warehouse it is not economical to store goods for a long time since they lose value and they build capital. That is why it is important to have a high turnover rate.\textsuperscript{43}

In every system it is important to have low costs in order to be able to maximize the profit. The warehouse is a crucial system for the hidden costs (loss of value of goods at rest). The total investment in the inventory was 20-25\% of the annual Gross National Product (GNP). In the last quarter of 1999, 1.37$ trillion is invested in US.\textsuperscript{44} This is a comparable fact to show the importance of the inventory related to its investment.

\textbf{3.2.6 Machine (Equipment)}

The Warehouse is a system where goods are stocked, mixed and distributed. The main purpose of having machines in a system is to help the labourer with their jobs. Most of the jobs in a warehouse require the selectivity of human senses; many machines can be used to make the processes easy for labourer but machines require humans to function. For example,

\textsuperscript{40} Van Den Berg, J. P. (2007) p.118
\textsuperscript{41} Tompkins, J. A. et al. (1998) p. 340-352
\textsuperscript{42} Ackerman, K. B. (1997) p. 138
\textsuperscript{43} Ross, D. F. (2004) p. 286
\textsuperscript{44} Tang, O. (2008) Presentation no.1 p. 17
in a floating system it is the labourer who decides to use, which stocking position will be used next but computers or databases are the machines in this situation to help the labourer to keep the data safe instead of just having the labourer memorize all the stocking locations and corresponding goods in those positions.

The inbound part of the warehouse system begins with receiving the order upon arrival at the warehouse, receiving, putaway and storing. After accepting the order it needs to be placed in its assigned position, which is based on the system that the warehouse is using. In this part of the process the position of the stored item needs to be entered and saved in the database.

Receiving an order from a customer starts the outbound part of the warehousing process, order picking, packing and shipping. An order is picked based on, which order-picking method the company uses and once the order has been picked it is sent to be packed and finally delivered.

All warehouse processes that are mentioned in Section 3.3.5. Method, are detailed in Section 3.4 Warehouse Processes, but for this part of this work it is important to identify the machines that can be used in those processes. In the warehouse system there are:

- Storage equipments
- Handling equipments
- Data equipments

More detailed information about those equipments is as follows:

**Storage Equipments**

As we have seen so far, a warehouse is not only a place to keep the goods but has more functions to accomplish. The warehouse needs equipments to be able to handle the functions that are explained in Section 3.2 Warehouse. A simple storage technique is block stacking. In block stacking products are piled on each other without any support or racks.\(^{45}\) Most of the equipments are selected with the consideration of total system cost, the nature of warehousing, order picking choices (single, bulk, area...) planned volume, flexibility needs

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\(^{45}\) Van Den Berg, Jeroen P. (2007) p.58
and reliability.\textsuperscript{46} There are many different types of storage equipments that can be used in a warehouse such as:\textsuperscript{47}

\textit{Normal racks}: These racks have no speciality; they are most likely to be three levels high, something, which allows a warehouse to stack three levels of pallets. In Färggossen this type of racking is commonly used.

\textit{Double-deep racks}: These types of racks can hold two pallets, in a line, in the same rack, which means that the rack in front blocks the rack behind.

\textit{Drive in racks}: Is the type of rack with little difference from other types of racks. In this type of rack there is not a bottom for each shelf, instead there are flanges on the sides that are used to grip the edge of the pallets. Drive in racks can be considered to standing columns, which are very high and deep. This type rack has the most density in storing, which has a disadvantage in handling efficiency but a huge benefit of space efficiency. An example for drive in racks is presented in Figure 6.

\textit{Tier rack}: is a special rack system for goods like tires, which has no packaging and structural strength. The items can be stacked very high and supported by the rack structure.

\begin{figure}[h]
\centering
\includegraphics[width=0.5\textwidth]{drive-in-rack.jpg}
\caption{Drive-in Rack. (Source: http://www.storagenequip.com)}
\end{figure}

\textsuperscript{46} Ackerman, K. B. (1997) p. 461
\textsuperscript{47} Ackerman, K. B. (1997) p. 463-465
**Live storing:** is the system where the goods are mostly stacked from the behind. This system has a slope at the bottom, from back to front, to help to move goods on its own. Typically they have guides along the sides of the base. This system is good to use for fast moving goods.\(^{48}\) An example for live storing is presented in Figure 7.

![Figure 7: Live Storage. (Source: http://www.jungheinrich.de)](image)

Another version of live storing is *gravity flow rack* where pallets or individual cases enter from the rear and moves forward with the help of rollers and gravity. The FIFO (First In First Out) policy and avoidance of the aging of inventories is the benefit of this type of storing.\(^{49}\)

**Carousels:** Carousels can be defined as a series of modular, moveable shelves divided into compartments, linked together with a motorized oval track.\(^{50}\) According to Garcia-Diaz (2007) the carousels are the most ingenious material handling devices. There are three types of carousels: horizontal, vertical and independent rack carousel. Carousels are reliable, simple and very efficient.\(^{51}\) An example for horizontal carousel is presented in Figure 8 below.

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\(^{48}\) Ackerman, K. B. (1997) p. 465
\(^{49}\) Van Den Berg, J. P. (2007) p.59
\(^{50}\) Ross, David Frederick (2004) p. 596
\(^{51}\) Garcia-Diaz, A. et al. (2007) p. 347-349
The simplicity of carousels comes from how the goods are selected. There are two ways of selecting goods, either the worker moves around the carousel or the carousel moves around while the worker stands still. Basically carousels are moving storage units. The benefits of using carousels is that it provides better space utilization, increases productivity, improves picking accuracy, management, inventory control and safety.52

According to Ross (2004) in addition to the storage equipments that have been explained above, conveyors are possible storage equipment that can be used in a warehouse even though they are mostly used in manufacturing systems.53

In a warehouse, efficiency is very important in order to provide cost/profit balance. The main goal to achieve in a warehouse is to use the storage area as efficient as possible and using storage equipment is the best way to achieve this goal. In a warehouse high racks are required since the most cost efficient spaces are the spaces closest to roof, but because of restrictions like safety, weight, etc. every warehouse has its own limitations.

**Handling Equipments**

The handling process starts when the ordered goods are received. Once the goods are brought from the dock the handling of the items can be conducted by using several different

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52 Garcia-Diaz, A. et al. (2007) p. 347
equipments such as lift trucks, pallet jacks, forklifts, turret trucks, single-reach truck, double reach truck, Drexel trucks and automated lifting systems.

Forklifts are used to transport pallets and have a reach of approximately 3-5m. Reach trucks are used to reach higher positions in the warehouse and since they are quite broad they require an aisle width of 2-2.5 m.\textsuperscript{54} Double reach trucks are similar to the reach trucks; however, they are designed to load deep racks with the help of its extension.\textsuperscript{55} Drexel truck is a version of a forklift truck that has an ability to turn the fork 90 degrees.\textsuperscript{56}

There are many different types of equipments that can be used for handling products. The most important is to consider the warehouses needs when choosing the right equipment. The warehouses inputs needs to be taken into consideration when making decisions about equipments.\textsuperscript{57}

\textbf{Data Equipments}

In a system, goods are not the only thing that flow; there should be information flow as well. In data management many different types of equipment can be used based on the needs of the system.

Computers and network equipments are the main elements of data equipments. If it is a smaller and a simpler system, pre-printed forms and tables can be considered as data tools as well. If a barcode system is being used in a warehouse the barcode readers, database program, barcode printers are the main elements of the data equipments.

While Ackerman (1997) only mentions barcode systems and their usage, other authors illustrate detailed information about automated systems in their books; however, these systems will not be addressed since they do not, size wise, apply to our focus company and also the systems are cost inefficient.

\textbf{3.2.7 Milieu (Environment)}

Milieu is a word that has a very wide meaning in terms of warehousing; we are discussing this topic under two titles: outer milieu and inner milieu.

\textsuperscript{54} Van Den Berg, J. P. (2007) p.59
\textsuperscript{55} Kulwiec, R. A. et al. (1985) p. 205-206
\textsuperscript{56} \url{http://www.landoll.com/mhp/}
\textsuperscript{57} Ackerman, K. B. (1997) p. 461
A warehouse cannot be considered separately from the environment that it is in. The warehouse environment and its conditions are defined as outer milieu. Outer milieu can affect many things; such as the warehouse efficiency can be related to its location, weather conditions, national restrictions, etc. Outer milieu can be identified as the location of the warehouse, every location has its own advantages as well as disadvantages.

When a location is being selected for a warehouse, company requirements need to be considered very carefully. For some companies weather conditions might not really carry any importance, on the other hand for some other companies rainy weather can be very costly. Some of the conditions that need to be considered when choosing a location are listed in Table 1 below. Due to the needs and priorities of a warehouse those conditions need to be considered very carefully. The decision of a new location will be more satisfying than a random location.

<table>
<thead>
<tr>
<th>Site-Planning Criteria Hierarchy (Source: Garcia-Diaz, A. et al. (2007) p. 363)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geology</td>
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<tr>
<td>• Rocks</td>
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<tr>
<td>• Soils</td>
</tr>
<tr>
<td>• Weathering and erosion</td>
</tr>
<tr>
<td>Hydrology</td>
</tr>
<tr>
<td>• Underground water</td>
</tr>
<tr>
<td>• Water bodies</td>
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<tr>
<td>• Drainage patterns</td>
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<tr>
<td>• Surface flow</td>
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<tr>
<td>Climate</td>
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<tr>
<td>• Microclimate</td>
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<tr>
<td>• sun/orientation</td>
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<tr>
<td>• air movement</td>
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<tr>
<td>• precipitations/snow removal</td>
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<tr>
<td>Topography</td>
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<tr>
<td>• Surface contours</td>
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<tr>
<td>• Slopes</td>
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<tr>
<td>• Views/vistas</td>
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<tr>
<td>Ecology</td>
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<td>• Environmental impacts</td>
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<td>• Vegetation</td>
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<td>• Wild life</td>
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<tr>
<td>Overall Suitability</td>
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<tr>
<td>Legal/political</td>
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<tr>
<td>• Land ownership</td>
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<tr>
<td>• Federal and state statues</td>
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<tr>
<td>• Zoning</td>
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<td>• community support</td>
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<td>Financial</td>
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<td>• Feasibility</td>
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<tr>
<td>• Site $</td>
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<tr>
<td>• Benefit/costs</td>
</tr>
</tbody>
</table>

58 Garcia-Diaz, A. et al. (2007) p.363
Just like the outer milieu, inner milieu has its own restrictions. The structural part of the warehouse layout is discussed in this section of the thesis work. When we consider the warehouse from the structural view, there are many components of the warehouse such as floor, framing, docks, doors etc.

**Floor:** According to Ackerman (1997) the most important component in a warehouse is the floor. The goal for a warehouse is to have a floor, which will need a minimum level of maintenance, and, which has a durable wear surfaces. The floor itself cannot be stronger than the earth underneath. That is why it is necessary to know about the topographic qualifications of the land when making a new location decision. Tompkins et al. (1998) discuss some floor-load requirements and suggests that over-design might be a good investment in the long run.

There are three floor types such as; compacted fill, structural floors and raft floor design. Compacted fill’s specialty is its flexibility, which is dependent on the filling material, which is sand or gravel. In the long run the floor will fail due to loss of air in sand/gravel.

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59 Ackerman, K. B. (1997) p.114
Structural floor is used when compacted fill is not suitable because of the soil condition; it acts as a bridge or membrane and is supported by column footers. The third type raft floor design can be considered as a floating ship on an unstable base. As it can be understood from the description, this is fairly expensive floor to have. Raft floor only chosen if structural floor is not possible to apply.60

Material that the floor will be built from is as important as the ground underneath. If the material is not solid and durable, the end result will not be flat and strong as needed, which will cause problems in due time.

**Structural system and roof:** Another important component in the inner milieu is structural system and roof. What is expected from the roof and structural system is to live the longest with the least maintenance needs. Walls are one of the components of the structural system. Design of the walls in a warehouse is dependent on the climate and economical situation. There are four types of walls, which are commonly used: brick walls, concrete panels (precast or tilt slab), walls of single-face (pre-painted steel panels insulation mounted on the inside), and finally sandwich panels, which are made of two pre-painted steel panels with insulation materials between.61

Just like the walls there are several types of roofs, what is important for a roof is to be able to handle an expected degree of temperature change. Metal pre engineered roofs are most commonly used versions but there are other aspects about the roof then its material. A smooth aim is desirable for the roof to make it easier for the workers to walk on it during the maintenance. Drainage is another important and critical factor in roof system.62

**Docks and Drive areas:** Docks are the main area for incoming and outgoing goods, which makes it important for them to have a long life and low maintenance. Drive areas are important for a healthy work flow therefore it is desirable for them to be durable as well, but the definition of quality for dock areas are not significantly different then the warehouse floor.

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60 Tompkins, James A. et al. (1998) p. 299
62 Ackerman, K. B. (1997) p.115
**Illumination and Heating:** the best way to keep a warehouse heated is to use an air rotation system. As in lightning it is a well known fact that fluorescent lights are not effective in cold weathers so HID (high-intensity discharge) lightning is better.⁶³

**Foundations and Building Heights:** The height of a warehouse is designed in the light of the safety systems and the legal restrictions. Foundations are commonly used as precast concrete. They are very practical to use and makes the construction process much faster when compared to casting them while building.⁶⁴

The factors that are explained are very important in the building design. When inner milieu is considered, the building on its own is not enough to have an efficient warehouse space, space planning needs to be done. Warehouse is a building where we hold the goods, but how much space do we need? What determines the space requirements? Is there a way to make the warehouse more flexible?

These are some of the many questions that can be asked while deciding on the warehouse material. The layout planning shows that 40% of the space in a warehouse is wasted for aisles, docks and staging areas. The left 60% is the stocking area in a warehouse. In a warehouse there might be limitations for height, stacking number for products and such.

In a warehouse it is needed to use the maximum cubic space as much as possible. There are three main ways to make better use of the cubic space.⁶⁵

- Increase stacking height
- Reduce aisle width
- Reduce the number of aisles

Managing space in a warehouse is very crucial; however, good planning will contribute to simplifying this. This simplifying effect can be established with good planning of labour, time, orders, space, data, etc. Lastly, another important aspect of the inner milieu is the safety in the warehouse which is addressed in the subsequent section.

### Safety in the Warehouse

In every facility, even in our houses, accidents happen. The important point is to be ready for the accidents. Since there is a lot of lifting, pushing, pulling, human interaction with power equipment it is more likely to have accidents in a warehouse then an office. An important

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⁶³ Ackerman, K. B. (1997) p. 116
⁶⁴ Ackerman, K. B. (1997) p. 118
⁶⁵ Ackerman, K. B. (1997) p 147
part of warehousing is to take action to reduce the chances of accidents, with consideration of corporate policies about safety, training personnel and analysis of potential hazards. \(^{66}\)

As Ackerman (1997) mentions, new workers are not the ones who are at the highest risk of facing injuries in a warehouse. Instead workers with five or more years of experience are the ones who get injured. \(^{67}\) Even small injuries and fatalities in a warehouse should be recorded.

As an example, this section presents data for the industry on the number of workplace fatalities and the rates of workplace injuries and illnesses per 100 full-time workers in warehousing and storage. An injury or illness is considered to be work-related if an event or exposure in the work environment either caused or contributed to the resulting condition, or significantly aggravated a pre-existing condition.

<table>
<thead>
<tr>
<th>Data series</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of fatalities</td>
<td>21</td>
<td>27</td>
<td>17</td>
<td>31</td>
</tr>
<tr>
<td>Total recordable cases</td>
<td>9.3</td>
<td>8.2</td>
<td>8.0</td>
<td>7.7</td>
</tr>
<tr>
<td>Cases involving days away from work, job restriction, or transfer</td>
<td>5.8</td>
<td>5.4</td>
<td>5.6</td>
<td>5.5</td>
</tr>
<tr>
<td>Cases involving days away from work</td>
<td>2.8</td>
<td>2.2</td>
<td>2.2</td>
<td>2.1</td>
</tr>
<tr>
<td>Cases involving days of job transfer or restriction</td>
<td>3.0</td>
<td>3.2</td>
<td>3.4</td>
<td>3.3</td>
</tr>
</tbody>
</table>

Injuries and illnesses are just one input of safety, fire, natural disasters need to be considered as well and warehouse planning should be sufficient enough to avoid these. According to Tompkins et al. (1998) one of the improvements in safety is a warehouse sprinkler system. \(^{68}\)


\(^{67}\) Ackerman, K. B. (1997) p 215

\(^{68}\) Tompkins, J. A. et al. (1998) p. 412
As is it can be seen in the Figure 9, a warehouse with a sprinkler system, damage and loss will be less.

### 3.2.8 Method

As mentioned previously, a warehouse is a sub-system of a company that needs to be managed in a delicate way, since investment values are somewhat expensive and small mistakes can have several unexpected results.

There are many decisions to be done in every process. Every process in warehouse flow has its own methods, which will be discussed in 3.4 Warehouse Processes section; to be able to understand a system, a flow chart can be created. Making a flow chart of the system gives the investigator the ability to understand clearly.

In a warehouse system there are some questions that need to be answered, such as the amount of the products that should be kept, variety of the variables that are changing the capacity of the warehouse and the recent active capacity of the warehouse.

The questions mentioned previously are to be mapped by making an analysis of the warehouse by answering simple what, who, when, where and how questions. According to Ackerman (1997) the easiest and the wisest way to express answers to these questions is to draw the flowing chart.

Every procedure in a system can easily be defined and understood by personnel. Ackerman (1997) summarizes a simple material handling job as which can be seen in Figure 10 below.

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Tompkins, J. A. et al. (1998) p. 412
The flow of the process needs to be defined and drawn as shown in Figure 10 above, which briefly and clearly describes the hand stacking process. According to Figure 10 flow for the process starts and hand stack packages are put on pallets, they are being counted and after that the flow ends. As can be seen in Figure 10, different shapes present different actions, while elliptic shapes are showing the start/end of a flow, rhombus shapes express that there are physical actions, and square shapes shows that there is an inspection being done. More detailed information about the shapes that can be used in a flow are explained by Ackerman (1997), since this is not directly related to our thesis, we will not have further information about flow charts.

3.2.9 Material (Goods/Products)
Materials in a warehouse system are the goods that are being transported and stocked. Every product has its own attributes and limitations. Product attributes are the characteristics by, which products are identified and differentiated; they usually comprise features, functions, benefits, and uses (Weight, dimensions, flammability, etc.)

In a warehouse system material handling is one of the most important functions. Proper material handling can only be achieved with a good description of product attributes, for example you cannot carry liquid materials with a forklift unless they have proper packaging.

Products are packed, for making handling and storage easier. One of the most popular carrying platforms is pallets. Normally there are three packaging levels, a pallet holds a number of cases and cases contain a number of individual products. The individual levels are called full pallets, full cases and individual pieces respectively.70

3.3 Warehouse Processes
Another important part of the warehouse system is the warehouse processes. The process is a particular course of action intended to achieve a result.71 There are several processes that need to be understood in a warehouse system something, which can be seen from the Figure 11.

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71 Wordnet.princeton.edu
If the warehouse flow needs to be investigated, the process starts with receiving the goods. In this process, the goods are accepted at the dock to be delivered to their stocking positions. The first decision that needs to be taken here is if the received items are acceptable in quality and quantity. A simple visual inspection is done, related to the importance and worth of the goods that are received; other inspections can be done (physical tests, chemical tests, durability tests, material tests, etc.) if needed.

Once the goods are received and taken to their locations, there is another decision to be made by the management previous to stocking, will the items be placed randomly to an empty spot or does it already have an assigned position in the warehouse.

Order picking is another point, which brings another decision; will the items be picked one by one or as a batch? Will there be a pre-defined path for order picking? The decisions that need to be taken keeps coming up as the processes keep running, for example the way the packaging will be done, details of shipment and frequency of inventory etc.

A warehouse system process as shown in Figure 12 will be addressed further in the upcoming sections. Similar to the inputs of the warehouse, processes of the warehouse are important, since they describe how things work in a warehouse.
3.3.1 Receiving Process
Receiving is the action of accepting the goods from the suppliers, unloading them and if needed repacking the goods. The goal of the receiving process is to make sure that the supplier has delivered the right product, in the right amount, in good condition and on schedule. Tompkins et al. (1998) discusses that the receiving process is a deceptively simple process, but that just like the shipping process, it is one of the most labour-intensive processes. The receiving process should be scheduled, which will bring the opportunity to the warehouse to measure work-load and handle the labour scheduling in that light.

3.3.2 Putaway Process
The putaway process is the action of moving the goods from the unloading dock to their storing positions. Frazelle (2001) has described putaway as ‘order picking in reverse’. There are two possible methods that Mulcahy (1993) mentions about putaway. The first method is manual putaway and replenishment, which is the action of a truck operator deciding to remove the goods from the receiving dock and placing them in reserve positions, which are random. The second method is the document method, which involves a printed document that assigns a reserve position for the received load.

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73 Mulcahy, D. E. (1993) p. 4.1  
74 Tompkins, J. A. et al. (1998) p. 794  
75 Van Den Berg, J. P. (2007) p. 60  
76 Frazelle, E. (2001) p. 81  
Mulcahy (1993) defines two methods of putaway processes, which have just been explained, Frazelle (2001) discusses the putaway process from a different perspective. Frazelle (2001) focuses on the putaway process based on four principles:78

*Direct put away:* is defined as transporting good directly to their primary or reserve positions.

*Directed put away:* as a fact of human nature, the labourer who is handling the products will choose the easiest or closest position for the received goods. The labourer should be directed by the warehouse system, to putaway the received goods in a way that utilizes the warehouse space as efficiently as possible. The aim of this putaway principle is to increase space efficiency in the warehouse.

*Batched and sequenced put away:* The received orders should be sorted to be putaway according to the zones and locations etc. The aim of this putaway principle is to increase efficiency in time usage and labour usage.

*Interleaving:* The main idea in this principle is to combine putaways and retrievals when it is possible. Once a received order is putaway, the labourer/machine should be picking up a customer order to be delivered. The aim of this principle is to minimize the time the labourers/machines spend travelling without carrying goods.

### 3.3.3 Storing (Bulk and Pick) Process

In the warehouse there might be some activities, which affect the products, such as inner movements to optimize the space and inventory counts on a regular basis etc. The replenishment process that is explained in Section 3.4.4 replenishment process is one of those activities, which requires a bulk storage area. The bulk storage area is where the goods on pallets are kept to replenish the pick storage area.79 Bulk storage area is defined as reserve area by Mulcahy (1993).

An important issue that Van Den Berg (2007) and Mulcahy (1993) have a common understanding of was space efficiency, which was one of the objectives of warehouse layout that was discussed in Section 3.2.2 Warehouse Layout. In the storing process maximizing volume is needed in order to have space efficiency.

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78 Frazelle, E. (2001) p. 81-84
According to Ackerman (1997) there are three different ways of stock locating, which directly affects the space requirement in a warehouse:

**Fixed slots:** According to the fixed slot stock locating system, stocks are coded and fixed for specific items that fluctuate substantially in volume. According to this system every item has its own specified slot, which in some cases might require a very large space in total.

**Floating slots:** According to the floating slot stock locating system, stocks locations are assigned on a random basis. This system is only efficient when the inventory records are accurately maintained with identified locations. Floating slot stock system gives flexibility to the warehouse, which is the ability to move items due to requirements.

**Family grouping:** The family grouping system is a system between fixed slot system and floating slot system. Family groups are assigned to a fixed area but in that area they are handled according to the floating system. This system combines the beneficial parts of two systems.

Both Ackerman (1997) and Mulcahy (1993) agree that a fixed slot storing system will increase the space and replenishment labour need in a warehouse, whereas the floating system most likely will increase the travelling distance in the pick up process.

**Locator Addressing System**

To be able to use the storing systems in a warehouse one should have a sensible system that everyone easily can understand, to designate the locations. This designation is defined as locator addressing system. The locater addressing system is a group of codes that corresponds to the stocking positions in the warehouse. Not only will a locator address system help to find the stocking locations easily, a locator address system can also help rotate the stock. If the date of the receipt is noted, outbound shipping instructions can send the order picker to the location with the oldest stock.

According to Briggs (1978) there are two types of locator systems, memory system and serialized location system:

- **Memory system:** This is probably the first system ever used in a warehouse. This is a system, where the worker in the warehouse who puts the items at a location and then tries to remember the location when there is need. If the number of the articles are

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80 Ackerman, K. B. (1997) p.144-146
81 Ackerman, K. B. (1997) p 147
low, the warehouse is small in size, the personnel in the work area are few and the turnover rate is low then it is likely to be successful. It is likely to have lost items in the system as the time passes. If we try to use this system in a big company, with several warehouses, which are likely very big in area, it is easy to see that there will be immediate problems. This system is lacking an understanding of locator addressing systems and their benefits.

- **Serialized location system:** Following the memory system several organizations develop a method of storage based on placing stocks in a sequence with a serial number applied to each unit. A worker walks down the aisle and looks for the numbers until he comes to the one that corresponds to the product he is looking for.

Furthermore, Briggs (1978) discusses some drawbacks in the locator addressing system. The first one is, if the shelf that is assigned to an item does not have enough space, and then the amount that will not fit to the shelf needs to be placed in a remote location known as overflow. If this remote location is not memorized within the data system and the worker forgets where he put the overflow material then time will be wasted.

Another drawback Briggs (1978) discusses is the need to add additional numbers to the addressing to identify colour changes, batch difference and size difference etc. If there is enough space to support these additions then there is no problem but the fluctuation in the inventory and the limited space can become a problem after a while.

Briggs (1978) suggests a system of significant location symbols, which can be shown as ‘324-112-223’, first three digits identifies the building and the floor, second group stock row, and finally third group is for the stack position. The locating system can differ between companies, depending on the choice. A company can prefer using the first three digits as stock position while having the final three as the building number.

### 3.3.4 Replenishment Process

When an item level is low in the pick area, it is replenished from the bulk area. According to Mulcahy (1993), the replenishment method changes due to the pickup position of the goods. If the pickup position is a fixed slot then the workers have to fill the pickup position from the bulk storage area, which means more transportation within the system as well as time loss. On the other hand, if the system is a floating one, due to the way the system works the finished product in a position, already has another pick up point that was created when

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84 Van Den Berg, J. P. (2007) p. 60
another order of identical goods were received. This creates the advantage of almost no need for replenishment, even though this system increases the travel time of the workers in the pick up process; it decreases the replenishment so the risk of damage that might occur is minimized during the travel within the warehouse.85

3.3.5 Picking Process
The picking process is the action of gathering the items from the pick to fulfil a customer order. If a customer order contains products, which are exactly a pallet in quantity then it is picked from the bulk area but if it is less then that then the pick area is used. 86

According to Tompkins et al. (1998) the order picking can be classified based on the size of the unit that will be picked such as pallet picking, layer picking, case picking, split case picking and broken case picking. This is a descending way of defining the picking process, pallet picking is retrieving of full pallets, layer picking involves retrieving full layers of cartons from the pallet, case picking deals with picking full cartons from storage, split case picking is when inner packs are picked from the cartons in the storage and finally broken case picking is retrieving individual items from storage.87

This classification only deals with the size, to accomplish the picking process in general there are three different methods:88

Discrete Order Picking: In this type one labourer picks one order at a time, which is a very simple and common method. This method reduces the errors in the picking process since the order is dealt with at once, but travelling time is excessive when compared with other methods.

Zone Picking: Each zone has a labourer assigned to pick the parts that are located in the zone, at the end the picked items are combined into the complete order. The reason for using this picking system is to support different skills and equipment needs. To reduce the travel time large zones can be divided into subzones, it is a good idea to size the zones to balance the workload in between.

Batch Picking: One labourer receives all the orders at once and picks all the products. If the items are small and in low quantities, then the products can be separated to their own order positions while being picked up, otherwise they will be separated into their orders in the

86 Van Den Berg, J. P. (2007) p. 60
87 Tompkins, J. A. et al. (1998) p. 806
88 Tompkins, J. A. et al. (1998) p. 809
designated area at the end of physical picking action. Instead of picking up a single order, the labourer completes picking up several orders in one tour.

3.3.6 **Shipping Process**

After picking, consolidating and packing is over the order is placed in a truck and shipped.\(^\text{89}\) Shipping has the main goal of fulfilling the customer order with the right product, in good condition, in right quantity and on schedule.\(^\text{90}\)

Mulcahy (1993) claims that there are five main functions of the shipping process:\(^\text{91}\)

*Checking*: This activity is done to ensure that the right product, in good condition and in right quantity is delivered to the correct address. This can be handled manually or with the help of technology (barcodes, sensors etc.) at the packing station.

*Packing*: Once the checking function is over, goods are put in assigned packages, which have the directions for delivery visible on the package.

*Sealing*: It is done to ensure that the product is protected against damage and environmental effects.

*Securing*: This activity is done to ensure that packaging is secure onto the shipping device.

*Manifesting*: This activity is done to ensure that the customer’s order was handled in the warehouse.

*Loading*: it is the physical movement of the packages to the shipping device.

3.3.7 **Cross-docking Process**

According to Frazelle (2001) in cross-docking loads are scheduled and sorted immediately for delivery after receiving and transported. There is no inspection at the receiving process and there is no storing needed. Van Den Berg (2007) expresses comments regarding the fact that a short period of storing might be needed for cross docking process. According to Frazelle (2001) and Van Den Berg (2007) expressions, cross-docking can be defined as load that are received to be transported immediately or in a short period.

3.3.8 **VAL (Value Added Logistics) Process**

Van Den Berg (2007) defines value adding logistics as all remaining services beyond the ones that have been explained. It is possible to have a special kind of packaging or coding for the

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\(^\text{89}\) Van Den Berg, J. P. (2007) p. 60

\(^\text{90}\) Mulcahy, D. E. (1993) p. 4.2

\(^\text{91}\) Mulcahy, D. E. (1993) p. 4.69-4.70
orders in a warehouse. VAL can occur at any stage of the warehouse flow. There can be many different kind of VAL in a warehouse like labelling, testing and repacking etc. VAL is aiming to customize the goods according to the customer requirements. According to Tompkins et al. (1998) VAL should be a win/win situation. In some situations, VAL is necessary for doing business with a specific customer, the benefit of providing VAL to a customer is that those services might help the warehouse to develop a better and stronger partnership, which might end with a long-term relationship.

3.4 WAREHOUSE SYSTEM OUTPUTS

From the definition of system that has been done by Wasson (2005) and Kerzner (2009), system is a group of elements being organised for achieving a common goal.

All the elements of the system should work in an integrated manner to increase the capability of an individual element and should add some value to accomplish some higher level goal or purposeful mission. The goals are the outcomes of the system that can be affected by any change of the inputs. From this we can interpret warehouse outputs by observing the inputs and processes. The interactions of the inputs with processes are:

Man input: The labourer in the warehouse is the main element that accomplishes all the processes, receives the goods, puts them away, stores the goods and handles replenishment etc. ‘Man’ input directly affects the output, which in this case is ‘Efficiency’ according to Langford (2006) and Ackerman (1997). The effect of the ‘Man’ input on efficiency has been explained in Section 3.3.1 Man (Personnel).

Other outputs that might be affected from ‘Man’ input are ‘Product availability’ and ‘customer satisfaction’. For example if labourers decide to go on a strike, there will be no processes accomplished in the warehouse; this will bring the result of no product and no deliveries.

Money input: All the expenses in a warehouse are supposed to satisfy the customers, which also created ‘Product availability’. As an extreme example; if the company stops purchasing then there will be no products or customer satisfaction.

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93 Tompkins, J. A. et al. (1998) p. 62
Machine input: Machines are helpful elements in the warehouse system. Interpretation of 'Machine' inputs within the processes brings 'Customer Satisfaction', 'Efficiency' and 'Products in good condition'.

It is possible for the operator to choose a sequence of machines and shelves to improve efficiency. As an example, if there are no shelves or if there is no material handling equipment, products might get damaged during transport or storage and warehousing would be a time consuming (inefficient) system.

According to Tompkins et al. (1998) efficiency in a warehouse has to do with space, equipment and labour. 'Machine' input is not only important with regards to 'product conditions' but also speed in delivery, which will affect the customer satisfaction.

Milieu input: Just like the machines, milieu is a helpful input in a warehouse system. As mentioned in Section 3.3.4 Milieu (Environment) if the outer milieu aspects are out of acceptable values this would cause the company loose customer satisfaction. For example if the warehouse is too far away from transportation, orders will be delivered late and with a higher cost. Tompkins et al. (1998) discuss that if the doors in a warehouse are too small to allow unloading/loading with ease, efficiency will be decreased. According to Mulcahy (1993) the correct design of the building structure supports excellent space usage, product flow, labour efficiency, minimal product damage. From this we can easily see that the outputs that will be affected by 'Milieu' input are, 'Efficiency', 'Product availability' and 'Product condition'.

Method input: According to Ackerman (1997) the floating slot system, which is a storing system method, increases the travel distance for picking and this causes a decrease in order picking efficiency. The orders will be picked in a longer period that might cause the customer to wait longer to receive his order. Methods of process are another input that might affect the 'Customer satisfaction' and 'Efficiency'.

Material input: Material in our text is defined as the goods that are being received, stocked and delivered to the customer. According to Van Den Berg (2007) availability of the material helps with sating customer demand with a short response time, this improves the customer

\[95\] Ackerman, K. B. (1997) p. 461
\[96\] Tompkins, J. A. et al. (1998) p. 730
\[97\] Tompkins, J. A. et al. (1998) p. 433
\[98\] Mulcahy, D. E. (1993) p. 3.18
service. Any kind of changes on ‘Material’ would change the ‘customer satisfaction’ level. For example, an item with a bad quality instead of a good quality item might not satisfy the customer; an item that has been damaged in the storing process will have the effect on customer satisfaction.

From the interpretation of inputs with processes we come up with the warehouse outputs as can be seen from Figure 13.

![Figure 13: Input and Process Interpretation. (Source: Our Own)](image)

The main outputs of the warehouse can be seen in Figure 13 above:

- Product availability
- Customer satisfaction
- Product condition
- Efficiency

Each of the system outputs are addressed individually in the subsequent sections.

### 3.4.1 Product Availability

Products are the main entities in a warehouse and are very important to satisfy the customer; warehouses must have great control to ensure availability and reliability.\(^{100}\) Having inventory serves many purposes, such as availability, which serves to supply customer demand with a short response time.\(^{101}\) According to Tompkins et al. (1998) accuracy of the inventory is very important since customer service, resupply from vendors, labour utilization and system integrity rely on inventory availability.\(^{102}\) If the warehouse system is working as it should be, product availability is an output of the system, but if there is a problem then there will be a lack of products, which might bring shortage costs and reliability loss.

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\(^{100}\) Ross, D. F. (2004) p. 495  
\(^{101}\) Van Den Berg, J.P. (2007) p. 31  
\(^{102}\) Tompkins, J. A. et al. (1998) p. 8
3.4.2 Customer Satisfaction

Customer service is the output of the logistic system; customer satisfaction is the result that occurs when all the components function well. Customer service does not only affect the existing customer loyalty, it also brings more customers and will eventually impact the market share.\textsuperscript{103}

Communication is the common base with the customer and the communication with the customer has priority in the warehouse. Customers need to be informed about every detail.\textsuperscript{104} Any pick up error may cause a lost customer for the warehouse.\textsuperscript{105} One of the solutions to increase customer satisfaction is having a Customer Relation Management (CRM) system. CRM is a window to the customer, which allows better knowledge and communication with the customer. The goal of CRM is to provide an overall perspective of the customer.\textsuperscript{106}

Knowing more about the customer allows the warehouse to serve the customer better. Warehouse performance can be measured by customer service and inventory investment. Both of those cannot be considered separately from each other. There is a trade-off between inventory investment and service levels. If a warehouse wants to keep service levels good/high then the investment in inventory will increase and vice versa.\textsuperscript{107} Service levels are targeted by the warehouse management from the company strategy.\textsuperscript{108}

3.4.3 Product Condition

The main entity in the warehouse system is the product, and keeping it in good condition will avoid having extra costs and customer satisfaction loss. Packaging is mainly aimed to protect products from damage and represents a trade-off between minimum cost and protection of the product. Ideal the packaging should provide protection and be designed to reveal all damage. Garcia Diaz (2007) discusses how products are received; they should be inspected to detect damage.\textsuperscript{109} Damage might happen during warehousing, handling or transporting.\textsuperscript{110} Having proper inner milieu in the warehouse reduces product and equipment damage.\textsuperscript{111}

3.4.4 Efficiency

\begin{flushleft}
\textsuperscript{103} Tompkins, J. A. et al. (1998) p. 183-186
\textsuperscript{104} Ackerman, K. B. (1997) p 87
\textsuperscript{105} Ackerman, K. B. (1997) p 450
\textsuperscript{108} Van Den Berg, J.P. (2007) p. 34
\textsuperscript{109} Garcia Diaz, A. et al. (2007) p. 328
\textsuperscript{110} Ackerman, K. B. (1997) p 52-58
\textsuperscript{111} Mulcahy, D. E. (1993) p. 3.9
\end{flushleft}
Efficiency by Langford (2006) and Ackerman (1997) has been considered from a ‘Man’ input perspective. Langford (2006) claims that efficiency is related to the physical condition of the labourers while Ackerman (1997) disregards this and claims that efficiency is dependent on the time usage of the labourer.

Every change in the input can affect efficiency, labour efficiency, machine efficiency, milieu efficiency, etc. For example Tompkins et al. (1998) discuss that knowing where the products are stored will have a positive impact on pick up efficiency because finding the products will be less time consuming.\textsuperscript{112}

\textsuperscript{112} Tompkins, J. A. et al. (1998) p.700
4 TASK SPECIFICATION

This chapter firstly presents a clarification of the purpose. The purpose is broken down into smaller sections and analysed in order to make it easier to manage and understand the aim of the thesis. Secondly, this chapter presents directives which were given by Färggrossen. Lastly, the thesis research questions are identified.

4.1 PURPOSE CLARIFICATION

The thesis’ introduction addresses how important it is for Färggrossen to improve its warehouse management in order to cope with future demands and expansions. The purpose of the thesis is, as described in Section 1.3 The Purpose of the Thesis,

*to map and to analyse the company* in order to *improve the inventory, warehouse layout* and *the methods* being used in warehouse management. The result should *in part be based on benchmarking* with other companies.

In order to clarify the purpose of the thesis, the words in bold are explained and clarified in deeper detail.

- ‘map [...] the company’

A wide-ranged literature study was conducted in order to narrow down the vast area of interest for the thesis. The results of the literature study produced a framework which clarified the thesis’ topic and which in turn helped to narrow down the specific areas. The different areas were in turn mapped in order to gain more information for our case studies. This is what we refer to as to ‘map the company’. Furthermore, the literature study also functioned as a means for conducting the interviews at the companies where the specific areas were addressed in deeper detail.

- ‘analyse the company’

The information gathered from the literature study and the different company interviews was subsequently compared in a cross-case synthesis and a within-case analysis in Chapter 7 Analysis and Recommendations. This is what we refer to as to ‘analyse the company’. Prior to the analysis, each of the three companies where visited in order to conduct interviews, which in turn provided us with information which was used for conducting our three case studies and the analysis. Moreover, the information’s reliability and validity was addressed in Chapter 5 Research Design and Methodology in order to strengthen the trustworthiness of the thesis.
‘improve the inventory, warehouse layout and the methods’

The thesis primary target is to improve the inventory, warehouse layout and the methods used in the warehouse management. In order to achieve this goal, a cross-case synthesis will be conducted, since this might provide both us authors and Färggrossen with possible solution suggestions. Furthermore, it is very important to take the workers of Färggrossen’s opinions into consideration since they will be conducting the necessary changes and recommendations which are presented to them in Chapter 8 Conclusions and Further Work. Without the workers acceptance, addressing these changes and recommendations is pointless. Moreover, it is also important to take into consideration that the company is a SME with limited financial assets. This is what we referred to as to ‘improve the inventory, warehouse layout and the methods’.

‘in part be based on benchmarking’

In order to provide Färggrossen with suggestions on how to improve their warehouse management we also need to look at how other companies manage their warehouses. By doing this, both positive and negative aspects from the three companies will be identified and which in turn will provide essential information. This is what we mean with be ‘in part based on benchmarking with other companies’.

4.2 Research Questions

From the beginning of conducting the theoretical frame of reference, we were aware that not all of the addressed theories will be applicable to our case. Limitations such as time constraints, lack of relevance, financial assets and due to limitations given by Färggrossen, theories where written off as interesting. Subsequent, the research questions which arose from discussions in the theoretical frame of reference and which are to be answered in this thesis are presented. Each research question will be addressed with the aim to clarify the purpose of the question for the reader and it also paves the way for the interview guide used for conducting the interviews at each company.

As mentioned earlier, in order to answer the thesis purpose we need to consider a number of research questions. Since our thesis is a multiple case study Färggrossen was not the only company which needed to be observed and interviewed. The other two companies that were chosen for this study was BSAB, located in Nybro, and ECO, located in Borås.
Since the main aim of this study is to provide Färggrossen with recommendations on how to improve their warehouse management we believe that the first step is to study the three companies individually. In order to achieve this, we have chosen to categorize the research questions into three categories; general, main and comparison questions. The choice of the categorization is based on the fact that the main question section focus’ on Färggrossen itself while the general and comparison questions have a more broadened focus not only on Färggrossen.

4.2.1 General Questions

Since the aim of the thesis is to provide Färggrossen with suggestions in order to improve their warehouse management we first of all, need to study the warehouse management of each of the three studied company. By studying each company’s warehouse management it will give us an overview, more understanding and insight into how the companies are organized. This will in turn provide us with information which can be useful for the three companies, information such as managing order picking in a more efficient way in order to decrease the workload for the warehouse workers.

The first research question was identified and will be answered in each of the sections in Chapter 6 The Case Studies:

1. How do the companies organize their warehouse management?

After identifying how the companies organize their warehouse management, by observing and posing questions to the interviewees, provided us with a deeper insight into the business current situation. In every business it is important to identify the key issues which concern warehouse management and address and improve them in order to improve the warehouse efficiency.

This led us to the second research question and it will be addressed in Chapter 6 The Case Studies and in Chapter 7 Analysis and Recommendations:

2. What are the key issues concerning warehouse management, and how do companies handle these issues?
4.2.2 **Main Questions**

The answer to the two first questions will provide the basis for our study. The question regarding the organization of the warehouse management will demonstrate the different ways of organizing the warehouse management, while the second question will help Färggrossen to deal with similar problems that the other companies also might be experiencing. It will also provide information on how each company tackles and handles these key problems. Moreover, by observing how each of the warehouses are managed and by comparing Färggrossen to other companies, certain positive and negative aspects together with differences and similarities will be identified. This will not only provide Färggrossen with interesting information but BSAB and ECO might also benefit from the comparison.

This led us to identifying the third research question which will be addressed in Chapter 7 *Analysis and Recommendations*:

3. **What are the key problems and why are Färggrossen experiencing them?**

At Färggrossen we had the opportunity to observe the different warehouse processes. With information on what issues Färggrossen were experiencing and with knowledge about changing warehouse layouts, from previous courses, in order to improve warehouse processes, we had some thoughts in mind that might be interesting for Färggrossen. Prior to visiting the company improvement suggestions such as simulating the warehouse layout in order to see how the warehouse processes were affected by changes in the layout, etc. However, this suggestion could be eliminated directly due to time limitations and the structure of our thesis.

Since Färggrossen is a SME there are limitations which have to be taken into consideration. In order to be able to provide Färggrossen with suggestions which could be applicable to the company, we needed to look into literature regarding SME’s, all literature we had studied focused on larger companies. Conducting observations on location and researching the present situation in the storage area and the locations of articles will help us to conduct our mapping and answer this question. We will also consider whether there are alternative ways of storing some of the products according to which product family they belong to and also according to their different size and weight in order to improve the efficiency. Moreover, looking into matters such as improving the markings and signs in this area and looking into if a locater addressing system could be implemented in order to simplify the procedures for
the workers to find products in the warehouse became more relevant. Authors have many different checklists for how to keep a warehouse in order. While Hales (2006) states that relationship, space and adjustment; key input data: product, quantity, routing, support and time; material flow; flow determinants; space type; fixity; flow patterns and four phases of layout planning: location, overall layout, detailed layout and installation need to be taken into consideration, other authors think that cross-docking, space requirements, inventory and locating control systems and order picking need to be considered.113

Furthermore, thoughts concerning matters such as the questions: Is it possible to store the products based on their product family?; How could these marking look like?; Could different colours or signs be used in order to divide the storage area into different areas depending on what article is to be stored?; Should the markings concern all of the products?; also arose.

