Case study to locate the future Customer Distribution Centre and create a material management to handle e-commerce
FOREWORD

Great thanks to BILTEMA and IKEA who made this thesis possible. Special thanks to Jönsson CIO of BILTEMA, Hansson CIO of Retlog and Andersson Process Developer of IKEA CDC, for their valuable experience and knowledge. Further the authors want to extend our gratitude to all other respondents that have made the empirical basis of this paper through interviews and observations.

It is a privilege to test theoretical knowledge on a multinational company and try to support the establishment of a new business area with the help of a best in practice business. Without the openness and cooperativeness, this project would not have had the broad empirical basis.

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_________________________________________  _______________________________________
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ABSTRACT

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Title: Case study to locate the future Customer Distribution Centre and create a material management to handle e-commerce

Background: Before BILTEMA’s decision-making in investing in e-commerce, many questions have to be answered such as market demand, expansion and other decisions, appropriate for the company’s existing operations and strategies. The importance of selecting warehouse location has the theoretical goal of profit and to support the overall business strategy of the firm.

Some of the most suitable warehouse locations in Sweden are Halmstad, Linköping, Jönköping and Örebro. Besides warehouse localisation, material management is an important part to consider regarding the establishment of e-commerce and a new Customer Distribution Centre (CDC). The material management can be planned and outlined in different ways depending on the nature of the company.

Purpose: The purpose is to find a suitable location in Sweden to establish a Customer Distribution Centre, for BILTEMA. The second purpose is to create a plan for the material management inside the future Customer Distribution Centre, for BILTEMA.

Method: The thesis is bases on a qualitative and quantitative case study through semi-structured interviews, direct observations and benchmarking. Interviews with BILTEMA’s different management levels were made in the company’s headquarter. The authors also visited different department stores in order to gain an overall view of the company’s major sales channel and knowledge of the product range. Empirical data has been gathered from the chosen regions’ municipalities and government statistics in order to find a suitable warehouse location. A benchmarking at IKEA CDC in Torsvik was executed and the further gathered information regarding BILTEMA’s product range has supported the authors to create a suitable material management for the company’s future CDC.

Conclusion: The authors deemed the expansion and the secured supply strategy equally important for BILTEMA’s future e-commerce orientation. A point system was developed in order to create a basis for decision-making and as such the conducted points indicate Örebro as the most suitable CDC location for BILTEMA, regarding opportunity for expansion, accessibility, as well as being located closest to the centre of gravity of all Nordic countries’ inhabitants. Furthermore our suggestion for BILTEMA’s material management plan consists of receiving, storage, order-picking and packaging. BILTEMA should not invest in an automated system and should mainly perform manual material handling, due to current insufficient demand for e-commerce orders in general.
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1. INTRODUCTION

The introduction chapter begins with a company presentation of BILTEMA and is followed by background description of the thesis’s subject. Furthermore a problem discussion will be presented, which results in three research questions and purposes for the thesis’s purposes. The created figure in the end shows the thesis’s overall disposition.

1.1 COMPANY PRESENTATION

BILTEMA is the leading Nordic company within car accessories, spare parts and tools. The company’s sales channels are the department stores located in Sweden, Norway, Finland and Denmark. The only country with e-commerce is Finland. (Birgma.com, 2014)

The Swedish car mechanic Sten-Åke Lindholm founded BILTEMA about 50 years ago. The car industries had low profit margins on their cars but increased the margins through expensive spare parts. His concerns about the expensive prices the car industries charged the consumers, created the idea of selling cheap car components. BILTEMA was founded in the Swedish city, Linköping and began with mail orders. The company sourced spare parts’ manufactories and made direct purchases. The elimination of intermediaries allowed BILTEMA to offer competitive prices to end customers. Today, the company has several purchase offices in Europe and Asia. (BILTEMA, 2014)

During the 1980’s the company started business in Norway and three years later the company also established in Finland. BILTEMA has currently more than 100 department stores within the Nordic European countries. (BILTEMA.se, 2014)

According to BILTEMA’s CIO (Chief Information Officer), the company planned to open ten to fifteen warehouses per year during the upcoming years. (Jönsson of CIO, 2014-01-14)