This led us to the fourth research question and is addressed in Chapter 7 Analysis and Recommendations:

4. **What are the possibilities to improve the layout of a storage area and is it possible to improve the storage layout, hence improving the product flow, the handling of goods, etc.? If so, how and in what ways?**

When observing the warehouse processes, procedures and activities, at Färggrossen, it was clear that there could be improvements made. Authors such as Van Den Berg (2007), Berry (2009) and Tompkins et al. (1998), state that there are several common key factors which have to be taken into consideration in order to improve warehouse processes.114

One of the most common faults in optimizing warehouse resources is not sufficiently using cube utilization, which refers to the use of space within a storage area, which also includes using the storing space located high up near the ceiling.115 This space is too often forgotten and by not using the cube as a guideline when optimizing the warehouse resources, can lead to increased costs; costs which derive from excess storage space that might not be needed. In connection with optimizing warehouse resources is making sure that there are enough products available when the order picking process is conducted. A shortage of products will

hinder the worker from conducting the order picking process which directly affects the warehouse process efficiency.

For keeping track on the location of stored products and the quantity of products has for centuries been managed manually and is still today managed manually in some companies. Nowadays companies also have access to different technology systems and technology is constantly evolving and new systems and updates are entering the market on a regular basis. Having an efficient stock-locator system might seem fundamental; however, it is a known shortcoming in some management systems but in order to maintain an accurate inventory, investing in an efficient stock-locator system might be considered.116

In modern warehouses all kind of modern technology such as bar code systems can be found; however, in SME’s this is not as common. Systems like this aid the workers throughout the receiving to delivery processes and have many different advantages such as tracking of products, faster processes, etc.

Maintaining a flexible warehouse is also essential when regarding uncertainties in the future. Demands, expansions, changed product characteristics, etc. affect the warehouse flexibility and the flexibility is therefore an obligatory factor for warehousing.

After discussions about the above mentioned factors, our brainstorming process began. Questions such as is it possible to have a certain area only dedicated to incoming goods, and another area dedicated to outgoing deliveries arose. Regarding these areas it is important to have information about size and frequency of the deliveries in order to efficiently store and deliver the products. It is also important to have knowledge about the different types of articles and when the products are to be delivered. If the workers lack this information it can contribute to products being stored in the wrong places which in turn affects the delivery time to customers, as well as the inventory, since the inventory level then is inaccurate. However, good knowledge regarding these areas will contributes to the improvement of the preciseness of the deliveries.

Having these key factors and thoughts in mind, the fifth research question was identified and is addressed in Chapter 7 Analysis and Recommendations:

5. How is it possible to improve the warehouse process competence?

116 Berry, C. (2009)
4.2.3 **Comparison Questions**

All the above research questions have laid a solid basis for the continuation of our thesis. As stated earlier, Färggrossen is eager to learn from how other companies manage their warehouse. In order for Färggrossen to achieve this, benchmarking between the companies was conducted. According to Lema and Price (1995) ‘benchmarking is a positive, proactive process that can change business operations in a structured fashion to achieve superior performance’. Lema and Price (1995) also cite Planning (1992) who in turn defines that ‘Benchmarking is a systematic and continuous measurement process; a process of continuously measuring an organisation’s business process against business leaders anywhere in the world to gain information which will help the organization to take action to improve its performance’. Performing benchmarking means that not only a company’s positive processes will be highlighted but so will the negative processes.

The above discussion lead to the sixth and seventh research questions being indentified and they will be addressed in Chapter 7 *Analysis and Recommendations:*

6. **What** similarities and differences exist between the three studied companies concerning warehouse management and **what** can Färggrossen learn from other companies’ handling of key issues in warehouse management and vice versa?

7. **What** actions do Färggrossen need to take in order to benefit from the lessons learned from the experiences of other companies about handling of key issues in the warehouse?

The research questions which have been identified above are summarized below in their belonging categories:

**General Questions:**

- *How* do the companies organize their warehouse management?

- *What* are the key issues concerning warehouse management, and *how* do companies handle these issues?

**Main Questions:**

- *What* are the key problems and *why* are Färggrossen experiencing them?

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- *What* are the possibilities to improve the layout of a storage area and is it possible to improve the storage layout, hence improving the product flow, the handling of goods, etc.? If so, *how* and in *what* ways?
- *How* is it possible to improve the warehouse process competence?

Comparison Questions:
- *What* similarities and differences exist between the three studied companies concerning warehouse management and *what* can Färggrossen learn from other companies’ handling of key issues in warehouse management and vice versa?
- *What* actions do Färggrossen need to take in order to benefit from the lessons learned from the experiences of other companies about handling of key issues in the warehouse?

### 4.3 Directives

Some directives have been given for this thesis by Färggrossen. These directives were given at an early stage when formulating the conditions for the upcoming work. The directives where that we should focus on the warehouse management and if there was time, also look at their distribution lines and if possible optimize them.

#### 4.3.1 Research Strategy

Based on the fact that Färggrossen is eager to learn more from other companies and in that way improve their own warehousing, this study will be performed as a *multiple-case study*. Each of the three selected companies will be studied separately and then benchmarked.

In Chapter 5 *Research Design and Methodology*, the multiple-case study is presented along with different methodology approaches and strategies which we have taken into consideration when conducting the literature study and resulting in the elimination of approaches and studies not applicable for this thesis.

The table below, which Yin (2003) summarized, helped when choosing an appropriate strategy for this study and it will be addressed in Chapter 5 *Research Design and Methodology* deeper detail.
4.3.2 Selection of the Studied Companies

In order to choose suitable benchmark companies for Färggrossen we needed to have certain knowledge about the warehouse management and organization. Since Färggrossen, more specifically Mikael Lindgren, has a deeper knowledge and experience within these areas he was given the task of selecting suitable companies for the study. Färggrossen were also responsible for setting up the initial contact with the right people at each company and Patrick Ledin accompanied us on each company visit.
5 Research Design and Methodology

This chapter describes the structure of the thesis and presents the research design and methodology approaches used to gather and interpret the necessary data for answering our research questions. It also presents the method problems and errors and how to design the case study; this is followed by the different steps of the study, collection methods, the interview question as well as analyzing case study evidence. Lastly, the thesis analysis model is created and discussed.

5.1 Research Design

There are many definitions of research design; one definition that Kelliher (2005) uses is that ‘research design is the blueprint for fulfilling research objectives and answering questions where it aids the researcher in the allocation of limited resources by posing crucial choices in the methodology’. Other definitions are that research design is an activity- and time-based plan and a guide for selecting sources and types of information to obtain answers to research questions.

It can be complicated to select an appropriate research design since there are various options to choose between: e.g., surveys, case studies, explanatory or exploratory research approaches, quantitative or qualitative approaches, etc. By creating a research design which uses a combination of methodologies, researchers can achieve greater insight than if they where to follow methods which are used frequently or methods which have been mentioned the most in media. As stated in Section 4.3.1 Research Strategy, the multiple case study strategy will be used in combination with other research strategies and method approaches in this thesis.

5.2 Research Purposes and Approaches

As just mentioned above, a research design can be divided into different categories. This thesis will focus on the exploratory, descriptive, and explanatory research purposes; and these will be presented along with qualitative and quantitative research approaches which are the methods used when performing an empirical study, and which are the methods which are appropriate for our thesis.

119 Kelliher, F (2005) p. 2
120 Blumberg, B et al. (2005) p. 127
5.2.1 METHODS AND SUPPORTIVE THEORIES USED IN THIS THESIS

Using *case studies* for research purposes ‘remains one of the most challenging of all social science endeavours’. The case study method is chosen to deepen the study of a situation, person or event. Cited by Saunders et al. (2003, p.93), Robson (2002) defines case studies as ‘a strategy for doing research which involves an empirical investigation of a particular contemporary phenomenon within its real life context using multiple sources of evidence’. This definition is also supported by Yin (2003) who in turn highlights five different strategies; see Table 4 below.

**Table 4: Research Design Strategies. (Source: Yin, R.K. (2003 p.5))**

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Form of Research Question</th>
<th>Requires Control of Behavioral Events?</th>
<th>Focuses on Contemporary Events?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experiment</td>
<td>how, why?</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Survey</td>
<td>who, what, where, how many, how much?</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Archival analysis</td>
<td>who, what, where, how many, how much?</td>
<td>No</td>
<td>Yes/No</td>
</tr>
<tr>
<td>History</td>
<td>how, why?</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Case study</td>
<td>how, why?</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Since the purpose of this thesis is to map the company and analyse the company in order to improve the inventory, warehouse layout and the methods being used for warehouse management, and since the result should in part be based on benchmarking with other companies, the purpose raises the questions ‘how’ and ‘why’. This leads to the choice between the two strategies of experiment versus case study; both of these require control of behavioural events and focus on contemporary events. Our thesis does not require any control of behavioural events, but it does focus on contemporary events; this means that the right choice for this these is a case study. Some of the advantages with case studies are: an entity can be investigated in depth; more attention is given to details; the data is strong in reality due to it being based on people’s experience; generalizations are allowed; and data can be archived for further research work.

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124 Blaxter, L et al. (2006) p. 74 and Blumberg, B et al. (2005) p. 190
We chose to conduct a multiple case study based on the fact that we decided to perform a benchmarking with three companies to gain deeper understanding of how Färggossen is organized. According to Yin (2003), when answering ‘how’ and ‘why’ questions, case studies should be preferred to histories or experiments in certain situations: in particular, when asking about a contemporary set of events over which the investigator has little or no control; or alternatively when investigating a contemporary phenomenon within real-life context, especially when the boundaries between phenomenon and context are not clearly stated.\textsuperscript{125} Furthermore, Yin (2003) states that the evidence from multiple case studies is more compelling, and the overall study is more robust, but at the same time multiple case studies can require extensive resources and time while the ‘rationale, for single case studies cannot be satisfied by multiple case studies’, and that the unusual, rare and critical cases are single case studies.\textsuperscript{126} Blumberg et al. (2005) also supports Yin’s (2003) argument about multiple case studies, stating that multiple case studies are more appealing since their results are more robust and that the generalization of the results become more robust.\textsuperscript{127}

Furthermore Yin (2003) believes that research should be done either to explore, describe or explain a phenomenon, and the following sub-topics discuss these different research approaches.

**Exploratory Research**

An exploratory research is a useful method to use when the researcher lacks knowledge of the problem which he or she will face during a study. Through exploration, the researcher acquires necessary knowledge and explores the subject more deeply. According to Cooper et al. (2008), the researcher ‘develops concepts more clearly, establishes priorities, develops operational definitions, and improves the final research design’; moreover the method also saves time and money.\textsuperscript{128} Saunders et al. (2003) believe that the aim is to achieve new insights into phenomena, to ask questions, and to assess the phenomena in a new light.\textsuperscript{129} The benefit with an exploratory strategy is that it is flexible and adaptable to change, and, as Saunders et al. (2003) point out, the researcher has to be willing to change the direction of the study if new data and new insight occur when conducting an exploratory research.\textsuperscript{130}

\begin{itemize}
  \item \textsuperscript{125} Yin, R.K (2003) p. 9-13
  \item \textsuperscript{126} Yin, R.K (2003) p. 46-47
  \item \textsuperscript{127} Blumberg, B et al. (2005) p. 192
  \item \textsuperscript{128} Cooper, D.R et al. (2008) p. 134
  \item \textsuperscript{129} Saunders, M et al. (2003) p. 96-97
  \item \textsuperscript{130} Saunders, M et al. (2003) p. 96-97
\end{itemize}
**Descriptive Research**

A *descriptive research* attempts to answer the questions ‘who’, ‘what’, ‘when’, ‘where’ and, in some cases, ‘how’. In addition, the researcher tries to describe or define a subject, by creating a profile of a group of problems, people, or events. The descriptive investigation can be seen as an extension of an exploratory research. The investigation can be used when there is basic knowledge and understanding of an area, and where the aim is to describe and not to explain the current relationships.

**Explanatory Research**

An *explanatory study* is grounded in theory which is created to answer the questions ‘why’ and ‘how’. Cooper et al. (2008), states that an explanatory study goes beyond describing a case and tries to explain the reason for the phenomenon which was only observed in the descriptive study. ‘The researcher uses theories or hypotheses to account for the forces that caused a certain phenomenon to occur’. The research focuses on a deeper studying of a situation or problem in order to describe and explain the relationships between variables.

**Choosing a Research Strategy**

When choosing a research strategy the researcher has to take into consideration what kind of questions he or she wants answered. As Table 5 below illustrates, different answers to the posed questions will provide the researcher with an alternative strategy or strategies. For example, if the researcher wants the questions ‘how’ and ‘why’ answered, he or she will have to choose between an exploratory or an explanatory strategy; moreover, if he or she wants to know ‘who’ and ‘how much’ he or she will have to choose between an exploratory and a descriptive strategy. After choosing a strategy the researcher will then be able to choose the right methodology approach. As Table 5 also illustrates, an exploratory strategy with ‘how’ and ‘why’ questions being answered will lead the researcher to a qualitative methodology approach, while ‘who’ and ‘how much’ questions will lead the researcher to a quantitative or a qualitative methodology approach, if choosing a descriptive strategy. Table 5 below illustrates the different research strategies, the connecting questions and examples of appropriate methodologies.

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131 Cooper, D.R. et al. (2008) p. 11-14  
132 Saunders, M et al. (2003) p. 97  
134 Cooper, D.R et al. (2008) p. 11-12  
135 Cooper, D.R et al. (2008) p. 20  
### Table 5: Research Strategies. (Source: Ellram (1996))

<table>
<thead>
<tr>
<th>Objective</th>
<th>Question</th>
<th>Examples of Appropriate Methodologies</th>
</tr>
</thead>
</table>
| Exploration | how, why | Qualitative  
• experiment  
• case study  
• participant observation  
Quantitative  
• survey  
• secondary data analysis |
| Explanation | how, why | Qualitative  
• experiment  
• case study  
• grounded theory  
• participant observation  
• ethnography  
• case survey  
Quantitative  
• survey  
• longitudinal  
• secondary data analysis |
| Description | who, what, where, how many, how much | Qualitative  
• case study  
• experiment  
• grounded theory  
• participant observation  
• ethnography  
• case survey  
Quantitative  
• survey |
case study. The study can also be seen as explanatory because we explain what factors contribute to making a successful organized warehouse by answering our research questions.

An exploratory approach is used in order to help solve the problem with the unorganized storage area in the warehouse, and if possible to open up more storage space. The advantage of an exploratory approach is that the study can start off with a broad focus which in time will narrow when more insight concerning the relevant areas is gained. Furthermore, our thesis is also to some extent exploratory since from an early stage we, together with Mikael Lindgren, examined what areas in the storage part of the warehouse and what factors had to be taken into consideration. We have also asked questions to the benchmark companies through our interview guide which is based on the theory research we have conducted. It can also be argued that the thesis is descriptive in the sense that the storage area in the warehouse is observed, and that the articles are mapped and listed.

The conclusion is that our thesis is predominantly an exploratory multiple case study but it also has explanatory and descriptive approaches.

The next step of the research design is to decide if the multiple case studies are quantitative or qualitative case study. This will be discussed in Section 5.2.2 Qualitative versus Quantitative Research below.

5.2.2 Quantitative versus Qualitative Research

Quantitative research is ‘empirical research where the data are in the form of numbers’.\textsuperscript{137} Quantitative research is also referred to as data which can be expressed numerically or classified by some numerical value.\textsuperscript{138} However, everything cannot be measured quantitatively and this sets boundaries for a quantitative research. Questionnaires and mathematical models are some methods which are more suitable for quantitative research.\textsuperscript{139} The advantages of a quantitative research is that it is representative, tests hypotheses, gives precise measurements, has large data sets, has reliability of observations and reliability of measurements.\textsuperscript{140}

Qualitative research is used to create a deeper understanding of a specific subject, specific event or situation, and it is more suited for observations and interviews.\textsuperscript{141} A qualitative

\textsuperscript{137} Punch (2005:3) cited by Blaxter, L (2006) p. 64
\textsuperscript{138} Lancaster, G (2005) p. 66
\textsuperscript{139} Björklund, M and Pailsson, U (2003) p. 63
\textsuperscript{140} Holme, I,M and Solvang, B.K (1991) p. 75-88
\textsuperscript{141} Björklund, M and Pailsson, U (2003) p. 63
research is not determined by how many people say something; rather, it is determined by what the people say and how they say it. This approach is more holistic and more suitable for research where the purpose is to gain more insight and understanding of an area. The advantage of qualitative research is that it is flexible, shows an overall picture and that there is a close relationship to the source.

This thesis is predominately based on a qualitative research method. In Section 5.2.1 Methods and Supportive Theories used in this Thesis, we came to the conclusion that an explanatory research method is best suited for our thesis, and together with a qualitative research method, which has more depth to its questions than a quantitative research method, our questions will be answered to the depth we required. By conducting e-mail interviews with the owner and face to face interviews with the owner and warehouse manager, we gain a better understanding of the problems and the current situation.

However, we also argue that our thesis consists of both quantitative and qualitative data, even though case studies mostly focus on qualitative data. The quantitative data was collected through studying Färggrossen’s internal documentations which led to the collection of article specifications and the lead time and by recording the interviews. The qualitative data on the other hand was gathered through interviews. Our argument can be supported by Ellram (1996), who cites Yin (1984) and argues that case studies gather quantitative data but with a focus on a smaller area due to the depth which is required. The disadvantage with choosing a qualitative research approach is that the collected data might be biased. But to decrease that risk, different techniques can be used to ensure the research design quality; these techniques will be discussed in Section 5.3 Quality Assurance.

Table 6 below, gives an overview of the differences between a quantitative and qualitative research method and helped point us to the appropriate methodology choice.

<table>
<thead>
<tr>
<th>Methodology Approach</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Qualitative</td>
<td>Holme, I.M and Solvang, B.K (1991) p. 75-88</td>
</tr>
<tr>
<td></td>
<td>Ellram, L.M (1996) p. 95</td>
</tr>
</tbody>
</table>

143 Holme, I.M and Solvang, B.K (1991) p. 75-88
144 Ellram, L.M (1996) p. 95
<table>
<thead>
<tr>
<th>Method</th>
<th>Quantitative research</th>
<th>Qualitative research</th>
</tr>
</thead>
<tbody>
<tr>
<td>Features</td>
<td>Hard, fixed, objective, value-free, survey, hypothesis testing and abstract</td>
<td>Soft, flexible, subjective, political, case study, speculative and grounded</td>
</tr>
<tr>
<td>Empirical</td>
<td>Survey data, secondary data, in conjunction with statistical analysis such as: factor analysis, cluster analysis and discriminant analysis</td>
<td>Case studies, participant observation, ethnography. Characterized by: limited statistical analysis, often non-parametric</td>
</tr>
<tr>
<td>Modelling</td>
<td>Simulation, linear programming, mathematical programming and decision analysis</td>
<td>Simulation and role playing</td>
</tr>
<tr>
<td>Observation</td>
<td>Preliminary work, e.g. prior to framing questionnaire</td>
<td>Fundamental to understanding another culture</td>
</tr>
<tr>
<td>Textual Analysis</td>
<td>Content analysis, i.e. counting in terms of researchers’ categories</td>
<td>Understanding participants’ categories</td>
</tr>
<tr>
<td>Interviews</td>
<td>Systematic and structured observations, survey research: mainly fixed-choice questions to random samples</td>
<td>Unsystematic and unstructured observations, e.g. deeper interviews or interview guides with ‘open-ended’ questions to small samples</td>
</tr>
<tr>
<td>Audio and video recording</td>
<td>Used infrequently to check the accuracy of interview records</td>
<td>Understanding the organization of talk, gaze and body movements</td>
</tr>
</tbody>
</table>

These different methods have advantages and disadvantages, and some of these will be discussed in the Section *The use of Multiple Sources of Evidence*, part of Section 5.3.1 *Construct Validity*, along with some other methods. But first, some common misunderstandings about case study research are presented.

### 5.2.3 Common Misunderstandings About Case Study Research

The case study as a research method has for decades been criticized for (many) different reasons. Some of the most common criticisms are:
• Case studies offer no ground for establishing reality or generality of findings.\textsuperscript{145}
• Case studies contain a bias toward verification.\textsuperscript{146}
• The case study method is an exploratory tool that is appropriate only for the exploratory phase of an investigation.\textsuperscript{147}
• Case study research takes a long time and may result in a mass of, unreadable documents.\textsuperscript{148}

One of the most common criticisms mentioned above, about case studies is that there cannot be any generalization of findings. However, Yin (2003) and Ellram (1996) disagree with this conclusion.\textsuperscript{149} Both argue that case studies can be used on smaller scales when conducting explanatory and descriptive studies. To refute this misconception, Yin (2003) presents a detailed explanation of the difference between analytic generalization and statistical generalization. Yin (1984), states that ‘in analytic generalization, previously developed theory is used as a template against which to compare the empirical results of the case study’.\textsuperscript{150} Ellram (1996), on the other hand, in a different way than Yin (2003), addresses the seven misconceptions which she believes are the most common, and considering one at a time, she argues that each misconception is wrong.\textsuperscript{151} Moreover, Flyvbjerg (2006) considers the statement by Abercrombie et al. (1984 p. 34) that case studies ‘cannot provide reliable information about the broader class’ and argues that this in incorrect.\textsuperscript{152}

The following section is one of the most important parts of research design. This section describes the quality assurance of a case study.

### 5.3 Quality Assurance

According to Lekvall and Wahlbin (2001) and Björklund and Paulsson (2003), the quality of a research design should be judged by its validity and reliability.\textsuperscript{153} Along with Lekvall and

\textsuperscript{145} Soy, S.K (1997)
\textsuperscript{146} Flyvbjerg, B. (2006)
\textsuperscript{147} Ellram, L.M (1996 p. 94
\textsuperscript{148} Hoque, Z (2006) cited Halfpenny, 1979; Yin, 1984; Patton, 1987; Miles and Huberman, 1984; p. 365
\textsuperscript{150} Yin, R (1984) p. 38
\textsuperscript{151} Ellram, L.M. (1996) p. 94-114
\textsuperscript{152} Flyvbjerg, B (2006) p.2
Wahlbin (2001), Yin (2003) and Ellram (1996) take these criteria a step further by dividing ‘validity’ into the three sub-criteria: construct validity, internal validity, and external validity; these are the criteria which will be used in this thesis. On the other hand, Cooper et al. (1998) propose the three types of validity: content, criteria-related and construct validity; however, these six criteria can be compared to each other.

Robson (2002), who is cited by Saunders et al. (2003), mentions the different threats to reliability and validity; as regards reliability, some of the main threats are subject or participant error, subject or participant bias, etc; as regarding validity the threats are history, testing, instrumentation, etc. These threats can be reduced in different ways, and in Section The Use of Multiple Sources of Evidence, part of Section 5.3.1 Construct Validity, this will be addressed.

5.3.1 Construct Validity

Construct validity addresses ‘establishment of the proper operational measures and instruments for the concept being studied’. Due to the fact that most instruments and measures are not as accurate as desired, it is common to use multiple measures of the same construct as part of the same study. Trochim (2006) states that there are three conditions which need to be met when establishing construct validity:

1. You have to set the construct you want to operationalize within a ‘semantic net’; this means that you have to tell us what your construct is more or less similar to in meaning.
2. You need to be able to provide direct evidence that you control the operationalization of the construct -- that your operationalization looks like what they should theoretically look like.
3. You have to provide evidence that your data support your theoretical view of the relations among constructs.

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155 Cooper, D et al. (1998) p. 166-171
156 Saunders, M et al. (2003) p. 100-102
157 Ellram, L.M (1996) p. 105
158 Yin, R.K (1993) p. 39
Moreover, Yin (2003) mentions that there are three other principles of data collection which are associated with the establishment of construct validity: 160

1. The use of multiple sources of evidence
2. Creating a case study database

When comparing Trochim’s (2006) conditions to Yin’s (2003), one can draw the conclusion that they both, to some extent, are talking about the same principles but in different terms.

These three principles, stated by Yin (2003), will be discussed deeper in individual sections below. Both Ellram (1996) and Yin (2003) also state that construct validity is a part of the data collection which is closely tied to reliability. This will be addressed in the Section 5.3.4 Reliability. 161

**The use of Multiple Sources of Evidence**

According to Green et al. (2005), it will always be preferable to use multiple sources of evidence. 162 One of the method’s strength is that ‘the use of multiple sources can corroborate evidence found from each of the sources’. 163 Moreover, Yin (2003) supports these statements and mentions that there are six, most commonly used, sources of evidence one should take into consideration when doing case studies. These have been summarized, in Table 7, together with strengths and weaknesses of each of the sources:

<table>
<thead>
<tr>
<th>Sources of Evidence</th>
<th>Strengths</th>
<th>Weaknesses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Documents</td>
<td>Stable: Can be reviewed repeatedly Un-obtrusive: not created as a result of the case study Exact: contains exact names, references and details of an event Broad coverage: long span of time, many events and many</td>
<td>Retrieve ability: can be low Biased selectivity, if collection is incomplete Reporting bias: reflects (unknown) bias of author Access: may be deliberately blocked</td>
</tr>
</tbody>
</table>

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162 Green, J.L et al. (2005) p. 116
163 Everard et al. (2004) p. 178

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Page | 75
<table>
<thead>
<tr>
<th>Evidence Source</th>
<th>Settings</th>
<th>Same as above for documentation</th>
<th>Accessibility due to privacy reasons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Archival Records (e.g. student records)</td>
<td>Same as above for documentation</td>
<td>Precise and quantitative</td>
<td></td>
</tr>
<tr>
<td>Interviews (e.g. open-ended conversations with key informants)</td>
<td>Targeted: Focuses directly on case study topics</td>
<td>Bias due to poorly constructed questions</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Insightful: provides perceived casual inferences</td>
<td>Response bias</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Inaccuracies due to poor recall</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Reflexivity: interviewee given what interviewer wants to hear</td>
<td></td>
</tr>
<tr>
<td>Direct Observations (e.g. observations of classroom behaviour)</td>
<td>Reality: covers events in real time</td>
<td>Time-consuming</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Contextual: covers context of events</td>
<td>Selectivity: unless broad coverage</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Reflexivity: event may proceed differently because it is being observed</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cost: hours needed by human observers</td>
<td></td>
</tr>
<tr>
<td>Participant Observations (e.g. being identified as a researcher but also filling a real-life role in the scene being studied)</td>
<td>Same as above for direct observations</td>
<td>Same as above for direct observations</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Insightful into interpersonnel behaviour and motives</td>
<td>Bias due to investigator’s manipulation of events</td>
<td></td>
</tr>
<tr>
<td>Physical Artefacts (e.g. computer printouts of student work)</td>
<td>Insightful into cultural features</td>
<td>Selectivity</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Insightful into technical operations</td>
<td>Availability</td>
<td></td>
</tr>
</tbody>
</table>

For this study, multiple sources of evidence have been used; key employees within Färggrossen have been interviewed in order to gain deeper insight and understanding of the subject and the interviews were recorded for later validation. To gain even more insight: homepages have been accessed; annual reports, literature and articles concerning the subject...
have been read and studied; and visiting the company has given the opportunity for direct observations which have been a great help. The form of comparison which was used was triangulation. By triangulating, i.e., ‘combining multiple theories, methods, observers and empirical materials one is able to produce a more accurate, comprehensive and objective representation of the object studied’.\(^{164}\) Also by performing triangulation, we sought to overcome some of the weaknesses contributed by each of the sources of evidence, e.g., to overcome bias when interviewing people.

Despite the advantages with using multiple sources of evidence there are some drawbacks with the method. The method ‘imposes a great burden on the researcher, and on any other case study investigator, since the collection of data is expensive and each investigator needs to know how to carry out the full variety of data collection techniques’\(^{165}\).

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**CREATE A CASE STUDY DATABASE**

The case study database has to do with ‘the way of organizing and documenting the data collected for case studies’.\(^{166}\) Yin (2003) states that ‘case study data are synonymous with the narrative presented in the case study report, and a critical reader has no recourse if he or she wants to inspect the raw data that led to the case study’s conclusions’.\(^{167}\) According to Everard et al. (2004) the case study database has two aspects: the evidence collected and the reports written by the researcher.\(^{168}\) The lack of a formal case study database is a major shortcoming, and needs to be corrected. Yin (2003) describes the problems of creating a database in terms of these four components:\(^{169}\)

- Case study notes
- Case study documents
- Tabular materials
- Narratives, such as open-ended answers to questions in the case study protocol

To keep track of the collected data which we believed should be saved separately from this report, we decided to create a shared place where this data could be stored; a case study database. The database contains several documents, such as a copy of the individual

\(^{165}\) Yin, R.K (2003) p. 99-100
\(^{166}\) Yin, R.K (2003) p. 101
\(^{167}\) Yin, R.K (2003) p. 101
\(^{168}\) Everard et al. (2004) p. 178
\(^{169}\) Yin, R.K (2003) p. 102-104
interview guides for the benchmark companies, the answers to the questions of each case and the recorded interviews. Since we use multiple sources of evidence, such as internal/external documentations, recorded interviews and e-mail interviews about the studied companies, this is also included in the database. The database helps us to remember to include important findings in our report.

**Maintain a Chain of Evidence**

Maintaining and establishing a chain of evidence ‘relates to the ability of the reader of the case study to follow the case study data and to analyse from the initial formulation of the research questions to its final conclusions’. The principle of maintaining a chain of evidence is to allow an external observer to follow the derivation of evidence ranging from initial research questions to the ultimate case study conclusions, and which in turn will help the observer to trace the steps back and forth. The structure of maintaining a chain of evidence which is presented by Yin (2003) is the following:

![Diagram of maintaining the chain of evidence](source: Yin, R.K. (2003, p.106))

To maintain a chain of evidence in this thesis, the authors have had recurring discussions concerning the report’s structure as well as following up the interviews and research questions. In addition we have also had two opponents and our supervisor reviewing the work at different stages of our writing; this has provided us with external verification.

**Draft Review by Key Informants**

The last element to support construct validity which Ellram (1996) mentions is to have a draft review by key informants. To support the construct validity in our thesis our supervisor has

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170 Ellram, L.M (1996) p. 106
171 Kuo, C. et al. (1999) p.2
reviewed parts of the collected information to verify that the case facts are accurate. To ensure that we had understood and interpreted the information correctly and to rule out conflicting information, we used this method as a guide. Using this method of validation allowed us to make changes when needed. Also key informants at the studied companies have reviewed the collected information to verify that the facts are indeed correct.

### 5.3.2 Internal Validity

*Internal validity* examines to what extent one’s result corresponds with reality. Merriam (1988) cites Ratcliffe (1983) who states that first and foremost the information does not speak for itself; there is always an interpreter and a translator. Secondly Merriam (1998) states that one cannot observe or measure a phenomenon without altering it and ends by stating that numbers, equations and words are abstract, symbolic representations of reality, and not the actual reality. Internal validity is only valid for explanatory or casual studies and not for exploratory or descriptive studies.

To increase the internal validity of our thesis we have chosen to use methodological triangulation which means the use, within a data collection format, of more than one method of obtaining information. For instance, when using questionnaires, we have employed the use of more than one type of questions; this has involved fixed choice alongside open-ended questions, or -- when interviewing -- mixing structured with semi-structured interviews.

### 5.3.3 External Validity

*External validity* refers to how accurately the results of a scientific study can be generalized; without internal validity there is not external validity. Merriam (1988) cites Guba and Lincoln (1981) who state that ‘in order to discuss if results of a scientific study can be generalized, the study must have an internal validity because it is pointless asking if meaningless information can be generalized’. Taking this into consideration, it can be seen as pointless to generalize a single studied case. Ellram (1996) argues that the lack of generalizing is a major criticism of case studies. This can however be addressed by replicating case studies and verifying patterns. Yin (2003), states that by replicating the theory findings, in other cases, or in multiple-case studies, the theory will be strengthened.

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172 Merrian, S.B (1994) p. 177-180
175 Yin, R.K (2003) p. 37
177 Ellram, L.M (1996) p. 105
Yin (2003) further argues that strengthening the theory will lead to improvements in generalizing and external validity.\textsuperscript{178} The conclusion one arrives at is that multiple case studies have higher external validity than single case studies.

This thesis contains three case studies and if the same results are achieved a replication will occur which will increase the studies external validity. However, to generalize the findings might not be possible due to the fact that the studied companies are quite different. Other ways of increasing the thesis validity was to record the interviews which took place at the different companies.

\textbf{5.3.4 Reliability}

Reliability is to what extent the results can be repeated, and if it is possible to achieve the same results.\textsuperscript{179} If a researcher was to conduct the exact same case study, in the exact same manner with help of documentations made by a previous researcher, the latter researcher should come to the exact same findings and conclusions. The goal of these criteria is to minimize errors and bias in the study. To increase the reliability one can use control-questions in questionnaires and interviews where the aspects will be examined once again. Triangulating could also be used to increase the studies reliability.\textsuperscript{180} According to Ellram (1996) a case study context has two keys to reliability: use of a case study protocol and the development of a case study database.\textsuperscript{181} This is supported by Yin (2003) who also adds that the use of a pilot study and establishing and maintaining a chain of evidence will contribute to increasing the reliability of a case study.\textsuperscript{182} Reliability and validity are bound together in an inseparable manner, and there is no internal validity without reliability, and by increasing the internal validity it will automatically increase the reliability.

Recording the interviews by using recording devices and by taking notes contribute to increasing the reliability of the study since it then is possible to analyse and verify the answers afterwards. Furthermore, by observing the phenomena in the warehouse, and by documenting and photographing the warehouse, also contributed to increasing the reliability.

\textsuperscript{178} Yin, R.K (2003) p. 46-53
\textsuperscript{179} Merriam, S.B (1994) p. 180-183
\textsuperscript{180} Björklund, M and Pailsson, U (2003) p. 59-60
\textsuperscript{181} Ellram, L.M (1996) p. 104
\textsuperscript{182} Yin, R.K. (2003) p. 35-36
In the same way as Yin (2003) stated for construct validity, Yin (2003) suggests that the two principles of data collection - create a case study database and maintain a chain of evidence - should be taken into consideration when concerning reliability.¹⁸³ These two principles have already been discussed in the Section 5.3.1 Construct Validity above. Since a pilot study was not conducted for our thesis, this will not be addressed.

**The Case Study Protocol**

A case study protocol is similar to a planning report, it is a detailed document with comprehensive guidelines which will guide the research and present feedback on whether the case study makes any sense or not. More specifically, as Everard et al. (2004) argues it is a detailed statement of what the researcher is trying to achieve, as well as a plan that indicates how the objectivities will be met.¹⁸⁴ The case study protocol forces researchers to consider all relevant issues concerning their research which in turn contributes to greater internal and external validity. When dealing with multiple case studies, a case study protocol is essential to ensure reliability.¹⁸⁵ This statement is supported by Yin (2003) who also argues that a case study protocol is more than a questionnaire or instrument: first and foremost it contains the instruments, procedures and the general rules to be followed; and secondly the protocol is directed at a different party than that of an instrument.¹⁸⁶ Yin (2003) mentions that the six sources of evidence for data collection should be used and he continues stating that it is essential for multiple case studies to have a protocol which should contain:

- An overview of the case study project - including project objectives, case study issues, and presentations about the topic under study
- Field procedures - reminders about procedures, credentials for access to data sources, location of those sources
- Case study questions - the questions that the investigator must keep in mind during data collection
- A guide for the case study report - the outline and format for the report

Instead of creating a case study protocol we decided to use a planning report which is, as mentioned earlier, similar to a case study protocol. To make sure that we are on schedule with our work, the planning report is revised on a regular basis.

¹⁸⁴ Everard et al. (2004) p. 171
5.4 Designing the Case Study

When designing a case study Yin (2003) states that there are five components of a research design which are especially important:\[188\]

1. A study’s questions.
2. Its proportions, if any.
3. Its unit(s) of analysis.
4. The logic linking the data to the proportions.
5. The criteria for interpreting the findings.

5.4.1 The Study's Research Questions

This section of the thesis is meant to highlight the research questions which have been used to answer the thesis purpose from Section 1.3 which is ‘to map and to analyse the company in order to improve the inventory, warehouse layout and the methods being used in warehouse management. The result should in part be based on benchmarking with other companies’. The research questions are discussed further in Section 4.2 Research Questions.

5.4.2 The Study’s Propositions

The study’s propositions derive from ‘how’ and ‘why’ questions which led to the choice of a multiple case study as the appropriate strategy for this thesis. Each proposition directs attention to something that should be examined within the range of this study and which will guide the researcher in the right direction and focus on the study’s goal. According to Tellis (1997), who cites Yin (1994), every case study is not required to have propositions, and an exploratory case study rather has a stated purpose or criteria on which the success will be judged. Therefore, this thesis is predominantly explorative, no determined hypothesis or propositions will be tested.

5.4.3 The Units of Analysis

This component is related to the way one has defined their research questions and also to the problem of defining what a ‘case’ is; an individual, a group of individuals, an event, an entity, an object etc. Trochim (2006) states that it is ‘he analysis you do in your study that determines what the unit is’. By accurately specifying the primary research questions a

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\[188\] Yin, R.K (2003) p. 19-21
\[189\] Yin, R.K (2003) p. 22
http://www.socialresearchmethods.net/kb/unitanal.php
\[191\] Trochim, W.M.K http://www.socialresearchmethods.net/kb/unitanal.php
selection of an appropriate unit of analysis will occur’. 192 However, ‘if the questions do not lead to the favouring of any unit of analysis the questions are either too vague or too numerous and there will be difficulties in conducting the case study’. 193 In Yin’s Case Study Research: Design and Methods one can distinguish that the unit of analysis has two Sections; Holistic Versus Embedded Cases and Single versus Multiple Cases Study which will be discussed before moving in to the next section.

Since this case is multiple and embedded, the case is split into multiple units of analysis.

**Holistic Versus Embedded Case**

A case study can involve more than one unit of analysis. Within a single case study this occurs when attention is given to a subunit or subunits. If a study examined a global nature of an organization or a program it will be considered as holistic, however if a study concerns a single organization where subunits are to be examined it is referred to as an embedded case. 194 Scholz et al. (2002) argue that a holistic case is created by a thoroughly qualitative approach that relies on narrative, phenomenological descriptions while an embedded case involves more than one unit, or object, of analysis and are usually not only limited to qualitative analysis. 195

Both of these approaches do not only apply to single case studies, but they also apply to multiple case studies. In cases regarding multiple case studies, a single multiple case study can consist of multiple holistic cases or multiple embedded cases. Figure 15 below shows the case study design which Yin (2003) was trying to illustrate:

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195 Scholz, R.W et al. (2002) p. 9
**Figure 15: Holistic versus Embedded Units of Analysis. (Source: Yin, R.K. (2003 p.40))**

### Single versus Multiple Cases Study

Within case study research one distinguishes between single versus multiple case studies; single based on information from one case while multiple is based on information from several cases. Eisenhardt et al. (2007) cites Siggelkow (2007) who states that single-case studies can richly describe the existence of a phenomenon while multiple-case studies provide a stronger base for theory building.\(^{196}\) According to Blumberg et al. (2005), and defended by Yin (2003), it is better to investigate an issue in more than one context than basing the results on just a single case; this will in turn contribute to increasing the chances of producing a good case study. However, Blumberg et al. (2005) point out that there are times when single case studies are more sufficient than multiple case studies. If case studies are critical, extreme or unique it is more appropriate to use a single case study, highlighting that in these cases that there is usually only one recorded case that has occurred.\(^{197}\)

Multiple case studies are more appealing since they provide more robust results. Yin (2003) supports this by stating that the analytic benefits from having two, or more, cases may be substantial since multiple case studies have more distinct advantages and disadvantages, the evidence is considered to be more compelling and the overall study is regarded as being more robust. Blumberg et al. (2005) mention that multiple case studies are based on replication logic, which means that based on a researchers theory it is expected that the same phenomenon occurs in the same circumstances or that the phenomenon differs if the

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\(^{196}\) Eisenhardt, K.M et al. (2007) p. 27

\(^{197}\) Blumberg et al. (2005) p. 192-193
circumstances changes.\textsuperscript{198} Blumberg et al. (2005) also states that it is important to remember that case study results are generalized to theoretical propositions and not to population as they are in surveys. Moreover, Yin (2003) points to that multiple case studies can require extensive resources and time which can be a limitation for a researcher.

Our choice of conducting multiple case studies will contribute to us being able to generalize some of our finding which in turn will help to find answers for our research questions. The disadvantage with this choice however, is that it will act as a time limitation for our thesis since it would not be possible to in depth investigate the individual cases as much as we would like. However, our choice of the multiple case studies as an approach is the best for our thesis even though there are some disadvantages with the method.

The next section will present the study’s units of analysis which we argue is applicable for our thesis.

\textbf{The Units of analysis in this Thesis}

Since our study concerns a single organization where a subunit, the warehouse, is being examined, the embedded case design is chosen. As we already have established we are also dealing with multiple case studies which will put us in the bottom right picture in Figure 1. \textit{Holistic versus Embedded Units of Analysis}; this means that our study is a multiple embedded case.

In each case, each company, there is one embedded units of analysis, namely the warehouse, which we are focusing on. Since ECO has more than one warehouse the warehouse which we will be focusing on is the finished goods warehouse. In the BSAB and ECO cases we will try look at the most interesting aspects and identify what we believe will add insight to the Färggrossen case. By identifying the most interesting and relevant aspects it will aid us in the work process of the analysis.

\subsection*{5.4.4 Logic Linking the Data to the Propositions and The Criteria for Interpreting the Findings}

Conrad et al. (2001) cites Pedhazur and Schmelkin (1991) who state that logic linking the data to propositions and the criteria for interpreting the findings are useful research questions when deciding an appropriate research design.\textsuperscript{199} Together with the fifth component, ‘The Criteria for Interpretation the Findings’, these represent the data analysis step in case study

\textsuperscript{198} Blumberg et al. (2005) p. 192-193
\textsuperscript{199} Conrad et al. (2001) cites Pedhazur and Schmelkin (1991) p. 377
research, and a research design should lay a solid foundation for this analysis. Linking data to propositions can be conducted in many different ways; however the most promising approach for case studies is the ‘pattern matching’.\textsuperscript{200}

There is no precise way of setting the criteria for interpreting the findings; however the findings can be interpreted in terms of comparing at least two rival propositions. When concerning both logic linking the data to the propositions and the criteria for interpreting the findings in exploratory and descriptive studies where the propositions are not used, one cannot use these components since they cannot be clearly defined beforehand.\textsuperscript{201}

The pattern matching approach will be addressed in the Section 5.7 Analyzing Case Study Evidence.

\section*{5.5 \textbf{The Sequence of Work in this Thesis}}

This section will present a literature study. The study has been divided into several steps which are illustrated in Figure 16 below. The three main domains are: Theory, Analysis and Empirical Studies.

\textsuperscript{200} Yin (2003) p. 26

\textsuperscript{201} Yin (2003) p. 26
Each of the boxes in Figure 16 are addressed individually in the subsequent sections.

5.5.1 Discussions with Färggrossen Regarding the Purpose, etc.

Our study began with discussions with Färggrossen’s CEO, Mikael Lindgren, about the purpose of the thesis, initial directives and what Lindgren’s aim for the thesis. Furthermore,
discussions with warehouse manager, Patrick Ledin, occurred in order to inform Ledin on why our study is being conducted. One of the directives which Lindgren emphasised on, was to concentrate on improving the warehouse layout and processes, and if there was time also study the delivery lines in order to improve them.

5.5.2 Literature Study

A literature study examines recent or historically significant research studies, as well as company data or industry reports; all of these act as a basis for the proposed study. The literature can also consist of information, electronically or printed, from books, brochures, articles and magazines. The studied information is considered to be secondary data and it is important to take into consideration that this information might be biased.

The first step of our literature study was to collect necessary and important information to enable us to gain more insight and a good overview of the relevant theories, and also to make it possible for us to write the methodology chapter of the thesis. The principle method used for this literature study was to study secondary printed literature, books and articles, from Linköping University library. The electronic literature was studied from the Linköping University database, more specifically from Business Source Premier and Emerald. These databases were predominantly studied for information which we considered to be most valid and reliable, which in turn will provide us with a valid literature study. The Business Source Premier database consists of over 10 000 economic journals and out of them over 9 000 are in full-text articles while the Emerald database consists of about 200 economic journals, and the majority of them are full-text articles.

Also scientific articles, not found on these two databases as well as annual reports, were studied for further insight into the appropriate areas.

The advantage of a literature study is that it is an inexpensive way of collecting information. However, the information which is collected is secondary and it is essential that the gathered information comes from trustworthy sources, such as well known authors or from scientific articles.