The company’s goal is to satisfy families, recreational handymen as well as professionals with a wide product range of 23 000 articles. BILTEMA’s basic
collection is accessories for many car brands and models. The range of products also includes bike and boat accessories, computer and mobile phone fittings, and home and leisure articles. (Birgma.com, 2014) Most products carry the BILTEMA brand and are sourced from East Asia, but the company also have a product development department, which gives suggestions and product design specifications to the manufacturers and suppliers. The company’s catalogue is still an important information way to show the product range and is issued twice a year. The website also presents the whole product range, with information and smart search functions. One smart function is, a search function using car license numbers to identify spare parts for a specific car model. The company’s department stores have ambitions to simplify the store layout for their visitors. The goal is to make customers feel a sense of convenience through the use of charts on the stores’ walls which symbolize and divide the products into different departments. (Jönsson, CIO of BILTEMA, 2014-01-14)

There are about 30 warehouses in Sweden and the company Retlog handles the company’s logistics. The new organisation structure was founded 2011 when the company decided to merge into one company. The warehouse facilities is owned and taken care by XXX (classified), which is not included within the BILTEMA-group. (Jönsson, CIO of BILTEMA, 2014-01-14)

BILTEMA - BILTEMA’s headquarter is based and located at the same warehouse building in the Swedish harbour city, Helsingborg. Departments like customer service centre, technical and product development divisions, information system developers among others are based in this headquarter. (Jönsson of CIO, 2014-01-14)

Retlog - Retlog is the company’s Distribution Centre which handles the inbound logistics. The inbound goods are mainly from East Asia which is delivered by containers by sea. Therefore the DC is located at the west coast of Sweden’s harbour city, Halmstad. The two DC facilities in Halmstad are located at the west coast and by the highway (E6). The facility close to the harbour is appropriate for BILTEMA’s inbound logistics, when receiving containers by sea and allows the company to avoid duty processes and directly transfer goods to Norway. The other facility by the highway is convenience for inbound logistics when goods are arriving by truck from
European countries. Retlog uses sea and road transports in their deliveries to warehouses during the break bulking processes. The material handling mainly consists of truck activities and provides goods to retailers, which is BILTEAMA’s own department stores. (Jönsson of CIO, 2014-01-14)

The only country with e-commerce is Finland. The e-commerce business is located at one of BILTEAMA’s Department Stores in Åbo Finland. The department store has a specific area to handle e-business orders. The picking starts when the company receives orders from customers by the company’s website. The operational worker uses baskets to collect products in the department store, packs and ships the order before leaving the store. (Jönsson of CIO, 2014-01-14)
1.2 BACKGROUND

E-commerce is defined as all purchases, sales, marketing and other digital business transactions performed through a communication network. (Magnusson, 2006)

E-commerce is a relatively young market channel but is steadily growing from having almost no market shares in the early 90’s to having a few at the end of 90’s, and now there are 2653 pure mail-order/e-commerce businesses in Sweden and 1500 recently established (Larsson, VD HUI, 2014-01-24) and total about 8000 businesses with e-commerce (Intelligent logistik, nr: 6-7, 2013). According to Swedish HUI and PostNord’s report (e-barometer, 2013) for the second quarter, the retail within e-commerce businesses has increased with 19% to a total turnover of 31,6 billion SEK. Although the figures are not from the same year they give an indication of how the e-commerce has grown and it’s growing importance for the foreseeable future.

According to Bardonaba-Juste et al. (2012) e-commerce adoption is considered to be a disruptive innovation that completely changes the traditional way of doing businesses. Companies need to continuously be prepared to restructure themselves to meet the changes. E-commerce business requires different material handling and different warehouse facilities, compared to traditional warehouse management. (Intelligent logistik, nr: 6-7, 2013)

Two e-commerce methods

There are different ways to perform e-commerce. According to Deketele et al. (2013) the most two common ways to perform e-commerce business are by single order-pick in specialized warehouses for end customers, also known as CDC. The second method for e-commerce order-picking is by using the department store’s existing capacity to serve online customers. The order-picking is performed directly from the store’s shelves. The problem with the method is the “competition” between end-customers in store and the order-pickers as they might need to pick the same products. Furthermore there are concerns for unexpected stock-outs or missing items for the online shoppers or the in-store shoppers. One benefit with using this method is the reduced, or eliminated, initial investment costs for a new CDC.
BILTEMA has decided to establish e-commerce in one of Norway’s department stores as a test for the company’s customers’ demand for their products on an e-commerce market. Picking and packing activities will be performed in the department store’s current locales with no bigger investment or store extensions. Distribution services to deliver orders to end customers will be outsourced to logistic service providers (LSP). The e-commerce division at the store will handle all the orders from the online shop for Norway. (Jönsson of BILTEMA 2014-02-14) The reason for the test drive is the uncertainty of demand for BILTEMA’s product range in an e-commerce environment.