202 Cooper, D.R et al. (1998) p. 92
204 http://www.bibl.liu.se/databas/db_alf.asp
5.5.3 **Planning the Thesis**

Based on the information gathered from the literature study as well as the information collected through the initial discussions at Färggrossen, the planning of the thesis was initiated. A time plan was created to function as a guideline throughout the entire study, and with the aim to help us meet our deadlines. By observing the activities at Färggrossen we decided, in agreement with Lindgren, to study the warehouse processes, such as putaway and storing, to limit the literature research in order to deal with a manageable amount of literature.

5.5.4 **Literature Search and Interview Planning**

Subsequent to creating the time plan as well as being given the directives, we initiated the structuring and working with the theoretical frame of reference as well as creating the interview guides. To conduct the interviews, studying literature regarding different interview techniques is required and this led to the interview guide being carefully planned and structured in order to guarantee asking the right questions. The reason for each interview question is addressed in Section 5.7 Interview Questions and a summary of the interview questions is found in Appendix 1.

5.5.5 **Frame of Reference**

A wide-range theoretical research was performed in order to the areas of interest which in turn led to narrowing down the specific areas of interest as well as to create the interview guide. With the help of the information gathered from the literature study, the main areas of interest were narrowed down and studied in deeper detail. In order to enhance the credibility of our thesis, the information gathered through the literature study consisted of books, articles, etc. from well-known authors as well as from other reliable sources which have been mentioned in Section 5.5.2 Literature Study above.

5.5.6 **Thesis Specification**

Subsequent to completing the steps mentioned above, the task specification was initiated. Firstly, the purpose was broken down into smaller sections in order to elucidate the purpose of the thesis for the reader. Secondly, the thesis research questions were identified and their relevance to our thesis was explained. Lastly, the thesis directives were presented in order to clarify the process of the thesis.

5.5.7 **Interviews with Färggrossen, BSAB and ECO**

Based on the research questions as well as the theoretical frame of reference the interview guide was created. As stated in the Section Interview Techniques, part of Section 5.6.1 Primary
Data and Information Collection, face-to-face interviews were conducted. Questionnaires were used to follow up on the gathered information in order to validate it as well as having e-mail contact with representatives at each of the three companies. The results of each of the companies’ interviews are found in Chapter 6 The Case Studies as well as in Appendix 2, 3 and 4.

### 5.5.8 Cross-case Synthesis and Within-case Analysis

Subsequent to conducting the three interviews as well as interpreting the collected information in the case studies, the analysis process was initiated. Through a within-case analysis, the individual cases were compared to the theory in order to find patterns and identify the similarities and differences. A cross-case synthesis compared the individual cases with each other and also identified patterns as well as similarities and differences. Each of the research questions are addressed individually and the results are discussed and commented on and suggestions and recommendations are made.

### 5.5.9 Conclusions and Preliminary Recommendations

Based on the analysis results, the conclusions are summarized and briefly addressed in the three categories; main recommendations, secondary recommendations and future recommendations. In order to clarify the recommendations we have suggested, these recommendations need to be conducted in order to achieve an improved warehouse layout and processes, hence, in order to fulfil the purpose of the thesis as well as Lindgren’s goals.

### 5.5.10 Discussions with Färggrossen Regarding Conclusions and Recommendations

Discussions with Färggrossen will be conducted subsequent to the preliminary recommendations being identified. The purpose of these discussions is to involve Färggrossen and take into consideration their opinions regarding our suggestions. This is important since the workers at Färggrossen will be performing the changes and it is essential that they are not resistant to implementing the changes. The outcome of these discussions will hopefully result in feasible recommendations which can be implemented in Färggrossen.

### 5.5.11 Final Recommendations

Lastly, final recommendations are provided to Färggrossen. These recommendations should function as a guideline for improving the warehouse layout and processes at Färggrossen as well as for other companies in similar situations.
5.6 Data and Information Collection Methods

There are two different ways of collecting data and information: primary and secondary. Primary data is new data which has been gathered specifically for the purpose, while secondary data is data which has already been collected for some other purpose.\(^\text{205}\) As mentioned in the Section The use of Multiple Sources of Evidence, part of Section 5.3.1 Construct Validity, Yin (2003) states that there are six different data collection sources used to gather information.\(^\text{206}\) He further states that ‘any finding or conclusion in a case study is likely to be much more convincing and accurate if it is based on several different sources of information’ and this is what he refers to as triangulation. Stake (1995), cited by Scholz et al. (2002), refer to triangulation ‘as the process of substantiating interpretations’ and that the process aims to enable the reader ‘gain insight into the case analysis or the construction of meaning and to improve the validity of case analysis’.\(^\text{207}\) Scholz et al. (2002) also cite Denzin and Lincoln (1994), stating that ‘the researcher has a choice of not only using co-observers, panellists or reviewers from alternative theoretical viewpoints, but they can also use standard tools of qualitative research’.\(^\text{208}\)

The sources which are used in this thesis are: documentation, archival records and interviews. The next section discusses the data collection methods which have been used for this thesis.

5.6.1 Primary Data and Information Collection

Primary data, which can be collected in different ways, are referred to as data collected with the purpose of being used in the current study.\(^\text{209}\) Saunders et al. (2003) refer to primary data as ‘the first occurrence of a piece of work’, and state that these primary data are in the form of published sources such as reports, planning documents, memos etc.\(^\text{210}\)

The primary data which was collected for our thesis was collected through interviews with each of the three companies. Björklund and Paulsson (2003) categorize interviews as questioning which takes place through personnel direct contact, via telephone, e-mail or text messaging.\(^\text{211}\)

\(^{205}\) Saunders, M et al. (2003) p. 188  
\(^{207}\) Scholz, Dr R.W et al. (2002) p. 21  
\(^{208}\) Scholz, Dr R.W et al. (2002) p. 22  
\(^{209}\) Houser, J (2008) p. 246  
\(^{210}\) Saunders, M et al. (2003) p. 51  
\(^{211}\) Björklund, M and Paulsson, U (2003) p. 68
The following topic will discuss the different interview techniques which were used for our primary data and information collection.

**Interview Techniques**

Interviews can be conducted in many different ways such as through face-to-face interviews, e-mail interviews, telephone interviews and questionnaires. Using interviews, reliable and valid information useful for the research can be gathered; depending on the situation, the different methods can be more or less appropriate. Lekvall and Wahlbin (2001) briefly summarize the different interview techniques and their characteristics in Table 8 below:

*Table 8: Interview Technique and Their Characteristics. (Source: Lekvall, P. and Wahlbin, C. (2001 p.263))*

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Questionnaire</th>
<th>Telephone interview</th>
<th>Face to face interview</th>
<th>Internet interview</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost per interview</td>
<td>Low</td>
<td>Fairly Low</td>
<td>Often High</td>
<td>Fairly Low</td>
</tr>
<tr>
<td>Speed</td>
<td>Often Low</td>
<td>High</td>
<td>Fairly High</td>
<td>High</td>
</tr>
<tr>
<td></td>
<td>Special when posting</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Risk for large losses</td>
<td>Often High</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Sometimes High</td>
</tr>
<tr>
<td>Control of who is answering</td>
<td>Often Bad</td>
<td>Good</td>
<td>Good</td>
<td>Limited</td>
</tr>
<tr>
<td>Possibility to ‘dynamic’ questions</td>
<td>None</td>
<td>Fairly Good</td>
<td>Good</td>
<td>Limited</td>
</tr>
<tr>
<td>Limitations in question technique</td>
<td>Large</td>
<td>Some</td>
<td>None</td>
<td>Few</td>
</tr>
<tr>
<td>Maximal reasonable extent of an interview</td>
<td>Up to 40-50 questions with a total of a couple hundred ‘items’</td>
<td>5-30 min Depending on the interest of the respondent</td>
<td>Up to 2-3h when interesting subject for the respondent</td>
<td>About the same as for a questionnaire</td>
</tr>
<tr>
<td>Possibility to guarantee anonymity for the respondent</td>
<td>Good</td>
<td>Limited</td>
<td>Limited</td>
<td>Limited</td>
</tr>
</tbody>
</table>

Furthermore, Yin (2003), Saunders et al. (2003) and a few other authors classify interviews into different categories which we have summarized in Table 9:

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### Table 9: Interview Classifications. (Source: Our Own)

<table>
<thead>
<tr>
<th></th>
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<th></th>
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<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Structured</td>
<td>Semi-structured</td>
<td>Unstructured</td>
<td>Structured</td>
<td>Semi-structured</td>
<td>Structured</td>
<td>Structured</td>
<td>Survey</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Respondent</td>
<td>Group interview</td>
<td>Unstructured</td>
<td>Open-ended</td>
<td>Focused</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Informant</td>
<td></td>
<td>Informant</td>
<td>Focus group</td>
<td>Open-ended</td>
</tr>
</tbody>
</table>

Generally the authors use the same or similar classifications for the different interview techniques. *Structured interviews* use questionnaires based on predetermined and *standardized* or identical set of questions which also can be compared to the *respondent interview* where the interviewer directs the interview, and the interviewee responds to the questions of the researcher. By comparison, *semi-structured* and *unstructured interviews* are *non-standardized*; where in semi-structured interviews the researcher has a more informal list of questions to be covered while unstructured interviews are informal and are used for in-depth interviews. These can also be linked to the *informant interview*, where it is the interviewee’s perceptions that guide the conduct of the interview.213

For our thesis we have chosen to combine *face-to-face interviews* with *e-mail interviews*. Our plan was also to gain information and understanding through a *pilot study* which was to be done for the benchmarking of three companies; however, lack of time resulted in the pilot study not being conducted. By not conducting a pilot study will not affect our study negatively, however, we will not be able to use the pilot study to link the information to Färggrossen which in turn will increase the studies reliability.

Furthermore, we chose a combination of *focused* and *open-ended interviews* as our interview approach. According to Silverman (2006), open-ended interviews require skills such as flexibility, rapport with interviewee and active listening; this argument is supported and taken further by Yin (2003), who states that open-ended interviews are commonly used.

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within case studies and that key respondents can be asked about the facts of a matter and their opinion about events.\textsuperscript{214}

The information gathering at Färggrossen began with semi-structured interviews. As Robson (2002:59), cited in Saunders et al. (2003) state, ‘semi-structured interviews allow the researcher to conduct an exploratory study where in-depth interviews could help the researcher to find out what is happening [and] to seek new insight’.\textsuperscript{215}

The interviews which took place at BSAB and ECO were structured interviews where we used an interview guide, originally our pilot study, as a basis.

The information we gathered at the interviews with the three companies was recorded to ensure minimizing the loss of information. This way we were also able to reconfirm the collected information at any given time without having to re-interview the key persons.

\textbf{5.6.2 Secondary Data and Information Collection}

Blaxter et al. (2006) refer to secondary data as ‘data which already have been collected, and also possibly analysed’, by somebody else, while Cooper et al. (1998) refer to secondary data as ‘data which have had at least one level of interpretation inserted between the event and its recording’.\textsuperscript{216} Secondary data and information can be divided into two categories: internal and external data, where internal data are available within the studied company and external data are provided by sources outside the company.\textsuperscript{217} The advantages with secondary data are that the information is already collected, easy to analyse, often come from reliable sources; and its inexpensive and less time consuming to collect data.\textsuperscript{218} The disadvantages however are that the information can be hard to get, the information may not be available, there may be problems in the quality and accuracy of the information, and the information might be biased.\textsuperscript{219}

\textbf{Internal Secondary Information}

Internal secondary information is obtained from the studied company and consists of information within the company.\textsuperscript{220} However, as we noticed early in the process, the company, like other companies, had not collected or maintained sales and cost data in a


\textsuperscript{215} Saunders, M et al. (2003) p. 245-247


\textsuperscript{217} Blumberg, B (2005) p. 346-348


\textsuperscript{220} \url{http://www.fao.org/docrep/w3241e/w3241e00.HTM}
detailed way. The previous owner did not believe in the use of computers which resulted in all records being kept on paper and impossible to study. The advantage of internal secondary information is that it is an inexpensive way of gathering information and that the information is easily available for research investigations.\textsuperscript{221}

For this thesis information in form of annual reports and maps of the warehouse layout have been obtained from the company.

**External Secondary Information**

External secondary information is obtained from outside sources, such as, from libraries. The Section 5.5.1 *Literature Study* has already discussed the different information gathering methods which have been used for this literature study; other examples of external data sources which can be used are:

- Federal/State governments
- Statistics agencies
- Trade associations
- Magazine and newspaper articles
- Annual reports
- Academic and general business publications
- Library sources and computerized bibliographies

Most of them are mentioned by Crawford (1997).\textsuperscript{222}

As mentioned in the previous section we chose to gather information through general business publications, magazines and newspaper articles, annual reports, academic publications, library sources and computerized bibliographies as well as through the interviews.

The following section presents the questions which were asked at each of the three interviews and the reason to why each question was asked as well as how each question can be linked to the theory and to Färggrossen.

\textsuperscript{221} http://www.steppingstones.ca/artman/publish/article_60.shtml
\textsuperscript{222} http://www.steppingstones.ca/artman/publish/article_60.shtml
5.7 Interview Questions

Färggrossen are experiencing many different problems in their warehouse and at our meeting with Färggrossen we were informed about those problems, which we plan to answer with the help of the research questions that are identified in Section 4.2 Research Question. To initiate the project, we reviewed some theoretical studies and we tried to explain the warehouse layout. The researched theory is related to the problems which Färggrossen are experiencing, and our main goal is to enlighten the problems which Färggrossen are experiencing as well as suggesting recommendations with the help of benchmarking and through researching theory. In order to make significant recommendations, it is important to clearly understand the problems.

As our main research approach, we decided on multiple case studies, which was addressed in Chapter 5 Research Design and Methodology. The reason for choosing this research approach lies in the theoretical framework which was based on large scaled companies. Since the suggestions focused on large scaled companies, which require vast investments, most of the suggested solutions from the theory, would be too expensive for Färggrossen.

With a multiple case studies as our methodology, we planned to examine similarities and differences between the selected companies. Even though the similarities and differences are important, identifying the advantages and disadvantages of different methods, used in different processes in different companies, is more important. This comparison is planned to provide us with information regarding the variety of decisions and choices that can be made.

The multiple-case study will help us identify the solutions to the key issue in each company, which we in turn will compare with the theory and which would provide us with recommendations for Färggrossen. The companies, ECO and BSAB, were chosen by Färggrossen’s CEO based on their size and their functional similarity.

BSAB and ECO were both visited in order to conduct interviews with Jonas Sjöö at ECO as well as Thomas Nygren and Sanna Nygren at BSAB. The main questions which were asked mainly concerned the warehouse system and prior to the interviews we had carefully planned an interview guide. Following the structure of the interview guide guaranteed that all questions we needed answered were answered and follow ups on the interview were conducted in order to confirm the credibility of the gathered information. All three companies were asked the exact same questions in order to simplify the analysis process as well as simplify comparing the companies with each other and to the theory.
The following sections address the reasons for why the interview questions were asked.

5.7.1 General Information Questions

The reason behind asking general questions is to learn basic facts about each company. The company name, ownership, etc. is necessary information which is needed in order to provide the reader, as well as ourselves, with basic information about the companies. The names of the interviewed company representatives are important data which needs to be stated in order to strengthen the interview’s credibility.

Questions about financial facts are asked in order to compare the sizes of the companies. Production is not something which Färggrossen deals with, therefore, the questions regarding production aim learning more about the final warehouse supplier as well as identifying where the demand planning starts.

5.7.2 Human Resources Questions

The human resources questions are asked in order to learn how many employees the company has as well as how many of those employees are work in the warehouse. The organizational charts define the order-command chain which might help understand who the people in charge are.

1. How many employees does the company have?
2. How many of these employees work in warehousing/procurement?
3. Describe the organizational structure.

In Section 3.3.1 Man (Personnel) in the theoretical frame of reference, it was stated that efficiency is closely related to workers performance and usage of time in many different aspects. Observing the workers is important in order to learn more about time loss and their classifications. However, due to time limitations it was not possible for us to visit the companies for longer periods of time in order to collect this kind of data. The questions regarding picking times are asked in order to compare the companies regarding time usage.

As follow up questions, detailed information about the order-command chain as well as working shifts and noticeable problems regarding worker performance, were asked.

5.7.3 Customer Relations

As an output of the warehouse, customer satisfaction is addressed in Section 3.5 Warehouse System Outputs. Since a multiple case study is used for conducting this thesis, it is important that we study the companies’ customer portfolio as well as if each company has special offers.
for the customers. In addition, it is important to examine what Färggrossen can learn from the other companies in order to maintain a high customer satisfaction level.

- *How is the customer relations managed?*

The number of customers which each company has is important to know in order to identify the intensity when comparing the companies.

- *How many customers does the company have?*

The customer locations and delivery times is one of the main customer satisfaction aspects in service businesses. A customer might be receiving its order in two weeks even though the warehouse is ten minutes away.

- *Where are the customers located? What is the lead time to customer?*

As a follow up question, we asked each interviewee if the company had contracts or special agreements with their customer.

- *How is the customer contracts formed?*

### 5.7.4 Demand Planning Questions

When regarding warehousing, customer satisfaction is a prioritised output since supplying customer orders at the right time, with the right products, in the right quantity and without time loss is essential.

As previously mentioned in the theoretical frame of reference, keeping inventory is a large investment for the company. Holding inventory is fairly expensive but there are other costs, mentioned in Section 3.3.2 Money, which are also expensive. Keeping inventory involves and affects many different costs, which indicated that this process needs to be carefully planned.

The demand level is the main input that affects the decision on the warehouse stock levels, which in turn can be affected by economical situations as well as seasonal fluctuations. Questions regarding demand planning will provide facts about cost, customer satisfaction and company contingency plans.

1. *How does the company handle demand planning?*

This question is asked in order to learn if the company applies demand planning as well as to find out what kind of method is used to determine safety stocks.

2. *Do you use a technique to determine seasonal variations, and the intensity of seasonal swings? If so, what kind of technique?*
This question aims to answer if the company is aware of the stock level fluctuations in the warehouse.

3. Do you use a technique to determine average order-size? If so, what kind of technique?

When mentioning the warehouse, it is important to keep in mind the vast amount of tied up capital. Therefore, it is important not to order more products than necessary as well as avoiding experiencing stockouts and risk loosing customers. This question aims to observe the companies awareness.

4. How accurate was the company’s demand planning?

Planning is considered to be easy, but it is important to know what is considered during the planning period. Is the planning conducted with updated and valid data? Is the planning done according to seasonal fluctuations?, etc.

5. Has the company ever had problems due to demand planning? If so, please elaborate.

With this question, we find out if any of the companies have lost a customer due to stockouts or if any of the companies has been forced to pay any fees due to failing to fulfill a customer contract.

6. Is there any documentation about demand planning?

Keeping som sort of documentation or records means that the data in the system is valid and updated. This question is aimed at providing us with answera if the data regarding demand planning is valid.

5.7.5 Warehousing Questions

The most important part of our interview questions that need to be answered is the warehouse questions. Since our thesis regards overall warehousing factors - such as how it works, which machines are used, personnel profile, where the warehouse is located, what kind of racks are used and why the racks are organised the way they are - leads us to the warehouse layout theory.

1. How is the warehouse managed? Please explain the procedure.

To be able to understand to warehouse, we asked the company to define their warehouse processes. After studying the overall warehouse processes, detailed questions are asked regarding each process.
2. How many warehouses does the company use? (Explain for raw material, end product, etc.)

3. How did the company decide the location of the warehouse/s?

This question aims at learning variables such as why the warehouse was built and which factors are prioritized in the decision making.

4. Is/are the warehouse/s owned, rented, leased or contracted? Why?

This question is asked in order to know more about the type of warehouse which is used.

5. How did the company decide on the layout of the warehouse?

Since the main topic of this thesis is the warehouse, it is important to know what the companies consider when deciding the warehouse layout.

6. Are the stocking positions in the warehouse coded for specific products?

This question is asked in order to know what kind of stocking system the companies are using (family grouping, fixed or floating slots).

7. What is taken into consideration in the placement of a product in the warehouse?

The aim of this question is to find out if there are any specific products which require the need of any special precautions when being stored.

8. How does your information system work?

This question is asked in order to distinguish if the warehouse data about such as products, stocking positions, stock levels, etc. are valid and up to date.

9. Is the company using a locator address system? (Rack codes, etc.)

This question is asked in order to find out if the company has a locator addressing system that covers the entire warehouse as well as if it was easy to understand and use. Via visual observations this kind of data will be gathered.

10. Is the company using a specific item coding system?

This question is asked in order to know more about the companies' value adding logistics as well as finding out if it is easy to find products and how the different products are perceived.

11. How accurate is the warehouse system? (Was it easy to find products?)
One of the main problems in Färggrossen regards locating products. If a product needs to be found it is necessary to find the worker who handled the product placement in the putaway process. This question aims to compare the situation in other companies and how they deal with this issue.

12. *What kind of emergency plans does the warehouse have? (Safety-equipment etc.)*

This question is aimed to know more about the companies fire safety equipment, educational background and work health awareness.

13. *Have there been any problems in the warehouse system? Please explain*

Asking this question will provide us with information on how the companies view the problems which they are experiencing in the warehouse system as well as the identified solution to the problems.

14. *What kind of storage materials are being used in the warehouse? (Types of racks etc.)*

Different types of handling equipment and its area usage might provide us with new ideas regarding what can be used in Färggrossen. Different types of storage equipment and the benefits from different types is also another thing that Färggrossen might benefit from. All of those decisions are motivated with customer satisfaction.

The reason for asking the questions in the previous sections is in order to identify patterns in the Sections 3.3.3 Machine (Equipment), 3.3.4 Milieu (Environment), 3.3.5 Method, 3.3.6 Material (Goods/Products) and 3.2.1 Warehousing Classifications. The questions regarding outer milieu leads us to future recommendations.

5.7.6 **Goods Reception Questions**

This section presents questions regarding how the products/goods are received at the three different companies. These questions are asked in order to gain deeper understanding in how this process in conducted and in order to provide Färggrossen with suggestions that might improve this process.

1. *How are the goods checked in?*

In the warehousing system, the work flow starts with receiving goods and the methods which the companies use are important know. If inspections are conducted as well as what methods are used to inspect the incoming goods, is also important to know.
2. **How is the scheduling for reception of goods?**

The scheduling and the frequency of the incoming goods will provide us with ideas of comparing workload, the intensity of labour and time usage.

3. **How are the deviations in the shipments managed?**

In Section 3.3.5 Method, it is mentioned that the order placement is very important to know in order to understand how the system works. Therefore, this question mainly aims at understanding how the receiving is scheduled and correspondingly, the labour management according to the schedule.

4. **Have there been any problems in the reception process? Please explain**

A company’s view of their own problems provides us with more valid information since we only have a limited time to observe the process. This question aims to compare the companies’ problems in the receiving process.

5.7.7 **Material Handling Questions**

Material handling is one the main functions in the warehouse. Our interview questions are asked in order to learn who manages the material handling and what types of equipment are used in the companies. The reasons behind the decisions of the specific equipment are asked as follow up questions.

1. **How is the handling of materials managed?**

2. **What kind of equipment is used for handling materials?**

There might be different types of machines that are used by one of the companies that might be applicable to Färggrossen which in turn will help us with our thesis. This question is asked in order to identify the similarities and differences in decisions regarding machine usage.

3. **What is the approximate time for handling materials after they have been received? Have there been any studies about this by the company?**

Another important factor regarding material handling is the time usage of material handling. This kind of data is not reliable unless the companies have conducted any time studies and they can provide us with ideas through benchmarking the companies in order to identify
time wastes. This question corresponds to the time usage which is addressed in Section 3.3.1 Man (Personnel).

4. Have there been any problems in the handling materials? Please explain

The problems regarding material handling will provide us with the opportunity to compare different companies’ material handling processes. This might lead us to what kind of material handling equipment which is needed and which processes that can be improved by comparing the different companies.

5.7.8 Order Picking Questions

After receiving and handling the goods, the order picking process is initiated once the order is received from a customer. Order picking is another crucial function in the warehouse system. The questions regarding order picking are asked in order to distinguish what types of machinery, data systems and methods are used to during the order picking process.

5. How is the order picking managed?

General information about how the company handles order picking is asked in order to learn more about material handling in the companies.

6. What kind of equipment is being used for order picking?

What types of equipment is used in the order picking process and is there any special equipment that is needed in the company are also questions which need to be asked.

7. In, which order are the goods being picked?

According to our research, there are different types of method to choose from with regards to order picking and the companies’ benefit from the selected method is what we needed to know. With this question we want to identify the company’s preference regarding order picking methods, which have been addressed in Section 3.3.5 Method (bulk picking, zone or discrete). This is an important factor that affects the delivery times and customer satisfaction.

8. What is the approximate order picking time? Have there been any studies about this by the company?

The time spent on order picking allowed us to distinguish the level of customer satisfaction. Unless the company has some particular time studies about this topic, the data we are given
will not have any significant value; however, it is always good to know where the company thinks it stands.

9. *Have there been any problems in the order picking? Please explain*

This question is asked in order to find out if the companies think they experience any problems with regards to order picking process.

### 5.7.9 Purchasing/Inventory Questions

The warehouse is where the products are received, stocked, picked and delivered to customers. While we previously discussed the inventory costs, purchasing is also a crucial factor with regards to receiving, handling and stocking the goods. The number of items being ordered and how often they are ordered directly affects the receiving process, frequency and as a result, the labourer usage.

1. *How the purchasing is managed?*

This question will provide the answer to how the items are ordered, from which supplier, how the suppliers are selected and if the company asked for quotation or ordered directly.

2. *How is the ordering process managed?*

This question is aimed to reveal the details of the ordering process, who orders the goods, how the order quantities are assigned, when the order decisions are made and what the criterions are.

3. *How is the ordering decisions given?*

It is important to know who made the decision and, what criterion ae taken into consideration in the decisions.

4. *Do the suppliers confirm orders?*

This question is asked in order to distinguish the communication level between the company and its suppliers.

5. *How were the suppliers found, and how are the relations handled?*

Regarding suppliers and their reliabilities it is important to simplify the communication in order to predict how the order receiving is conducted. Knowing more about the companies’
suppliers will provide us with the benefit of allowing us to disregard or pay more attention to the fluctuations at the receiving process depending on the results that we find.

6. **What is the company’s strategy on supplier selection?**

While some companies prefer working with one supplier and get an increased discount as time passes, other companies like to have more suppliers that they can choose from and purchase from based on quotation. This questions aim is therefore to learn the companies choices regarding these options.

7. **Have there been any problems in the ordering process? Please explain**

The purchasing questions are asked in order to learn more about the warehouse background. The gathered data allows us to learn more about the different companies’ warehouse systems - such as the types of products that are ordered (Section 3.3.6. Material (Goods/Products)), the type of products determines what type of equipment they will be handled with (Section 3.3.3 Machine (Equipment)) and in which type of stocking equipment they would be stocked (Section 3.3.3 Machine (Equipment))

5.7.10 **Information System Questions**

So far, we have asked questions in order to understand the manner in which the warehouse and management functions. All questions regard clearly defining the system as well as to have enough information in order to compare all companies with each other.

No kind of business can function without an information flow and all the information in the company, is contained in the information system and when it is needed, the system covers the data flow. Without data flow, the system will not work efficiently and the orders cannot be delivered as they are ordered, which with time will cause customer satisfaction loss.

1. **Does the company use a database or any kind of ERP system? If so, what kind?**

Information systems are complicated and at a first glance they are not easy to understand and that is why detailed questions regarding the informations system are not asked. For a warehouse information system, data such as inventory levels, stock locations, customer orders, supplier deliveries, item codes and similar data should be saved. This important question is asked in order to distinguish the level of information system usage in the companies.

2. **What kind of data was being saved?**
The type of data which is being saved and the availability and ease of use is very important. Without being able to review the data that is saved, there is no point to save the data.

3. *Was it easy to find specific data in the system?*

4. *How is the data input handled in the system?*

‘Data’ input is where the information flow actually starts. Delays and repeats regarding the data entry is very important since the data once viewed might be outdated.

5. *Was there a back-up system?*

If data is kept for longer periods, historical outcomes can show the trends that affect the company. That is why it is very important to keep records of saved data for longer periods and that is why backup systems are necessary.

6. *Have there been any problems in the information system? Please explain*

In our meeting with Färggrossen, we were informed that Färggrossen experiences problems with data such as inventory levels, stock positions, and pick up routine decisions, locator addressing systems and item coding. Through the literature study it was possible to find answers to information system problems which require expensive investments. We disregarded these solutions due to Färggrossen’s financial limitations.

Knowing the problems which other companies face and knowing the solutions to those problems, can provide us with recommendations for Färggrossen.

The information system questions aim to distinguish the data equipment usage which has been addressed in Section 3.3.3. *Machine (Equipment)* and how often the equipment is being used.

### 5.7.11 The conclusion of Interview Questions

At our meeting with Färggrossen, we were informed about the system and the problems in the warehouse, which are discussed in Section 6.1 *The Färggrossen Case*. The method which is used for conducting this thesis is a multiple case study and through the interviews we acquired the data from the selected companies.

The purpose of the interview guide was to cover all the present issues which Färggrossen are experiencing. Having the directives given by Färggrossen in mind, we mapped our theoretical work as well as creating the interview questions.
The questions addressed in the previous sections are planned to enlighten the critical issues that have been addressed as problems in Färggrossen. With the help of the interview question answers, the thesis research questions will be answered which in turn will lead to us providing recommendations to Färggrossen.

The following section presents how the gathered information should be analysed.

5.8 Analyzing Case Study Evidence

This part of the case study methodology is considered to be the least developed part and also the most difficult part to conduct.\textsuperscript{223} When it concerns analyzing case study evidence Yin (2003) states that the data analysis consists of examining, categorizing, tabulating, testing or recombining the quantitative and qualitative evidence in order to address the initial propositions of a study.\textsuperscript{224} Analyzing case study evidence is difficult because the strategies and techniques have not been well defined. Furthermore, Yin (2003) argues that there are five techniques for analyzing case studies which should be used; pattern matching, explanation building, time-series analysis, logic models and cross-case synthesis. These will be discussed individually later on in this section.\textsuperscript{225}

5.8.1 Analytic Strategy

Analyzing data is the heart of building theory from case studies but at the same time it is the most difficult and least codified part.\textsuperscript{226} Yin (2003) supports this statement and he also believes that ‘every case study should strive to have a general analytic strategy’.\textsuperscript{227} Furthermore, Yin (2003) argues that the three strategies - relying on theoretical proposition - setting up a framework based on rival explanations - developing a case description, could help case studies to achieve a general analytic strategy. Yin’s (2003) three strategies will be briefly summarised in the sections below.\textsuperscript{228}

Relying on Theoretical Propositions

Relying on theoretical propositions is the most preferred strategy which leads to the case study. The original objectives and design of case studies were theoretically based on

\begin{itemize}
  \item \textsuperscript{223} Tellis, W (1997)
  \item \textsuperscript{224} Yin, R.K (2003) p. 109
  \item \textsuperscript{225} Yin, R.K (2003) p. 109
  \item \textsuperscript{226} Eisenhardt, K (1989) p. 8
  \item \textsuperscript{227} Yin, R.K (2003) p. 110
  \item \textsuperscript{228} Yin, R.K (2003) p. 110-114
\end{itemize}
propositions which in turn reflected sets of research questions, reviews of literature and new hypothesis and propositions. The proposition focuses on certain relevant data and ignores others and it also helps to organize the entire case study. Since this strategy answers the questions ‘how’ and ‘why’, we find that this strategy can be used as a help in this thesis.

**Setting up a Framework Based on Rival Explanations**

Setting up a framework based on rival explanations deals with the attempt to define and test rival explanations. This theory can be related to relying on theoretical propositions but it can also be relevant in the absence of theoretical propositions. Since this thesis does not deal with hypotheses, this strategy is not considered to be relevant.

**Developing a Case Description**

Developing a case description consists of the development of a descriptive framework for organizing a case study. This strategy is the least preferable approach but if one of the other two mentioned alternatives cannot be to any use for the proposed study, this strategy should be applied.

**5.8.2 The Analytic Strategy in this Thesis**

For this thesis we argue that developing a case description is the strategy which will be used in this thesis. The strategy helps us by making it easier to organize each of the three case studies in a similar manner; it helps us to focus on specific areas and it guides our case study analysis in the right direction.

In Chapter 6 *The Case Studies*, the case study descriptions are structured based on the combination of the research questions, the interview guide layout and our own insight and understandings from the interviews.

When conducting our analysis in order to simplify the work, the Färggrossen, the BSAB and the ECO cases are structured in a similar manner. The theoretical frame of reference is also structured in a similar manner as the cases. The order which we have chosen for the theoretical frame of reference makes it easier to conduct the analysis and the comparison of the cases. Structuring the theoretical frame of reference in this way simplifies the work when comparing a section at a time.

Lastly, we create an analysis model, which is based on the analysis between gathered information from the interviews and the case studies and the insights from the theoretical
framework as well as from literature. This model is presented and discussed in the subsequent Section 5.8.4 Creating an Analysis Model.

5.8.3 Specific Analytic Techniques

Blumberg et al. (2005) along with Yin (2003), state that survey researchers use precision tools when analyzing their information while case study researchers are deprived of these types of tools. However, case study researchers can also use other types of tools when analyzing their information: pattern-matching, explanation building and time-series. These analyzing techniques are addressed individually and each technique is divided into smaller sections. Since time-series is only applicable for single case studies this technique will not be addressed.

Pattern-matching

Pattern-matching essentially involves forming ‘a general picture of the case by detecting patterns in the information’; there are several ways of approaching this.\(^{229}\) First and foremost, when using this approach ‘a conceptual or analytical framework has to be established’.\(^{230}\) Followed by the framework, the researcher needs to ‘utilize existing theory and test the sufficiency of the framework’.\(^{231}\) An empirical pattern is compared to a predicted pattern and if they match it is a sign that the internal validity’s threats can be disregarded which in turn enhanced the internal validity. Saunders et al. (2003) and Yin (2003) state that ‘in an exploratory case study the patterns can relate to dependent or independent variables of study while if the case study is descriptive, pattern matching is relevant as long as the predicted pattern of specific variables is defined prior to data collection’.\(^{232}\)

Blumberg et al. (2005) suggest that there are several different approaches to predict a pattern of outcomes; Blumberg et al. (2005) suggest to ‘split theoretical dependent variables into different non-equivalent variables, looking for patterns with rival explanations and time-series’. These suggestions are supported by Yin (2003) as follows;\(^{233}\)

Non-equivalent Dependent Variables as Patterns

\(^{229}\) Blumberg, B et al. (2005) p. 198
\(^{230}\) Saunders, M et al. (2003) p. 390
\(^{231}\) Saunders, M et al. (2003) p. 390
\(^{233}\) Yin, R.K (2003) p. 116-119
Non-Equivalent Dependent Variables (NEDV) in its simple form is a very weak design with respect to internal validity. However, as Trochim also argues when used as pattern matching it is a very powerful tool. Pattern matching NEDV requires that the researcher tries to match multiple dependent variables evident in the case study patterns with a predicted set usually derived from an existing theory. Moreover, it requires detailed measurements which in turn can improve the case studies construct validity. If the patterns match, ‘the conclusion about the effect of decentralization can be drawn’, but if the patterns do not match, ‘the initial propositions would be questioned’.

**Rival Explanations as Patterns**

When regarding pattern matching, rival explanations should be used if independent variables are concerned. This requires the development of rival theoretical propositions, but the concern of the overall pattern of results and the degree to which a pattern matches the predicted one. This strategy can be adapted both to single and multiple case studies. In single cases, matching patterns to the rival explanation confirms that the explanation was correct while when obtaining the same results in multiple cases, literal replications of the single cases would have been accomplished and cross-case results can be stated more assertively. However, if the same results differ in a second group of cases theoretical replication would have been accomplished which lead to robustness of the initial results.

However, Yin (2003) argues that *time-series* should be addressed when discussing explanation building, which we also have chosen to do.

**Explanation Building**

Saunders et al. (2003) citing Yin (1994), describes explanation building as a ‘special type of pattern matching which involves the attempt to build an explanation while collecting data and analyzing it rather than testing a predicted explanation’. Hartin Iorio (2004) uses a similar definition of what explanation building is: ‘an inductive approach that requires the investigator to use the data collected to build up an explanation about the case or cases’. Yin (2003) recognizes that this theory is similar to the ‘grounded’ theory; ‘the grounded theory procedures are designed to build an explanation or to generate a theory around the core or centre theme that emerges from your data’; however he distinguishes between the two

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234 Trochim, W.M.K (2006)
235 Yin, R.K (2003) p. 117
236 Saunders, M et al. (2003) p. 391
theories, since the former is designed to test theoretical propositions.\textsuperscript{238} Yin (2003) further states that he believes his hypothesis-testing approach is related to exploratory case studies, while the hypothesis-generating approach developed by Glaser and Strauss (1967) is relevant for exploratory studies, which in turn means that Yin’s (2003) approach and the approach by Glaser and Strauss’ (1967) approach are similar.\textsuperscript{239}

The explanation building has been divided into the following sub-topics by Yin (2003), whose comments we briefly summarize and quote below.\textsuperscript{240}

\textbf{Elements of Explanation}

To ‘explain’ a phenomenon is to ‘specify a presumed set of casual links which are similar to the independent variables in the previously described use of rival explanations’. In case studies, these links are difficult and complex to measure precisely and also the explanation building occurs in narrative form which means that in the better case studies, explanations have reflected theoretically significant propositions.

\textbf{Iterative Nature of Explanation Building}

Explanation building has not been well documented in operational terms when dealing with explanatory case studies. In this case, the case study evidence is examined, theoretical aspects are revised and the evidence is re-examined from a new perspective. The aim is to show that the explanations cannot be built, given the actual set of case study events. As in our case, when applied to a multiple case study, the results can lead to conducting a cross-case analysis.

\textbf{Potential Problems in Explanation Building}

When discussing potential problems in explanation building, Yin (2003) warns that the approach consists of many hazards.\textsuperscript{241} The approach requires the researcher to have great analytic insight; this requires that the researcher constantly refers to the original purpose of the thesis, use case study protocols, establish case study databases and follow a chain of evidence to safeguard herself or himself.\textsuperscript{242}

\textsuperscript{238} Yin, R.K (2003) p.120-122 and Saunders, M et al. (2003) p. 398
\textsuperscript{239} Yin, R.K (2003) p.120-122
\textsuperscript{240} Yin, R.K (2003) p.120-122
\textsuperscript{241} Yin, R.K (2003) p.122
\textsuperscript{242} Yin, R.K (2003) p.122
**Cross-Case Synthesis**

The cross-case synthesis is a technique which is commonly used for multiple case studies to highlight the cases similarities and differences. The technique requires that collected data from different individual cases are compared to each other.\(^{243}\) Performing a cross-case synthesis will increase the robustness of the studies; as proven earlier, by different authors, multiple case studies provide more robust results than single case studies do.\(^{244}\)

However, Miles et al. (2002) argue that there are disadvantages with the method since it is ‘driven by the reality that people are notoriously poor processors of information’. To support their argument they cite different authors, including themselves who state that people ‘leap to conclusions based on limited data (Kahneman and Tversky, 1973), they are overly influenced by the vividness (Nisbett and Ross, 1980) or by more elite respondents (Miles and Huberman, 1984), they ignore basic statistical properties (Kahneman and Tversky, 1973) or they sometimes inadvertently drop disconfirming evidence (Nisbett and Ross, 1980).\(^{245}\)

A cross-case synthesis will be carried out for this thesis.

**Specifics on Within-Case Analysis and Cross-Case Synthesis.**

*Within-case analysis* - a term used by Miles et al. (2002) - is similar to the *cross-case synthesis* technique.\(^{246}\) Instead of comparing the individual case studies against each other, one compares the individual case studies against the theory which is being used. Yin (1994) discusses *within-case analysis* and explains it as ‘the researcher goes within the case and compares his or her data to theory which are being used and which are presented in the frame of reference’ while Miles et al. (2002) refers to *within-case analysis* as a method which ‘can help investigators cope with deluge data [and that it] typically involves detailed case study write-ups [pure descriptions] for each site.’\(^{247}\)

Comparing data this way will provide the researcher with answers if his or her data matches previous theory - so called pattern-matching. It can also in some case provide the researcher with information which has not been presented in previous studies.

As mentioned earlier, comparing case studies to each other is a technique which is called *cross-case analysis*. The technique is used to analyse and reduce the amount of data so that it is easier to draw conclusions. The cross-case analysis can provide the researcher with similar

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\(^{244}\) Yin, R.K (2003) p.133-137

\(^{245}\) Miles, M.B et al. (2002) p. 18

\(^{246}\) Miles, M.B et al. (2002) p. 17

\(^{247}\) Yin, R.K (1994) and Miles, M.B et al. (2002) p. 17
results as those which the researcher might have found in the within-case analysis, and it is this that which contributes to the richness of the data and the data being easier to generalize. However, how to structure the within-case analysis is completely up to the researcher since there is no standard way of doing this; and it is important to remember that the main purpose is not to generalize the data - rather the point is to gain better insight and understanding of the studied phenomenon.

Choosing Analytic Techniques

Even though *pattern matching* and *explanation building* are considered to be the techniques which are most frequently used for multiple case studies, we have chosen not to use these techniques. When discussing which of the above techniques could be applicable for this thesis, we arrived at the conclusion that the techniques which are applicable are cross-case synthesis and within-case analysis.

To some extent, these two choices cover the pattern matching technique since they also are used when comparing multiple case studies. Furthermore, these techniques in turn increase the feasibility, and especially when concerning within-case analysis and cross-case synthesis. Using within-case analysis helps us to handle the large amount of data which has been collected from the multiple case studies. For the within-case analysis we have a detailed and descriptive report for each case which helps us to handle the large amount of data which has been collected early during the thesis work process. For ease of comparison, we have chosen to structure the reports in a similar manner for each of the studied companies. The three cases are compared to each other in a structured manner in order to compare strategies and different work methods concerning warehouse management. The structure which is used is that an area of interest in a case will be compared against the other cases by using the cross-case synthesis. Each area will be addressed one at a time and the differences and similarities will be identified; this also makes sure that we do not overlook any relevant information. The results will provide us with information which we in turn can interpret; and at the end of this thesis we will be able to provide Färggrossen with recommendations on how to handle the key problems they are experiencing.

In the analysis part of this thesis, focus is on comparing Färggrossen to literature, and the BSAB and ECO cases. This is done by the help of the analysis model which we have created

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248 Miles, M.B et al. (2002) p. 17
as a guideline for the analysis process. By comparing Färggrossen to the other companies and the literature, the purpose of the thesis will be fulfilled and Färggrossen will have gained more understanding as to why they have been experiencing their problems. The manner, in which we have chosen to conduct the analysis, is, first of all, to compare Färggrossen to the theoretical frame of reference, and then to compare Färggrossen to BSAB and ECO.

Concluding, the cases are analysed and compared which each other and conclusions about similarities, differences and key problems will be addressed. After comparing the cases regarding the most relevant aspects in order for us to reach our goal the cases are compared in a more general manner. The thesis analysis model is created and discussed in the subsequent section.

5.8.4 CREATING AN ANALYSIS MODEL

In order to efficiently carry out the analysis of the gathered information, an analysis model is created in order to help with this step. The analysis model combines the synthesis with each of the case studies. The model illustrates the different steps of the analysis: how the information is compared to the theory, how the case studies are compared to each other and how the information is analysed and interpreted, i.e., the model functions as a guide. In turn, the guide simplifies the analysis process regarding drawing conclusions from the case studies. Figure 17 below illustrates the analysis model’s layout.
Information Gathered From Interviews and Case Studies

Opinions not applicable to Färggrossen are disregarded.

Does the Information from the Interviews/Case Studies Correspond With the Theory?

NO

Agreed opinions?

YES

Interpreting Collected Information

Cross-case/Within-case analysis, State the Results Which Have Been Identified.

Why Does the Information Not Concur?

NO

Non Applicable Results are Disregarded after Being Discussed

Analysis and Recommendations

Are the Results Applicable For Färggrossen?

YES

Conclusions

Are the Results Feasible, i.e. Can the Results be Implemented at Färggrossen??

NO

Non feasible Results are Disregarded

Conclusions and Further Work

Final Recommendations

YES

Preliminary Recommendations

FiguRe 17: Analysis Model. (Source: Our Own)


**INTERPRETING COLLECTED INFORMATION**

The first step of the analysis model is to interpret the gathered information; information from the interviews, literature, etc. The theoretical frame of reference provided information on theories applicable to companies in the similar situation as Färggrossen; however, all theories are not feasible due to company limitations. The feasible theories led to identifying the research questions which in turn formed the basis for the interview guide.

Firstly, conducting a wide-range literature search provided us with a vast amount of theories. In order to narrow down the area of interest, limitations such as Färggrossen being a SME where kept in mind and based on these limitations some theories were disregarded. The relevant theories are compared to the gathered information from the interviews and the case studies, as well as comparing each case with each other. Subsequent, the analysis process is initiated by studying if the compared information corresponds.