**Warehouse Location**

The importance of selecting warehouse location has the theoretical benefit of maximizing profit and support the overall business strategy. There are many different factors that need to be considered, one which is the geographical location and the distances to main suppliers, which can lead to an increase or decrease of transport costs. On the other hand the distances to the company’s main customers should also be concerned and shortened, in order to attain quicker response time to customers’ orders. Connected to the previous two factors is the level of infrastructure that is developed and its availability to the company, the infrastructure affects the transport lead-time and in extension the replenishment of supply and the ability to deliver customer orders. (Himola and Lorentz, 2010; Özcan, 2011) BILTEMA owns a warehouse facility in Linköping (Sweden) and have mentioned an interest in establishing a future Customer Distribution Centre (CDC) at the existing warehouse.
facility to handle the company’s future e-commerce. (Jönsson, CIO of BILTEMA 2014-02-14)

The magazine Intelligent Logistik (Nr: 6-7, 2013) has listed several top locations in Sweden to establish companies’ warehouses. Among these locations are Norrköping, Jönköping, and Gothenburg. BILTEMA’s current organisation structure includes a DC in Halmstad, which is by the harbour. Close to Halmstad on the west coast is Sweden’s second largest city, Gothenburg. These circumstances create an incentive for further investigations around the Halmstad region. The fact that BILTEMA already has an existing warehouse in Linköping, located thirty minutes from Norrköping and the advantages of lower investment costs for BILTEMA, motivates further investigation of Linköping as a future location for a CDC. (Jönsson, CIO of BILTEMA 2014-02-14) Another article by Intelligent Logistics (Top 25 logistic locations, 2014) lists Örebro as the second best location after Gothenburg in Sweden to locate warehouses. Örebro also increased their warehousing capacity with 62 000 square meters during 2013 and does not seem to cease with the expansion and growth within the foreseeable future, as there currently is a project for increased logistical cooperation in the Baltic sea region. (intelligent logistic, 2014; regionförbundet Örebro, 2014) A recently released report suggested a national investment into two new main railway lines; these lines are to run from Stockholm to Gothenburg/Malmö with a cross-section in Jönköping. Thus with the massive investments in railway connections with their central point in Jönköping suggests that the accessibility and the potential for great logistical expansion in the region is great. (Trafikverket, 2014)

Except from the accessibility of the warehouse location other factors such as availability of labour forces, opportunity for breaking bulks, operating cross-docking system and opportunity to add value to products as part of the postponement strategy are also important. (Himola and Lorentz, 2010; Özcan et al., 2011) Furthermore the warehouse daily operational activities should also become optimized. These activities consist of receiving, inspection and quality control transferring, order picking and transportation of goods to shipping area (Farahani et al., 2011)

Material Management

The difference between a CDC and the company’s current Distribution Centre (DC) in Halmstad (Sweden) is the material management. A DC only handles deliveries to retailers, which consists of bulks, and try to avoid the breaking of single pallets before
deliveries. A CDC only handles single packages to deliver directly to company’s end customers. The facility will be designed to utilize equipment suitable for single package handling processes. (Jönsson, CIO of BILTEMA 2014-02-14)

To decide the material management for the upcoming warehouse to create efficient operations, different benchmarking methods could be applied. Benchmarking is one of the most common tactics to learn from other companies (Wong and Wong, 2008). IKEA has many common traits with BILTEMA. Among these are wide product range with different product characteristics in terms of sizes and weights. This requires different handling methods. Furthermore the businesses’ core ideas are “do-it-yourself” (DIY) which leads to compressed package design. Therefore IKEA is a suitable benchmark company for BILTEMA. (Jönsson, CIO of BILTEMA, 2014-02-14)

1.3 PROBLEM DISCUSSION

According to Jönsson (CIO of BILTEMA, 2014-01-14) the company has experienced a loss of market and potential sales during later years. The trend to start e-commerce within retail business for car accessories, spare parts and tools has increased and resulted in additional competition to the company’s traditional retail business, since BILTEMA does not have any e-commerce in Sweden, Norway or Denmark. E-commerce businesses such as skruvat.se are considered to be one of the main competitors for BILTEMA. Skruvat.se is one of the leading e-commerce businesses in Scandinavia, and has been especially successful within the field of car components and accessories (Motormagasinet.se, 2013 and nyhetsrummet.se, 2013). The growth rate is continuous (Jönsson of CIO, 2014-01-14) and the number of employees has almost doubled every year since Skruvat.se was founded (allabolag.se, 2014).