**ANALYSIS AND RECOMMENDATIONS**

The initial phase of the analysis identifies applicable theories for Färggrossen by studying if the compared information corresponds. If the information does not correspond, reasons for why the theory could not be applicable to Färggrossen are presented and the theory is disregarded. If the compared information corresponds, the first step consists of conducting a cross-case synthesis and within-case analysis. These analysis methods are merged together in order to avoid unnecessary repetitions. By addressing each research question individually the analysis is conducted in a structured and efficient manner. Results which correspond with information from the interviews/case studies and the theory are seen as results which might be applicable to Färggrossen; whereas results which do not correspond with the information from the interview/case studies and theory, are investigated why they do not correspond, and then they are disregarded. The decision to ignore some results are based on apparent reasons, such as the results sloely being applicable to large companies, for ignoring the results and based on company limitations. Suggestions on how to improve the warehouse layout and processes are also discussed.

**CONCLUSIONS AND FURTHER WORK**

The conclusions and recommendations which arose from the analysis are addressed in *Chapter 8 Conclusions and Further Work*. However, a brief overview of the chapter is presented here.

Subsequent to the information being compared in a merged cross-case synthesis and a within-case analysis, conclusions regarding feasible improvement changes as well as theories
where identified. Firstly, with the help of the information in the individual case studies, conclusions regarding each individual research question are drawn in Chapter 7 *Analysis and Recommendations*. The conclusions are then compared and addressed in order to improve the current situation at Färggrossen and preliminary suggestions are made. Discussions with Färggrossen will provide us with information which is essential in order to evaluate what suggestions are feasible for Färggrossen and which suggestions are not. Suggestions which are not applicable to Färggrossen are then disregarded after considering Färggrossen’s employees opinions. The last step is to provide final recommendations for Färggrossen as well as for ECO and BSAB. Once a pattern is established between Färggrossen and the conclusions, the final recommendations are made.
6 The Case Studies

This chapter presents the information gathered through the interviews at Färggrossen, BSAB and ECO. Firstly, a brief introduction of the company is presented followed by a mapping of the warehouse, the products, the warehouse processes, and the product flow as well as performance criteria and warehouse safety.

6.1 The Färggrossen Case

If nothing else is stated, all the information in this section is gathered from the interview with the CEO of Färggrossen, Mikael Lindgren and the warehouse manager, Patrick Ledin. Information about the database system is gathered from NetProSale’s homepage. The answers to the interview questions are found in Appendix 2.

6.1.1 Company Background

Färggrossen was founded in 1976 in Kalmar by Åke Svanbäck. Together with seven associates, all with individual stores and years of experience within the paint industry, Svanbäck decided to start a joint paint company. An octopus with eight arms was chosen as a logo to represent each of the eight associates. The company began its operations by purchasing paint and then distributing it. After many years in Kalmar the company was forced to change location due to logistical issues and relocated to the nearby town, Nybro, where Schenker Logistics, a logistic company which Färggrossen uses for distribution, is also located. Färggrossen was forced to relocate a second time, due to being evicted from their premises; the company relocated to premises on the outskirts of Nybro which is the current location.

Soon Svanbäck started to buy out the other seven associates, one by one and then to build the current premises outside Nybro; around 2000 when these premises were completed, the company moved the organization there. On 1st September 2008, current CEO, Mikael Lindgren, bought the company. At that time the company did not have any computers since the previous owner believed that it was more convenient to keep records by hand. This problem was addressed by the CEO as soon as he took over the business, and the company has now started the process of keeping records electronically.

The company has also launched a web shop where their customers can log in and order products electronically instead of faxing or ringing in the orders as previously; however quite a lot of faxing and ringing in of orders still occur. This web shop has been designed in
consultation with the customers, which is important in order for it to be customer friendly, and for its operations to be as efficient as possible.

**Organizational Structure**

Färggrossen has six employees working in the company. The company is led by the CEO Mikael Lindgren, while the warehouse and financial sections are organised by their own managers, who report to the CEO.

The CEO’s responsibilities involve managing the company and approving decisions which have been made by the warehouse and finance managers; but the CEO is also responsible for finding new suppliers and for handling negotiations and contracts.

The warehouse manager is responsible for all the storage and loading activities within the warehouse; he is also responsible for procurement and sales, both receiving and delivering orders.

The finance manager is mainly responsible for the accounting and legal activities, but also for cash flow, billings, payments and loan tracking.

In the warehouse department there are two employees; one who is responsible for the procurement, acceptance of goods and storing in the warehouse, while the other one handles deliveries, and at the same time works as a salesman, customer adviser and liaison.

In the finance department there is one accounting employee who is responsible for the invoicing and accounting.

The organizational structure of Färggrossen can be seen in Figure 18 below:
**Brief Company History**

- Founded in 1976 by Åke Svanbäck
- Moved to Nybro 2000
- 1st September 2008 Mikael Lindgren bought the company
- September 2008, the introduction of computers to the company
- December 2008, the opening of the web shop
- 15th April 2009, we started our thesis, which will hopefully result in improvements for the warehouse of Färggrossen.

**The Company and its Goals**

Customer satisfaction has a priority in Färggrossen, beyond the other goals such as maximizing profit and having a large market share. Färggrossen has always and is still known for owning its own trucks, providing a high level of service and distributing its products straight to the door; in addition, the company has the reputation that its products are delivered without damage. This has obviously paid a large part in the company having good relations with its customers. In addition, ‘deliveries straight to the door’ enables its customers to get additional information about the products from the truck driver of Färggrossen; this level of service, which involves personal contact, is appreciated by the customers.

Färggrossen nowadays has another important goal and that is to improve the warehouse and cut from the costs.

**Competitors**

In the market actually the real competitors of Färggrossen, are their own suppliers, which will be detailed further in the upcoming section. According to Färggrossen, if one of their customers grow bigger then it is very likely that suppliers might try to get rid of the distribution warehouse, Färggrossen, and directly work with the customer itself.

Even though this is a threat for Färggrossen's business, yet again Färggrossen has a good relation with their customers and also the competitors do not have the consolidation advantage that Färggrossen does. When a customer is working with Färggrossen, they can benefit from the variety of brands and products.
**Suppliers**

Färggrossen is a warehousing company that has approximately 25-30 suppliers; beyond the Swedish companies, they also deal with some companies based in the United Kingdom and The Czech Republic, but their products are primarily at the level of testing to ensure that they are suitable for Färggrossen’ product portfolio. Even though Färggrossen has approximately 30 suppliers, the company prefers to work primarily with a small number of suppliers for a long term, which they believe brings the benefits of discounts and mutual trust. Most of the deliveries from the suppliers are delivered within 3-4 days.

Färggrossen is handling approximately 5,000 different types of products. However, 90 % of the goods are bought from the 15 suppliers as can be seen in Table 11.

<table>
<thead>
<tr>
<th>No</th>
<th>Supplier</th>
<th>Items</th>
<th>%</th>
<th>Cumulative %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Jotun Sverige AB</td>
<td>910</td>
<td>16,75%</td>
<td>16,75%</td>
</tr>
<tr>
<td>2</td>
<td>ECO-Boråstapeter AB</td>
<td>787</td>
<td>14,49%</td>
<td>31,24%</td>
</tr>
<tr>
<td>3</td>
<td>Göico AB</td>
<td>670</td>
<td>12,33%</td>
<td>43,58%</td>
</tr>
<tr>
<td>4</td>
<td>Boråstapeter</td>
<td>590</td>
<td>10,86%</td>
<td>54,44%</td>
</tr>
<tr>
<td>5</td>
<td>Duro</td>
<td>585</td>
<td>10,77%</td>
<td>65,21%</td>
</tr>
<tr>
<td>6</td>
<td>Anza</td>
<td>382</td>
<td>7,03%</td>
<td>72,24%</td>
</tr>
<tr>
<td>7</td>
<td>Herdins Färgverk</td>
<td>237</td>
<td>4,36%</td>
<td>76,60%</td>
</tr>
<tr>
<td>8</td>
<td>Hagmans Kemi AB</td>
<td>135</td>
<td>2,49%</td>
<td>79,09%</td>
</tr>
<tr>
<td>9</td>
<td>Penselimporten</td>
<td>105</td>
<td>1,93%</td>
<td>81,02%</td>
</tr>
<tr>
<td>10</td>
<td>Eskil Åkerberg</td>
<td>94</td>
<td>1,73%</td>
<td>82,75%</td>
</tr>
<tr>
<td>11</td>
<td>Walldecor</td>
<td>87</td>
<td>1,60%</td>
<td>84,35%</td>
</tr>
<tr>
<td>12</td>
<td>Bostik AB</td>
<td>86</td>
<td>1,58%</td>
<td>85,94%</td>
</tr>
<tr>
<td>13</td>
<td>Sandbergs Grosshandel AB</td>
<td>82</td>
<td>1,51%</td>
<td>87,44%</td>
</tr>
<tr>
<td>14</td>
<td>Landora Färgindustri AB</td>
<td>75</td>
<td>1,38%</td>
<td>88,83%</td>
</tr>
<tr>
<td>15</td>
<td>3M Svenska AB</td>
<td>64</td>
<td>1,18%</td>
<td>90,00%</td>
</tr>
</tbody>
</table>

**Customers**

Färggrossen has quite a long history and a reputation in their own market. The long history of the company has brought them valuable experience and good relations with customers. Since the main goal of Färggrossen is customer satisfaction, they have accordingly had many years of trade with the customers, which have given Färggrossen several satisfied customers. Beyond these old customers Färggrossen is adding new customers to its clientele every day.

Färggrossen has about 400 customers, who can be divided into two main groups’ private painters and paint stores. The company is considering stopping the sales to the individuals. Färggrossen only has customers within Sweden, which are located in the south of Sweden.
**INVENTORY CONTROL**

Färggrossen is a distribution warehouse where different products from different companies are ordered and stocked to satisfy the needs of the customers. Even though Färggrossen has contracts with their suppliers, they own the products that they store, which brings a very high level of cost that is discussed in Section 3.3.2 Money. Customer satisfaction has the priority in the company which brings a mentality of refusing to decline customers with the statement that the order they requested is not in stock. According to Färggrossen fast and correct delivery is what establishes customer satisfaction, which is why the company orders the products before they are finished in the warehouse, in some situations this is causing product overflows in the warehouse.

Some products in Färggrossen has a very high level of stock, this is caused because of several reasons; personal preferences of the warehouse manager on ordering decisions, lack of a information system validity, etc. The warehouse manager is responsible for placing new orders for the products that are low in quantity in the warehouse, since the database system of the company is not functioning in a way, which supports the warehouse system with data about the product quantity; this decision is made based on the warehouse manager’s memory. This sometimes results with overage of a product and cost regarding overage. In time these overage products will be sold, however tying up the capital and space in the warehouse is taking the capital that could be invested in some other point as well as causing space issues. The purchasing cost of these items is not the only problem in this situation, the capital that is spend on the holding cost is of great importance, as well the lost profit regarding the time between purchasing and sales.

Another problem in the inventory is the products that the customers would not desire: old season wallpapers as well as paints, chemicals and tools that are damaged. These types of products which should to be destroyed or send back are instead kept at random places in the main area, which also brings further holding costs and space problems.

**6.1.2 MAPPING OF THE WAREHOUSE**

In this section, the warehouse part of Färgggrossen will be explained. Even though there are no clear definitions for the different parts in the warehouse; it is possible to divide the warehouse into three different areas by checking the types of products that are stored in these areas in general. The wallpaper area, the main area and the chemical area will have a detailed explanation in the upcoming section.
STORAGE AREA

Färggrossen is a wholesale company which owns the products it sells. Färggrossen deals with many different types of products; the main product is paint which is packaged in a variety of different ways depending on brand, type and colour. The second most important type of product is wallpaper and there are also a variety of other products which are used for painting.

The company is housed in only one building: the warehouse. The warehouse in Färggrossen is roughly divided into three parts; the main area contains many paints, there is in another area where wallpapers are stocked and finally the last area is where the chemicals are stored.

In Färggrossen there is no special area defined as the bulk area, which is an area that is used to replenish the pickup area and clear definitions of different storage areas have not been done.

Paints are stored in almost every part of the warehouse but they are primarily located in the main storage area. As a firm policy, Färggrossen stores most of the products on the shelves by hand, not on pallets. There are many different kinds of paints and some of them have a very high selling frequency, it is sometimes possible to see these paints stacked randomly on pallets lying on the floor throughout the warehouse.
Wallpapers in the warehouse are stored in a separate area, which we defined as the wallpaper area, with in smaller shelves then the ones in the main area. The shelves in the wallpaper area are designed in a poor way to stack the wallpaper cases, which is causing space loss due to the workers being able to stack only two cases per shelf with some space left above. This space that is being wasted with this type of design is so significant that with a tiny change in the design, another level of cases can be stacked.

Another problem in this section is the chaotic situation, which is a result of the different products from different productions lines or batches that are mixed. The difference between the wallpapers from different production lines or batches is not immediately apparent when they are stacked in the warehouse but it will be blatantly obvious when they are put up on the wall together.

The chemical part of the warehouse has shelves that are smaller than the other parts, but they are sufficient for the chemical products. In the same area there are some high shelves used to store some pallets which contain fast selling paints that can be considered to be the bulk area.
The loading area is where the trucks that are owned by Färggrossen are parked when they are not on the road and also where the loading/unloading takes place. In the loading area, there is a platform, which is an extension of the warehouse that is on the same level with the warehouse itself. When a truck arrives to load/unload, it can easily access the platform with its rear end something which allows the forklifts to pick up/load the packed goods directly from/to the truck.

**Storage Equipments**

In Färggrossen the main storage equipment is normal racks and there are several different sizes of this equipment depending on the size of the products that is being stored in them. High racks are used to store paints on pallets. Middle size racks are used to store wallpapers and the products that are emptied from the pallets. Small sized racks are used to store the chemicals, clothes, tools as well as some small paints.

In the storage area it is very likely to see goods on pallets/cases/ boxes placed randomly on the floor, which was explained to us as fast moving goods. According to our observations, only some of these were fast moving goods, the rest were just goods which the company did not know where to store or they were not sure of how to store them.

Different types of shelves might help to support the arrangement of the warehouse space as well as the bulk area.

**6.1.3 Mapping of Products**

Färggrossen is warehousing approximately 5,000 different types of products and the locations of these products are presented in this section. The locations of the products are in turn mapped and discussed. By observing the storage area and the product locations, it was clear that some kind of system was used.

**Business Segment and Product Families**

Färggrossen has been in the market since 1976. There are more than 5,000 different types of products, which can be divided into the five main categories listed below:

- Paint
- Wallpaper
- Tools and gadgets
- Chemicals
- Other type of painting materials
**Product Information**

It is common knowledge that paints have various types due to their solvency: oil, water, etc. Paints can also be classified according to where they are used: outside, inside, doors, windows and furniture etc. The greatest variation in the products of Färggrossen comes from the paints.

Wallpapers have a great variety in the products due to the fact that they are produced in batches. Even if two different batches of wallpaper are produced on the same day, from the same production line, they will have significant differences and must thus be considered different items. That is why Färggrossen is being very careful about the batch number of the wallpapers when picking an order.

Färggrossen’s main interest of products is paints, wallpapers, chemicals and also some tools like brushes, cloth, etc. The ratio of the paints is higher when compared with the other products.

6.1.4 **Mapping of Warehouse Processes**

The following sections will discuss the warehouse processes in Färggrossen. The aim of this section is to clarify the methods that are being used in these processes.

**Receiving Process**

As mentioned previously in the supplier section of Färggrossen, even though the company has around 25-30 suppliers, they prefer to work primarily with only 15 of those companies. Due to this lower number of suppliers, the relations between Färggrossen and its suppliers are very solid and trustworthy.

Once the products are sent by the suppliers to Färggrossen, the packed goods are attached with a delivery note. When the delivery is received by Färggrossen, from the dock area, the goods are carried into the warehouse with the help of forklifts and labourers depending on the size of the goods. Once orders are received from the dock area, the goods are controlled visually to see if there are any damaged goods. Another inspection in this process is that the products are also checked from the delivery note to ensure that the delivered quantity is correct. Further special inspections such as chemical test, material tests, etc. are not done.

**Putaway Process**

Putaway is the process of moving the goods from the receiving dock to their stocking positions. In Färggrossen the stocking positions for the received goods are decided by the
warehouse manager and the memory system is used. This means the stocking positions are not written on a paper or entered to a database nor printed out, but only known by the labourer that handles the putaway. As mentioned previously, there are approximately 5,000 different products in Färggrossen and the memory system is only successful when there are a low variety of products. Since Färggrossen has more than one worker who is responsible for order picking and putaway, this technique, is causing a lot of hidden time losses in the warehouse.

Storing Process

As discussed previously in the Section 3.4.3 Storing Process we have seen that there are three types of placement methods that can be chosen from in a warehouse: floating system, fixed system and family grouped. In Färggrossen it can be assumed that they are applying the family grouped locating system, because the company has three main areas in their warehouse, primarily used to serve different product groups. On the other hand, it is not clearly possible to call the method that Färggrossen is using, as a family grouping method due to fact that some products can be found in every area of the warehouse.

More importantly, Färggrossen has no locater system, once a product is placed in a position, only the labourer who has stored it to the position knows where the product is, and if it is needed, the labourer who handled the putaway is the only one who can easily retrieve the item, but he cannot easily explain where the item can be found to another worker.

Replenishment Process

Since the placement method in Färggrossen is not very clear, the replenishment method is not clear either. Replenishment is not done according to a method but rather, by the warehouse manager, depending on his opinions of what needs to be replenished. The warehouse manager bases his opinions on looking through the inventory on a daily basis and noticing that the product is running low. Just like the putaway process, the replenishment system has some uncertainties, which are causing a waste of storage area and time. For example, it is possible to see two half pallets placed on the floor at the same time which are loaded with the same product.

Order Picking Process

Once an order is received from a customer, an order list document is printed out; in Färggrossen order picking is done according to this printed order list. When this document is taken to the warehouse physically then the order picking process starts. A labourer gets the
simple trolley and starts picking the products from the shelves or the pallets that are placed on the floor, while putting a mark on the order list document showing that he picking of that entity is completed. Most of the time the order picking process takes quite a long time, because only the labourer, who handled the putaway, is able to find the product easily. If the labourer has not done the putaway of the product or not directed by the labourer who handled the putaway, he needs to search the warehouse for the product. Order picking is very simple and quick if it is done by the labourer who handled the putaway. The picking process is over when picking of all the goods is accomplished and every entity in the order list is marked.

It is clear that the company is using discrete order picking and the main problem that the labourers face in order picking is the lack of a locator system and that there is no clear information of where the products are stored if the labourer who putaway the goods is not around.

**Shipping Process**

Once orders are picked, they are prepared to be shipped. Before they are shipped, according to the size of the order they are either put in cases or prepared on pallets and attached with a delivery note to be sent.

Färggrossen has about 400 customers, who can be divided into two main groups’ private painters and paint stores. For the shipment, Färggrossen uses third party logistics as well as their own trucks, which they use to deliver orders in eight different routes throughout the south of Sweden. In Table 11 the distribution of the customers in the distribution lines can be seen. In Figure 20 the distribution lines are shown on the map of Sweden.

**Table 11: Amount of Customers per Line. (Source: Our Own)**

<table>
<thead>
<tr>
<th>No</th>
<th>Colour</th>
<th>Customer Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Line 1</td>
<td>Red Line</td>
<td>135</td>
</tr>
<tr>
<td>Line 2</td>
<td>Yellow Line</td>
<td>46</td>
</tr>
<tr>
<td>Line 3</td>
<td>Green Line</td>
<td>95</td>
</tr>
<tr>
<td>Line 4</td>
<td>Blue Line</td>
<td>52</td>
</tr>
<tr>
<td>Line 5</td>
<td>Black Line</td>
<td>30</td>
</tr>
<tr>
<td>Line 7</td>
<td>Orange Line</td>
<td>23</td>
</tr>
<tr>
<td>Line 8</td>
<td>Gray Line</td>
<td>43</td>
</tr>
<tr>
<td>Line 9</td>
<td>Purple Line</td>
<td>44</td>
</tr>
</tbody>
</table>
**Value Adding Logistics**

Value adding logistics has been defined as any kind of work that adds value in the warehouse. In some situations Färggrossen needs to mix paints and send catalogues when requested by the customers. There is no re-coding for the items or special kind of packing done in Färggrossen.

**6.1.5 Mapping of Product Flow**

In a warehouse, products are received, putaway, stored and picked up to be shipped. In between every process there is an action of handling of products, as well as an information flow between different departments of the warehouse. The equipment and personnel that is used in handling of products and information flow are detailed in this section.

**Equipment and Personnel in Use**

In Färggrossen there is a variety of product types regarding shapes and sizes. Even though there is this variety present, the orders from the suppliers can come either in cases or on pallets, which makes the handling of the products process quite simple for the company. That is why the company is using palette jacks and simple forklifts for the handling of the products as well as labourers.
In Färggrossen there is a warehouse manager, a warehouse worker and a driver as labourer. During the high season, which is defined as late spring and early summer, Färggrossen hires some summer workers for the warehouse. According to our visual observations, the labourers in the warehouse were in acceptable physical condition according to Langford (2006).

**Information Flow**

The information system which Färggrossen has installed and has been using is ‘Savea’. Developed by NetProSale, it is a program that deals with complete web-solutions and is suitable for Small Medium Enterprises (SME). Savea supplies a choice of four different software’s: E-Shop, Payment, Order and Logistics. Färggrossen have all of these software installed and which together integrate inventory management, sales management and financial management in Färggrossen. The investment in Savea was approximately 21,000 SEK, plus additional maintenance fees to keep the system upgraded which costs approximately 2,100 SEK per month.

Even though Färggrossen owns Savea and it is implemented by professionals, information flow in Färggrossen is lacking a lot of data that are crucial for the warehouse system to function properly. Once the orders are received from the dock, the only inspection done is a visual one. Even though the entry of the data on the delivery note is saved in the database, there is no data in the database system about inspections or the stocking positions. Quantity data of the products is not valid due to the database system being new and because there has not been a yearly inventory in the period.

Färggrossen has been managed as if it was a family company for such a long period that the company did not need a technologically advanced system, since the workers were very experienced and the warehouse was very small. The warehouse is not small anymore and that experience is not sufficient. With the change of the management (CEO) some problems due to the information flow have been noticed. The problems were realized when summer workers were not as helpful as they should have been: summer workers either picked the wrong products or were not able to find the products at all.

### 6.1.6 Performance Criteria

To be able to see the level of efficiency in a company there are many performance criteria’s that can be identified. In our thesis since we are focusing on the warehouse layout as
mentioned in the theory part we will be taking time usage and customer satisfaction as performance criteria.

**Time Usage**

Ackerman (1997) relates efficiency in the warehouse with the time usage and places time loss in two groups, obvious and hidden time wastes. Obvious time waste was clear: labourers being lazy, slacking, taking naps, etc. Hidden time was mostly caused by wrong decisions like stocking very fast moving products behind slow moving products.

Since there are few labourers in Färggrossen, the obvious time loss is not a big issue because there are many orders to be delivered within a limited time. Hidden time loss in Färggrossen however, is a big issue. As mentioned before there are quite a large portion of products that are being relocated from pallets to their stocking positions manually, which is a hidden time loss.

According to Langford (2006) efficiency was directly related to the physical condition of the labourers that are working in the warehouse. From our observations in Färggrossen that kind of efficiency loss is not an issue.

**Customer Service Levels**

In Färggrossen it is said that the customer satisfaction is almost 100%. This comes from the fact that most of the business relations they have, comes from personal contacts or long term business deals. Yet there is no significant data about this in the warehouse database system of the company.

**6.1.7 Safety in the Warehouse**

One of the most important parts of safety is, work safety for labour. As mentioned previously in Färggrossen most of the products are handled manually, in the long term this might cause ergonomic health problems for the labourer. We have been told that labourers have received some educational seminars about work safety and first aid. In the warehouse labourers have to wear steel shoes and since the products are environmentally friendly they do not threaten the labourer in a chemical way but rather in a physical way.

Another topic, when it comes to safety in the warehouse, is fire. Most of the products in the warehouse are flammable, in particular euro pallets, which are stacked in the middle of the warehouse. The only fire precaution in the warehouse are the fire extinguishers, emergency plans and exit signs.
6.2 THE BENGT SANDBERG BYGGPRODUKTER AB CASE

If nothing else is stated, all the information in this section is gathered from the interview with warehouse manager Tomas Nygren and finance manager Sanna Nygren at Bengt Sandersg Byggprodukter (BSAB). The information gathered about the database system id collected from the Bison Group homepage as well as the competitors’ homepages. The answers to the interview questions are found in Appendix 3.

6.2.1 COMPANY BACKGROUND

BSAB was founded in 1985 by Bengt Sandberg who had more than 20 years of experience and knowledge about nails, screws, attachments, etc. Thanks to good contacts among suppliers and on account of Bengt Sandberg being a well-known and respected name, the company grew rapidly on the Swedish building material market. February 24th, 2000 Bengt handed over the CEO post to his son Magnus who today still manages the company. The company is considered to be a Small Medium Enterprise (SME), and it deals with product development, trading and distribution of products and services mainly to building material stores and to house and building industries. Since the company mainly delivers product to the building material industry this is the market which they focus on.

Due to higher customer demands and expansions, BSAB has needed to expand the storage section of the warehouse several time, the last expansion took place earlier this year (2009). The company’s yearly turnover was 2008 approximately 53 MSEK.

ORGANIZATIONAL STRUCTURE

Today BSAB has six employees, five regular workers and one summer worker. The company is led by the CEO Magnus Sandberg, while the marketing, finance and warehouse section are organised by their own managers, who all report to the CEO.

The CEO’s responsibilities involve managing the company and approving decisions which have been made by the marketing, finance and warehouse managers; but the CEO is also responsible for finding new suppliers and for handling negotiations and contracts.

The marketing manager is responsible for recruiting customers which includes personal visits to customers which are interesting and might be beneficial for BSAB.
The finance manager is mainly responsible for the accounting and legal activities, but also for cash flow, billings, payments and loan tracking.

The warehouse manager is responsible for all the storage and loading activities within the warehouse; he is also responsible for procurement and sales, both receiving and delivering orders.

In the warehouse department there is one employee who is mainly responsible for the acceptance and storing of products in the warehouse. Also, every employee is responsible for one of the main stocked products, for instance the finance manager is responsible for screws, etc. Figure 21 below shows an overview of BSAB’s organizational structure.

![Organizational Chart](source: our own)

**Figure 21: Organizational Chart. (Source: Our Own)**

### Brief Company History

This section presents a brief company history of the most important events in order to give the reader an overview of how the company has developed over the years.

- 1985: BSAB was founded.
- 1990: Bengt’s son Magnus starts working for the company.
- 1999: BSAB moves into their current location and new office premises are built.
- 2000: February 24th, Magnus takes over the CEO post from his father.
- 2005: First stage of expanding the warehouse by adding a new building. A new computer system is installed.
- 2006: Second stage of expanding the warehouse. A second new building is added.
- 2009: Third stage of expanding the warehouse in order to meet future demands and expectations.

### The Company and its Goals
Ever since the company was founded in 1985 it has grown in many different ways. The
warehouse has been rebuilt in three different stages and the area has expanded from 520sqm
to 1,700sqm as well as the yearly handling of products which has increases from handling 2
million products at start to handling 10 million today. By expanding their business BASB will
be able to easier meet the future demands and expectations which will arise. The company’s
goals are to be its suppliers and its customers’ best cooperation partners and to keep their
existing customers and at the same time increase the number of customers. BSAB wants to
grow on the market in order to compete in a better way.

**Competitors**

BSAB’s main competitors are Gunnebo Industrier AB and Arvid Nilsson. Gunnebo
Industrier AB was founded in 1764 and is located in Gunnebo in the southeast of Sweden.
The company is BSAB’s main competitor regarding nails and fitting. Gunnebo Industrier AB
is divided into five business sections: blocks, fastenings, lifting, telescopic and traction
systems. The block section is one of the world leading developers, manufactures and
marketer of products for heavy lifting; fastenings is a leading manufactures and innovator of
complete and high quality fastening programs; lifting is one of the market leaders within
product development, manufacturing and marketing of complete systems for chain and lift
components for the handling of goods weighing between 1-125 ton; telescopic is the
European market leader of telescopic ladders and work platforms; transaction systems is
leading as developer, manufacturer and marketer of skidding protection for contract and
woodland machines as well as agricultural and transport vehicles.

Arvid Nilsson was founded in 1918 in Denmark and its subsidiary company in Sweden,
BSAB’s main competitor, is located in Kungälv, north of Gothenburg. The company is
BSAB’s main competitor on the market with regards to screws. Additional subsidiary
companies are located in Norway and Shanghai. Arvid Nilsson, located in Kungälv, provides
their customers with high quality fastening technology. Their largest customer market can be
found in seven different segments: electronics, telecommunication, wind power, transport,
OEM-customers, building and construction and do it yourself.

**Suppliers**

BSAB is a warehousing company that has approximately 15-20 suppliers; as well as Swedish
suppliers; they deal with Taiwanese and Chinese companies. There are more than 1,500
different types of products which can be divided into the main five categories listed below:
Today there are only a handful of BSAB suppliers who represent the majority of the purchasing volume. Like other companies BSAB wish to reduce the amount of suppliers which they have. However, the company wants to keep the good relationships which they have built up during many years and decades with most of their suppliers. BSAB’s aim is to keep the relationship with the existing suppliers which they believe are loyal and the most valuable to the company and at the same time reduce the amount of suppliers which they do not feel benefit the company as well as searching for new cheaper suppliers in order to better compete on the market.

Furthermore, late deliveries from the suppliers can result in late deliveries to BSAB’s end customers which in worst case scenario can result in customer loss. These late deliveries can depend on different circumstances, external as well as internal, and are not always the fault of the suppliers.

Both Sanna Nygren and Tomas Nygren believe that it is very important to maintain a good personal contact with their suppliers in order to improve delivery performances if needs be. The lead-time from BSAB’s suppliers varies depending on where they are located and if the requested products are in stock at the suppliers. Other factors which also affect the delivery time from the supplier depend on who the supplier is and what kind of product they want delivered. For instance fittings have a 3 week lead-time, screws 3-4 days and woodscrews up to 5 months. Taking into consideration that the products are in stock and the suppliers are situated in Sweden, products can be delivered the next day or within the next couple of days. However, when regarding the supplier in China and Taiwan the lead-time is at least a couple of weeks to a month. Products which BSAB keep in stock are usually delivered in one full truck load at a time.

BSAB are also constantly looking for cheaper suppliers in order to reduce their costs.
**Customers**

BSAB has approximately 144 customers who mainly are located in Sweden, Norway and Finland. The marketing manager is responsible for the recruitment of these customers. If a customer is considered as eligible on BSAB’s behalf, BSAB’s marketing manager pays the customer a personal visit.

Two of BSAB’s most important customers are Byggmax and Bejier to whom BSAB deliver products such as nails, screws, etc. Byggmax in not only located in Sweden, the company can also be found in Finland and Norway. The different customers have their own individual contracts with BSAB, for instance, Byggmax require weekly deliveries from BSAB while most of their other customers require next day deliveries. Since Byggmax require a vast amount of delivered product each week, BSAB have as a part of their contract with Byggmax an agreement that BSAB keep Byggmax inventory for the products they deliver to them.

The company estimate that they handled approximately 3,900 orders per year which is also equivalent to the amount of deliveries being done each year.

**Inventory Control**

There are many different reasons to keep inventories and in order to sell products throughout the year; inventories are required for a company like BSAB. The reason why BSAB’s keeps inventories is to prevent that stock outs and other delivery interruptions do occurs during seasonal and demand fluctuations or at any other time. In order to prevent situations like that, BSAB have a buffer inventory/safety stock as part of their ‘regular’ inventory. For BSAB this is essential since some of their most important customers require large weekly deliveries and experiencing stock outs when delivering to these customers is not an option. This has resulted in BSAB keeping a high inventory in order to prevent these delivery interruptions. In addition, by keeping this excess inventory BSAB’s most important customers are guaranteed deliveries as requested and BSAB do not have to risk losing these or their other customer.

On the other hand, BSAB are aware that their inventory level is too high and this has resulted in unnecessary tied up capital. However, BSAB do not believe that the financial burden for the company is that severe and that it is essential for them to have this excess inventory.

The disadvantage of keeping inventories is that the inventory cost might rocket if the prices of the products are expected to rise. In order to reduce the storage cost and tied up capital BSAB needs to know what products which are most frequently used where to store them and
then organize the warehouse accordingly. In order to achieve reduced tied up capital, BSAB have a yearly full warehouse inventory. However, in order to keep a record if their inventory is correct the company has small random inventories which can be initiated based on a customer not receiving its order.

It is also very important to report defected and damaged products. Not doing this will result in the information about the inventory being incorrect and by reporting the defected and damaged products will result in improving the control of the inventory in the future. BSAB do report defect and damaged goods and since BSAB hold Byggmax inventory they are required to pay for Byggmax wastage and loss.

### 6.2.2 Mapping of the Warehouse

This section presents the layout of the warehouse at BSAB. The warehouse is not clearly divided into different sub areas; however, since there are three semidetached warehouses the areas can be divided into the indoor area, outdoor area and loading and unloading area. The warehouse map is described in detail referring to the different areas as mentioned above.

#### Storage Area

BSAB is a wholesale company which owns the products it sells. With approximately 1,500 different types of products being stored in BSAB’s warehouse, it is important to optimally use the space in order to efficiently retrieve and store products. By organizing the warehouse in the most efficient way contributes to the warehouse being operated in an efficient and economically manner. These products are stored in many different ways depending on size, durability and order of arrival. The manner in which BSAB has organized its warehouse is referred to as random space allocation or floating location storage.

To be able to define the problems faced by BSAB it is necessary to understand the current situation in the warehouse. Due to the variety of the product shapes and sizes, BSAB has, as mentioned earlier, many different ways of storing their products in the warehouse. For the transporting of products to and from the racks there are pallet jacks and forklifts used.

The company is housed in only a semidetached building: the warehouse. In the warehouse building three are main sections and there is also an outdoor area for storing products. The outdoor area is however not considered a part of the warehouse, but since this area is used for storing products we include it as a part of the warehouse. The different sections are seen in Figure 22 below:
The office section
The indoor section
The outdoor section
The loading/unloading section

In the office section there are:

- 2 offices
- Staff area
- Kitchen/Dining area

Upon products being delivered to BSAB, the products are stored in the different storage sections.

The indoor section which consists of three semidetached warehouses has a very vast storage area. The two closest buildings to the loading/unloading section where expanded in 2006 and 2007. The racks in these areas have shelves assembled into them from top to bottom, where products which are small enough to fit on pallets are stored. The pallets are also stored on the floor beneath the bottom shelves. In the first building of the indoor warehouse there is a picking location area, which functions like a small work shop, where products for instance are unpack from bulk and repacked into boxes with the desired quantity. Furthermore, on the warehouse floor underneath each shelf there is picking places for the smaller products such as nails, screws, etc. Apart from these products being stored on the
floor, the company does not store products on the floor in the indoor area. Occasionally, depending on the situation, the repacked products are identified by new item coding. In this area the racks and shelves are coded, with letters and numbers, in order to easier locate the stored products.

The outdoor section is, as mention previously, not considered to be a warehouse; however, we find this section relevant since this is a large area which includes storage of vast, heavy and bulky products which are durable to weather changes and which are too vast to be stored in the indoor section. This area also includes space for trailers to drive into in order to load/unload goods which are meant to be stored in all the different warehouse sections and not only in the outdoor section.

The loading/unloading section is located in the newest part of the entire warehouse. It is a large area which also includes storage of vast, heavy and bulky products; however, these products are not durable to weather changes. This area also includes space for trailers to drive into in order to load/unload goods if the weather is bad.

When it comes to unloading products which are stored either in the loading/unloading area or the outdoor area it creates minor problems for the truck driver. Since the products are heavy and bulky they have to be unloaded from the long side of the trailer which means that the entire truck has to be reversed into the loading/unloading area during bad weather, in order to keep the products from getting damaged.

One can see that the map of the warehouse does not show any section which is considered to be a bulk area, an area for storing products for replenishment. As mentioned earlier, BSAB have implemented a buffer/safety stock in their ‘regular’ inventory and therefore do not need a bulk area.

**Storage Equipment**

After the products have been delivered to the company they need to be stored in the right location and the products can be stored in all kind of ways with the help of pallet-jacks and electrical forklifts as well as manual labour. There are different criterions which have to be considered when storing products, criterions such as size and how quickly the product needs to be available for delivery.

In the indoor area the racks and shelves are similar to the racks at Färggrossoen. These types of racks are called pallet-racks; each rack has four shelves. This type of rack is suited for
pallets, as the name indicates, as well as for large quantities of products. The products are stored on pallets and the majority of the products are stored on the same pallet and with the same packaging as they were delivered with.

Products which are stored in the outdoor area are not stored on pallets. Due to the vast size of these products they are transported with special load-carrying devices and are therefore also stored on these.

The loading/unloading area stores, as mentioned earlier, products which are either too vast to be stored in the indoor area or products which are not durable to bad weather so they cannot be stored in the outdoor section. As well as for the products stored in the outdoor area, these products are stored on the load-carrying devices which they were transported with.

6.2.3 Mapping of Products

This section presents the locations of the approximately 1,500 products at BSAB. The locations of the products are in turn mapped and discussed. By observing the warehouse and the products locations, it was clear that some kind of system was used.

Business Segment and Product Families

BSAB supplies Do-It-Yourself (DIY) shops in Norway, Sweden and Finland with all kinds of building materials and services and this is the company market which they focus on.

As mentioned earlier, BSAB have five main product categories which also are considered to be their five main product families, namely; nails, screws, pipes, shingles and fittings.

Product Information

BSAB stores approximately 1,500 different types of products, such as nails, screws, pipes, fittings, shingles, pasteboard, drainage, etc. However, the company’s focus is on the five main products which they store and distribute; nails, screws, pipes, fittings and shingles which in turn come in a bigger variety of different types. These types of products are commonly used during the summer season which is BSAB’s peak season. BSAB are currently seeking products which customers find desirable during the winter season as well as during the summer season. Since the winter period is the company’s low season they find it very important to find products to increase their sales during this period. Each product has its own product coding which is either situated on the product itself or on the product box or product case. Regarding the products which have been repacked, these are relabelled and entered into the system.
6.2.4 Mapping of the Warehouse Process

Warehouses are equipped with all sorts of different equipment which enables goods to be stored and retrieved more efficiently. The following sections provide the reader with insight into BSAB’s warehouse processes.

Receiving Process

Upon arrival the products are accepted by being received and prepared for storage. These steps include unloading and identifying the products via checking the delivery note to the company’s order records; however, if the products are meant to be stored in the outdoor area the products will be unloaded there. Arrived products are then signed for, a visual quality check for the bigger products is done to make sure the products have not been damaged during the transport and then the products are checked with the attached delivery note to make sure the right products and quantities have been delivered. Regarding smaller products such as screws and nails which are delivered in boxes, they are repacked and a quality check is done subsequent to that.

The amount of time that the products spend in this process should be as short as possible.

Putaway Process

As mentioned earlier, BSAB does not use fixed position; they use floating locations since their demand fluctuates considerably. This means that BSAB lacks a fixed form in which products are assigned and the products are stored at the first available position. By using floating location method, BSAB aim is to fill the warehouse. According to Mulcahy (1993), there are two systems for handling the putaway process; memory and documents. BSAB uses the document system which indicates that the positions of the stored products are recorded into the database in order to keep track of the available positions. As mentioned earlier, the size of the products decides where the products are stored and the database system registers which products are stored, where the products are stored and in what location they are stored.

Storing Process

Once the products have been inspected at the receiving process and gone through the putaway process, the products are prepared for storage. If the products are already delivered on an appropriate load-carrying device/pallet, the load-carrying device/pallet is stocked into the right storage location which is based on the floating locations method. For instance,
products are stored on shelves closest to the loading/unloading area if they are frequently used. If the products do not arrive on an appropriate load-carrying device/pallet the products will either be stored on an existing load-carrying device/pallet with the same types of products or on a new load-carrying device/pallet.

Replenishment Process

Since BSAB uses floating location storage the disadvantage of this method is that there is lower replenishment. This results in a decrease for replenishment labour and since the company does not deal with any system based demand planning or since they do not keep any safety stock, a greater amount of replenishment labour is not required. The only kind of demand planning which BSAB does is that the CEO revises the previous year’s sales and bases the orders’ quantity and delivery dates on that.

Order Picking Process

The basis for information flow in a logistics system is formed through an order which has three basic functions; to create a flow of information that precedes goods, accompanies and follows them. Order processing addresses handling and monitoring of an order and the process at BSAB, as well as in many other companies, can be divided into six different phases, according to Harmon (2003) as well as Pfohl (2004): order transmission, order preparation, order routing, order picking, order delivery and invoicing.

The company’s logistics process is triggered when a customer order is transmitted. This is the initial phase of the order processing and a customer at BSAB has three different ways of placing an order (order transmission), either places an order via fax, telephone or e-mail.

The second phase, order preparation, adjusts the customer’s order in order to meet BSAB’s company requirements and is then placed in BSAB’s business system, Bison. If it is a first time customer placing an order several steps need to be gone through, some of these steps are also gone through by regular customers – obtaining missing information, checking pricing and delivery conditions and checking the availability of products in the warehouse. In addition to these steps, BSAB also checks the new customer’s creditworthiness through Creditsafe database, which is a business solution that, among other things, warns your company if a customer is in a bad financial place. The order software which is used for the order processing is WIN3000 which is easy, diverse and flexible software to use for companies which are classified as SME’s. This software handles the entire process including order processing, merchandise management and invoicing procedures.
Order routing, the third phase, deals with confirming orders. In this phase, a delivery notification which contains all necessary delivery documents is arranged and which in turn informs the storage to start preparing the delivery. Since more and more of BSAB’s customers are requesting orders via e-mail this has led to a decrease of handling paperwork which is associated with the information flow and which contributes to less information being lost due to papers going missing.

The fourth phase, order picking, is based on the prepared and processed orders. The business system, Bison, prints a picking note after the order has been entered in the system. The picking note contains information such as quantity, units, picking location, etc. and the order picking is organised according to factors such as urgency, order size and orders which should be delivered concurrently. BSAB has as a routine to pick the heaviest products first since these will be at the base of the order. This phase also provides important information to BSAB’s warehouse and inventories with can be used for storage management and inventory book keeping. In cases when a customer wants to make changes to an order which already has been requested, BSAB has to try and fulfil the customers new request as best as possible. However, changes to an order may result in the customer having to wait a bit, a day, longer for the delivery.

After the order has been picked, the order is prepared for delivery, and the order delivery phase deals with this step. Delivery documents are prepared and a delivery note is attached to a box/case which is part of an order. BSAB’s orders are then transported to the end customer by truck.

The last phase, invoicing, is done at two different points depending on the customer’s financial situation, either as pre-invoicing or as post-invoicing. Pre-invoicing is used by BSAB when a customer’s financial situation is not the ideal and BSAB wants to assure that they will be paid for their products before delivery while post-invoicing is the method used most frequently and, as the name indicates, the customer’s are invoiced after receiving the delivery.

Shipping Process

The shipping process involves the delivery of the order and the delivery related activities. These activities include order receipts from the packing area, arrangements for delivery vehicles and loading of the order. Once an order is picked it is prepared to be packed and prepared for transportation. In the packing area the order is merged into a unit for delivery.
and depending on the size of the order it is either packed on a pallet or in some sort of box or case. The orders are then checked with the attached delivery note to make sure the order is complete. In the loading/unloading section there are two zones where the orders which are prepared for transportation are stored. The first zone stores orders which have been prepared for transportation but which are not going to be transported that same day while the second zone stores orders which will be delivered same day they have been picked. These zones are situated close to the truck entrance in order to simplify the management of the orders and if the weather is bad the trucks can reverse back into the warehouse in order to keep the orders from getting wet and possibly damaged.

For the transportation of the orders, BSAB uses a third party logistic company, which is part of the corporate group Börjes, on a daily basis. In turn, this company has its own trucks as well as using logistic companies such as Schenker and DHL. However, DHL is no longer used by BSAB since they experienced too many problems such as customer orders not being delivered on time or at all. BSAB has fixed delivery plans for some of their customers such as Byggmax who, as mentioned earlier, require deliveries on a weekly basis. This allows BSAB to easier plan the order and in that turn guarantees a delivery which contains the right products and the right quantity. Other customers require that the deliveries should arrive the day after the order has reached BSAB. Occasionally local customers or customers who have the possibility to collect the orders themselves do this. Usually this occurs if the customer is in need of the products right away and BSAB do not have the possibility or means to send a trailer right away to this specific customer.

**Value Adding Logistics Process**

The only parts of the order process which can be considered as value added is when the repacking of products such as screws and nails, which are ordered in bulks orders, is done. Moreover, performing quality checks to assure that each box/case has the right amount of items can also be considered as value added.

6.2.5 **Mapping of Product Flow**

This section presents the product flow within BSAB which is based on where the products are stored and the quantity of the products. To map the product flow based on any other factors would be impossible since this will require high-technology equipment which we do not have access to and since it is time consuming and time is a limitation for us.

**Equipment and Personnel in Use**
Many different means of conveyances can be used in order to efficiently move, store and retrieve products in a warehouse. At BSAB the different types of conveyances which are used are pallet jacks and electric forklift trucks. The pallet jack simplifies the storing and retrieving of products stored on pallets which are located on the floor underneath the bottom shelf of a pallet-rack while the forklift truck simplify the warehousing process for BSAB when it comes to storing and the retrieving products located on the pallet-racks and the handling of vast, heavy and bulky products. These kinds of ground conveyors which are used by BSAB are flexible and easy to adjust to the appropriate job and to future system changes and expansions.

The personnel who drive these forklift trucks are employees of BSAB and they are also the once who unload the orders from the trailers and store the products in the appropriate storage area. If one of the truck drivers for some reason is not available for a longer period of time, BSSB will hire someone to cover up for this person. This newcomer will be able to learn the warehouse storage system quite quickly since the racks and shelves are code with letters and numbers; however, clearer signs and marking would be beneficial even though it is a floating location system being used.

The overall observations which were made at BSAB regarding the personnel in use were that all the personnel where fairly young which might contributes to a higher work speed.

**Information Flow**

The flow of goods in BSAB are planned, managed and monitored by order processing. This means that the information flow precedes, accompanies and follows the flow of goods.

The CEO at BSAB places a yearly order to their suppliers which consists of information regarding required delivery dates and predicted quantities. Once BSAB has placed an order to their suppliers the flow of information has been initiated. The supplier then sends an order confirmation back to BSAB specifying the planed delivery time. This allows BSAB to plan and schedule for the arrival of the delivery which is essential in many different aspects such as when handling the flow of goods and it is a necessity for reducing the costs and service. As mentioned earlier, the business system Bison and software WIN3000 provides BSAB with appropriate programs and functions needed for conducting these processes.

The information flow provides all the involved parties with required information in order to perform activities regarding handling, storage and transport. Once the order is received by BSAB the checking off of the products versus the attached delivery note is initiated. The products storage location has previous been entered into the data system along with
information about items which have been re-coded and repacked. Regarding the order picking process, the information flow begins in the office and continues to the warehouse where a worker initiates the picking of an order.

The information flow which is available after the flow of goods is complete is regarded as follow-up information and concerns an invoice which is received by BSAB after the products have been delivered.

A backup of the database system is done on a daily basis and the company can access saved data stretching back to 1999.

6.2.6 Performance Criteria

In order to classify the level of efficiency in a company, there are several performance criterions which need to be identified. Since the focus of this thesis is on the warehouse layout, and taking the theoretical frame of reference into consideration, time usage and customer satisfaction will be addressed in this section.

Time Usage

The order picking time varies depending on the size of the order. A normal sized order might take 20 minutes to pick while a big order might take several hours to pick.

Visual observations at the warehouse indicate that the workers are considered efficient workers. Moreover, it is understood that there is no obvious time loss in the warehouse; however, time is lost when conducting quantity checks and repacking screws and nails into new boxes.

Customer Service Levels

As for many other companies, the customer service level is a very important aspect. BSAB focus a lot on satisfying and fulfilling their customers’ demands, and thereby maintaining a high customer service level. By random quality checks of screws and nails it contributes to customer satisfaction in the sense that damaged goods are found and thrown away. Also by fulfilling their customers’ demands regarding weekly or the next day deliveries contributes to keeping a high customer service level.

The indication which we got from BSAB was that the customer service level is quite high and that customers very seldom are disappointed with BSAB’s services.

6.2.7 Safety in the Warehouse
Since BSAB do not store any hazardous goods, except from truck batteries, their safety requirements are not that advanced. The company has access to the most necessary safety appliances such as steel toed shoes, fire extinguisher, neon exit signs and an eye rinse system in connection with where the truck batteries are stored.

6.3 The ECO-Boråstapeter Case

If nothing else is stated, all the information in this section is gathered from the interview with logistic, IT and quality manager Jonas Sjöö at ECO and from the company homepage. The answers to the interview questions are found in Appendix 4.

6.3.1 Company Background

ECO-Boråstapeter AB in the long term is a combination and merge of a lot of companies. Johan Alfred Hedenström established Norrköpings Tapetfabrik in 1880 and in the same year Carl Fredrik Engblad started Goteborg Tapetfabrik. At 1907 Engblad bought the recently started Ljungqvists Tapetfabrik in Norrkoping and in 1921 he started another company called Engblads Tapetfabrik in Goteborg.

In 1969 all four wallpaper companies, Norrköpings, Goteborg, Ljungqvists and Engblads Tapetfabrik merged under the name Engblad & Co, one of the Nordic region’s largest wallpaper companies. In 1980 Kåbergs Tapetfabrik and Galon AB and Garkett AB which were working in the vinyl wallpaper sector were added to the company.

In 1986 all the production gathered in Annenberg and the name changed to ECO wallpaper. In 2002 ECO wallpaper was acquired by Boråstapeter and production moved to Viared, Borås. Not too long after that ECO-Boråstapeter AB marketed ECO wallpapers as young and trendy wallpapers.

Organizational Structure

ECO has a vast organizational chart and Figure 23, below, only illustrates the main departments. The six departments at the bottom of the organization have all got subsidiary sections within them. Every manager is responsible for answering to the CEO and the development department works as an individual department. The Logistics, IT and Quality department has four subsidiary departments within it; IT, Warehouse, Project and MPS, who all answer to Jonas Sjöö, Logistics, IT and Quality Manager. This section will not be further addressed since it cannot be compared with Färggrossen due to the complexity of the organizational chart.
**Figure 23: Organizational Chart. (Source: Siöö, J. at ECO)**

**Brief Company History**

- 1880 Norrköpings Tapetfabrik was established by Johan Alfred Hedenström
- 1880 Göteborg Tapetfabrik was established by Carl Fredrik Engblad.
- 1907 Engblad bought Ljungqvists Tapetfabrik in Norrkoping
- 1921 Engblads Tapetfabrik was established in Gothenburg by Johan Alfred Hedenström
- 1969 Norrköpings, Göteborg, Ljungqvists and Engblads Tapetfabrik merged under the name Engblad & CO
- 1980 Kåbergs Tapetfabrik and Galon AB and Garkett AB are purchased by Engblad & CO
- 1986 Production moved to Annenberg, name changed to ECO wallpaper
- 2002 ECO wallpaper was bought by Boråstapeter and the production moved to Viared, Borås

**The Company and its Goals**

“Wall concepts with a novel, trendy design that highlight the room’s individuality” is the catching line of the ECO wallpaper. ECO have plans to expand its business in the United Kingdom where the company has a subsidiary company. Other future plans is to integrate the different process steps, grounding, etc. as it has been done in machine number 3.

**Competitors**

ECO Boråstapeter has customers in 45 different countries. ECO is the market leader in most of the countries that it has business in which brings competition at a higher level than what the local competition would bring.
ECO’s main domestic producers are Duro, Sandbergs and Decor Maisón, while their main competitors whom import wallpaper are Midbec, Tapetterminalen and Intrade.

**Suppliers**

Eco is a company which prefers to work with a limited number of suppliers. The company believes that a long term relationships with the suppliers, is more beneficial than having more suppliers since the raw material warehouse in the company is under the responsibility of the suppliers. Even though there is an automated control regarding planning in the raw material warehouse, suppliers are responsible for keeping the raw materials present in the warehouse according to the contracts.

Suppliers which ECO has long term relationships with are also part of the product development which occurs.

**Customers**

ECO is a large sized company who owns 50-55% of the wallpaper market in the countries where they are active. ECO has 300 customers in Sweden and beyond that they also have customers in 45 different countries; Scandinavia, Russia and China are the biggest markets for ECO.

ECO is willing to expand the business in England because of the subsidiary company that they own in England. ECO is handling 1,300-1,400 orders every day. They have about 95,000 deliveries each year. ECO has 30 different collections present in their production as well as in their warehouse. The company sells 5, 4 million rolls of wallpaper each year.

**Inventory Control**

In ECO there are three different types of warehouses, raw material warehouse, work-in-process warehouse and finally finished goods warehouse. Since ECO is a manufacturing company, the raw material warehouse and the work-in-process warehouses are not avoidable in the current situation. The raw material warehouse is under the responsibility of the suppliers. Work-in-process warehouses are not very big, since most of the production lines are automated and there is no need to stock any half-finished goods between different stations.

The finished goods warehouse is a very large area where a lot of wallpapers are stocked. The company has recently expanded the finished goods warehouse in order to satisfy the increased need for space. The space need is increased due to the increased number of
wallpaper collections as well as the locating method decision of the company, which will be explained in the upcoming section.

As the products are produced, they are brought to the finished goods warehouse, since there is no an assigned area as a bulk area. When a production line starts producing specific wallpaper, it does not only manufacture a few but thousands of wallpapers and there is more than one production line that is working in two shifts.

The company is aware of the stock levels and they prefer to keep the inventory as an overage rather than a shortage, since rejecting a customer is not acceptable.

6.3.2 Mapping of Warehouse

This section presents the layout of the warehouses in ECO. ECO owns three different warehouses, raw material, work-in-process and finally finished goods warehouse. The warehouse areas are described in detail below, referring to the different areas as mentioned above.

Storage Area

ECO is a big company with a production within, which picks up goods from the raw material warehouse as well as work-in-process warehouse and delivers products to the finished goods warehouse. The production is divided into roughly three parts; bleaching the paper rolls, printing and finally cutting and packing. There are many production lines in the company and work-in-process warehouses are used only in a few of them. Because most of the production lines are automated; once raw materials enter the system, the items depart the production line in cases of wallpaper.

The raw materials warehouse in the company can be divided into two main parts, the first part is where the chemicals and the packing materials are kept and the second area is where the raw paper rolls are kept. In those two areas no shelves are needed, because the chemicals come with their own cases, which are made of plastic with special protectors around and raw papers rolls are stackable on top of each other just like tires.

Work-in-process yet again can be divided into two separate parts, the first one is right after the bleaching process where the rolls with bleached paper are kept, and yet again they are stacked on top of each other. The second part is used as a general term designating the starting and ending points of the production lines, before/after the printing and before the
cutting process. Even though the area of the facility is large we only illustrated the finished goods warehouse and loading/unloading area as can be seen from the Figure 24.

Once products are produced, cut and packed into their cases, they are delivered to the finished goods warehouse. In this warehouse every item has its own coded stocking position; which is a fixed slot system. Even though a product has the same item code, it is very important for the company to keep different production line products separated from each other. Even though different batch items (same item code) are stocked in the same stocking position, the cases acquire the batch number for the product; during the order picking this is what is taken into consideration.

In the finished goods warehouse, normal racks with special adjustments are used. In every stocking position, there is a small shelf right underneath the big shelf, where the boxes are kept. The reason for this small shelf is to keep the individual items, which are left from the cases that were opened to fulfil a customer order that was smaller in quantity then the contents of a full case. To avoid mixing the different batch products in those shelves, the company is using colour coding, where there is an assigned warehouse labourer who is
responsible for opened cases; he transfers the products to the shelves, where they are supposed to be located and marks them with coloured tape from the side that is facing out.

The company has a very big finished goods warehouse and the company is building an additional part to this warehouse. In Section 3.4.3 Storing Process, having a fixed slot system in the warehouse was addressed as it requires a very large space in higher stock levels, which is a problem for ECO.

**Storage Equipments**

As mentioned in the previous section, neither the raw material warehouse nor the work-in-process warehouses require any kind of storing equipments due to the attributes of the products. These products are transported within the system with high reach forklifts. For the paper rolls, there is a special holder instead of a forklift fork. That special holder is designed to grab the paper rolls from the sides instead of picking them from the bottom like a normal forklift which brings efficiency both in stocking and cost. If the company wanted to use normal forklifts then there should have been pallets underneath each of the paper rolls, which would add a cost for each paper roll and would not allow the paper rolls to be stocked on top of each other as it is right now.

In the finished goods warehouse, normal shelves with specific adjustments are used as storage equipment.

**6.3.3 Mapping of Products**

There are 30 different collections in ECO and in this section the locations of the products at ECO are presented. The locations of the products are in turn mapped and discussed. By observing the storage area and the location of the products, it was clear that some kind of system was used.

**Business Segment and Product Families**

ECO-Boråstapeter has been in the market since 1880 and is one of the leading wallpaper manufacturers. The one and only production of the company is wallpaper. ECO does not manufacture wallpapers singularly; instead they manufacture them in very large a collection, which means that more than one type of wallpaper will be manufactured. ECO at present has around 30 different collections both in production and in their inventory.

**Product Information**
Wallpaper is the only product ECO Boråstapeter manufactures. There are many different types of wallpaper; different colours, themes, patterns, which brings a large variety in products. The production is planned for every day, every three months and every six months in ECO. The reasoning behind the three month and the six month production planning is to match items in the warehouse with the demand so that ECO can decide to end a particular collection of wallpaper if it is not desired in the market.

As mentioned previously the production decision for wallpaper is not made for a single wallpaper role but for an entire series of wallpaper. The reason behind this lies in the production process of the wallpaper.

Wallpaper production is a complicated and long process which starts with ground coating the paper, which can be compared to ground coating a house. The second step is bleaching the raw paper rolls. After bleaching the next step is to print the patterns. The printing pattern process can be compared to something as simple as potato stamping, with a little difference; instead of using potatoes big metal printing rolls with patterns on them are used. This is the most expensive and important part of the production process. Once the pattern rolls are prepared the company wants to use them as much as they can, to compensate for their cost. Most of the time one metal pattern roll is not sufficient, which is why more than one metal pattern roll is needed, something which in turn increases the cost by a great deal. This is the main reason why the company is establishing a collection instead of single wallpaper. In the collection different combinations of rolls are used for the different wallpapers and with this combination maximum usage of the metal pattern rolls is accomplished.

Since the only product is wallpaper and all wallpapers have the same attributes, ECO has the advantage of having identically sized products. All the products have almost the same dimensions and therefore the same packaging, which means volume efficiency and cost reduction, when compared to a warehouse with different sized products.

6.3.4 Mapping of Warehouse Processes

In this part of the empirical study we will not be detailing the processes in the raw material or work-in-process warehouse, since these parts are not compatible with our target company’s warehouse. The finished goods warehouse processes are discussed in this section to clarify the methods used.
**Receiving Process**

Receiving in this company can be divided into two main parts, receipt of the raw materials and receipt of finished products. Raw materials are delivered by the suppliers which is their responsibility. The finished goods are produced in the production facility of the company, inspected and packed with automated systems, which means that there is no need for extra inspections as the finished goods are received.

**Putaway Process**

As mentioned previously the stocking positions of the products are already decided due to the fixed system that the company is using. Once the production and packing of wallpaper is done either it is collected by a forklift driver to be placed to its position or transported with the help of the automated forklifts. In ECO putaway is directed with a document which means that the labourer or the automated forklift is directed to the assigned position for the product with the help of the warehouse database system.

**Storing Process**

In ECO a fixed slot system is being used, in the raw material area, the chemicals are mostly stored in very big tanks which are not very easy to move even with the forklifts. In the finished goods warehouse every product has a pre assigned position where it is stocked. In finished goods there are normal shelves with special adjustments for individual wallpapers, which were explained in the storage area section previously.

**Replenishment Process**

The company does not necessarily have replenishment since the supplier is next door. The company manufactures in bulk quantities which brings the result of the picking area being the bulk area at the same time.

**Order Picking Process**

In ECO order picking is a main focus, since the company takes customer satisfaction very seriously. As a company policy orders that have been received before 5pm should be delivered in the same day unless they are very high quantity orders or they are ordered with a future delivery date.

As a company policy, customers can place as many orders as they wish in a day. When the orders are received, they are listed in the warehouse database system after ten minutes. Once there are 16 orders in the queue, the labourer prints out the route that the warehouse
database system assigns and gets the special cart which is called matrix wagon that has 16 slots on it each is suitable for an order. According to the list the labourer starts going through the aisles and picking the ordered goods and places them in the slots of the cart. As it is addressed in Section 3.4.5 Picking Process, this is called bulk order picking.

Not all of the orders are suitable for this type of picking. If the order is of a very high quantity, then one labourer handles picking, which means that not only is bulk picking what happens in ECO but discrete picking is also used.

Once the picking is complete, the orders are packed to be sent away. ECO has the benefit of having the same size attributes in all of their products. This gives the opportunity of using the special cart very efficiently.

**Shipping process**

Once the picking is complete, the goods are packed according to the size of the shipment. A delivery note regarding the products in the pack is attached on the pack. If the packages that are prepared are small, then they are stocked in a cart, but if the package of the delivery is large then it is kept in the unloading/loading dock until the third party logistics truck comes to pick the delivery. Even though ECO is a big company with production, they do not own any transportation vehicles for deliveries.

When it comes to shipping, ECO only makes use of Schenker. The company has been working with Schenker approximately 50 years and it is told that Schenker was very familiar with their style of working and the relation with them is very important.

The complexity in shipping comes from the number of the orders from a customer, there can be more than one order in a day, and they are all registered in the system. The customer demands that all the orders to be delivered in one pack and also the company do not want to pay for each ticket opened to Schenker. The shipping cost includes the ticket price which is the same for each delivery even if it is a large or a small one and also the price that is set based on the weight of the delivery. When there is a delivery for export, the situation gets more complicated due to the invoicing and arrangement of the third party logistics.

The benefit ECO finds in third party logistics is not only limited to the opportunity of delivering quickly, in different quantities but the GPS system of the third party logistics is also used to inform the customers of the delivery.
ECO is a manufacturing company; products are being stocked after they are manufactured. Beyond special packing for special orders, ECO does not have any other value adding logistics.

### 6.3.5 Mapping of Product Flow

This section presents the product flow within ECO which is based on where the products are stored and the quantity of the products. To map the product flow based on any other factors would be impossible since this will require high-technology equipment which we do not have access to, or the time to make use of.

### Equipment and Personnel in Use

The material flow starts when the raw materials are received. In the production system there is a movement of the goods and finally after the production, products are placed to their final locations in the warehouse. Equipments that are being used in the material flow are explained in the warehouse mapping section. ECO has a significant larger workforce and a widespread age range than both BSAB and Färggrossen.

In ECO, the main material handling equipments are forklifts. The company does not have many different types of forklifts, but rather, similar forklifts with different extensions. As mentioned previously for paper rolls a grabbing tool is used. The end products, which are carried over pallets, are handled with high reach forklifts. The company owns an automated (robotic) forklift which does not require a driver; it is programmed to pick the palettes from the packing system and then to deliver them to their assigned positions.

There are some conveyors used, beyond those handling equipments, in the packing system.

### Information Flow

ECO as a company is using every aspect of technology, robots and computers are very common. Data validity is taken very seriously not only because it is beneficial to keep it that way but the company also possesses an ISO 9001 certification. In ECO it is possible to find the data about any product at anytime and back up is being done every day.

The company uses an ERP system, a business system named Garp, which supports the order-inventory-invoicing processes. ECO’s web-shop is in turn a standard module which is sold, by the company Microcraft, as a part of the ERP system. This web-shop is directly connected to the warehouse database and reports the orders to the warehouse to be picked. The web-
shop supports the policy of delivering in the same day that the company holds close to heart. In the warehouse system not only can the orders that the customer places through the web-shop be seen but also fax and phone orders are also listed. The person responsible in the warehouse can see the orders listed on the screen, he/she then prints the picking route and once 16 orders are in queue the order picking process immediately starts.

In the company demand and production planning is done by using the Microsoft excel program. Reports from these plans are used to support decisions regarding the production.

### 6.3.6 Performance Criteria

To be able to see the level of efficiency in a company there are many performance criteria that can be identified. In our thesis, since we are focusing on the warehouse layout, we will be taking time usage and customer satisfaction as performance criteria.

### Time Usage

As mentioned in the previous section, ECO has the policy of delivering products within the same day, unless the orders are placed after 5pm. Time usage in the warehouse is very crucial because of this principle.

When we asked the question ‘How long does it take an order to be picked up?’ there was not one answer, because the company has not done any time studies of this. It was told that once the orders are received and the warehouse labourer starts picking, depending on the quantities, order picking might take between 30 minutes to two hours.

### Customer Service Levels

As one of the biggest wallpaper manufacturer in Sweden, ECO is very considerate about customer satisfaction and this brings us to the question of customer service levels. The company is aiming for a very high level of customer service level, what is most important to ensure this for ECO is the delivery time of the orders, which is why ECO is aiming to deliver all the orders in the same day, which are unless they are ordered after 5pm.

### 6.3.7 Safety in the Warehouse

Raw materials in ECO are paper rolls, paints and other chemicals which are very flammable in nature. The company does not have a sprinkler system; instead they have section securing doors which are normally open wide on the sides parallel to the walls. These doors are very durable and are designed to isolate the section that is on fire from the rest of the facility.
 Once there is a fire in a section, fire detectors will detect it and alert the alarm system, which will inform the people in the facility and give them a chance to evacuate. After a while the doors will close and the section that is on fire will be isolated from the rest of the facility.

The company has regular fire drills to be ready for such a situation in order to avoid any casualties.

6.4 Comparison

In this section, case studies will be compared. As was discussed in Chapter 3 Theoretical Frames of Reference, different methods that are used and different choices of inputs are addressed for every company. As was discussed in Chapter 5 Research Design and Methodology, we have decided to use the method of multiple case studies and benchmarking, which means that we need to compare the data that we received from companies, which was discussed in case study section.

ECO has a longer history and more experience when compared with the other two companies, since ECO is a merge of a variety of different companies all throughout its history.

All three companies are aiming towards the same goal from different paths, they all want to increase customer satisfaction and as a result the market share. Färggrossen owns trucks and supports the warehousing system with delivery to the door, which the company sees as a tool to increase customer satisfaction. BSAB is searching for products that can be used during the low season, which will benefit the customer and increase the market share of the company. ECO has a history of aggressive growth and we were informed, by Jonas Sjöö, that the company plans to expand and grow on the foreign markets.

All three companies prefer working with a limited number of suppliers, which they believe brings mutual trust in long term. Färggrossen only works primarily with 15 suppliers and similarly BSAB limits its suppliers within the same range, but still looks for suppliers with lower prices. In ECO’s case, suppliers are responsible for the raw material warehouse.

Since all the companies are aiming for 100% customer satisfaction, the customers are very valuable for the companies. In Färggrossen new customers are searched for, by the CEO, but most of the current customers are either coming from previous contacts or personal contacts of the employees. Färggrossen has 400 customers which are located in the south of Sweden.
BSAB is working with 144 customers who are mainly located in Sweden. The most important customers for BSAB are Byggmax and Beijer, which the warehouse works as a contracted warehouse for.

ECO is working with 300 customers in Sweden and has trade with 45 different countries, while keeping Scandinavia, Russia and China as the most important ones. When clientele of the companies compared we can see that the largest customer network belongs to ECO, followed by BSAB.

ECO manufactures various types of wallpapers, at present the company manufactures and stores 30 different collections. BSAB is working with building materials and Färggrosen’s main focus is paints, wallpapers, etc. When markets are compared, ECO and Färggrosen share a similar interest in wallpapers, but BSAB does not have a common point with Färggrosen.

The variety in product is another important issue that needs to discussed, ECO warehouses approximately 5,000 products while this number in BSAB is approximately 1,500 and in ECO it is defined as 30 different collections.

Even though the companies have several differences, the similarities that they share make the comparison meaningful, since we are looking for improvements for Färggrosen. To be able to see this differences and similarities we have made a table using the data we gathered and interpreted that to make the comparison Table 12.

<table>
<thead>
<tr>
<th></th>
<th>Färggrosen</th>
<th>BSAB</th>
<th>ECO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Receiving</td>
<td>Special dock area</td>
<td>Special dock area</td>
<td>Special dock area</td>
</tr>
<tr>
<td></td>
<td>Forklifts, pallet jack</td>
<td>Forklift, pallet Jacks</td>
<td>Forklifts</td>
</tr>
<tr>
<td></td>
<td>Visual inspection</td>
<td>Visual inspection</td>
<td>No inspection</td>
</tr>
<tr>
<td></td>
<td>Nails/screws special quantity control</td>
<td>Nails/screws special quantity control</td>
<td></td>
</tr>
<tr>
<td>Putaway</td>
<td>Memory/direct putaway</td>
<td>Documented/direct putaway</td>
<td>Documented/directed putaway</td>
</tr>
<tr>
<td>Storing</td>
<td>Family grouping</td>
<td>Floating method</td>
<td>Fixed method</td>
</tr>
<tr>
<td></td>
<td>Normal racks</td>
<td>Normal racks</td>
<td>Normal racks with special shelves underneath for individual items</td>
</tr>
<tr>
<td>Replenishment</td>
<td>Unclear replenishment</td>
<td>No replenishment</td>
<td>No replenishment</td>
</tr>
<tr>
<td>Picking</td>
<td>Discrete</td>
<td>Discrete</td>
<td>Batch picking</td>
</tr>
</tbody>
</table>

Table 12: Case Study Comparison Table. (Source: Our Own)
In Chapter 3 *Theoretical Frame of Reference*, it was addressed that warehouse is a system with inputs, processes and outputs. In this section comparison of the different processing methods of the companies will be discussed and according to the literature, the advantages and disadvantages of the methods will be pointed out.

**Receiving**

In Section 3.4.1 *Receiving Process*, it was addressed that even though the receiving process is easy, it is a labourer intense process just like shipping. Receiving as a process is simple as defined previously, the important content in this process are the inspections that are done. The company needs to make sure that the received goods are sufficient in quality, condition and quantity.

In the Färggrossen and BSAB case studies we have seen that, in order to ensure that the received products are in good condition, a visual inspection is done. Products that are received are counted and compared with the delivery note to make sure that there are no missing products. In ECO case, there is no such need since the finished goods warehouse was directly supplied from the manufacturing facility.

An additional inspection is done to the nails and screws in BSAB, every pack of nails/screws are emptied and counted and finally packed into their cases again, which will be pointed out as a time loss in the warehouse system.

**Putaway**

Putaway is the process that occurs after the receiving process; once the goods are received they are to be transported to their stocking positions. In Section 3.4.2 *Putaway Process* it was addresses that Mulcahy (1993) defines two different methods for putaway; memory and document.

In BSAB and ECO it is document method that is being used, which means that before the products are put into their positions a document is helping the labourer to place the goods
into their correct locations. In Färggrossen the putaway process is in the control of the warehouse manager, who uses the memory system to handle this process.

In Section 3.4.2 Putaway Process, it was addressed that Frazelle (2001) defines four principles for putaway; direct, directed, batched and sequenced, interleaving. In our cases, ECO is handling the putaway according to the directed putaway principle, while BSAB is handling it according to the direct putaway principle just like Färggrossen is doing.

In BSAB or ECO, there is no problem locating a product when needed; on the other hand in Färggrossen the memory method that is being used is causing some problems, since the company is not recording the stocking positions of the products when they are putaway. In BSAB the locations selected for the goods in putaway process are recorded in the database system that the company is using. In ECO the database system is set to direct the labourer to the assigned positions.

**Storing**

Storing is an important process in the warehouse system; different warehouse areas and storing location methods actually affects the efficiency and validity of the system. In Section 3.4.3 Storing Process, it was addressed that two types of storage are possible, bulk and pick. Bulk storing is the reserve stock to replenish the pick storage area. When we check the situation in the companies regarding the definitions of these two areas, we see that none of the companies has a specific area defined as bulk storage area and at the same time all the companies are either building or planning to build new warehousing buildings to support the space need.

In the Färggrossen case, bulk items are stored high on the shelves in every section of the warehouse, BSAB and ECO keep their buffer/safety stock in their regular inventory. In both BSAB and ECO we were informed about the need for more space that they require, which is why both of the companies are building new sections for their warehouses.

In Section 3.4.3 Storing Process, Ackerman (1997) addresses that there are three different stock locating methods; fixed slot, floating slot and family grouping. In our case studies we have seen that all the companies we have visited are using a different type of stock locating method. In Färggrossen it is family grouping, BSAB; floating and finally in ECO fixed slot stock locating method is used.

In the case studies it was discussed in detail for each company, the advantages and disadvantages of these methods. In the warehouse of Färggrossen there were bulk products
that were randomly stocked all over the warehouse, which were not fitting to the family grouping stock locating method. Even though the company has approximately 5,000 different products the need for space was much lower than the other two companies.

In BSAB floating system is being used, the company warehouses approximately 1,500 products, the warehouse has been expanded a few times and the last expansion was done recently. The disadvantage that BSAB has is the variety in the shapes and sizes of the products, for example, if you compare a box of screws with a 500 litre water tank you will see that the space for those two different products varies substantially. These differences make the need of space in the warehouse greater than if the items had been of identical or similar sized.

ECO has a fixed slot system and as was mentioned in the case study, the level of stocks are high, the need for space will be similarly large. The main problem ECO is facing is the need for space, but the advantage that ECO has is the similar size of packages for every product.

**Replenishment**

Replenishment is defined as the action of filling the positions in the pick area from the bulk area. As mentioned previously none of the companies that we have interviewed, defines an area in the warehouse as a bulk area. The only possible designation of a bulk area is occurs in Färggrossen and the replenishment in the company is dependent on the warehouse manager’s personal decisions.

**Order picking**

Order picking is the opposite of the putaway process; Färggrossen and BSAB use discrete order picking method, while ECO uses bulk picking method. When the orders handled in a day are compared, it can be seen that while ECO is handling 1,400-1,500 orders in one day, this number is much lower in the other companies.

In the order picking process, Färggrossen and BSAB are using simple carts while ECO is using a special cart called matrix wagon, which was describes in the ECO case.

**Shipping**

None of the companies are using special packing for their deliveries, and all the firms use third party logistics to ship the goods to the customers. ECO has been working exclusively with Schenker, for the last 50 years.
In contrast to the other companies, Färggrossen despite using third party logistics, uses their own trucks to deliver, which brings customers trust and satisfaction, since the truck driver is also working as a salesman and informs the customers personally about the new products.

**VAL**

As value adding logistics, depending on the customer order Färggrossen is handling colour mixing, and BSAB is counting and repacking screws and nails while ECO does not have any sort of VAL.

**TIME USAGE**

In every company time wastes are explained. In Färggrossen the main waste of time is coming from two sources: the manual unloading of the products from pallets to the shelves and also the time spent looking for items due to the lack of a locator system and the lack of information flow.

In BSAB the main time waste is the counting and repacking of the screws/nails, but the company is willingly wasting this time to improve customer satisfaction.

When comparing the three companies, it is obvious that ECO is the most efficient, when it comes to time usage. Based on our observations during the time we spent at ECO, both the work of the labourers and the layout of the warehouse was designed to minimize time loss. This is also something that the people we interviewed attested to. To make sure that there really is no time loss in ECO we would need to conduct several time studies, however this is something that we simple did not have the time to do.

**INFORMATION FLOW**

As we have seen in the Section 3.3.3 Machine (Equipment), there are various types of automated systems that can be used in a warehouse. In ECO barcode systems, automated forklifts and database systems are being used in a very efficient manner.

When the sizes of the companies are compared, it can easily be seen that neither Färggrossen nor BSAB are at the economical level to support such technological solutions. Even though both companies have database systems, it is evident that the database system in Färggrossen is not working as it should be. This is an issue that should be investigated.
Safety in the Warehouse

All the companies have some fire and health care precautions. Färggrossen’s fire precautions are limited to signs to designate the exits and fire extinguishers while ECO using section securing doors, which are explained in the case study section. In BSAB fire is not seen as a severe hazard, since most of the items are made of metal.

All the companies have informational seminars and educational programs about work health and safety, as well as clothing rules.
7 Analysis and Recommendations

Firstly, this chapter presents the analysis model which helps us to carry out the analysis in a more structured manner. Secondly, we also present the empirical material: the Färggrossen, the BSAB and the ECO case, which is analyzed and compared with keeping in mind the methods used in a cross-case synthesis and a within-case analysis in order to gain insight and understanding to fulfil the purpose of the thesis. This is accomplished by answering the research questions, presented in Chapter 4 Task Specification.

7.1 Analysis Model

Based on the information gathered from the interviews and case studies as well as the information gathered from the literature and the theoretical framework, an analysis model was created in Section 5.8.4 Creating an Analysis Model. The analysis model was created with the purpose to guide us through the analysis process as well as simplify the process for analyzing the three cases and drawing conclusions from comparing them to each other as well as to the theory.

The structure of the analysis model has already been addressed and discussed in Section 5.8.4 Creating an Analysis Model; however, a brief summary of the different steps is presented below.

7.1.1 Summary of the Analysis Model Steps

The first step of the analysis model is to interpret the gathered information; information from the interviews, literature, etc. The feasible theories led to identifying the research questions which in turn formed the basis for the interview guide. The gathered information is compared to each other in order to answer the research questions. If the compared information corresponds, applicable theories are identified whereas if the information does not correspond the theory is after discussions disregarded.

Secondly, the analysis consists of a cross-case synthesis and a within-case analysis merged together. By addressing each research question individually the analysis is conducted in a structured and efficient manner. Results which correspond with information from the interviews/case studies and the theory are seen as results which might be applicable to Färggrossen, whereas results which do not correspond with the information from the interview/case studies and theory are investigated why they do not correspond and then they are disregarded. Suggestions on how to improve the warehouse layout and processes are also discussed.
Lastly, the conclusions and recommendations which arose from the analysis are addressed in *Chapter 8 Conclusions and Further Work*, as well as discussing conclusions regarding feasible improvement changes and identifying possible theories. The feasible conclusions are compared and addressed in order to improve the current situation at Färggrossen and recommendations and suggestions are provided to Färggrossen as well as for ECO and BSAB.

The analysis model is presented in Figure 25 below.
The answers to the research questions are presented in the upcoming section.
7.2 **Answers to the Research Questions and Recommendations**

This section presents the answers to the research questions which were identified in the task specification, Section 4.2 Research Questions, and which have been answered by conducting interviews at each of the three case study companies. Each research question is addressed individually and the results of each case, which are of interest to our thesis, are compared to the theory in a within-case analysis, and cases are compared with each other in a cross-case synthesis. This step is done in the following sections.

7.2.1 **Answers to the General Research Questions**

**Research Question 1**

- *How do the companies organize their warehouse management?*

The warehouse is viewed as a system; inputs, processes and outputs are defined in Section 3.3 Warehouse System Inputs, 3.4 Warehouse Processes and 3.5 Warehouse System Outputs in detail. The company and their warehouse management is viewed from the same perspective; the company-specific decisions regarding the inputs, processes and outputs are described in Chapter 6 The Case Studies. The answer to this question can be found in Chapter 6 Case studies.

In Chapter 6 The Case Studies, the backgrounds and histories of the companies are discussed, to clarify the experiences that the companies possess. Organizational charts are discussed to review the order-command chain and how the responsibilities are distributed. The goals, the customers and the suppliers are discussed to clarify the purpose of the warehouse.

Our thesis deals with warehouse layout, but without being knowledgeable about inventory itself discussing processes will be discussing theoretical ideas without any facts, which is why the inventory control and the products are discussed for each company. We mapped the warehouse, the products, the processes and the product flow.

Mapping of the storage section for each company aims to express the present situation in the companies regarding the layout, the warehouse areas and the equipment that is used.

Mapping of the products aims to discuss the types of products, the family groups and the attributes of the products as well as special warehousing conditions for the products and the way the companies handle these topics.
In the mapping of warehouse processes subsequent section, we explained the choice of the methods in the companies that were discussed in Section 3.4 Warehouse Processes, which we planned to compare with Färggossen to improve their warehouse management system. Mapping of product flow is aimed to discuss the labourer and equipment used in the product flow and more importantly how the information flow is occurring in the companies; what type of IT systems they use and how they benefit from it.

Performance criteria are used to compare the historical data of the companies, which is why time usage and customer service levels are considered to be the values that can be compared historically. In this section the work regarding time usage and customer service levels that the companies are handling are discussed.

Safety in the warehouse is not directly affecting the warehouse flow, but it is still very important since all the companies have some safety threats. The precautions the companies have and their plans regarding this topic are discussed in this section.

RESEARCH QUESTION 2

What are the key issues concerning warehouse management, and how do companies handle these issues?

Improvements can always be made in companies. Even the most organized and structured company has weaknesses in the organization which can be improved. The most important issues which we identified through observing the three companies were:

- Cube utilization (all three companies)
- Aisle width (BSAB)
- Excess inventory (BSAB)

These three factors will be addressed in a joint section below; however, issues regarding Färggossen will not be addressed in this section since they will be addressed in Section 7.2.2 Answers to the Main Research Questions instead.

KEY ISSUES AND THE HANDLING OF THEM

Cube utilization in the only common denominator which we have identified through observations and the interviews. All three companies experience the need for more space in one way or the other. In Chapter 6 The Case Studies, it clearly states that ECO and BSAB have the past years expanded their warehouses in order to meet future customer demands and in
order to handle seasonal and trend fluctuations as well as getting access to more space. In Section 3.2.2 Warehouse Layout of the theoretical frame of reference Mulcahy (1993) and Salvendy (2001) discuss the importance of utilizing and maximizing the available storage space. Observing ECO provided us with ideas of how to help Färggrossen strive to maximize their storage space since ECO maximized the utilization of airspace which neither Färggrossen nor BSAB currently do. Our opinion is that ECO has tried to solve their lack of available space by applying cube utilization as well as adding an extension to the premises. BSAB on the other hand have solved their issue with lack of space by adding three extensions to the premises within the past decade, but they have not applied any cube utilization or anything similar. Therefore, BSAB are still experiencing a lack of space and not addressing the issue will result in the company needing to add another extension which is currently not needed as well as it is an extra cost for the company. Applying the cube utilization method will automatically free a vast amount of space and which will contribute to the company having excess space for other purposes. Freeing space leads us to the second factor which was identified, namely aisle width.

The first observation which was made as soon as entering the warehouse at BSAB was that the company does not utilize the storage space appropriately at all. In Section 3.3.4 Milieu (Environment), Ackerman (1997) states that 40% of a warehouse’s storage space is wasted on aisle, docks, etc. and BSAB is one of many companies that has fallen into this category. The manner in which the, in the indoor section, are structured is not efficient at all since the structure has contributed to the aisle length being approximately 5-10m. There is no logical reason for the aisles to be this wide since BSAB do not own any trucks which require aisle of this width. The fact that the aisles are these wide contributes to a lot of space being wasted, space which could be used for other more appropriate purposes. The problem with the aisle length go hand-in-hand with cube utilization, and by applying the cube utilization method, BSAB will not only solve the problem with lack of space but also reduce the aisles widths and free large amounts of space. Even though we see this as a problem, BSAB do not have the same opinions as us and have therefore not identified there aisle widths as a problem, hence, the company has not addressed the problem.

Another problem which we identified at BSAB was that BSAB holds excess stock based on the fact that the company holds inventory for Byggmax and that the company needs to have excess stock in order to never experience stock outs. When asked if the company believed that they kept more stock than necessary, Thomas Nygren and Sanna Nygren stated that
they were aware that the company held more inventory than necessary and that it tied up capital. However, they did not believe that the tied up capital was an issue for the company at the present time. Even though BSAB do not consider the excess stock as an issue, our opinion is that the inventory level can be reduced and still with good margin cover the customer demands and fluctuations which might occur and with that reduce the tied up capital. Tied up capital is always an issue for companies and it is important to reduce it as much as possible, and since BSAB are aware that they keep too much inventory, there are possibilities to reduce it, hence, reduce tied up capital.

After identifying this issue our thoughts were turned to Färggrossen, if BSAB new that they held more stock than necessary, how does the situation look like for Färggrossen? This though was raised based on the fact that Färggrossen in general does not have control over its inventory and the thought was strengthened after accessing Färggrossen’s inadequate inventory records. However, we kept in mind that the records probably were faulty since some products had a thousand items in stock while others were out of stock, still we could find them in stock, as well as Färggrossen not having conducted an inventory for long. Despite the possibility of the records being faulty, we believe that there is a possibility that Färggrossen is not only holding unnecessary stock but that the company may be holding products in stock which there is no need for. If this is the case, the company needs get rid of the products which there are no need to keep in stock and look into reducing the amount of excess stock to an acceptable level in order to reduce its tied up capital.

In conclusion, Färgrossen can learn lessons from both ECO and BSAB on how and how not to handle these issues which the companies are experiencing.

7.2.2 Answers to the Main Research Questions

This section presents the answers to the main research questions. In order to identify the issues which Färggrossen are experiencing, the two general research questions are answered.

Research Question 3

What are the key problems and why are Färggrossen experiencing them?

By observing the warehouse processes, together with the information gathered at the interviews, we were able to identify some key problems which Färggrossen are experiencing. With the Fishbone diagram in the theoretical frame of reference in Section 3.2.2 Warehouse Layout, we summarized what we strongly believe are the different reasons for the main
problem, warehouse inefficiency, which Färggrossen need to address in order to improve their warehouse processes and warehouse layout. The table below follows the structure of the Fishbone diagram and addresses five of the six inputs and the main factors for each of those inputs.

<table>
<thead>
<tr>
<th>Main Problem: Inefficiency in the Warehouse</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MAN</strong></td>
</tr>
<tr>
<td>1</td>
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<tr>
<td>2</td>
</tr>
<tr>
<td><strong>MONEY</strong></td>
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<td>4</td>
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<tr>
<td>5</td>
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<tr>
<td>6</td>
</tr>
<tr>
<td><strong>MACHINE</strong></td>
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<td>7</td>
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<td>8</td>
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<td>9</td>
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<tr>
<td><strong>METHOD</strong></td>
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<td>10</td>
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<td>11</td>
</tr>
<tr>
<td>12</td>
</tr>
<tr>
<td><strong>MAERIAL</strong></td>
</tr>
<tr>
<td>13</td>
</tr>
</tbody>
</table>

Each input will be addressed individually; however, in order to provide a clearer picture for the reader, the different factors will not be addressed one-by-one, but rather addressed in connection with corresponding factors. This way all factors will be addressed without having to repeat the information.

**MAN (PERSONNEL)**

The factor, which is the first warehouse input which we strongly believe affects the warehouse processes, is the personnel. Since the personnel plays an essential part in the warehouse processes this section will therefore address the three categories which affect the personnel’s work the most: *insufficient numbers of workers, hidden and obvious time loss*. 
As stated in Section 3.3.1 Man (Personnel), the warehouse personnel are key factors when it concerns tasks such as assigning the placements of the products and order picking. Every warehouse process needs to be identified, defined and planned in order to work as efficiently as possible; by ‘efficiently’ we mean that the work needs to be conducted in an assigned limited time. Today, one cannot say that this is the case for Färggrossen. By observing ECO it was possible to see how this company was properly organized, and that the product flow as well as information flow was sufficient. At BSAB the organization was also well structured; however, due to the fact that there only was one forklift truck available, processes like receiving, putaway and shipping created a bottleneck since only one process could be conducted at once. Not only did the equipment function as a bottleneck, but so did the personnel since BSAB only have five fulltime working employees and adding a forklift truck to the warehouse would not eliminate that bottleneck because the company would not have an employee who could operate that extra forklift truck. Färggrossen are experiencing a similar situation as BSAB. Due to the company being a SME it has limited resources, and hiring a new employee might not solve any current problem since the company needs to address issues such as restructuring the warehouse layout before even thinking of hiring any new workers. If the warehouse layout is not addressed a new worker will not be able to learn the layout, which in turn will contribute to the warehouse processes being affected negatively due to the new worker slowing down the processes because he/she cannot find the products listed on the order note.

The misplacement of products brings us to the second and third factors which affect the man input of the warehouse namely hidden and obvious time loss. These factors are addressed below.

**Hidden and Obvious Time Loss**

As quoted by Ackerman (1997) in Section 3.3.1 Man (Personnel) of the theoretical frame of reference hidden time loss is difficult and crucial to figure out and is defined as: time loss which can be waiting for order lists, looking for equipment, time lost due to items being stored in the wrong place and fast moving items being stocked behind slow moving items or stacked high up on racks.

As mentioned in Section 6.1 The Färggrossen Case, hidden cost is a big problem at Färggrossen. For example, the fact that paint cans, which are delivered on pallets, are not
stored on these pallets, but rather repacked, and manually stacked one by one on shelves, is a huge waste of time.