Another company that BILTEMA also considers as a strong competitor is the Swedish retail company, Jula AB. Jula AB has similar product range as BILTEMA, but failed their implementation of e-commerce. During fall 2011, Jula AB closed the company’s Customer Delivery Centre (Jönsson of CIO, 2014-01-14) and explains that the company’s product range is not appropriate for e-commerce, which contains of big and bulky products which results in inefficient material handling. The costs exceeded the revenues from the e-commerce. (E-handel.se, 2013) According to Deketele et al. (2013) order-picking from department stores reduce investment capital
but at the same time leads to higher picking costs because of the stores layout are not optimal for order-picking activities.

Where should BILTEMA place their future CDC in Sweden in order to implement the company’s e-commerce?

Johnson et al. (2011) indicate that managers could be narrow-minded to different options. The uncertainty of future scenarios and lack of information create complications for decision-making. How the business environment of the company could be developed in the future requires certain researches and concerns of multiple forecast criterions. Atthage (CEO, 2014-01-14) pointed out that future scenario of the company’s expansion of the e-commerce is hard to predict in order to build a CDC. Özcan et al., (2010) mean that the selection of warehouse location is one of the basic decisions within logistics management. It motivates several criterions to be considered before choosing warehouse locations, since these decisions also support other units or departments within companies to achieve higher efficiencies. According to Nahmias (2009) a combination of qualitative and quantitative research methods should be used in the investigation of where to locate a warehouse. Himola and Lorentz (2010) problematize incorrect choice of warehouse location that could lead to future problems such as difficulties for third part logistics to access the warehouse. This leads to several other consequences concerning additional transportation costs, and more. Awasthi et al., (2010) continue, regarding the additional transportation costs, and mean that it is important to decide what is more important; the distances to the company’s customers or the distances to the suppliers.

Since BILTEMA does not have a Customer Distributions Centre at the moment, the problem of backlogs and shortages may occur in the future if an existing Department store is to handle all the e-commerce orders. It depends on the sales and the customer’s demand for BILTEMA’s e-commerce. (Atthage of CEO, 2014-01-14) The department stores are originally built for traditional retail businesses and do not have the required equipment or storage area to handle e-commerce’s single package handling such as additional area for packaging. (Intelligent Logistics, Nr, 6-7 2013). The decision to establish a future CDC may become the most beneficial for BILTEMA. The question is where to locate it. As Sweden has the company’s headquarters and the Distributions Centre (Retlog) based in Halmstad and the main
customers are based in Sweden, it is logical to consider a future CDC location to be in Sweden. (Atthage of CEO, 2014-01-14) The argument is supported by Nahmias (2009) regarding closeness to other divisions within the organisation to reach economic of scales. A report by Posten.se (2014) also motivates that the most attractive country to have e-commerce business between the Nordic countries, is Sweden. The map below shows that the proportion of businesses between the Nordic countries tips in advantage for the Swedish market. For example, it shows that Finland is purchasing 26% of the Nordic countries total e-commerce from Sweden but Sweden is only purchasing 1% from Finland.

The difficulties to decide the most suitable warehouse locations have been discussed in more than two decades. Different solutions and different cases have been overviewed to find the answer for selection of warehouse location. Choosing the most suitable location for warehousing is a crucial decision for any firm’s logistics strategy. Cost factors are dominated within decision-making models, one is optimizing transportation costs. (Hilmola and Lorentz, 2010) The quantitative method for warehouse localisation calculates the centre of gravity between suppliers and customers. In the calculation; coordinates, geographical sales, information costs, transportation cost are some of the aspects that ought to be concerned. (Nahmias, 2009)