At BSAB the storing process is handled in a quicker manner, since their products also are delivered on pallets they have chosen to store their products on these pallets which contribute to reducing the hidden time lost. We strongly believe that Färggrosen needs to examine this process; in fact the current structure of the warehouse layout is suited for storing products on pallets and we strongly believe that Färggrosen will benefit from storing the products on pallets rather than reloading them.

Quoted by Ackerman (1997) in Section 3.3.1 Man (Personnel) obvious time loss is referred to as ‘the time wasted on workers not doing their job due to them taking unnecessary breaks’. Observations at Färggrosen, BSAB and ECO clearly show that obvious time loss is not an issue at either of the companies. All three companies, especially Färggrosen and BSAB, have a heavy workload everyday and there is no opportunity for the workers to slack since doing this will affect the entire company and its goals to maintain a high customer satisfaction level.

**Money**

The second factor which affects the company as a whole and the warehouse in particular, is the money input. For a SME like Färggrosen finance is a limitation which cannot be ignored, hence, we will look at: limited sources, insufficient IT investments and inventory holding costs as factors which affect this factor the most.

**Limitations**

When providing Färggrosen with recommendations in order to improve their warehouse layout and warehouse processes it is essential that we consider the limited resources available to an SME such as Färggrosen. A larger company like ECO does not need to consider the available resources as Färggrosen and to some extent BSAB; therefore, we will not be comparing ECO and Färggrosen on this level.

One of the major limitations which affect Färggrosen is that the introduction of computers did not involve the most suitable IT support system. Färggrosen’s CEO is aware of the system’s limitations and has approached the manufactures in order to implement applications which will simplify several warehouse processes, but so far this problem has not been resolved. Moreover, in addition to certain applications are missing in the system, the current applications are not being used in the most useful way. For instance, it is possible to
enter the specifics of the products such as colour into the system, but this has not been done. Entering additional information like this into the IT system will increase not only the information flow, but it will also positively affect the inventory control and replenishment process.

We also strongly believe that it is important for Färggrossen to conduct inventories on a regular basis in order to keep track of the inventory. An inventory control system will help the company to conduct this task; however, it is essential that the company is aware of how to operate the system; otherwise it is not beneficial to the company. Presently, Färggrossen has no records of how high/low their inventory levels are for the products in store and they have no record if they are holding products which have been in stock for a considerable time and which are therefore tying up capital. Therefore, it is essential for Färggrossen to conduct inventories on a regular basis, preferable yearly as most companies are required to; conducting such inventories have helped BSAB to maintain an acceptable inventory level, even though they are required to keep excess inventory due to customer contracts. So what we are emphasising is that Färggrossen might be keeping inventories on products for which there is no longer any demand, and this contributes to increasing the company’s holding costs.

\[ \text{Machine (Equipment)} \]

Machines play an essential role in simplifying the warehouse processes for the workers and in order to fulfil the majority of the processes it is important for machines and other equipment to meet certain requirement in order to be sufficient for appropriate processes. Therefore this section addresses the handling and storing of products, lack of variety in different handling equipment and the lack of data equipment.

\[ \text{The Handling and Storing of Products} \]

Since Färggrossen stores a variety of products, which in turn come in a variety of different sizes, the warehouse layout obviously needs to take these properties into consideration, as well as product weight, flammability, etc. In order for the handling of products to properly function it is essential that the products’ properties are described in an appropriate manner. For instance, as mentioned in Section 6.3 The ECO Case, the wallpaper at ECO is stored in fixed locations on pallets; and above the bottom shelf there is a small shelf which holds single roll of wallpaper which belong to different batches. We strongly recommend that this system can be applicable to Färggrossen’s wallpaper area and will benefit the company in reorganising the current state. We also strongly believe that there is a need for different types
of racks, other than normal racks, on which the products should be stored. Once again, regarding the wallpaper at Färggrossen, the racks on which the wallpaper is stored are not of the appropriate size since the wallpaper sticks out beyond the shelf length; and it is also only possible to store single wallpaper, since the boxes are too big to stack on top of each other. This contributes to not utilizing the maximum cube space in an efficient manner, which is essential according to Mulchay (1993) and which is discussed in Section 3.2.2. Warehouse Layout, referring to maximizing the space utilization. Due to the wallpaper being stored in this manner, there is a vast amount of unnecessary space being used, and this has limited Färggrossen from adding more racks to the layout since there is currently no available space. Utilizing the cube would lead to a lot of space being freed and which in turn can be used for storing other products or be used for future expansions. Therefore, we recommend that Färggrossen needs to properly consider restructuring this section of the warehouse layout in order to properly utilize the cube and in turn free the space which is currently being occupied. If Färggrossen plans to expand in the future, the company needs to learn from ECO and BSAB regarding cube utilization. At the moment, none of Färggrossen’s warehouse sections sufficiently meet the space utilization requirement since storing is not prioritised from the point of view of height. If it was, as in the BSAB and ECO case, once again, a large amount of space will be freed. In addition to Färggrossen needing to utilize the space in the wallpaper area more efficiently, they also need to utilize the space in the main areas as well as in the chemical area, hence utilising the entire warehouse space in a more efficient manner. We strongly believe that cube utilization will free large amounts of space which will not only free space for Färggrossen but also provide the company with empty racks or options of a completely new storage layout such as floating or fixed slots due to the fact that these methods require more space.

THE LACK OF VARIETY IN DIFFERENT HANDLING EQUIPMENT

As stated in Section 6.1 The Färggrossen Case, the only equipments which are used for handling products at Färggrossen are a forklift truck and a pallet jack. BSAB use the similar kind of equipment while ECO uses more high technology equipment such as self-driven forklifts. Since ECO has more resources than Färggrossen we will not consider further their equipment, since similar resources are not available to Färggrossen. In Section 3.3.3 Machine (Equipment) in the theoretical frame of reference, we quote Kulwiec (1985) and Van Den Berg (2007) who both address different types of equipment which can be used for handling products in the different warehouse processes. They discuss different types of equipment:
reach trucks for high rack storing; double reach trucks for deep rack loading; Drexel trucks which are a version of a forklift which can be turned 90 degrees. Since it is essential that the right type of equipment is used for the handling processes in order to positively affect the warehouse processes, we strongly recommend that Färgglossen should consider the possibility of investing in better equipment which would go hand-in-hand with the new warehouse layout which we are suggesting to them. The different types of equipment which can be applicable to Färgglossen are the reach and double reach truck; whereas the Drexel truck is not necessary by Färgglossen since a truck which can rotate the product load 90 degrees is not required.

**The Lack of Data Equipment**

In order to maintain a good flow, both the product flow and information flow need to be maintained. Regarding data equipment, it is essential to have the appropriate computer and network equipments which should go hand-in-hand and create a stable basis for the product and information flow.

In Section *Data Equipment*, part of the Section 3.3.3 Machine (Equipment), Ackerman (1997) is quoted that a barcode system and its usage is an option for many companies. However, neither a barcode system nor an automated system is applicable to Färgglossen since both types of systems are used in larger companies and in companies with more resources. Therefore, we will only be considering a locator address system which Briggs (1978) refers to as *Serialized Location System*: a method based on placing products in a sequence with a serial number attached to each unit. Both BSAB and ECO use modern ways of keeping track of their products in the warehouse which contributes to maintaining not only the products flow but also the information flow. This in turn also allows the workers to easily find the location of the products which decreases the hidden time loss which Färgglossen are experiencing.

Other advantages which Färgglossen will benefit from, as BSAB and ECO have, is that the locator address system will help to rotate the stock. Even though we believe that an address locator system will benefit Färgglossen, the disadvantages - such as not enough shelf space and the need to add additional numbers to the addressing in order to identify colour, batch difference and size difference, etc., - need to be taken into consideration. For instance, ECO uses colour coding stickers to keep track of the different batches; however, if a database system can keep track of this, we strongly believe that this option will benefit Färgglossen the most and that the advantages of such a system outweigh the disadvantages.
**Method**

This section presents how making proper decisions regarding methods which are to be used in the warehouse processes can improve the warehouse efficiency. At the present time, Färggrossen have not made any precise decisions regarding the putaway, order picking and replenishment processes. As well as looking into these processes, the option of introducing a bulk area will be addressed.

**The Lack of Fixed-Floating-Family Decisions**

In the sections of Chapter 6 *The Case Studies*, the fact that Färggrossen do not have any defined methods for storing their products is addressed. Quoted by Ackerman (1997), in Section 3.4.3 *Storing (bulk and Pick) Process* of the theoretical frame of reference, there are three different ways of locating the stock which directly affect the space requirement in a warehouse: fixed slots, where the stocks are coded and fixed for specific items that fluctuate substantially in volume; floating slots, where the stocks locations are assigned randomly and the system is only efficient when the inventory records are accurately maintained with identified locations; family grouping, which is a combination of fixed and floating slot systems where each family is assigned to a fixed area and the area handles each family according to the floating system.

While the method which is used at BSAB is the floating locations and ECO uses fixed slots, Färggrossen does not use one specific method for storing their products. However, it can be argued that Färggrossen uses a mixture between floating locations and fixed slots as well as family grouping. In the main area the paints are grouped according to family grouping; while in the wallpaper area the wallpapers are stored according to an informal fixed slot system; and in the chemicals area the products are stored according to a fixed slot system and floating system depending on seasonal fluctuations. Of course it is possible for Färggrossen to store the products in the different sections based on different methods; however, we question if it is the most efficient way of storing the products. Therefore, we believe that the best option for Färggrossen needs to make an informed decision on which methods to use when storing the products strictly on the basis of improving the warehouse efficiency.

**The Lack of Order Picking Method Decisions**

The order picking routines at Färggrossen currently function; however, they can be improved. Färggrossen do not follow any specific order picking routine which we strongly believe contributes to time loss, and also creates a bottleneck in the product and information
flow. In Section 3.4.5 Picking Process, Tompkins et al. (1998) are quoted that order picking can be classified based on the size of the unit: layer picking, case picking, split case picking, and broken case picking. However, in order to fully fulfil the order picking process Tompkins et al. (1998) further state that there are three different methods to choose between: Discrete Order Picking which is a simple and common method where the labourer picks one order at a time; Zone Picking: where each zone has a labourer assigned to pick the products located in the zone and at the end the picked items are combined into the complete order; Batch Picking: where the labourer receives all the orders at once and picks all the products. Whereas ECO deals with batch picking, uses a 16-order matrix wagon for small orders and has a fixed picking route, on the other hand BSAB and Färggrossen respectively operate discrete order picking with a simple trolley to collect the products on a fixed picking route. The manner in which Färggrossen picks its orders is not efficient, since the different workers have different ways of picking the orders rather having one joint method to follow. While one worker picks orders based on their location, another picks the order based on the product’s size and weight starting with picking the heaviest products first. Since there is no consistency in the methods which are used, this contributes to an unorganised warehouse where the order picking routines are not the most efficient or effective. All the workers needs to agree on how to approach the order picking process and in turn increase the product flow which the company and its customers will benefit from.

**The Lack of Replenishment Method Decisions**

When an item is running low in stock, it is according to Van Den Berg’s (2007) statement in Section 3.4.4 Replenishment Process supposed to be replenished from the bulk area. None of the companies which we visited has any kind of bulk area and therefore, do not implement such a replenishment process. ECO do not need any bulk area since they restock directly from the production, whereas BSAB always have an excess inventory which can be considered as a buffer inventory. Since the putaway process at Färggrossen is not clearly defined and does not follow a specific method, the replenishment process is not clear. Our observations at Färggrossen indicate that there is no method being used for the replenishment process; rather the replenishment is based on the warehouse manager’s daily routine of manually checking the inventory and then making a decision as to whether there is any need to restock a product. This method is neither sufficient nor reliable and needs to be addressed in order to improve the company’s inventory management.
The last factor which we consider to be affecting the warehouse processes is the ‘material’, which we from now will refer to as ‘products’. This section will address warehouse safety precautions.

**WAREHOUSE SAFETY PRECAUTIONS**

One extremely important aspect which needs to be taken into consideration concerns the safety of the warehouse. As discussed in each of the case studies in Section *Safety in the Warehouse*, Färggrossen is the company which the most flammable inventory, the most flammable material at Färggrossen is the large amount of wooden pallets. While ECO uses fireproof doors instead of a sprinkler system because they believe that system is more efficient and appropriate for their type of products, BSAB has the basic precautions such as fire extinguishers and steel-toed shoes since their products are not flammable at all. The conclusion is that the safety precautions at ECO and BSAB cannot be considered as applicable for Färggrossen and therefore Färggrossen need to look into what risks they might face due to them storing hazardous and flammable products and take the appropriate precautions.

The fact that Färggrossen also requires a large amount of manual labour comes with a risk. As quoted by Ackerman (1997) statement in the subsequent Section *Safety in the Warehouse*, part of Section 3.2.7 Milieu (Environment), new workers are more prone to experience accidents than experienced workers, and in order to reduce the risk of accidents - such as for instance accidents related to the manually storing process - appropriate safety precautions need to be addressed.

In addition to each input factor, we also believe that there are other factors which affect the different warehouse processes in a negative manner. These factors are summarized in the table below and addressed in the same manner as in the previous sections.
### Table 14: Färggrossen’s Key Problems Regarding Warehouse Processes. (Source: Our Own)

<table>
<thead>
<tr>
<th>Main Problem: Inefficiency in the Warehouse</th>
<th></th>
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<tbody>
<tr>
<td><strong>Receiving</strong></td>
<td></td>
</tr>
<tr>
<td>1. Inspection time and data loss.</td>
<td></td>
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<tr>
<td>2. The use of memory rather than a documented system</td>
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<tr>
<td>3. No data recording</td>
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<tr>
<td>4. Manual placing of products from pallets to the shelves</td>
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<tr>
<td>5. Fixed-floating-family group decision unclear</td>
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<tr>
<td>6. Lack of rack variety</td>
<td></td>
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<tr>
<td>7. No locator addressing system</td>
<td></td>
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<tr>
<td>8. No IT support for stock levels and stocking positions</td>
<td></td>
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<tr>
<td>9. No defined bulk area</td>
<td></td>
</tr>
<tr>
<td>10. Unclear, random replenishment</td>
<td></td>
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<tr>
<td>11. No bulk area or corresponding equipment available</td>
<td></td>
</tr>
<tr>
<td><strong>Picking</strong></td>
<td></td>
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<tr>
<td>12. Discrete picking, time loss regarding information flow</td>
<td></td>
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<tr>
<td>13. No studies regarding order picking routines (further study)</td>
<td></td>
</tr>
<tr>
<td>14. No study about frequently used products (further study)</td>
<td></td>
</tr>
<tr>
<td><strong>Shipping</strong></td>
<td></td>
</tr>
<tr>
<td>15. Costs for owning own trucks</td>
<td></td>
</tr>
<tr>
<td>16. Frequent updating of delivery routes (further study)</td>
<td></td>
</tr>
<tr>
<td>17. Cost/benefit analysis for the owned trucks (further study)</td>
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</tr>
</tbody>
</table>

**Receiving**

The receiving process is negatively affected in the sense that time and data is lost during the inspection process. Since there is no inspection at ECO this does not concern them; however, as stated in Section 6.2 The BSAB Case, the products are visually inspected and screws/nails are recounted, weighed and repacked in order to reduce inaccuracies in product quantity. The inspection process also helps the company identify damaged products which in turn are taken out of the inventory and documented as damaged products. At Färggrossen this step is
not conducted due to the fact that the inventory management and IT support system is not sufficient for their needs.

**PUTAWAY**

As stated in the Section 6.1 *The Färggrosen Case* the putaway process at Färggrosen is not based on any specific or systematic method, rather it is based on the warehouse manager’s decision. By observing this process at the three companies, it was clear that BSAB and ECO used documented methods while Färggrosen relied on the old fashioned system, namely memory. In Section 3.4.2 *Putaway Process* in the theoretical frame of reference, authors such as Mulcahy (1993) and Frazelle (2001) address the putaway process with regards to different aspects: Mulcahy (1993) addresses the documented method and Frazelle (2001) addresses principles such as direct putaway. Even though the memory method currently works adequately at Färggrosen, it is no longer sufficient for their requirements, and therefore needs to be updated to a documented system. Implementing this change will not only contribute to people other than the warehouse manager knowing and finding the locations of the products, but it will also lead to reducing the pressure, stress and workload for the warehouse manager as well as the fact that everybody relies on him not to be sick or absent in any way. Due to the fact that the putaway process is based on the warehouse manager’s memory, there is no kind of records being maintained. This means that all the vital information is limited to the memory of the warehouse manager and nobody else can access it; this means that the presence of the warehouse manager is always required. In addition to the memory acting as a limitation and bottleneck, there is a further action that can also be considered as creating a bottleneck in the putaway process. The fact that paints which are delivered on pallets, and which could also be stored on these, are unloaded one by one and then stacked by hand on shelves, is a huge time loss. Keeping the paints on the pallets and storing the pallets on the racks will simplify the putaway process considerably as well as shortening the processes lead-time.

**STORING**

As mentioned in the previous Section *Lack of Fixed-Floating-Family Decision* Färggrosen has not a specific system which is used for storing the products. Due to this, the storing process at Färggrosen is a bit unclear and needs to be addressed. Furthermore, as also mentioned in the previous sections, the lack of different types of racks, lacking a locator address system and the lacking of a supporting IT system for keeping track of inventory levels and stocking position have all contributed to affecting the product and information flow in a negatively
manner. Since these are important factors they need to function in a manner which is sufficient to maintain an appropriate level of product and information flow. Therefore, suggestions on how to improve and address these factors have been discussed prior to this section.

In previous sections, it has been pointed out that Färggrossen do not have any kind of bulk area. Our recommendation is therefore that a bulk area is not a required option for Färggrossen as long as the company does not define their method for conducting replenishment. Since the replenishment and bulk area go hand-in-hand the replenishment process needs to function correctly in order to having a functional bulk area.

**Replenishment**

As just stated in the section above, as well as in Section 6.1 The Färggrossen Case, the replenishment process at Färggrossen is not clearly defined and can be seen to be conducted in a random manner since the process is based on decisions made by the warehouse manager on his daily visual inventory check. The theory in Section 3.2 Warehouse as well as in Section 3.4.4 Replenishment Process addresses the different replenishment methods used for the different storing methods. For instance, while Tompkins et al. (1998) state that replenishment is relocating products from a secondary area to a primary area, Mulcahy (1993) states that the replenishment process is not really required when the storing system is floating. Due to the fact that the product is located in one position, another identical product has already another pick up point which had been created when another order was received. Since neither BSAB nor ECO deal with replenishing, Färggrossen cannot look at these companies for suggestions on how to address this factor, so Färggrossen needs to look at the theory which we have stated above.

**Picking**

As we have previously established in Section Lack of Order Picking Method Decision, the picking routines at Färggrossen differ depending on which worker picks the order; these procedures can and should be improved. We recommend that the company uses a mutual way of picking orders in order to improve its product and information flow. The different picking methods which we have observed at Färggrossen have resulted in time loss due to the workers not having a fixed method and thereby needing to revisit the same storing locations several times before finishing the picking of an order. Furthermore, we strongly recommend that since there is no studies regarding order picking routines, Färggrossen should consider this as a further study; also it would benefit Färggrossen to consider further
studies about frequently used products. Prior to observing and accessing the data information at Färggrossen, looking at the companies frequently used products was an option; however, subsequently to accessing the data information and discovering that the company lacked this type of information we decided to look at other aspects. But we still strongly believe that it is a possible option for Färggrossen and it needs to be considered.

**Shipping**

The shipping procedures at the three companies are conducted in a similar manner. What distinguishes Färggrossen from BSAB and ECO is that Färggrossen own its own truck, as well as the fact that it uses third party logistics for delivering. Both ECO and BSAB use third party logistics as well; however, ECO has a standing contract with Schenker to deliver all their products. Owning its own truck is an extra cost for Färggrossen and the question is if it is worth the cost? In order to reach a conclusion whether Färggrossen benefits from owning its own truck as well as using third party logistics as compared to outsourcing the deliver process completely, a cost/benefit analysis based on these factors can be done. The results would either state that Färggrossen benefit from the present system or indicate that outsourcing the delivery will be more beneficial. In addition to a cost/benefit analysis we strongly recommend that Färggrossen further study their delivery routes on a regular basis. One aspect which might be needed to take into consideration while conducting this cost/benefit analysis is the fact that Färggrossen’s customers might consider delivery by the company’s private vehicle as value added logistics, since they then have a personal contact with Färggrossen. Moreover, Färggrossen’s CEO has mentioned the possibility of expanding the clientele along line 3. Prior to expanding along any route we strongly believe that a study regarding expanding the logistical route needs to be done in order to sufficiently plan the different route prior to the clientele expansion.

**Research Question 4**

- **What are the possibilities to improve the layout of a storage area and is it possible to improve the storage layout, hence improving the product flow, the handling of goods, etc.? If so, how and in what ways?**

There are many different ways to change the storage layout of a warehouse in order to improve the warehouse processes. After interpreting the gathered information we identified three changes of the warehouse which will improve the warehouse processes the most. The
four main categories, consisting of alternative changes that will contribute to improving the warehouse layout are: implementing a locator addressing system, grouping articles based on product families, implementing new procedures and further studies and new investments. The product families should be located in fixed locations while the high frequency products should be located close to the loading/unloading area. As a further result of implementing these changes, the product flow will be affected in a positive manner, as well as the internal transportation, even though they are considered insignificant in our case. Moreover, changed order picking routines and information flow are also factors which will affect the product flow and therefore these factors will also be addressed in the sections below.

**Changes to the Warehouse Layout**

Conducting changes to a warehouse layout comes with several factors which have to be taken into consideration. However, every factor cannot be taken into consideration; therefore, the factors which are taken into consideration in our study are factors which have arisen during the development of the thesis. The factors which are the most relevant in order to fulfil our thesis are: warehouse limitations, inventory control and restructuring of the warehouse layout.

**Warehouse Limitations**

As described in 6.1 *The Färggrossen Case* the warehouse in Färggrossen is not used as efficiently as it could be. As a result of this, there is excess space which can be used, and in order to efficiently dispose and organize the warehouse, there are several ways to increase the storage space. In one way the current warehouse facility is a restriction for Färggrossen; however, since the company does not utilize the current space in an efficient manner we do not consider it a limitation. Färggrossen also have excess land which they can choose to build on and expand the warehouse if needs be. The current structure of the three different areas; the main, the wallpaper and the chemical area, can be seen as a limitation since these areas are currently organised in a way that the wallpaper area is built to store wallpaper and not paints. The racks in each area currently decide what can be stored there, and since wallpaper and paints are not stored on the same sized rack this creates problems.

During the interviews at Färggrossen it has come up that there are bottlenecks in the warehouse processes such as in the putaway process. One recommendation is to improve the putaway and storing process in order to avoid these kinds of bottleneck which affect the warehouse process negatively. As discussed in Section 6.1 *The Färggrossen Case* the putaway process in Färggrossen is limited due to the fact that the process is based on the warehouse
manager’s experience and memory while at BSAB the putaway process is based on the floating location method and at ECO the putaway process is based on a fixed location system. The lack of a documented system, as in the cases of BSAB and ECO, become obvious when Färggrossen’s warehouse manager for some reason is absent. This limitation therefore needs to be addressed in order to improve the warehouse processes.

**Inventory Control**

The inventory control is a part of the warehouse process at Färggrossen which does not function properly and our opinions, after observing the processes, where confirmed during the interview. It is important to control the purchasing and deliveries in order to control the inventory, and it is this step that can be considered as a one of the bottlenecks in the warehouse process. Färggrossen has a history of having a high delivery performance level which they intend to keep, and for this level to maintain at a high, it is important to simplify the planning for the purchasing employee in order to manage to deliver products in time.

As mentioned in Section 3.5.1 *Product Availability* as well as mentioned in Section 6.2 *The BSAB Case*, there are many different reasons for holding inventory as well as there are many different types of inventories; seasonal stock, safety stock, buffer stock, etc. While BSAB need to have safety stocks integrated in their inventory, Färggrossen do not have any specific safety stock; however, the company has daily inventory check to assure that there is not any product in stock which is running low. One way of assuring that stock outs should not occurs and which also is a reason for holding more inventory than needed, as BSAB are required to, is to protect the company from uncertainties such as late deliveries from suppliers, increase in customer demand, etc.

Another way of controlling ones inventory is to use Vendor Managed Inventory (VMI), where the supplier controls the inventory. ECO uses this kind of system for the supply of some of their raw product; however, if this is an option for Färggrossen can be argued and our argument is that it is not necessary since Färggrossen are not a large company.

**Restructuring of the Warehouse Layout**

After observing the warehouse layout at Färggrossen, space utilization was one factor which came to mind. According to the theory in Section 3.4.2 *Putaway Process*, this process contributes to increasing or expanding the storage space in a warehouse. As a guideline, companies can use cube utilization when restructuring the warehouse. According to Mulcahy (1993), cube utilization contributes to increasing the storage space through e.g. more efficiently using air and ground space. Observations at BSAB and ECO indicated that
both companies utilized their space as best as possible; however, improvements could be made at BSAB. As mentioned in Section 6.3 The ECO Case, ECO have small shelves located over the wallpaper which is stored on pallets. These shelves store single wallpaper roles which are marked with different colours in order to keep a track of different batches. This is an option which can be considered for Färggrossen and which will solve the current disorganized situation. Implementing a fixed slot system might also contribute to structuring and organizing this section of the warehouse. While these changes can be considered for the wallpaper area, changes such as storing all the paint on pallets in the main area might lead to improvements in the warehouse processes. Nowadays, the majority of the paints are delivered on pallets; however, the paints are often manually lifted off the pallet and stored on shelves in the main area when there at the same time is a possibility to store that paint on the pallets.

Taking these factors into consideration and since part of the purpose of the thesis is to improve the warehouse layout, we therefore suggest that Färggrossen need to keep in mind that restructuring the warehouse, in order to make the necessary improvements, might be what is required of them.

Having the above mentioned factors in mind; three options of how it is possible to improve the warehouse layout are explained in detail in the following sections. The main options which we find most relevant for our study are: a locator addressing system and product relocation based on product families. However, we will also address options in a smaller scale which we strongly believe will affect and improve the warehouse processes and layout in order to fulfil the thesis purpose.

**Locator Address System**

The first option which we have looked at is to keep the current warehouse layout at Färggrossen. However, in order to do this, the markings and sign need to be improved since this is in the majority of places completely missing in the warehouse layout. Today it is not possible to find any signs which show where the products are located and the marking of product locations can only be found in the wallpaper area; however, these markings are not sufficient enough. As mentions in Section 6.2 The BSAB Case and in Section 6.3 The ECO Case, marking and/or signs are clearly a part of the warehouse layout in order to simplify locating products. This especially concerns the signing and marking of the different storage areas as well as the locations of the products. Although the warehouse manager and the warehouse worker know, by heart, where the products are stored, this is not a sufficient method and the information ought to be documented.
By introducing changes such as markings on the floor and hanging signs consisting of information such as product name, location, etc. will improve warehouse processes. The lacking of any proper storage and product definition leaves our work at Färggrossen opened for multiple changes. The current storage areas can be identified as the main area, the wallpaper area and the chemicals area; however, these definitions are not the most appropriate definitions since there is not only wallpaper stored in the wallpaper area. One alternative is to introduce letters in order to define the different warehouse areas while another alternative is to use numbers. As an example, the structure at BSAB, with both letters and numbers, is one way of organizing the warehouse layout and in turn simplifying the process of locating products.

As stated in Section 5.7.10 Information System Questions, it is essential to maintain the information flow since it closely linked with the product flow as well as it is important to maintain an efficient and working product flow.

Nowadays, as mentioned earlier, none of the areas has a sufficient locator addressing system. By adding a locator addressing system it would clarify where the products are located which in turn will simplify the putaway process as well as finding product for customer orders. Other recommendations to improve the warehouse processes, which are discussed Section 4.2.2 Main Questions, is the implementation of a barcode system. However, since we in Section 4.2.2 Main Questions came to the conclusion that a barcode system is not applicable to Färggrossen, we will not address this any further. The last recommendation which we find relevant to our case, is stated in the theoretical frame of reference, Section 3.4.4 Storing (Bulk and Pick) Process, where Briggs (1978) mentions that it is important to have some kind of serialized locator addressing system which simplifies the storing process of the warehouse. This system works in the sense that the system is a group of codes which correspond to the stocking positions in the warehouse.

While considering the different types of locater address systems which could be applicable to Färggrossen, our thoughts shifted to the possibility of a Warehouse Management System (WMS). WMS is a system with the main purpose to control the movement and storage of products within a warehouse, while its functions has expanding to transportation management, order management and complete accounting systems. However, we soon came to the conclusion that a WMS would not be applicable to our case since the systems are big, complex and data intensive as well as they require a lot of initial setup, a lot of system resources to run, and a lot of ongoing data management. On the other hand, we find that a
WMS provides functions which can be applicable to Färggrossen without implementing a WMS since a WMS is claimed to reduce inventory, reduce labor costs, increase storage capacity, increase customer service and increase inventory accuracy which are all essential factors in fulfilling our purpose.

While a barcode system is used in ECO, Färggrossen, nor BSAB, are currently using this kind of high technology and we therefore find it relevant to analyse if a serialized locator address system or any other system similar to a WMS, i.e. which has similar functions but which does not require as much time and money from the company, is applicable at Färggrossen.

**Product Families**

The products at Färggrossen are not sufficiently organized, despite this, it is currently possible to identify groupings according to similarity and product family, such as the wallpaper warehouse and paint brands such as Demi Dekk being stored together. According to Ackerman (1997) and Mulcahy (1993) in the theoretical frame of reference, Section 3.4.4 Storing (Bulk and Pick) Process, there are many different ways of grouping products some of which are according to product family, frequency, fixed slot, etc.

This second option is therefore to rearrange the warehouse layout according to product families and relocate the product family to an appropriate location. The location of the product family can be based on the same factors as in the previous section, i.e. based on the how frequently used the product family is. This means that the product families which are the most frequently used can be stored closest to the loading/unloading area since these products will be handled on a regular basis. Moreover, in order to make this change as efficient as possible we suggest that the grouping of product family changes should be conducted jointly with improving the locator addressing system in the warehouse.

As one can understand from the observations at Färggrossen and through information gathered from the interviews, Färggrossen do not use any specific placement method. The putaway process is decided by the warehouse manager who has the warehouse layout and location of products stored in his memory. A putaway process which is documented as in the cases of BSAB and ECO is a much more sufficient and reliable system than documenting everything in one’s head. Since both Mulcahy (1993) and Frazelle (2001), in Section 3.4.2 Putaway Process, state the importance of using a documented and modern technological system, we strongly believe that Färggrossen should invest in a new system. The memory system which is used today at Färggrossen currently works to some extent, though it is not sufficient. One can argue that the Färggrossen uses a mixture between a fixed and floating
system method when storing their products. This is particularly common during seasonal and customer demand fluctuations and since there in some cases is a lack of space, for instance for a certain paint brand which is stored based on product family, the product is located somewhere different. Therefore, for fixed locations, it is essential to make sure that there is enough space for each product family.

This is therefore why the second optional change for the warehouse layout concerns grouping products based on product family and to make sure that there is enough space for the product families considering seasonal and customer demand fluctuations. The factors which need to be taken into consideration for these divisions are: product size and aisle length; aisle length due to the fact that products such as the wallpaper sticks out from the racks and are ungainly. In Section 3.3.4 Milieu (Environment) Ackerman (1997) addresses the importance of taking aisle length into consideration since 40% of the space in a warehouse is wasted on aisles.

**Implementing New Procedures and Further Study**

Upon receiving product from suppliers it is important to check that the right product has arrived in the right quantity and without damages. This inspection is part of the receiving process and is conducted in Färggrossen and BSAB as well as theory states that it is a necessary and important process. The current way of conducting this process at Färggrossen is to check and inspect the order upon arrival and then store the products. We strongly believe that combining the receiving process with the putaway process will save Färggrossen time since during the putaway process a visual check is automatically done. In connection with the putaway process we also strongly recommend that the stocking positions of the products are recorded; this process in today not done. Recording the stocking positions is an essential procedure that needs to be done in order to control the inventory and maintain a good product and information flow.

One factor which has played a big part in affecting the warehouse processes and layout is the storing process and the manual labour whiles conducting this process. In previous sections as well as in 6.1 The Färggrossen Case it is clear that Färggrossen do not utilize the warehouse space sufficiently and that the types of rack which they use for storing are not appropriate for the stored products. In the main area we have established that the majority of paints are not being stored on pallet, rather they are manually relocated from the pallets to shelves on the racks. This process is, as mentioned previously, time consuming and not necessary since the
racks are fully appropriate to store pallets on, which is done for the two top and the floor levels but not for the second level from the bottom. We therefore strongly believe that this process needs to be eliminated in order to spare time and reduce the ‘lost time’.

Suggestions about conducting a cost/benefit analysis in order to come to a conclusion if Färggrossen should completely outsource the transportation to a third party logistic company or keep the current system with owning their own truck and well as using third party logistics. While conducting this analysis we recommend that the customer’s opinions regarding Färggrossen’s private deliveries should be taken into consideration since this can be seen as VAL in a customer’s point of view. In addition we suggest that Färggrossen should conduct a market research among their customers in order to clarify what kind of VAL its customers want.

One factor which is not clearly defined at Färggrossen is the replenishment process. Today it is not clear how this process is conducted; however, our conclusion, based on observations, is that it is based on the warehouse manager’s decision which in turn is based on his daily visual inventory check. The lack of a proper replenishment process leads us to the idea of creating/defining a bulk area in the warehouse layout. As stated in Section 3.4.4 Replenishment Process the bulk area acts like a buffer and stores reserve products, and when a product is running low in the picking area it will be replenished from this area. Creating a bulk area has several advantages whereof one is to protect the company from having stock outs. The disadvantages are that the company will need to invest in a new lift truck and might need to invest in additional racks.

**NEW INVESTMENTS**

This section presents suggestions which we believe will have a positive effect on Färggrossen’s warehouse processes and layout. The two previous sections presented suggestions which need to be done regardless the outcome of our other recommendations. Locater addressing systems are an essential part of the warehouse layout and need to be improved and implemented in order to be able to improve the warehouse layout and processes overall.

Since Färggrossen store more than paints, wallpaper and chemicals it is important to consider storing alternatives for these other paint accessories. The paint accessories which are stored in the main and wallpaper area at Färggrossen are painting clothes, brushes, rollers, brochures, etc. and the racks which these accessories are stored on are not appropriate for
storing these types of products. The clothes are stacked on the same type of rack as the wallpaper is stored on as well as on small wooden racks which can be bought in any convenient store while the other products are stored in all sized boxes and loosely on similar racks. In addition, the accessories are stored in both the wallpaper and the main area which we consider to be inefficient. We have therefore looked into different alternative ways of storing all these accessories together in the same area in order to organize and simplify the structure of the warehouse layout which in turn will simplify the putaway and order picking processes for the workers since all accessories will be stored in the same area. Gathering all the accessories in the same area will lead to reduced time loss since the workers would not have to pick accessories in different areas and waste time moving in between these areas. Hence, we strongly believe that investing in a simpler type of Carousel or Live Storage will benefit Färggrossen profoundly. As discussed in Section 3.3.3 Machine (Equipment), Garcia-Diaz (2007) argues that carousels are simple, reliable, efficient ingenious product handling devices and that there are three types of carousels which should be considered; horizontal, vertical and independent rack carousel. Generally the bigger carousels are very expensive and are therefore not applicable for Färggrossen; however, the smaller types of carousels can be implemented in the company.

Regarding investing in a live storage system we strongly believe that a Carton Live Storage System will benefit Färggrossen in many different ways. Implementing a carousel of this type will according to Garzia-Diaz (2007), among other things, improve cube utilization, reduce the order picking time, reduce the time wasted moving between the two areas, introduce the First-In-First-Out (FIFO) principle, increases picking accuracy and reduce ‘lost time’ during order picking. In addition, since the system does not have any shelves or back/partition sheets the visibility is improved, the products slide forward directly to the worker instead of the worker needing to walk around in order to access the products, the putaway and retrieval process can be conducted simultaneously which will reduce the overall process time and restocking in done from the back in order to avoid interrupting the order picking which is done from the front. In conclusion, we strongly believe that investing in a carton live storage system will not only free space at Färggrossen in order to utilize this space for other purposes, but it will also help the company organize and structure this part of the warehouse which is neither structured nor organized sufficiently. In addition, this implementation will lead to a reduction in the picking time and overall improve the picking routines in this section.
The majority of the racks holding paints at Färggrossen are sufficient enough for storing these products; however, the main area as well as the chemical and wallpaper area currently store paints due to lack of space which is based on the seasonal fluctuations. While observing the warehouse it was evident that the smaller paint cans where stored on shelves which did not utilize the warehouse space. These shelves are similar to the shelves storing the wallpaper and we strongly believe that this is neither sufficient nor efficient. In addition, we strongly believe that Färggrossen need to keep the different areas separated in order to maintain an organized and structured warehouse. By only storing paints in the main area, which is possible, and not in all three areas will improve the warehouse processes as well as the warehouse layout since the layout will appear more structured and logical as well as professional. It will in turn also contribute to simplifying the order picking process for the workers since they only need to focus on one area of the warehouse at a time when picking orders.

In conclusion, by improving the racks and shelves which the smaller paint cans are stored on, by investing in racks which utilize the space more efficiently and by gathering all the paint in the main area instead of having it spread out in the three different areas, space will be freed which can be utilized for other purposes.

Regarding the wallpaper area, this area is the least utilized area. The shelves in this area are, as mentioned earlier, not appropriate size wise for the wallpaper roles. However, the biggest problem with this section is that the rack do not utilize the air space, the racks are only high enough for a person standing on the floor to reach to the top level. In conclusion, the racks which hold the wallpaper could be expanded and doubled in height, into the airspace, which in turn will free space which can be utilized for other purposes. Looking at a new type of rack system for this area would also be a suggestion, since when utilizing the airspace will cause problem accessing the top levels without some kind of ladder or other equipment. Since Färggrossen do not store a vast amount of wallpaper like ECO does they do not require the same type of rack system; however, the shelves which are used for storing the wallpaper can be an option.

Concerning the chemical area, this area is probably the most unorganized area. The area does not only work as a chemicals area but also as a ‘dumping’ area, with that we mean that this area acts like a spare room for putting products which cannot be stored in the other areas due to lack of storing space based on seasonal and customer demand fluctuations. This areas
needs to be improved over all and since it is already a ‘dumping’ area, this space could be considered for the placement of the bulk area.

In the previous section one of the recommendations was to create a bulk area which replenishment would be conducted from. Since the replenishment procedure is not currently clear, the process needs first of all to be clarified. Creating a bulk area will not only involve restructuring of the warehouse layout in order to make space for this area, but as an option Färggrossen could invest in drive in racks for this area. Creating a bulk area will in turn involve investments in additional racks and in a lift truck which is appropriate for the process; however, the systems benefits are according to Mulcahy (1993) that it requires less warehouse space and lower building construction costs.

Lastly, it has in Section 6.1 The Färggrossen Case been clarified that the Färggrossen lack a warehousing computer program which directs the workers to the correct stocking positions as well as it increases space efficiency in the warehouse. Therefore, we strongly believe that Färggrossen need to invest in some kind of warehouse management program or a WMS which will help improve these steps.

**RESULTS OF CHANGES TO THE WAREHOUSE LAYOUT**

This section presents the results which might arise when making the three changes mentioned above. In order to clearly see advantages and disadvantages with each option a table addressing the advantages and disadvantages will be presented as a summary at the end of each section.

**RESULTS OF IMPLEMENTING A LOCATOR ADDRESS SYSTEMS**

One of the first advantages which come to mind, regarding the implementing of locator addressing system, is that the products will be easier to locate which in turn might contribute to improvements in the warehouse process. These implemented changes do not only affects not the permanent workers but also the temporary workers since the workers then will have a clear locator addressing system to help guide them to the right product and location. These changes will lead to a better structured warehouse than which currently exists at Färggrossen today. By marking the different warehouses with either letters or numbers, for instance like in BSAB, will improve the visibility as well as the understanding of the warehouse layout in the sense that it will be easier to locate the products. This will in turn contribute to the warehouse having a logical structure, not only according to the employees at Färggrossen but even by outsiders, which can be argued that they do not currently have.
Regarding the serialized locator address system, the advantages with the system is that it will help to simplify finding the products stocking locations as well as help to rotate the stock. In Färggrossen’s case this is an essential necessity since the process regarding locating products is not considered to function in a sufficient way. Furthermore, in Section 3.4.3 Storing (Bulk and Pick) Process, Briggs (1978) addresses some disadvantages with locator addressing systems. Briggs (1978) states that it is important to make sure that each fixed location has enough space in order to handle seasonal fluctuations and in order to avoid having to locate products in other locations which are missing serial marking. Moreover, Briggs (1978) addressed the fact that if information, numbers, referring to identifying products colour, batch number, size, etc. need to be added to the serial marking, the risk is that there might not be enough space for that which can prove to be a problem.

The implementation of these changes mentioned above provides several advantages; however, there might be some disadvantages which need to be considered as well. One disadvantage is the fact that the employees will need to accept the changes and learn the new warehouse layout. In addition to this, the warehouse processes might change which the workers will need to adjust to.

One thing Färggrossen needs to be aware of is that implementing these changes will require a lot of time as well as money. However, when considering implementing a locator addressing system we feel that the cost, both money and time, will be trivial in comparison to the benefits which these changes will provide for the warehouse layout and processes and the company as a whole.

The table below summarizes the advantages and disadvantages of implementing a locator address system.

**Table 15: Advantages/Disadvantages of Implementing a Locator Address System. (Source: Our Own)**

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>A structured warehouse will lead to improving the warehouse processes</td>
<td>The cost for making the changes, buying signs and making the markings, will both take time and cost money</td>
</tr>
<tr>
<td>Implementing a locator address system will provide a more structured and clear warehouse layout</td>
<td>At the beginning, the employees will have difficulties adjusting to the new warehouse processes</td>
</tr>
<tr>
<td>The employees will easier find the location of the products</td>
<td></td>
</tr>
<tr>
<td>A locator address system will improve the inventory control and in turn improve the information flow</td>
<td></td>
</tr>
</tbody>
</table>
RESULTS OF PRODUCT FAMILIES

In order to achieve a warehouse which is comparatively structured in the sense that it is easy to locate and access products, organizing the warehouse according to product families is an option. As mentioned earlier, it is important to take into consideration that the company puts aside enough space for each product family in order to assure that there is enough space to store the products during seasonal and customer demand fluctuations. The accessibility of products is important depending on what kind of method is used. Implementing these changes will result in rearranging the warehouse layout and relocating similar products in different parts of the warehouse, which in turn will contribute to an improved inventory control and control over all as well as improved utilization of the existing warehouse space.

The disadvantage of implementing these changes is that the company might meet resistance from the employees since they will be the ones learning the new warehouse layout. Another advantage is that these changes will require a lot of time and money from the company.

The table below show the advantages and disadvantages with implementing product family changes.

**Table 16: Advantages/Disadvantages of Implementing Product Family Changes. (Source: Our Own)**

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>A structured warehouse</td>
<td>Rearranging the warehouse will cost the company both money and time</td>
</tr>
<tr>
<td>• Improves access and simplifies the process of finding the products</td>
<td>• The employees can resist to the new changes and it will take time for them to adapt to the new layout</td>
</tr>
<tr>
<td>• Reduces the order picking time</td>
<td></td>
</tr>
<tr>
<td>• Improves the inventory control and the control overall</td>
<td></td>
</tr>
<tr>
<td>• Improves the use of cube utilization i.e. leads to creating more free space</td>
<td></td>
</tr>
</tbody>
</table>

RESULTS OF IMPLEMENTING NEW PROCEDURES AND FURTHER STUDY

The first advantage which comes to mind and which is a result of implementing several of these new processes as well as combining processes, such as the inspection and putaway, is the reduces ‘time loss’. As stated in Section 6.1 *The Färggrosen Case*, hidden time loss is a problem at Färggrosen and by implementing changes to processes it will be reduced and which in turn will leave time to focus on other matters in the warehouse. In connection with the putaway process a large amount of time is wasted on reloading paints from pallets onto
shelves when there really is no need for this since there are possibilities to store the products on the pallets they are delivered on. Eliminating this process, inspection process, will free this wasted time as well as reducing the workload for the warehouse manager who is conducting this unnecessary activity. In addition, recording product locations into a data system will benefit Färggrossen in the sense that the information and product flow will improve. Since the product locations will be documented it will simplify the order picking process for the workers in the sense that it will be easier to locate the products as well as it will be easier to control the inventory since everything is documented. This is one of the main advantages with these implementations.

The only main advantage of conducting a cost/benefit analysis is if the result turn out to show that Färggrossen will benefit from completely outsourcing the transportation to a third party logistics company rather that partially outsourcing the transportation and partially handling the transportation themselves. However, the results might provide Färggrossen with other aspects to think about.

Lastly, a returning topic is the replenishment process, or rather the lack of it. In order to properly control the inventory it is important to have a functioning replenishment process and as we have stated before, the end results will benefit Färggrossen. The advantages are that a bulk area, used for replenishing, will act as a precaution against stock outs while the disadvantage is that the company will need to invest in new forklift truck/trucks and might need to invest in additional racks.

In conclusion, we strongly recommend that all suggestions should be considered even though we might only recommend one or a combination of a few suggestions to Färggrossen.

The table below summarizes the advantages and disadvantages of implementing new procedures and looking into further studies.

**Table 17: Advantages/Disadvantages of Implementing New Procedures and Looking Into Further Studies. (Source: Our Own)**
Investing in an alternative way of storing the paint accessories at Färggrossen will benefit the company in several different ways. The advantages of implementing a carousel or a live storage system will mainly organize gather and structure all the accessories to one location instead of them being stored at several different locations in the warehouse, improve cube utilization, increase the picking accuracy, reduce the time wasted spent on moving in between the different sections and simplify the putaway process. In addition, the order picking time will be reduced, visibility will be increased and the overall process time will be reduced. The disadvantages of implementing a system of this competence is that the investment costs can be expensive depending on the size and how advanced the system is.

Further advantages which regard cube utilization arrive from making changes to the racks storing small paints in the main area. Upgrading these racks or completely changing them will result in freeing space which can be utilized for other purposes. By restructuring and/or completely reorganizing the chemical area cube utilization will also be achieved. This area is currently the most chaotic since everything is ‘dumped’ there and making this area the bulk area could solve several issues such as freeing a vast amount of space and reducing the order picking time since for instance all the paints will be located in the same area instead of spread out in all three. The disadvantages are that it might be a time consuming process for the workers, and that it might cost the company to invest in additional racks as well as the workers might be hesitant to the changes. Moreover, restructuring and investing in a new rack system in the wallpaper area will also contribute to maximizing cube utilization and thereby freeing space.
In the previous section the advantages and disadvantages of creating a bulk area was discussed. As mentioned, the advantage is that the replenishment process will be defined and conducted according to a method rather than random restocking. The disadvantage is that the company will need to invest in new equipment in order to properly conduct the processes in this area as well as investing in additional racks such as drive-in racks which is an alternative way of storing products in this section. The replenishment process will contribute to a better inventory control which also will be improved by investing in some kind of WMS which will help to improve not only the control of product movement and the storing in the warehouse but also the transportation and order management which all are essential factors for improving the warehouse layout and processes.

The table below illustrates the advantages and disadvantages of making new investments.

**Table 18: Advantages/Disadvantages of Making New Investments. (Source: Our Own)**

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Improved cube utilization</td>
<td>• Investment costs for the carousel, live storage system, drive-in racks and/or additional racks</td>
</tr>
<tr>
<td>• An organized and structured warehouse</td>
<td>• Investment costs for a new truck/truck for the bulk area</td>
</tr>
<tr>
<td>• Reduced order picking time and 'lost time'</td>
<td>• Investment costs in a new WMS, locator address system or similar system</td>
</tr>
<tr>
<td>• Improved order picking accuracy and inventory control</td>
<td>• It is a time consuming process to address these changes and time costs money</td>
</tr>
<tr>
<td>• A WMS or other kind of system that controls the movement and storage of products as well as addressing transport and order management and provides an accounting system</td>
<td></td>
</tr>
</tbody>
</table>

**Changes to the Product Flow**

The changes which are mentioned above affect the warehouse layout as well as the product flow. Since the changes are implemented with the purpose of improving the warehouse layout and providing the company with a more structured layout, the warehouse manager as well as the other employees will easier be able to control the product flow. Moreover, since the changes affect the product flow, they will also affect the product management since these go hand-in-hands. This section therefore addresses the impact which these changes have on the product flow and will address the topics: product management, information flow and changed order picking routines.
The main purpose of product management has been addressed in Section 3.1 Definitions and Terminology and addresses how to solve the problems which a company is experiencing from a company’s point of view. In Section 3.3.1 Man (Personnel), it is stated that it is important to improve utilization, which can be done by efficiently maximizing space, referred to as cube utilization by other authors, in order to achieve continuous product flow. In order to improve a company’s product flow it is essential to observe the overall problem as well as to see the entire picture. In order to generally solve these problems which companies face, one has to look at factors such as organizing product function performances, maintaining a good communication network and controlling the product flow. For a company like Färggrossen, as well as for other companies, it is essential for the product flow to deliver product as the right time, in the right quantity and without damages in order to avoid bottleneck as much as possible. As stated in 6.2 The BSAB Case, in Section 6.3 The ECO Case as well as in Section 3.4.6 Shipping Process it is important to obtain these goals in order to fulfil a customer order in a satisfactory manner. Today Färggrossen have a high customer satisfaction level, as well as BSAB and ECO; however, Färggrossen’s internal product flow is not functioning well and if the product flow continues in this manner, future expansions and demands will contribute to the company having difficulties meeting their customers’ demands and customer satisfaction. When suggesting possible changes to Färggrossen we will therefore take into consideration how BSAB and ECO have managed to keep a high customer satisfaction level while maintaining a high level of internal product flow which can be improved by having a functioning information flow.

**INFORMATION FLOW**

The basis for information flow in a logistics system is formed through an order which has three basic functions; to create a flow of information that precedes, accompanies and follows goods. In order to maintain a well structured and organized warehouse it is essential to maintain a high level of information flow. As stated in Section 5.7.1 Information System Question, information flow is the backbone of a company and if used correctly, the information can have an immense impact on the product flow as well as on the company as a whole. The handling of information between Färggrossen and its suppliers determines what products are to be delivered, in what quantity and when the products are delivered. While Färggrossen lays orders whenever needed, BSAB places one vast order per year and ECO do not have to place any orders to suppliers since they produce their end products. The manner in which BSAB places an order to its suppliers can be discusses and argued if it is an optimal way of placing an order. However, for Färggrossen we do not find this method as applicable.
and it is therefore disregarded. Deliveries at Färggrossen, as well as for BSAB, arrive every
day during the week and on some days the company receives more deliveries than on other
days. Since the delivery time from Färggrossen’s suppliers to Färggrossen are not considered
long, max a few day, this contributes to a more continuous flow of incoming products which
in turn helps Färggrossen plan its deliveries in a better manner.
Since Färggrossen is a SME it only uses one information system which contributes to a
reduction of communication problems which might occur in larger companies which use
more than one information system.

**Changed Picking Routines**

The third and last factor which needs to be considered when discussing product flow
changes is changing the picking routines. In *Chapter 6 The Case Studies*, in the Färggrossen
case, the reader is informed that when handling products the equipment that is used is
mainly a forklift truck and a pallet jack. These types of equipment are also used at BSAB and
ECO; however, since ECO is a vast company they have the advantages of using more high
technological and modern equipment such as self-driven forklift trucks. In Section 3.3.3
*Machine (Equipment)* the different equipments available are discusses and amongst those are
double reach trucks and high reach forklifts, used in ECO, which might be an option for
Färggrossen. Both types of equipment are used to putaway and retrieve products in the
warehouse and simplify these processes. As well as the equipments being used, Färggrossen
also rely a lot on manual labour since they putaway and retrieve products by hand when
these have been stored on shelves without pallets. In BSAB and ECO, manual labour is not
relayed on in the same sense. One can never get away from manual labour; however, in
Färggrossen the warehouse processes rely quite a bit on it. As mentioned in Section 3.3.1 *Man
(Personnel)* it is important not to rely on manual labour to that extent as Färggrossen does
especially when there are better and more efficient alternatives. The fact that Färggrossen
only own one forklift truck might lead to delays in several warehouse processes such as the
unloading of arrived products, the putaway process, retrieval of products to be delivered
and the loading of products. This can be seen as a weakness but on the other hand due to the
company size it might not be financially possible to afford another forklift truck and at the
moment the company is managing the workload with only one forklift; however, future
expansions might require a second forklift truck. Comparing Färggrossen to BSAB, similar
sized company, BSAB also mange which only one forklift truck and since BSAB have
expanded their business the past years we strongly believe that Färggrossen will make do
with one forklift truck at the present time.
Overall, we believe that Färggrossen will benefit profoundly from studying other similar sized companies picking routines.

**Results of the Warehouse Layout and Product Flow Changes**

This section presents the results of the product flow changes which in turn are linked to the results of the warehouse layout changes in the previous section. To map the exact product flow at Färggrossen was impossible due to several reasons; however, despite this we were able to map parts of the flow and the results are presented in the following sections.

**Results of Implementing a Locator Address System**

Taking implementing locator addressing system in Färggrossen into consideration, this section presents the option of keeping the current warehouse layout and location of products and only implementing a locator addressing system, as just mentioned, as well as changing the order picking routines. Since part of the purpose of the thesis is to improve the warehouse layout, adding a locator addressing system to the layout will not only improve the information flow but it will also contribute to the warehouse appearing in a more professionally structured manner as well as simplifying the task of locating products for people not familiar with the warehouse layout. As well as improving the structure in order to simplify the locating of products for outsiders, the most important fact is that the employees will benefit from these changes by gaining a better understanding for the warehouse layout.

The locator addressing system will also contribute to reduced time looking for the location of the products. By adding the locator addressing system it will be clearer where the different products are stored, which will lead to the workers spending less time looking for specific product located in the wrong area. Both in BSAB and ECO this is not a problem since the companies have sufficient locator addressing systems which help and guide the worker to the right product and its location.

The disadvantages with implementing a locator addressing system are that it might contribute to less flexibility in the sense that the locator addressing system could create a warehouse which is fixed. However, this is rather a choice made by the company, furthermore, according to Ackerman (1997) in Section 3.4.3 Storing (Bulk and Pick) Process fixed positions might result in requiring a vast area for the products. ECO apply a fixed slot system and therefore require a vast area which they have, although through the interview we were informed that the lack of space is becoming a problem. Another disadvantage is that if
If the products need to be relocated for some reason, this results in an extra cost for the company.

The table below shows a summary of the advantages and disadvantages of implementing a locator addressing system with regards to changes in the product flow.

**Table 19: Advantages/Disadvantages of Implementing a Locator Address System Regarding Changes in the Product Flow. (Source: Our Own)**

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Easier to locate the products</td>
<td>• Relocating the products will affect the product flow negatively at first since the workers will have difficulty adapting to the new layout</td>
</tr>
<tr>
<td>• Easier to locate the right location during the put away process</td>
<td>• Lack of flexibility based on choices made by the company since the locations can be fixed.</td>
</tr>
<tr>
<td>• Internal transports will be more structured</td>
<td>• It will cost money and time to rearrange the warehouse layout according to the signs and markings. The product flow will be affected negatively during this transaction period</td>
</tr>
<tr>
<td>• Outsiders will easier be able to locate products since the warehouse is better structured and organised</td>
<td>• The employees will gain more understanding to the warehouse layout</td>
</tr>
</tbody>
</table>

**Table 20: Advantages/Disadvantages of Implementing Product Families Regarding Changes in the Product Flow. (Source: Our Own)**

Taking the changes made in Section *Products Families* into consideration, several advantages were raised. These changes contribute to a more organised and structured warehouse which in turn contributes to simplifying locating the stored products i.e. the employees do not need to waste time looking for products in the wrong location. Moreover, by implementing these changes contributes to the warehouse having a more professional appearance which indicated that the company is focusing on maintaining an organised product flow. All the above mentioned changes contribute to improving the overall product management in the sense that future expansions will be managed in a better manner regarding the handling of products and the fact that the employees work performance will have improved.

The table below shows the advantages and disadvantages with implementing product families with regards to changes in the product flow.
Since part of the purpose of the thesis is to improve the warehouse layout, implementing new procedures as well as recommending further studies, will improve the information and product flow as well as making the warehouse appear in a more professional, structured and organized manner. A warehouse with this appearance suggests that the company focuses on maintaining an organized product flow. The changes and eliminations made to the processes will contribute to a reduction in ‘time loss’ as well as improving the overall process times. By clarifying and defining the processes and having a mutual way of conducting the processes will also contribute to a reduction in ‘time loss’. The disadvantages with implementing new procedures are that it might take time for the worker to learn the new methods as well as the workers being resistant to the changes.

The table below shows the advantages and disadvantages with implementing new procedures and looking at further studies with regards to changes in the product flow.

**Table 21: Advantages/Disadvantages of Implementing New Procedures and Looking at Further Studies Regarding Changes in the Product Flow. (Source: Our Own)**
Since part of the purpose of the thesis is to improve the warehouse layout, looking into the possibility of making new investments, might contribute to improving the information and product flow as well as making the warehouse appear in a more professional, structured and organized manner. Implementing a system such as a carousel or a live storage will, as stated earlier, contribute to not only improving the product and information flow but also the product management as well as maintaining a good inventory control. The new investments have several advantages as well as a few disadvantages, but overall the investments will contribute to a reduction in ‘time loss’ and order picking time as well as improving the overall process times and product flow.

The disadvantages with new investments are that it might take time for the worker to learn the new layout and where the products are located as well as the workers being a resistant to the changes. Since the investing in a new system for stocking paint accessories is a fixed position, it might in the future lead to longer internal transportations if Färggrossen expand the warehouse a bit more. Furthermore, it might take time for the workers to get used to and understand how the newly implemented warehouse management support system functions.

The table below shows the advantages and disadvantages with making new investments with regards to changes in the product flow.

**Table 22: Advantages/Disadvantages of Making New Investments Regarding Changes in the Product Flow. (Source: Our Own)**

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Improved product flow and increased space</td>
<td>• It will take time for the workers to learn how the new warehouse management support system works</td>
</tr>
<tr>
<td>• Improved product management</td>
<td>• The workers can be resistant and will have difficulties adapting to learning the new layout, processes and everything which comes with the new investments</td>
</tr>
<tr>
<td>• Better inventory control and overall view of the product movement in the warehouse</td>
<td>• Since the new system is a fixed location, internal transportations will increase in the future</td>
</tr>
<tr>
<td>• Decreased internal transportation due to easier access and easier to find products</td>
<td></td>
</tr>
</tbody>
</table>
**Research Question 5**

❖ *How is it possible to improve the warehouse process competence?*

In Chapter 3 *Theoretical Frame of Reference*, we discussed that the warehouse is a system with its own inputs, processes and outputs. These entities, while entirely separate from each other, are still affected by changes that are applied individually. Answering this question, provided possible improvements in the processes of a warehouse system regarding the key issues that are addressed in Section *Research Question 3* above. In order to clarify the possible process improvements, the processes are addressed in detail in the following sections; receiving, putaway, storing, replenishment, picking, shipping, VAL.

**Receiving**

In Section 3.4.1 *Receiving Process*, it is mentioned that even though Tompkins et al. (1998) consider the receiving process as easy, it is a labourer intense process just like shipping. Receiving is considered to be a simple process and an important part of this process is the inspection that is done. The company needs to make sure that the received goods meet the company’s requirements regarding quality, condition and quantity, which Mulcahy (1993) in Section 3.4.1 *Receiving Process* mentions as standard company requirements.

In Section 6.1 *The Färggrosset Case* and 6.2 *The BSAB Case* it is described that in order to ensure that the received products are in good condition, a visual inspection is done. The received products are counted and compared with the delivery note to confirm that there are no inaccuracies. At ECO, there is no need for inspections since the manufacturing facility directly supplies the finished goods warehouse, which in turn contributes to time being saved.

At BSAB, an additional inspection regarding nails and screws is conducted; the first box of nails/screws are emptied, counted and repacked into the same box. This procedure is considered time loss for the warehouse system, time loss that gives an advantage when considering customer satisfaction. With this inspection customer satisfaction is kept at a high level, since the customer will receive the exact quantity. Conducting an analysis of how frequently the received boxes of nails/screws contain insufficient quantities, might be good in order to question the need for this inspection. If the frequency is low then this inspection can be considered time waste, but if the frequency is high then it might threaten the customer satisfaction, which signifies that the inspection is necessary. BSAB has performed this
inspection for a long time and it is an experience based decision, which is why conducting a scientific analysis can contribute to improving the company.

A suggestion to Färggrossen is to eliminate the inspections at the receiving process and instead combining it with the putaway process, in order to save time. Even though the combining of the processes might save time, mistakes might be made which is why it should be designed and applied very carefully. Since the inspection is not considered as complicated, the benefit will be greater than the risk of experiencing damaged or inaccurate deliveries.

**Putaway**

Putaway is the process that occurs after the receiving process. The process is initiated when the goods are transported to their stocking positions. In Section 3.4.2 Putaway Process, it was addresses that Mulcahy (1993) defines two different methods for putaway; memory and document.

In Section 6.2 The BSAB Case and 6.3 The ECO Case it is discussed that BSAB and ECO implement the document method, which means that before the products are stored, a document guides the labourer to the products correct locations. At Färggrossen the warehouse manager controls the putaway process by implementing the memory system.

In Section 3.4.2 Putaway Process, it is stated that Frazelle (2001) defines four principles for putaway; direct, directed, batched and sequenced as well as interleaving. In ECO the putaway process is performed according to directed putaway, while in BSAB and Färggrossen putaway process is performed according to direct putaway.

In BSAB and ECO there are no problems locating products, whereas Färggrossen are experiencing problems, due to the memory method, since the company is not recording the stocking positions of the products when they are put away. In BSAB the product locations, in putaway process, are recorded in the database system that the company is using and in ECO the database system is set to direct the labourer to the assigned locations.

As previously mentioned, one of Färggrossen’s key issues is the problems that rise due to the memory method being used. Therefore, a very important recommendation for Färggrossen is to abandon the memory method and implement the document method in the putaway process.
Another improvement that can be suggested is to apply the batch and sequenced putaway principle, which is one of the principles that Frazelle (2001) discusses in Section 3.4.2 Putaway Process. Since the warehouse of Färggrossen is divided into three sections, because of the family groups, this principle can be appropriate. As it was discussed in the Färggrossen case, the stock locating method is a family grouped method, which is quoted by Ackerman (1997) in Section 3.4.4 Storing (Bulk and Pick) Process as: ‘family groups are assigned to specific areas but there is a floating method used in the areas’.

When Färggrossen receives an order, it is already arranged to be stocked in the wallpaper, the main or the chemical area. Since there are no suppliers who produce different family group products simultaneously, there are no orders that contain different family group products, and therefore, the selected storing areas can be decided on beforehand. An order contains only one family group of products and instead of waiting and putting away all received orders at once, the orders can be grouped with other orders that contain the same family group. In turn, the family groups are put away together which means that the putaway process will be handled zone by zone.

Färggrossen has two other options relating to the principles previously discussed. The company can choose to invest in a warehousing computer program to direct the labourers to stocking positions in order to increase the space efficiency in the warehouse or they can arrange their data entry methods and record the stocking positions after the putaway process, which will correspond to the directed or the direct putaway principle.

If Färggrossen chooses to invest in a warehouse computer program, the putaway principle will be a directed putaway and the space efficiency will be improved by the computer program. If Färggrossen chooses to improve the data entry frequency then the system will be kept as direct putaway but the memory method will be eliminated.

A database system will support the warehouse with the stocking positions, quantity levels as well as support the system’s validity. The only disadvantage of investing in a database system is the cost of the investment.

**Storing**

Storing is an important process in the warehouse system where different warehouse areas and storing location methods affect the efficiency of the system. In Section 3.4.3 Storing Process, Mulcahy (1993) is quoted that there are two types of storing, Bulk and Pick, whereas in bulk storing the reserve stock is used to replenish the pick storage area. Studying the
situations in the companies regarding the definitions of these two areas, indicates that none
of the companies have a specific area defined as a bulk storage area, and at the same time the
companies are either building or planning to build additional warehouse sections in order to
support the need for space.

In Section 6.1 The Färggrossen Case, it was discussed that bulk items at Färggrossen are stored
high on the shelves in every section of the warehouse while as in Section 6.2 The BSAB Case
and 6.3 The ECO Case it was discussed that BSAB and ECO implement the buffer/safety
stock into the regular inventory. In Section 6.2 The BSAB Case and 6.3 The ECO Case it is
stated that there is a need for space, which is why both BSAB and ECO are building
additional sections to their warehouses.

In Section 3.4.3 Storing Process, Ackerman (1997) mentions three different stock locating
methods; fixed slot, floating slot and family grouping. The three companies which are
included in our case studies use different types of stock locating methods; Färggrossen uses
family grouping, BSAB uses floating slots and ECO uses fixed slots. Each case study, in
Section 6 The Case Studies, addresses the advantages and disadvantages of these methods in
detail.

In Färggrossen’s warehouse there is bulk products randomly stored everywhere, which does
not correspond with the family grouping method. Even though the company approximately
store 5,000 different products the need for space is much lower than in BSAB and ECO.

In BSAB floating slots are used to store the approximately 1,500 products as well as the
warehouse has been expanded a few times, where the last expansion was recently
completed. The disadvantage that BSAB has is the shape variety and the sizes of the
products, for example, the space needed to store a box of screws compared to the space
required to store a 500 litre water tank varies substantially. These differences contribute to
the need for space in the warehouse being greater than if the items had been of identical or
similar size.

ECO uses fixed slots and, as mentioned in Section 6.3 The ECO Case, if the stock levels are
high, the need for space is equally large. The main problem ECO is facing is the need for
space, and the advantage ECO has is the similar sized products.

Even though there is no urgent need for space at Färggrossen, a main problem is that the
need for space occurs during the high season, which is why we suggest an arrangement
within the warehouse where a bulk area is defined and where the reserve inventory should
be stored. Drive-in racks are the most space efficient storing equipment, which is why we recommend that Färggrossen should use these types of racks in the bulk area.

A defined bulk area will allow the company to organize the picking areas and instead of storing bulk products randomly throughout the warehouse, the bulk products are stored in one area in an efficient manner with the use of drive-in racks. Drive-in racks, as discussed in Section 3.3.3 Machine (Equipment), are the most volume efficient way of storing, which improves the volume flexibility which is required during seasonal fluctuations.

As previously mentioned ECO and Färggrossen store wallpapers and even though the product quantity differs between the companies, the system that ECO uses, a simple shelf, can easily be applied to Färggrossen. This implementation would improve the disorganized situation in the wallpaper area which is caused by different batches being stored in same location. Färggrossen can benefit from using the fixed slots, that ECO is using, in the wallpaper areas as well as the additional shelves previously mentioned.

Even though fixed slots, for the wallpaper, can be applicable for the wallpaper area due to the low variety of wallpapers, applying the method to the whole company would require a vast amount of space. The advantage that the company achieves from applying this recommendation is that the disorganized situation in the wallpaper area will be resolved.

Another important topic in the storing process is the locator addressing system in the companies. As discussed in Section 3.4.3. Storing (Bulk and Pick) Process, Ackerman (1997) defined the locator addressing system as ‘a coding system for the warehouse building, areas, racks and shelves and it is a logical system to address the locations’. According to Briggs (1978) and mentioned in Section 3.4.3. Storing (Bulk and Pick) Process, there are two types of locator systems: memory system and serialized location system.

Serialized locator addressing systems, as discussed in Chapter 6 The Case Studies, are used in BSAB and ECO while the memory system is used in Färggrossen. As it was quoted by Briggs (1978) in Section 3.4.3 Storing Process, a memory system can only be successful if the personnel in the work area are few, the numbers of articles are low and the turnover rate is low. In Färggrossen there are three warehouse labourers, which can be accepted as a low number of workers; however, the number of articles cannot be considered as low since Färggrossen store approximately 5,000 products.

A recommendation to Färggrossen would be to apply a serialized locator addressing system that covers all the warehousing area. This addressing system should define/mark every
shelf, every aisle and every area. These markings/definitions contribute to a clear addressing which will benefit the warehouse. The efficiency improves not only in the storing process, but also in the putaway and picking processes, since both processes are directly related to the stocking positions.

**Replenishment**

According to Van Den Berg (2007) replenishment is the action of restocking the positions in the pick area from the bulk area and as discussed in Section 3.4.4 Replenishment Process, none of the companies have a defined bulk area. The only possible definition of a bulk area can be found in Färggrosen where the replenishment process is based on the warehouse manager’s personal decisions.

According to Mulcahy (1993), the replenishment method changes due to the pickup positions of the goods. The family grouping method acts as a combination of fixed and floating slots, which is why there is less replenishment than what would be required in a warehouse which uses fixed slots and more than if a warehouse uses floating slots would require.

A suggestion regarding replenishment can be reducing the replenishment as much as possible in order to avoid unnecessary transports, and the need for flexibility in storing equipments will be increased, since it is not efficient to store wallpapers on big shelves which are designed to store paint pallets. This is why we decided to disregard this option.

To increase the replenishment level, the recommendation to define a bulk area should be applied. Defining a bulk area will provide more usable space for the picking area. This recommendation provides the company with volume flexibility.

**Order Picking**

As discussed in Section 3.4.5 Picking Process, order picking is the opposite of the putaway process. According to Tompkins et al. (1998) there are three methods that can be used in order picking: discrete order picking, zone picking and bulk picking.

In Section 6.1 The Färggrosen Case and 6.2 The BSAB Case, it was discussed that both Färggrosen and BSAB use discrete order picking, while Section 6.3 The ECO Case mentions that ECO uses bulk picking. When the handling of daily orders are compared, it is clear that ECO handle 1,400-1,500 orders per day while this number is much lower in the Färggrosen and BSAB.
In the order picking process, Färggrossen and BSAB use a simple cart while ECO uses a special cart called *matrix wagon*, which is described in Section 6.3 *The ECO Case*.

In Section 6.1 *The Färggrossen Case*, it is described that there is an obvious inefficiency in the order picking in Färggrossen. There is definitely a difference in the number of orders being picked, between discrete and bulk picking, but the inefficiency of the picking process in Färggrossen is not caused because of the method choice. Since Färggrossen and BSAB have similarities in the picking method and product variety, the difference between the two companies is obvious.

The order picking process is inefficient in Färggrossen because the company has not implemented a locator addressing system as well as based on the memory method being used in the putaway process instead of a document method.

The company can benefit from “picking routine studies”; however, the benefits that they can gain are limited until they solve the problems previously explained.

**Shipping**

None of the companies’ use special packaging for deliveries, and all the companies use third party logistics to deliver the products to the customers. While ECO has been working exclusively with Schenker for the last 50 years, Färggrossen and BSAB outsource the deliveries to Börjes Corporate Group.

In contrast to the other companies, Färggrossen despite occasionally using third party logistics primarily uses their own trucks to deliver. This provides the advantage of customers trust and satisfaction since the truck driver also works as a salesman and personally informs the customers about the products.

From observations made, it is possible to say that only using third party logistics might be beneficial for Färggrossen. Abandoning their own trucks and only using third party logistics can be a suggestion for Färggrossen, but the company is using this as a customer satisfaction tool. A cost/benefit analysis should be done in order to find the best choice.

**VAL**

As value adding logistics, depending on the customer order, Färggrossen deals with colour mixing, BSAB counts and repacks screws and nails while ECO does not have any sort of VAL.
Since customer satisfaction is very important to Färggrossen, a market research can be performed in order to identify what kind of VAL the customer’s truly want.

7.2.3 Answers to the Comparison Research Questions
This section presents the answers to the comparison research questions. In order for Färggrossen to learn from other companies’ experience as well as handling of key issues, the two comparison research questions are answered.

Research Question 6

What similarities and differences exist between the three studied companies concerning warehouse management and what can Färggrossen learn from other companies’ handling of key issues in warehouse management and vice versa?

The three studied companies have all different backgrounds, histories, products and methods in their warehouse management. Even though there are differences, in order to compare the companies, the similarities need to be identified in order to improve the warehouse management in Färggrossen. Therefore, both similarities and differences are analysed in the subsequent sections.

Similarities
This section addresses the similarities between the three companies which were identified. The selection of the two benchmark companies, ECO and BSAB, was based a decision made by Färggrossen’s CEO, Mikael Lindgren, who suggested that we compare Färggrossen with these companies.

When comparing the companies’ history, the merges in ECO’ history could be considered to be similar to the act of Åke Svanbäck, when Svanbäck bought the shares of his associates one by one. The fact that Färggrossen and BSAB are both young companies is seen as another similarity.

The product portfolio is another area where the companies share similarities; however, although BSAB and Färggrossen do not share the same or similar products, the product size variety can be considered a similarity. ECO and Färggrossen store wallpaper as a similarity; however, Färggrossen store other products that need to be taken into consideration when a warehouse decision is made.
All companies have a healthy workforce and takes steps to maintain it, which according to Langford (2006) was important regarding warehouse efficiency as discussed in Section 3.3.1 Man (Personnel).

All the studied companies have a special docking area and the storing equipment used in the three companies are mainly normal racks, such as the material handling equipments, and forklifts. None of the companies have special packing for deliveries or any other VAL regarding deliveries and all companies use third party logistics.

As previously mentioned, Färggrossen and BSAB both use similar methods in the receiving, putaway and picking processes.

**Differences**

The three companies have many differences, some of which give advantages and the others disadvantages. The main difference is the size of the companies, even though Färggrossen and BSAB can be considered small sized companies, ECO is considered as a large company, which can confirmed by studying the financial facts as well as the number of the employees, which is discussed in Chapter 6 The Case Studies.

Comparing the companies investments against each other shows that Färggrossen’s biggest investment, after purchasing and holding costs, is the shipping cost because of the trucks they own, which is discussed in Section 6.1 The Färggrossen Case. For BSAB, the most important cost is the purchasing and holding costs because of the excess inventory and the ordering frequency, which is once a year, which is discussed in Section 6.2 The BSAB Case. In Section 6.3 The ECO Case, it is mentioned that even though there is a constant excess inventory, which causes a very high level of inventory costs and holding costs, the IT cost is the most important investment.

When machines and equipment are compared, Färggrossen and BSAB have similarities in the material handling equipment while ECO on the other hand, uses different gripping tools for forklifts as well as high reach forklifts, which is explained in Section 6.3 The ECO Case.

Regarding the warehouse milieu, ECO has the most qualified inner milieu with specially designed shelves for products whereas floors, illumination, air condition issues are handled with special care. In Färggrossen the floors are designed to appropriately suit the warehouse; however, the racks are not specially design. In BSAB, the floor consists of simple concrete which is not smooth enough to allow efficient energy use for the transportation and to ensure product safety, but on the other hand the stored products are not fragile.
The products can be compared as well, even though the products size variety in Färggrossen and BSAB can be considered to be similar, the products size variety is much greater in BSAB than in Färggrossen. ECO only has wallpapers, which means that there is no product size variety.

The different methods that are used by the companies are summarized in the Table 23 below.

<table>
<thead>
<tr>
<th>Table 23: The Comparison Table of the Process Methods in the Companies. (Source: Our Own)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Färggrossen</strong></td>
</tr>
<tr>
<td><strong>Receiving</strong></td>
</tr>
<tr>
<td><strong>Putaway</strong></td>
</tr>
<tr>
<td><strong>Storing</strong></td>
</tr>
<tr>
<td><strong>Replenishment</strong></td>
</tr>
<tr>
<td><strong>Picking</strong></td>
</tr>
<tr>
<td><strong>Shipping</strong></td>
</tr>
<tr>
<td><strong>VAL</strong></td>
</tr>
</tbody>
</table>

The first difference that can be identified is in the receiving process. While Färggrossen and BSAB conduct inspections, ECO does not need to perform any inspections since the supplier for finished goods warehouse is the manufacturing facility. Even though inspections are needed, the companies should try to minimize them as much as possible in order to increase efficiency.

Regarding the putaway process, Färggrossen uses a memory method while the ECO and BSAB use the documented method. As mentioned in the Section Research Question 5 above, a suggestion is that Färggrossen needs to implement a locator addressing system as well as a warehouse database system to support the processes. ECO uses a directed putaway principle.
while Färggrossen and BSAB use a direct principle. ECO has in general a different way of deciding the fixed slots stocking positions, which is beneficial in their case since all the products have similar size.

In the storing process all the companies use different methods, ECO uses fixed slots, BSAB uses floating slots and Färggrossen uses family grouping. The situation which Färggrossen is in allows Färggrossen to choose any of the three methods. If Färggrossen uses fixed slots the need for space will increase immensely since the company stores more than 5,000 different types of products this requires the same amount of 5,000 storing positions. Due to seasonal fluctuations, Färggrossen is faced with two options, either designate a bulk area where the seasonal products are stored or increase the space designated for the individual items in the pick area so that the products can be placed there when needs be.

If Färggrossen decides to use floating slots, there will be a need for a vast amount of space since the variations of the products size are quite large. Our personal opinion is that family grouping is more beneficial than fixed or floating slots for Färggrossen.

Another difference between the companies is the picking process where ECO uses batch picking and ECO and BSAB use discrete picking. This is related to the size of the company as well as the number of orders that need to be delivered. If batch picking is applied in the ECO or BSAB, the products size variation as well as the number of orders in a single day might not support the batch picking method. Situations when using batch picking might be beneficial which is why further study is needed.

The most significant difference between Färggrossen and the other two companies is that Färggrossen owns its own trucks, which provides a competitive advantage in the market regarding customer satisfaction. ECO and BSAB could also benefit from using their own trucks instead of relying on third party logistics. To determine which option is the most beneficial, a cost/benefit analysis should be performed.

Depending on the customers’ needs, Färggrossen deals with colour mixing while BSAB counts and repackages nails/screws and ECO does not have any kind of VAL. Considering a product perspective, ECO and Färggrossen can be compared regarding wallpaper; however, ECO does not have any value adding logistics that Färggrossen can benefit from. Considering product size variety, Färggrossen does not store small products that need to be recounted before being sent to the customers, such as the procedure BSAB conducts.
What actions do Färggrossen need to take in order to benefit from the lessons learned from the experiences of other companies about handling of key issues in the warehouse?

From the case studies and related literature that is discussed in Chapter 6 The Case Studies and Chapter 3 Theoretical Frame of Reference as well as mentioned in the previous questions, our suggestions are divided into three categories:

- Main recommendations
- Secondary recommendations
- Future recommendations

The warehouse outputs have in Section 3.5 Warehouse System Outputs been defined as; efficiency, product condition, product availability and customer satisfaction. The definition stated that ‘any changes either in the inputs or the processes will affect the outputs’. Since the changes we are suggesting both affect the inputs and outputs, we decided to discuss the outputs that the recommendations will be affecting.

Some of their commendations are related both to the inputs and the processes and to be able to distinguish which aspect of the warehouse system they relate to, Figure 26 below illustrates this. This figure is an interpretation of all the recommendations and the ways in which they would benefit the company.
Main Recommendations

This section presents and discusses the main recommendations which are suggested in order to improve the warehouse management of Färggrossen. The difference between these recommendations and the secondary as well as the future recommendation is that the main recommendations do not require any investment, they are not limited of apparent reasons and they can be implemented immediately.
1. **Manual labour should be eliminated as much as possible**

Manual labour is primarily used in Färggrossen during the putaway process where the products are lifted, by hand, from pallets to shelves. We strongly recommend that Färggrossen should store the products, which arrive on pallets, in the shelves on the belonging pallets rather than manually placing individual products on the shelves. The purpose of this recommendation is aimed to improve the efficiency by eliminating time loss that is caused by the manual labour. The product condition outcome will also improve since the products will not be unnecessarily transported from pallets to shelves.

2. **Inventories should be conducted**

Conducting inventories is suggested to Färggrossen in order to update data regarding product quantity in the warehouse. This recommendation will be more effective once the IT (database) system is active and the data entries are constant. The aim of this recommendation is to improve the product availability as well as the customer satisfaction outputs.

3. **A bulk area should be defined**

Defining a bulk area should be applied in Färggrossen in order to increase space efficiency and eliminate the randomly stored bulk products. It is possible to apply a bulk area without purchasing new equipment; however, we recommend defining a bulk area and purchasing drive-in racks as well as double reach trucks to load these racks, will increase the space efficiency more than applying the recommendation without new equipment.

The aim of this recommendation is to get rid of the randomly stored bulk products throughout the warehouse and to store them in a joint area. This contributes to clarifying the storing system while improving the space efficiency of the pick area at the same time. This recommendation is aimed to improve the product availability, efficiency and product condition outcomes.

4. **The replenishment process should be supported**

It is previously discussed that Färggrossen experiences problems in the replenishment process, since the bulk products are randomly stored in the warehouse. Excess inventory or shortage and stock outs are more commonly than experienced wanted. With a defined bulk area the replenishment will increase as well as the process will be controlled. This recommendation aims to improve the product availability outcome.

5. **The small shelf solution, that is being used in ECO, should be applied in Färggrossen**
Even though other storing equipments are defined as secondary recommendations, the situation is different regarding the small shelf suggestion, since this recommendation does not require a great deal of investment. The racks which are currently used for storing wallpaper can be re-designed by adding additional shelves in order to apply this recommendation. This recommendation aims to solve the disorganized situation in the wallpaper area by providing the advantage of storing individual wallpaper rolls on the small shelves that are suggested. It is aimed to improve the efficiency output.

6. A fixed slot system should be applied to the wallpaper area

The system used for storing wallpaper in ECO is the main idea behind our recommendation to improve the wallpaper area in Färggrossen. Not only will the shelves be implemented but so will the stock location method. Färggrossen does not store a vast amount of wallpaper, as ECO does, and because the wallpaper inventory stock level is not as high, this recommendation is applicable. With this recommendation we aim to improve the space efficiency in the wallpaper area, which will in turn affect the space efficiency of the warehouse as a whole.

7. A serialized locator addressing system should be applied

With this recommendation we suggest that all the areas, aisles, racks and product positions should be defined. Applying a locator addressing system in the warehouse will improve the putaway, the storing, the replenishment and the picking processes, since all these are dependent on either finding the location or finding the product. This improvement will increase efficiency since the putaway and the picking processes will be improved. Product availability and customer service levels will also be improved because of the improvement in the efficiency.

Even though applying a locator addressing system will immensely improve the warehouse management, it should be supported by investing in an IT (database) system for the warehouse. This will in turn cross reference the quantities and the attributes of the products with the locations of the products. The aim of this recommendation is to improve the efficiency, the product availability and the customer satisfaction outcomes.

8. The inspections that are done should be combined with the putaway process

This recommendation deals with the receiving and the putaway process; every order is inspected before they are putaway. Inspections are necessary in order to confirm that the
suppliers delivered the right quantity of products, at the right time and in good condition. Even though the inspections are necessary, they can be done while the putaway process is performed, since the inspections are basic. This recommendation aims to increase the efficiency by eliminating time loss. The efficiency and the product condition outcomes will be improved.

9. **Safety precautions should be implemented**

Implementing safety precautions will improve the product condition outcome, for example, if there is a fire and the company already has planned how to put out the fire, there will be no or little damage to the products and the labourers.

**Secondary Recommendations**

Many different recommendations arose during the process of the thesis which we strongly believe will improve Färggrossen’s warehouse management. Some of the recommendations were classified as secondary recommendations, since these require investments and are therefore limited by the company’s financial resources. These recommendations will be discussed in detail in this section.

1. **New employees should be hired**

Hiring new employees will cause an increase in the number of workers per stocked product, which would in turn increase work efficiency and customer satisfaction. Since the aim is to achieve a customer satisfaction, as close to 100% as possible, even though 100% is desirable but not realistic, this is one step closer to achieving it. This recommendation is limited by the capital that the company is willing to put on staff cost.

2. **Carousels and live storage systems should be implemented in the warehouse for smaller items (brushes, clothes, etc.)**

This recommendation suggests the use of different racks, carousels and live storage systems that will be used to store products such as clothes, brushes and other tools, which do not require a large amount of space. Most of these items are currently placed randomly in the warehouse or stored in boxes on the floor in the main area. This recommendation aims to eliminate the random storing as well as to improve the product condition outcome, since these products will be stored in a better manner. This recommendation is limited by the capital that the company is willing to spend on equipment costs.

3. **IT investment should be made**
An important way in order to improve the warehouse management is investing in an IT (database) system for the warehouse, which can be used to distinguish the quantities, attributes and locations of the products. If this recommendation is applied it will affect the efficiency, product availability and customer satisfaction outcomes in a positive manner. This recommendation is limited by the capital that the company wants to invest on the IT (database) system; however, without applying a locator addressing system, which is another recommendation, the IT system will not be as effective as it can be.

4. *A double reach truck should be purchased to load the drive-in racks in the bulk area*

Purchasing a double reach truck goes hand-in-hand with implementing a defined bulk area as well as investing in drive-in racks. Without these components there is no need to purchase a double reach truck. This recommendation is based on defining a bulk area and limited by the capital that the company is willing to spend on equipment costs.

5. *Drive-in racks, for the bulk area should be purchased*

Purchasing drive-in racks goes hand-in-hand with defining a bulk area and without defining a bulk area; drive-in racks will not be efficient. These racks are designed for storing products on pallets in order to support space efficiency and they are not suitable for storing individual products. This recommendation is based on defining a bulk area and limited by the capital that the company is willing to spend on equipment costs.

**Future Recommendations**

1. *Färggrossen’s data entry methods should be improved*

Färggrossen has an IT system which is not appropriate in order to support the warehouse functions, because of the programs limitations. Implementing a new IT (database) system for supporting the warehouse functions alone is not enough as long as it is not supported by a continuous data entry. This recommendation aims to, in the future; improve the data entry methods in the company, so that the data in the system will be accurate. This recommendation aims to improve the product availability and customer satisfaction outputs.

2. *Picking routine studies should be applied*

An important process in the warehouse is the picking process, since it directly affects the customer satisfaction outcome. A study on picking routines in Färggrossen should be applied once the improvements about the location addressing system and the IT (database)
system are implemented, because without the presence of these recommendations the picking routine study will not be as effective as it is aimed to be.

3. *A cost/benefit analysis of the own trucks and third party logistics should be done*

Owning trucks can be considered as an advantage for Färggrosen. Since ECO and BASA outsource the shipping process to a third party logistic company, a cost/benefit analysis should be done in Färggrosen in order to distinguish if the benefit gained from using own trucks is greater than using solely third party logistics. This recommendation aim at positively affecting the efficiency, since shipping costs represents a large portion of the total costs in Färggrosen.

4. *Market research of VAL should be done*

VAL is limited to mixing colours in Färggrosen. A market research about the customer’s wishes regarding VAL should be conducted as further work, since the main recommendations are prioritized in our recommendation list.
8 Conclusions and Further Work

This chapter presents the conclusions of the thesis. The last section presents the reflections from the authors and possible future works that can be conducted to improve the warehouse layout in Färggrossen.

8.1 Conclusions

In our first meeting with Färggrossen, we noticed that there were several things that needed to be improved. The products stored on the floor in the main area and having no numbers to define stocking positions were some of the problems that we noticed at first. We were informed that the company was trying to solve this situation with small changes like introducing an IT system and making use of computers in the company, but so far the problem has still not been resolved. Implementing an IT system has not improved the processes at Färggrossen, since the system is not used in a useful manner, due to the warehouse management not being properly prepared for the implementation. Several other improvements should have been prior to implementing the IT system, and these improvements and recommendations were address in Chapter 7 Analysis and Recommendations.

The purpose of the thesis is ‘to map and to analyse the company in order to improve the inventory, warehouse layout and the methods being used in warehouse management. The result should in part be based on benchmarking with other companies.’ Our recommendations are based on benchmarking the other companies as well as being based on literature.

The recommendations made in Chapter 7 Analysis and Recommendations are divided and discussed in three categories: main recommendations, secondary recommendations and future recommendations. Main recommendations such as implementing a locator addressing system and defining a bulk area in the warehouse do not require any investment and the recommendations are not limited by any other factors. This is why these recommendations are defined as main recommendations and which is why they should be applied as soon as possible in order to improve the warehouse management in Färggrossen.

The recommendations in the three categories aim to improve at least one of the outputs that are defined in Section 3.5 Warehouse System Outputs. The effects of the recommendations, on the outputs, are:
Efficiency: By implementing the following changes; hiring new employees, combining inspections with the putaway process, eliminating manual labour in the putaway process and conducting picking routine studies, the efficiency output will be improved.

Product condition: Implementing the following changes; defining a bulk area and addressing safety precautions, will contribute to improving the product conditions.

Product availability: This output will be improved subsequent to; defining a bulk area, supporting the replenishment process and implementing an IT (database) system.

Customer satisfaction: By implementing the following changes; recommendations to improve the storing, replenishment and picking processes, conducting a cost /benefit analysis regarding owning trucks as well as performing a market research on VAL, this output will be improved.

Once the main recommendations are applied and once the company has the financial resources, the secondary recommendations should be applied in order to benefit from our recommendations as much as possible. There are more possible improvements, which we discussed in Chapter 7 Analysis and Recommendations, but these are not possible to implement before both the main and the secondary recommendations have been addressed.

These recommendations have contributed to us fulfilling the purpose of this thesis; the recommendations aim to improve the inventory, the layout and the methods that are being used in the warehouse. The most challenging part of preparing this thesis was the time limitation, since the main focus of this thesis was very abroad; we believe that every topic in this thesis can be researched in deeper detail in order to further improve the warehouse management in Färggrossen. The lack of time contributed to us not being able to study Färggrossen’s delivery lines, which we would have hoped to do. Not studying the delivery lines has however not affected the warehouse improvements or the thesis outcome. Färggrossen’s financial limitation is another factor we had to consider when searching for the literature and providing our recommendations and suggestions.

The main purpose of writing a thesis is to provide suggestions and recommendations on how to improve current situation for the company; however, by conducting this thesis, we also contribute with new information to the literature. Even though the literature defines warehouse inputs, processes and outputs as well as addressing them individually, the literature does not present an overall definition for the system approach for the warehouse. Defining a system approach of Färggrossen’s warehouse, as well as using benchmarking to
modify the suggestions from the literature in order to make it suitable for Färggrossen, is our contribution to the literature.

8.2 Further Work

As future recommendations, we suggested that data entry methods, picking routine studies, cost/benefit analysis for trucks and market research about VAL should be conducted. All these recommendations can benefit the company if the main and the secondary recommendations are applied in the company. To improve the warehouse management system of Färggrossen more studies then what is suggested as further recommendations can be conducted.

Further work beyond our thesis regarding Färggrossen can be frequency studies and flexibility analysis for seasonal variations on the products to improve product availability. Furthermore, time studies on processes to improve efficiency, and customer relation analysis to improve customer satisfaction can also be considered for future purposes.
REFERENCES
Books and E-books


**Thesis (Background reading)**


The Companies Internal Sources

Oral Sources

Mikael Lindgren. Company owner. Färggrossen. Nybro. Interview 2009/05/08

Patrick Ledin. Warehouse manager. Färggrossen. Nybro. Interview 2009/05/08

Tomas Nygren and Sanna Nygren. Bengt Sandbergs Byggprodukter AB. Nybro. Interview 2009/06/17

Jonas Sjöö. ECO-Boråstapeter. Borås. Interview 2009/06/22

Ou Tang course notes ‘Advanced Manufacturing Management’ 2008, Linköping University

Electronic Sources
Articles


Emerald


Others

Arvid Nilsson, Visited: 2009/08/19
Available: www.arvidnilsson.com

Andres&Hamilton Co., Inc. Visited: 2009/08/25

The Bison Group, Visited: 2009/08/09
Available: http://www.bison-group.com/infoglue DeliverLive_bison/ViewPage.action?siteNodeId=123&languageId=1&contentId=-1

Available: http://www.fao.org/docrep/w3241e/w3241e00.HTM

DHL- Discovering Logistics, Visited: 2009/08/29

Diamond Phoenix Corporation Visited: 2009/08/25

Encyclopaedia Britannica, Visited: 2009/05/29
Available: www.britannica.com/EBchecked/topic/540976/shipping
Estaclish, United Logistics Group, Visited: 2009/06/04

Francoudi & Stephanou, Visited: 2009/06/05
Visited: 2009/05/29

Free-Logistics, Visited: 2009/06/04

Gunnebo Industrier, Visited: 2009/08/19
Available: www.gunneboindustries.com

InventoryOps Dictionary/Glossary, Visited: 2009/08/28

Landoll Power solutions, Visited 2009/07/15
Available: http://www.landoll.com/mhp/drexel/

Logistics Platform, Visited: 2009/06/10

Pearson Higher Education, Visited: 2009/06/05

Jungheinrich Group, Visited: 2009/08/25
Princeton University  Visited: 2009/06/05
Available:http://wordnetweb.princeton.edu/perl/webwn?s=logistics&sub=Search+WordNet&o2=&o0=1&o7=&o5=&o1=1&o6=&o4=&o3=&h=
Visited: 2009/05/29
Available:http://wordnetweb.princeton.edu/perl/webwn?s=warehouse&sub=Search+WordNet&o2=&o0=1&o7=&o5=&o1=1&o6=&o4=&o3=&h=

Supply Chain & Logistics Consulting LTD, Visited: 2009/08/29
Available: http://www.supplychainlogistics-consulting.co.uk/warehouse.html

Tell el-Far’ah ,Israel Excavation Project ,Visited: 2009/06/05
Available: http://farahsouth.cgu.edu/dictionary/#L/

Available: http://netprosale.se/
APPENDIX

Appendix 1 - Interview Questions

0. COMPANY CHARACTERISTICS AND GOALS
   0.1. What is the history of the company?
   0.2. What type of company is it, what does the company offer?
   0.3. Which markets does the company focus on?
   0.4. Who are the company’s main competitors?
   0.5. Who are the company’s main competitors?
   0.6. What has the revenue been during the last years?
   0.7. What has the profit been during the last years?
   0.8. What has the turnover rate been during the last years?
   0.9. How many employees does the company have? How many of these employees work in warehousing/procurement?
   0.10. Does the company use scheduling for its workforce? Please explain
   0.11. How many orders are handled annually? Inbound/outbound?
   0.12. How many deliveries are handled annually? Inbound/outbound?
   0.13. What is the company’s vision for the future?
   0.14. What is the business strategy?
   0.15. How does the company define logistics, and what is its logistic strategy? What does the company want to achieve with its logistics?
   0.16. What are the logistics goals? Are there different logistics goals for different products or flows?
   0.17. How important is logistics for the company?
   0.18. What are the customers’ demands regarding logistics?
   0.19. Is there any documentation on the logistics strategy?

1. PRODUCTION
   1.1. Do you have production? If so, what kind of products are you producing?
   1.2. How many different types of products do you produce?
   1.3. What are the total product numbers approximately?

2. HUMAN RESOURCES
   2.1. How many employees does the company have?
   2.2. How many of these employees work in warehousing/procurement?
   2.3. Describe the organizational structure.

3. CUSTOMER RELATIONS
   3.1. How is the customer relations managed?
   3.2. How many customers does the company have?
   3.3. Where are the customers located? What is the lead time to customer?
   3.4. How is the customer contracts formed?

4. DEMAND PLANING
   4.1. How does the company handle demand planning?
4.2. Do you use a technique to determine seasonal variations, and the intensity of seasonal swings? If so, what kind of technique?
4.3. Do you use a technique to determine average order-size? If so, what kind of technique?
4.4. How accurate is the company’s demand planning?
4.5. Has the company ever had problems due to demand planning? If so, please elaborate.
4.6. Is there any documentation about demand planning?

5. WAREHOUSING
5.1. How is the warehouse managed? Please explain the procedure.
5.2. How many warehouses does the company use? (Explain for raw material, end product, etc.
5.3. How did the company decide the location of the warehouse/s?
5.4. Is/are the warehouse/s owned, rented, leased or contracted? Why?
5.5. How did the company decide on the layout of the warehouse?
5.6. Are the stocking positions in the warehouse coded for specific products?
5.7. What is taken into consideration in the placement of a product in the warehouse?
5.8. How does your information system work?
5.9. Is the company using a locator address system? (Rack codes, etc.)
5.10. Is the company using a specific item coding system?
5.11. How accurate is the warehouse system? (Is it easy to find products)
5.12. What kind of emergency plans does the warehouse have? (Safety-stock etc.)
5.13. Have there been any problems with the warehouse system? Please explain
5.14. What kind of storage materials are being used in the warehouse? (Types of racks, etc.)

6. GOODS RECEPTION
6.1. How are the goods checked in?
6.2. How is the scheduling for reception of goods?
6.3. How are the deviations in the shipments managed?
6.4. Have there been any problems in the reception process? Please explain

7. HANDLING OF MATERIAL
7.1. How is the handling of material managed?
7.2. What kind of equipment is used for handling material?
7.3. What is the approximate time for handling materials after they have been received? Are there any studies about this in the company?
7.4. Have there been any problems in the handling material? Please explain

8. ORDER PICKING
8.1. How is the order picking managed?
8.2. How is the order picking managed?
8.3. In which order are goods being picked?
8.4. What is the approximate order picking time? Are there any studies about this in the company?
8.5. Have there been any problems in the order picking? Please explain

9. PURCHASING
9.1. How is purchasing managed?
9.2. How is the ordering process managed?
9.3. How is the ordering decision given?
9.4. Do the suppliers confirm orders?
9.5. How are the suppliers found, and how are the relations handled?
9.6. What is the company’s strategy on supplier selection?
9.7. Have there been any problems in the orders? Please explain

10. INFORMATION SYSTEM

10.1. Does the company use a database or any kind of ERP system? If so, what kind?
10.2. What kind of data is being saved?
10.3. Is it easy to find specific data in the system?
10.4. How is the data input handled in the system?
10.5. Is there a back-up system?
10.6. Have there been any problems with the information system? Please explain
Appendix 2 – Färggrossens’s Answers

Svar från: Mikael Lindgren
Granskat av: Cara Edgar och Dilek Tanyildz
Företagets namn: Färggrossen AB
VD (CEO): Mikael Lindgren
Grundat år: 1976
Produkt typer: Paints, wallpapers, chemicals and painting tools

0. COMPANY CHARACTERISTICS AND GOALS

0.1. What is the history of the company?
- Founded in 1976 by Åke Svanbäck
- Moved to Nybro 2000
- 1st September 2008 Mikael Lindgren bought the company

0.2. What type of company is it, what does the company offer?
Färggrossen is a wholesales company with its focus on wallpaper, paints and paint accessories. The company serves in the market for the south of Sweden, has the experience and willing to expand.

0.3. Which markets does the company focus on?
The wallpaper and paint market

0.4. Who are the company’s main competitors?
Colorama is the biggest competitor.

0.5. What risks does the company face?
The main risks are that the company’s system as a whole is faulty.

0.6. What has the revenue been during the last years?
2004/2005 26,7 million SEK
2005/2006 20,9 million SEK
2006/2007 20,9 million SEK
2007/2008 22 million SEK

0.7. What has the profit been during the last years?
2004/2005 6,75 million SEK
2005/2006 8,28 million SEK
2006/2007 8,23 million SEK
2007/2008 7,69 million SEK

0.8. What has the turnover rate been during the last years?
Missing information regarding this
0.9. How many employees does the company have? How many of these employees work in warehousing/procurement?

6 employees including Mikael himself, 3 of them works in the warehouse

0.10. Does the company use scheduling for its workforce? Please explain

They don’t use scheduling.

0.11. How many orders are handled annually? Inbound/outbound?

700-800

0.12. How many deliveries are handled annually? Inbound/outbound?

700-800

0.13. What is the company’s vision for the future?

The company wants to enlarge the customer number and market share.

0.14. What is the business strategy?

The company is aware of the problems they have in the warehouse, our thesis work is considered to lead to some improvements in the warehouse. The company is aiming to achieve having an efficient warehouse and expand in the market.

0.15. How does the company define logistics, and what is its logistic strategy? What does the company want to achieve with its logistics?

Logistics in Färggrossen is considered as the delivery to customer which is why the company owns two trucks to make their own deliveries.

0.16. What are the logistics goals? Are there different logistics goals for different products or flows?

Right now the company has some delivery routines, as a next step they are considering about improving the delivery lines.

0.17. How important is logistics for the company?

Logistics is very important for the company since customer satisfaction has a priority for Färggrossen.

0.18. What are the customers’ demands regarding logistics?

According to Färggrossen, customers they have are very happy about the short delivery times. What more important is the information that is supplied to customers by the driver/salesman personnel.

0.19. Is there any documentation on the logistics strategy?

Not that we know off

1. PRODUCTION

1.1. Do you have production? If so, what kind of products are you producing?

The company does not have any production

1.2. How many different types of products do you produce?

The company does not have any production

1.3. What are the total product numbers approximately?

The company does not have any production

2. HUMAN RESOURCES

2.1. How many employees does the company have?

6 employees
2.2. How many of these employees work in warehousing/procurement?

3 of the workers are working in the warehouse.

2.3. Describe the organizational structure.

Finance and warehouse managers report to CEO. There are 3 employees in the warehouse including the warehouse manager, warehouse labourer and driver/salesman. In the finance department, there is a manager and a worker who handles the daily financial documentation like invoices and orders etc.

3. CUSTOMER RELATIONS

3.1. How is the customer relations managed?

Most of the customers have been customers for a long period and personal connections are very active in customer relations.

3.2. How many customers does the company have?

The company has approximately 400 customers whom are located in south Sweden.

3.3. Where are the customers located? What is the lead time to customer?

Customers are located in the south of Sweden. Lead time to customer depends on the delivery line they are in and the quantity of the order received from the customer. Even though main delivery method for Färggrossen is by their trucks, the company prefers using third party logistics when the order has either low quantity or it is an urgent order.

3.4. How is the customer contracts formed?

The company does not have contracts with the customers.

4. DEMAND PLANING

4.1. How does the company handle demand planning?

There is demand planning done in the company.

4.2. Do you use a technique to determine seasonal variations, and the intensity of seasonal swings? If so, what kind of technique?

As mentioned previously company does not use a scientific method to determine the demand levels. Seasonal variations and intensity of seasonal swings are supported by experimental guesses.

4.3. Do you use a technique to determine average order-size? If so, what kind of technique?

No

4.4. How accurate is the company’s demand planning?

There is no demand planning active in the company.

4.5. Has the company ever had problems due to demand planning? If so, please elaborate.

No

4.6. Is there any documentation about demand planning?

No

5. WAREHOUSING

5.1. How is the warehouse managed? Please explain the procedure.

Warehouse is managed with the lead of Patrik. In the first sight when entered to the warehouse, unorganized structure can be seen clearly.

5.2. How many warehouses does the company use? (Explain for raw material, end product, etc. raw material, end product, etc.)
There is only one warehouse that the company owns.

5.3. How did the company decide the location of the warehouse/s?

There has been a moving for the warehouse before and the main reasoning for this was the ease of reach to third party logistics.

5.4. Is/are the warehouse/s owned, rented, leased or contracted? Why?

The warehouse is owned by the company.

5.5. How did the company decide on the layout of the warehouse?

The layout of the warehouse is experience dependant.

5.6. Are the stocking positions in the warehouse coded for specific products?

The stocking for the products are assigned by the warehouse manager, there is a family grouping in the warehouse which was assigned by experience. Wall papers, paints and chemicals are stored in different areas.

5.7. What is taken into consideration in the placement of a product in the warehouse?

Warehouse managers decision, which are depending on his personal experiences.

5.8. How does your information system work?

There is not a significant information system except the order forms and invoices.

5.9. Is the company using a locator address system? (Rack codes, etc.)

Some parts of the warehouse are coded but generally there is not a valid, understandable locater address system.

5.10. Is the company using a specific item coding system?

Item codes are being used as they are received from the customer.

5.11. How accurate is the warehouse system? (Is it easy to find products)

Not really, the company is suffering from a lot of time loss because of this.

5.12. What kind of emergency plans does the warehouse have? (Safety-stock etc.)

none

5.13. Have there been any problems with the warehouse system? Please explain

Not being able to find the products, not being able to keep track of what the product levels are the most important problems in the company. Overrun in the high season becomes a problem as well.

5.14. What kind of storage materials are being used in the warehouse? (Types of racks, etc.)

Normal shelves in different sizes.

6. GOODS RECEPTION

6.1. How are the goods checked in?

When orders arrive they are unloaded and checked from the invoice and order form.

6.2. How is the scheduling for reception of goods?

There is no scheduling for reception

6.3. How are the deviations in the shipments managed?

They are not managed

6.4. Have there been any problems in the reception process? Please explain

Not really
7. HANDLING OF MATERIAL

7.1. How is the handling of material managed?

Materials are received in the dock area, then delivered to their manager assigned positions or sometimes manually but mostly with the help of pallet jacks, forklifts. Even though goods are mostly receive with palettes or boxes, almost all the products are places on the shelves manually without their palettes.

7.2. What kind of equipment is used for handling material?

Forklifts, pallet jacks and simple trolleys

7.3. What is the approximate time for handling materials after they have been received? Are there any studies about this in the company?

There are no scientific studies about material handling. Around 20-30 minutes.

7.4. Have there been any problems in the handling material? Please explain

No problems related to material handling has been noticed by the company

8. ORDER PICKING

8.1. How is the order picking managed?

Once the order is received from the customer, the order list is delivered to warehouse manager, either himself or the warehouse labourer starts picking the items from the shelves, with following no specific route.

8.2. How is the order picking managed?

If the order includes a pallet of some product then forklift or pallet jack is used. If the order has many individual products then a simple trolley used.

8.3. In which order are goods being picked?

Random

8.4. What is the approximate order picking time? Are there any studies about this in the company?

For a page order it takes around 20-30 minutes.

8.5. Have there been any problems in the order picking? Please explain

The main problem that the company is facing is the time loss regarding finding the products.

9. PURCHASING

9.1. How is purchasing managed?

Warehouse manager decides on what items needs to be ordered regarding the products with the help of his personal experiences.

9.2. How is the ordering process managed?

Orders are given by the warehouse manager.

9.3. How is the ordering decision given?

Depending on personal experiences.

9.4. Do the suppliers confirm orders?

No

9.5. How are the suppliers found, and how are the relations handled?
Färggrossen prefers working with a limited number of suppliers, long term relations are important for Färggrossen, but this does not mean that the CEO of the company is not trying to expand the product variety in the company by finding new suppliers.

9.6. What is the company’s strategy on supplier selection?
When choosing a supplier it is important for the company that the supplier has a good reputation but more importantly the products of the supplier needs to be environment friendly and should satisfy a quality level.

9.7. Have there been any problems in the orders? Please explain
Sometimes wrong products are received.

10. INFORMATION SYSTEM

10.1. Does the company use a database or any kind of ERP system? If so, what kind?
The company uses a database program called SAVEA, which at the moment not able to support the needs of the company.

10.2. What kind of data is being saved?
Data that is kept is mostly for accounting purposes.

10.3. Is it easy to find specific data in the system?
If the data is related to accounting yes, if it is about warehousing for example a stocking position for a product, it is not possible.

10.4. How is the data input handled in the system?
Data input is done manually

10.5. Is there a back-up system?
The company has an archive to keep old files and a server for the computer systems.

10.6. Have there been any problems with the information system? Please explain
The company is aware that the database they own is not sufficient enough for the warehouse itself.
Appendix 3 - BSAS’s Answers

Svar från: Tomas Nygren och Sanna Nygren
Granskat av: Cara Edgar och Dilek Tanyildz
Företagets namn: Bengt Sandberg Byggprodukter AB (BSAB)
VD (CEO): Magnus Sandberg
Grundat år: 1985 av Bengt Sandberg
Produkt typer: Byggprodukter och material, ~ 1,500 produkter

0. COMPANY CHARACTERISTICS AND GOALS

0.1. What is the history of the company?
1985: Efter mer än 20 års erfarenhet och kunskap om spik, skruv, infästningar etc grundar Bengt Sandberg sitt företag, Bengt Sandberg Byggprodukter. Tack vare goda kontakter inom leverantörsleden och tack vare sitt kända och respekterade namn växte företaget snabbt på byggmaterialsmarknaden i Sverige.
1990: Bengts son Magnus börjar jobba på företaget.
2000: 24 februari lämnar Bengt över sin VD post till sonen Magnus.
2007: Lagret byggs ut ytterligare.
2009: Lagret byggs ut en tredje gång.

0.2. What type of company is it, what does the company offer?
BSAB bedriver produktutveckling, handel och distribution av produkter och tjänster främst till byggmaterialhandel, hus och byggnadsindustri. Sortimentet omfattar spik, skruv, byggbeslag, markavlopp / dränering, polyeten, papp, shingelprodukter samt serviceprodukter.

0.3. Which markets does the company focus on?
Företagets fokus ligger på byggmaterials marknaden. I och med att företaget levererar olika typer av produkter så finns fokus på olika marknader, men generellt ligger fokus inom byggmaterialsmarknaden.

0.4. Who are the company’s main competitors?
Spik: Gunnebo Industrier AB i Gunnebo, Skruv: Arvid Nilsson i Kungälvs Beslag; Gunnebo Industrier AB i Gunnebo

0.5. What risks does the company face?
Att andra företag med lägre konkurrenspriser etablerar sig på marknaden och att kunderna väljer att gå över till dem istället. Att BSAB:s leverantörer ökar sina produktpriser vilket kan bidra till BSAB måste öka sina priser gentemot sina kunder vilket kunderna antagligen inte kommer uppskatta.

0.6. What has the revenue been during the last years?

0.7. What has the profit been during the last years?
2006: 5,32%, 2007: 6,15%
0.8. What has the turnover rate been during the last years?
Ca. 3 mån

0.9. How many employees does the company have? How many of these employees work in warehousing/procurement?
5 anställda: se fråga 6

0.10. Does the company use scheduling for its workforce? Please explain
nej

0.11. How many orders are handled annually? Inbound/outbound?
ca. 3900 order

0.12. How many deliveries are handled annually? Inbound/outbound?
Se punkt 12

0.13. What is the company's vision for the future?
Företaget har redan växt en hel del de senaste åren. Lagret har byggts ut i tre omgångar och ytan har ökat från 520 kvm till 1700 kvm, dels så hanteras 10 miljoner artiklar jämfört med 2 miljoner som det var från start. BSAB mål är att vara sina leverantörs och sina kunders bästa samarbetspartners, att få behålla sina befintliga kunder och att samtidigt öka kundantalet. Vill växa sig större på marknaden och kunna konkurrera bättre.

0.14. What is the business strategy?
BSABs affärsplan är att vara sina leverantörs och sina kunders bästa samarbetspartner genom personligt bemötande, snabba exakta beslut, leveranser i rätt tid, ett attraktivt sortiment av produkter och tjänster i rätt kvalitet till konkurrenskraftiga priser och villkor.

0.15. How does the company define logistics, and what is its logistic strategy? What does the company want to achieve with its logistics?
Snabba och exakta leveranser till kund.

0.16. What are the logistics goals? Are there different logistics goals for different products or flows?
BSAB har som mål att kunna leverera varor till sina kunder i rätt tid, rätt mängd och utan skador.

0.17. How important is logistics for the company?
Väldigt viktig och speciellt vid leverans till de större kunderna då försenade leveranser kan innebära straffpåföljder för BSAB, i värsta fall förlorade kunder.

0.18. What are the customers' demands regarding logistics?
Kundernas krav varierar, tex. Byggnax kräver leverans en vecka efter lagd order medan de mindre företagen vill helst ha leverans dagen efter lagd order.

0.19. Is there any documentation on the logistics strategy?
nej

1. PRODUCTION

1.1. Do you have production? If so, what kind of products are you producing?
nej

1.2. How many different types of products do you produce?
1.3. What are the total product numbers approximately?

2. HUMAN RESOURCES

2.1. How many employees does the company have?

6

2.2. How many of these employees work in warehousing/procurement?

1-2

2.3. Describe the organizational structure.


3. CUSTOMER RELATIONS

3.1. How is the customer relations managed?

BSABs marknadschef Claes är den som sköter sökandet av kunder. Kunder som anses kunna vara bra för BSABs verksamhet besöks personligen av Claes. Företaget använder sig av systemet Creditsafe som erbjuder företaget kreditupplysningar om sina kunder. Systemet uppdateras dagligen och ger information om bland annat de 3 senaste årens bokslut, eventuella betalningsanmärkningar, skuldsaldo, aktuell ratingbedömning, trendindikationer, nyckeltal, revisorskommentarer mm. Detta hjälper företaget att hålla koll på sina kunder. Systemet informerar om kunder som har det dåligt ekonomiskt ställt, dessa kunder ber BSAB att betala för sina produkter innan leverans. På detta sätt försäkrar sig BSAB om att de får betalt för sina varor. BSAB anser också att de har väldigt ärliga kunder.

3.2. How many customers does the company have?

Företaget har ungefär 144 aktiva kunder.

3.3. Where are the customers located? What is the lead time to customer?


3.4. How is the customer contracts formed?

Genom förhandlingar med kund.

4. DEMAND PLANING

4.1. How does the company handle demand planning?


4.2. Do you use a technique to determine seasonal variations, and the intensity of seasonal swings? If so, what kind of technique?

Nej!

4.3. Do you use a technique to determine average order-size? If so, what kind of technique?

Nej!
4.4. How accurate is the company’s demand planning?

Ganska noggrann.

4.5. Has the company ever had problems due to demand planning? If so, please elaborate.

Nej

4.6. Is there any documentation about demand planning?

Nej

5. WAREHOUSING

5.1. How is the warehouse managed? Please explain the procedure.

Finns fyra olika ”lager byggnader”. Alla produkter som företaget lagerför finns i dessa lager. Längst ner på lagergolvet i första ”lagret” finns plockplatser för de mindre artiklarna så som skruv, spik mm. Här finns även ett plockbord för plock av spik, skruv mm som beställts in i bulk och så måste plockas om i boxar med rätt antal.

5.2. How many warehouses does the company use? (Explain for raw material, end product, etc.)


5.3. How did the company decide the location of the warehouse/s?

Begränsningar av tomt storlek.

5.4. Is the warehouse/s owned, rented, leased or contracted? Why?

Ägs

5.5. How did the company decide on the layout of the warehouse?

Planering mellan Byggherren-Bygghirman-BSAB

5.6. Are the stocking positions in the warehouse coded for specific products?

Nej, inget streckkodssystem eller liknande används men hyllplatserna är markerade med nummer och bokstäver för att lättare kunna hitta varorna.

5.7. What is taken into consideration in the placement of a product in the warehouse?

Plockflöde kontra placering av produkter.

5.8. How does your information system work?

Bra

5.9. Is the company using a locator address system? (Rack codes, etc.)

Se fråga 5.6

5.10. Is the company using a specific item coding system?

Ja

5.11. How accurate is the warehouse system? (Is it easy to find products)

Ja det är lätt att hitta produktom i lagret, även för utomstående.

5.12. What kind of emergency plans does the warehouse have? (Safety-stock etc.)

I och med att företaget inte lagerhåller produkter som är brandfarliga så har man det nödvändigaste i säkerhetsväg. Dvs, skor med stålhett, brandsläckare, skyttade nödutgångar och ögonskölj vid batteriförring till truckarna.
5.13. Have there been any problems with the warehouse system? Please explain

Nej

5.14. What kind of storage materials are being used in the warehouse? (Types of racks, etc.)

I och med att BSAB får in väldigt mycket varor på pall använder sig mycket av pallställslagring. För de stora och otymliga varorna som rör ställs direkt på golvet och staplas i den nyaste delen av lagret.

6. GOODS RECEIPTION

6.1. How are the goods checked in?

Följesedel kontrolleras mot ankommet gods,

Godset läggs in i affärssystemet när fakturan kommit och stämmer mot följesedel.

6.2. How is the scheduling for receipt of goods?

Bra

6.3. How are the deviations in the shipments managed?

Leverantören kontaktas.

6.4. Have there been any problems in the reception process? Please explain

Nej

7. HANDLING OF MATERIAL

7.1. How is the handling of material managed?

?

7.2. What kind of equipment is used for handling material?

Företaget använder sig av en handtruck och två eldrivna truckar.

7.3. What is the approximate time for handling materials after they have been received? Are there any studies about this in the company?

Omgående hantering. Inga studier

7.4. Have there been any problems in the handling material? Please explain

Nej

8. ORDER PICKING

8.1. How is the order picking managed?


8.2. How is the order picking managed?

För småplock används ingen utrustning utan ordern kan plockas för hand. För de större och tyngre produkterna används hand- och eltruck för att kunna lyfta.

8.3. In which order are goods being picked?

Produkterna är grupperade baserat på typ av produkt, dvs trådspik, dyckertspik mm. Produkterna plockas i princip i den ordning det står på ordersedeln, dock börjar man plocka de tyngsta produkterna först då de kommer ligga i botten på den beställda ordern.
8.4. What is the approximate order picking time? Are there any studies about this in the company?

Genomsnittliga tiden varierar. En stor order till Byggmax kan ta 30-45 min att plocka ihop medan en mindre order kan ta 10-20 min att plocka ihop.

8.5. Have there been any problems in the order picking? Please explain

Visst "felplock" kommer vi aldrig ifrån.

9. PURCHASING

9.1. How is purchasing managed?

Beställningsförslag i vårt affärssystem.

9.2. How is the ordering process managed?

Se fråga 9.1

9.3. How is the ordering decision given?

Se fråga 9.1

9.4. Do the suppliers confirm orders?


9.5. How are the suppliers found, and how are the relations handled?

De leverantörer företaget har i dags läget har de haft en längre tid, byggt upp bra relationer med leverantörerna. Letar ständigt nya billigare alternativ för att få ner priser och kunna konkurrera på marknaden.

9.6. What is the company’s strategy on supplier selection?

Ja och även kunderna granskas,. Företaget använder systemet CreditSafe som uppdaterar om minsta lilla förändring i verksamheterna. Ligger en kund/leverantör dåligt till ekonomiskt eller inte skulle vara kreditvärdig längre varnar systemet om detta.

9.7. Have there been any problems in the orders? Please explain

Nej

10. INFORMATION SYSTEM

10.1. Does the company use a database or any kind of ERP system? If so, what kind?

Företaget använder sig av systemet Winbas som erbjuder funktionerna: Administration för handel, budgetering, EDI, fakturering, inköpsystem, koncernredovisning, kundreskontra, lageradministration, logistik, marknads- och säljstöd, OLF Order-Lager-Fakturering, redovisning, tids- och uppdagsrapportering och workflow-ärendehantering.

10.2. What kind of data is being saved?

All data som hanteras i systemet sparas.

10.3. Is it easy to find specific data in the system?

Ja

10.4. How is the data input handled in the system?

Konstant

10.5. Is there a back-up system?


Ja det finns ett backup-system som dagligen sparar information och den sparade data som finns sträcker sig tillbaks till 1999.

10.6. Have there been any problems with the information system? Please explain

Nej!
Appendix 4 - ECO’s Answers

Svar från: Jonas Sjöö
Granskat av: Cara Edgar och Dilek Tanyildz
Företagets namn: ECO-Boråstapeter AB
VD (CEO): Peter Koch
Produkt typer: Tapeter

0. COMPANY CHARACTERISTICS AND GOALS

0.1. What is the history of the company?

Eco Wallpaper:

1880: Johan Alfred Hedenström startar Norrköpings Tapetfabrik samtidigt som Carl Fredrik Engblad startar Göteborgs Tapetfabrik.

1906: Engblad köper den nystartade Ljungqvists Tapetfabrik i Norrköping.

1921: Engblad grundar ytterligare ett företag, Engblads Taperfabrik i Göteborg.


1980: Kåbergs tapetfabrik i Handen och de två företagen Galon AB och Tarkett AB, båda inom vinyltapetindustrin, förvärvas.

1986: Produktionen samlas i Anneberg och verksamheten bedrivs under namnet Eco Wallpaper.

2002: Eco Wallpaper förvärvas av Boråstapeter och produktionen förflyttas till Viared, Borås och sortimentet fördubblas.

2005: Eco Wallpaper marknadsför som ett ugnt och trendigt varumärke genom Eco-Boråstapeter AB.

2007: Eco Wallpaper tar ett rejält kliv på nordiska och internationella marknaden.

Boråstapeter:


0.2. What type of company is it, what does the company offer?

Företaget har två varumärken, Eco och Boråstapeter, som erbjuder sina kunder tapeter. De har två byggningskolectioner som många hyresgäster runt om i Sverige utskan ta del av. Det är deras återförsäljare som vänder sig till de lokala fastighetsägare.

0.3. Which markets does the company focus on?

Företagets fokus ligger på

Inhemiska produceer: Duro, Sandbergs, Decor Maisón. Importörer: Midbec, Tapetterminalen, Intrade

0.4. Who are the company’s main competitors?

0.5. What risks does the company face?

0.6. What has the revenue been during the last years?
2005: 305,4 miljoner
2006: 307,7 miljoner
2007: 351,5 miljoner

0.7. What has the profit been during the last years?
2005: 12,16%
2006: 12,23%
2007: 12,62%

0.8. What has the turnover rate been during the last years?
Omsättningshastigheten för råmaterial är ganska högt, företaget försöker omsatta lagret så ofta som möjligt. Leveranser av råmaterial sker 3-5 gånger/vecka.

0.9. How many employees does the company have? How many of these employees work in warehousing/procurement?
Företaget har ungefär 115 anställda.

0.10. Does the company use scheduling for its workforce? Please explain
Företaget är väldigt beroende av planering på grund av lagret de har. Planeringen sker periodiskt.

0.11. How many orders are handled annually? Inbound/outbound?
Det hanteras ungefär 1300-1400 orderrader per dag vilket motsvarar ungefär 280 000 orderrader på ett år

0.12. How many deliveries are handled annually? Inbound/outbound?
Företaget hanterar ungefär 95 000 utleveranser per år

0.13. What is the company’s vision for the future?
Företaget har planer på att expandera i Storbritannien där de har ett dotterbolag. Att kunna integrera de olika stegen, grounding mm som man har gjort i maskin nr 3.

0.14. What is the business strategy?
Inte publik för närvarande.

0.15. How does the company define logistics, and what is its logistic strategy? What does the company want to achieve with its logistics?
Viktigaste delen av logistik är produktionsplaneringen då de är helt och hållet MTS. För stora lager och spill är en stor del av företagets utgifter.

0.16. What are the logistics goals? Are there different logistics goals for different products or flows?
99% leveransservice (99% av inkommande order skall vara möjliga att effektuera omedelbart), 99,5% leveransprecision (99,5% av inkomna order skall levereras på utsatt tid)

0.17. How important is logistics for the company?
Extremt viktigt. Företaget har som regel att leveranser ska ske samma dag som en order har inkommit, om inget annat anges angående leveransdatum.

0.18. What are the customers' demands regarding logistics?
En del viktiga kunder kräver att leveranser ska ske samma dag som en lagd order. Detta bidrar till att företaget håller ett för stort lager så att dessa krav kan uppnås.

0.19. Is there any documentation on the logistics strategy?
Nej inte i nuläget.

1. PRODUCTION

1.1. Do you have production? If so, what kind of products are you producing?
Ja, företaget sysslar med produktion och de har många olika tillverkningslinjer. Företaget producerar tapeter.

1.2. How many different types of products do you produce?
1400 SKU:er

1.3. What are the total product numbers approximately?
2200 SKU:er

2. HUMAN RESOURCES

2.1. How many employees does the company have?
Missing information about this

2.2. How many of these employees work in warehousing/procurement?
Missing information about this

2.3. Describe the organizational structure.
The organizational chart is quite vast. There is an CEO in top, a separate development department and then six subsidiary departments who answer to the CEO. The Logistics, IT and Quality department has four subsidiary departments within it; IT, Warehouse, Project and MPS, who all answer to Jonas Sjöö, Logistics, IT and Quality Manager.

3. CUSTOMER RELATIONS

3.1. How is the customer relations managed?
På alla nivåer. Kunderna är i hög utsträckning anslutna till en frivillig fackhandelskedja. Vi har tätta kontakter med fackhandelskedjorna (centrala avtal, faktureringsrutiner, marknadsföringsstöd). Fackhandlarna besöks i stort 6-7 ggr/år i och med våra fastställda säljcyclar. Vi arbetar också med marknadsråd (ca 10 kunder) som vi bollar lanseringsplaner och marknadsföringsinsatser med.

3.2. How many customers does the company have?
Företaget har ungefär 300 kunder i Sverige.

3.3. Where are the customers located? What is the lead time to customer?
Företaget har kunder i 45 olika länder, de finns mest i Skandinavien, Ryssland och China. Har dotterbolag i Storbritannien där de planerar att expandera i framtiden.

3.4. How is the customer contracts formed?
I (i stort sett) varje säljcykel presenteras ny kollektion. Kunden väljer då nivå av lagerläggning som kvalificerar honom till motsvarande nivå i prislisten. Leveransvillkoren, betalningsvillkoren och priserna är standardiserade och ej förhandlingsbara.

4. DEMAND PLANING

4.1. How does the company handle demand planning?
Företaget planerar sin efterfrågan väldigt noggrant och periodvis. Planeringen baseras på en kollektions livslängd och historisk data. Företaget jobbar inte med prognos jämntom leverantörer. När det gäller de stora produkterna, tex pappret som tapeten trycks på måste det finnas en uppskattning av hur mycket som kommer gå åt, men dessa siffror är väldigt runda.

En matematisk formel används för att bestämma hur efterfrågan uppskattas se ut från idag till utsångsdatumet.

4.2. Do you use a technique to determine seasonal variations, and the intensity of seasonal swings? If so, what kind of technique?
Ja, säsongsvariationerna revideras utifrån historiskt utfall på en aggregerad nivå. Planeringsteknikt multipliceras historisk försäljning med en matris av säsongsfaktorer för att beräkna prognos.

4.3. Do you use a technique to determine average order-size? If so, what kind of technique?
Ja, Wilsons formel används som bas men många praktiska faktorer överrider beräkningen (sevens, ingående komponenter, risk)

4.4. How accurate is the company's demand planning?
Som alltid är prognosteringen tämligen exakt på aggregerad nivå men tämligen inexact på enskild artikel.

4.5. Has the company ever had problems due to demand planning? If so, please elaborate.
Det inträffar att vi misslyckas med 1:a körsningen (denna måste av logistiska skäl ske långt innan införsäljning startar). När jag säger misslyckas menar jag att vi prognosticerar för mycket eller för litet och därmed skapar back-log alternativt överlager.

4.6. Is there any documentation about demand planning?
Nej, den enda dokumentationen som finns är i form av planeringssystemet.

5. WAREHOUSING

5.1. How is the warehouse managed? Please explain the procedure.
Lagret har byggs ut i 7 olika etapper. Ett lager för godsmottagning RVF och ett lager för slutprodukter, FVL.

5.2. How many warehouses does the company use? (Explain for raw material, end product, etc.

Se fråga 5.1

5.3. How did the company decide the location of the warehouse/s?
Lagret är på samma plats som tillverkningen vilket underlättar en hel del.

5.4. Is/are the warehouse/s owned, rented, leased or contracted? Why?
Ägs. Se fråga 4.3

5.5. How did the company decide on the layout of the warehouse?
Företaget försöker använda befintliga ytor så gott som det går. Höga ställage och liknande packning av produkterna bidrar till en "enklare" lagerstruktur.

5.6. Are the stocking positions in the warehouse coded for specific products?
Ja, lagerplatserna är märkta. Företaget använder ett system som ger förslag på vart i lagret man kan förvara en produkt. Programmet använder sig av xyz-koordinater då en söker av hyllplatsen för att hitta en ledig yta.

5.7. What is taken into consideration in the placement of a product in the warehouse?
Produkterna placeras parallellt och gångarna är tillräckligt breda för att gaffeltruckar ska kunna arbeta där.

5.8. How does your information system work?
Systemet håller koll på lager hyllplatserna och hjälper till med orderplock.

5.9. Is the company using a locator address system? (Rack codes, etc.)
Ja, se fråga 5.6

5.10. Is the company using a specific item coding system?
Företaget använder ett eget system för sina artiklar. När produkten befinner sig utanför systemet så tilldelas den vilken typ av produkt det är, vilken serie den tillhör och vilket batchnummer den tillhör. Samma produkt kan ha olika batchnummer, detta på grund av att olikheter kan förekomma mellan de olika batcherna.

5.11. How accurate is the warehouse system? (Is it easy to find products)
Ja, lagersystemet bygger på en datateknisk enhet (lagernummer) vilket är en unik kombination av artikel, antal, placering och batch. Hela lagret “består” av sådana lagernummer.

5.12. What kind of emergency plans does the warehouse have? (Safety-stock etc.)
De produkter som Eco-Boråstapeter lagerhåller är inte direkt brandfarliga. I och med att företaget är extremt miljövänliga så lagerhållerman inga farliga produkter. Därför har de istället för att investerat i ett dyrt sprinklersystem investerat i branddörrar. Brandövningar sker flera gånger per år för att kontrollera att branddörrarna fungerar.

5.13. Have there been any problems with the warehouse system? Please explain
Ja, det råder platsbrist i lagret.

5.14. What kind of storage materials are being used in the warehouse? (Types of racks, etc.)

6. GOODS RECEPTION

6.1. How are the goods checked in?
En av råmaterialtankarna fylls på kontinuerligt av leverantören. Finns elektronisk förbindning mellan leverantören och Eco-Boråstapeter. I övrigt tags produkterna emot i RVL och chauffören stämmer av med ansvarige i RVL.

6.2. How is the scheduling for reception of goods?
Den varierar? – godsmottagning sker kontinuerligt av utbildad personal som kvitterar inköpsorder i systemet av leverantören och Eco-Boråstapeter. I övrigt tags produkterna emot i RVL och chauffören stämmer av med ansvarige i RVL.

6.3. How are the deviations in the shipments managed?
Märkning ”avvikande gods”. Leverantörsansvarig ansvarar för att dra ärendet mot leverantör.

6.4. Have there been any problems in the reception process? Please explain
Nej.

7. HANDLING OF MATERIAL

7.1. How is the handling of material managed?
Materialet hanteras på olika sätt. Man anpassar utrustningen efter produkterna vilket sköts både via manuella och automatiska system.

7.2. What kind of equipment is used for handling material?
Företaget har 2 st klämtruckar, 2 st självgående truckar, gaffeltruckar, lastbärare. De har speciella klämtruckar som är anpassade för att lyfta rullar av råmaterial till tapeter.

7.3. What is the approximate time for handling materials after they have been received? Are there any studies about this in the company?
Finns inga direkta studier om detta.

7.4. Have there been any problems in the handling material? Please explain

8. ORDER PICKING

8.1. How is the order picking managed?
Orderplockningen sköts från en dator som automatiskt uppdateras var 10:de minut. Varje order har sin egen prioritet. Företaget har som mål att plocka ordern samma dag som ordern kommer in, dvs om inget annat anges av kunden.

8.2. How is the order picking managed?
När det gäller orderplock så är datorn och databassystemet det viktigaste. När det finns 16 kundorder i kön så påbörjas plockningen. Man tar då orderplockningsvagnen som rymmer 16 kundordrar och databasen förser plockaren med en viss rut den ska följa i lagret och plocka kundordrarna.

8.3. In which order are goods being picked?
Man går till den lagerplats där produkten ska finnas, plockar produkten och på vägen så lägger man produkten där den ska vara, dvs t.ex. tillsammans med andra varor från samma order.

8.4. What is the approximate order picking time? Are there any studies about this in the company?
Den genomsnittliga tiden för orderplockning är cirka 30 min. Men beroende på hur stor ordern är kan det ta upp till ungefär 60 min.

8.5. Have there been any problems in the order picking? Please explain
Inget direkt, men får man in en sen order, dvs en order precis före 17.00 så sätter det press på plockarna att hinna plocka den ordern innan den sista leveransen för dagen går.

9. PURCHASING

9.1. How is purchasing managed?
Det som kännetecknar företaget är att de inte har några inköpare. Detta sköts istället av leverantörernas produktionschefen som är ärtalsansvarig för inköp mm, även kallad inköpare av Eco-Boråstapeter, och drar den tyngsta lasten på företagen. Alla funktionschefer (prodC, logC, marknadsC, ekonomiC) har leverantörsansvar (inköpare). Planeringsansvaret är delegerat till personal enligt principen "brukaren ansvarar för avrop".

9.2. How is the ordering process managed?
9.3. How is the ordering decision given?

Oftast visuellt (kanban). I förekommande fall mot prognos.

9.4. Do the suppliers confirm orders?

Ja, oftast begär vi orderbekräftelse.

9.5. How are the suppliers found, and how are the relations handled?

Se ovan.

9.6. What is the company’s strategy on supplier selection?

Ofta (hos volymtunga leverantörer) är urvalet begränsat. Flertalet leverantörsrelationer är mer att likna vid partnerskap (mycket långsiktiga, produktutveckling sker tillsammans med leverantören).

10. INFORMATION SYSTEM

10.1. Does the company use a database or any kind of ERP system? If so, what kind?

Företaget använder ett system som är byggt på ms-access men den största delen av planeringen sköts via excel. ECO har ett ERP system (order-lager fakturering). Webshopen är en standardmodul som säljs till ERP-systemet (affärssystemet heter Garp och saluförs av ett företag i Borås som heter Microcraft).

10.2. What kind of data is being saved?

All data lagras och sparas.

10.3. Is it easy to find specific data in the system?

Ja.

10.4. How is the data input handled in the system?

Tex orderingång; 30% av kundorder registreras av kunderna själva genom e-handelsplattformen (resten kundtjänst).

10.5. Is there a back-up system?

Ja det finns ett backup system och backups görs varje dag.

10.6. Have there been any problems with the information system? Please explain

Nej