**How should the Material Management at the future CDC operate?**

Despite the enormous growth within the branch, the market is still considered relatively small, and the profitability as relatively low. Only one out of ten of all Swedish e-commerce retailers achieve sales profits. (Intelligent Logistics, Nr, 6-7 2013) Arne Andersson (e-commerce specialist, PostNord) means that the key-factor for profits within this branch is a well-developed e-commerce logistics strategy (Intelligent Logistics, Nr, 6-7 2013). According to Intelligent Logistics (Nr, 2-3 2013) and Deketele et al. (2013) e-commerce requires different inventory management to handle its operational flow within warehouses. The differences associated with single package handling are the extra requirements in picking and packing for single packages. Traditional warehouse material management that usually handles bulk, is not appropriate for e-commerce businesses, seeing as there are additional requirements for CDC’s such as; padding, wrapping
awareness and equipment. Jönsson (CIO of BILTEMA, 2014-01-14) points out that BILTEMA’s DCs in Halmstad only contain inbound bulk from Asia and Europe. Continuing on, the DCs (Retlog) break bulk for further distribution to the department stores and buffer storage on site. The DCs only provide goods to retail businesses (BILTEMA’s department stores) and do not break single pallets, which mean that the facilities are not suitable for single picking and packing to deliver orders directly to end customers. The existing warehouse’s equipment or personnel competence are also inappropriate for implementation of e-commerce. Therefore a completely new strategy for handling goods within warehouse operations should be created for the future CDC.

![Figure 4 E-commerce within Nordic Countries](image)

1.4 RESEARCH QUESTIONS

1. Where should BILTEMA place their future CDC in Sweden in order to implement the company’s e-commerce?
2. How should the Material Management at the future CDC operate?

1.5 PURPOSE

*The purpose of the Customer Distribution Centre is to handle e-commerce customer orders, thus this paper’s purposes are:*

The purpose is to find a suitable location in Sweden to establish a Customer Distribution Centre, for BILTEMA.
The second purpose is to create a plan for the material management inside the future Customer Distribution Centre, for BILTEMA.
## 1.6 ThesisDisposition

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Introduction</td>
<td>Company description, background, problem discussion, research questions and the purpose of the report are presented.</td>
</tr>
<tr>
<td>2. Methodology introduction</td>
<td>The methodologies for the thesis findings and approaches are presented.</td>
</tr>
<tr>
<td>3. Where should BILTEMA place their future CDC in Sweden in order to implement the company’s e-commerce?</td>
<td>Theoretical and empirical findings are compared and analysed to identify a suitable warehouse location.</td>
</tr>
<tr>
<td>• Theoretical frameworks</td>
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<td>• Empirical studies</td>
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<td>• Analyse</td>
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<tr>
<td>4. How should the Material Management at the future CDC operate?</td>
<td>Theoretical and empirical findings are compared and analysed to create the future material management.</td>
</tr>
<tr>
<td>• Theoretical frameworks</td>
<td></td>
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<tr>
<td>• Empirical Studies</td>
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<tr>
<td>• Analyse</td>
<td></td>
</tr>
<tr>
<td>5. Conclusion, critique of own work, socioeconomic aspects, future research</td>
<td>Conclusion of the thesis and answers to the research questions. Reflections and critiques of own work, impacts of society and future research areas are presented.</td>
</tr>
</tbody>
</table>

Table 1 Description of the thesis
2. METHODOLOGY

This chapter presents theories and discussions about the choice of scientific perspective, scientific approach, research strategy, research design and research ethical considerations. The collection of data, choice of respondents and analysis method are also described. The chapter ends with a presentation of the survey’s quality criteria and a summary of method choices.

2.1 SCIENTIFIC VIEW

Positivism advocates that knowledge is objective and that it is the same for one and all and can be confirmed with our senses. All scientists should therefore be able to reach the same results at a different time seeing as the knowledge is not affected by the scientists’ own interpretations. Hypothesis creations that are tested in reality in order to be accepted or challenged are common. In order to strengthen the objectivity the scientist is required to show the scientific method and approach used. (Bryman & Bell, 2011)

Hermeneutic approach advocates that the scientists always put their own interpretation on knowledge and that knowledge is created between individuals, it claims to understand how people and scientists react and interpret different situations. (Bryman & Bell, 2011)

Seeing as figures and what is said in interviews are interpreted by people as well as presented by people. This paper takes no stand whether or not people interpret and influence knowledge. This paper accepts that people might influence and create the knowledge but also that presented figures, information and know-how is described and presented objectively. Thus the paper takes a scientific view of being semi-positivistic and semi-hermeneutic.

2.2 SCIENTIFIC APPROACH

Deduction is usually used with the positivistic scientific view as deduction starts out with a hypothesis created through theory gathering and later a gathering of empirical data is performed in order to strengthen it. Continuing on a conclusion can be made of
the hypothesis whether existing theory needs to be revised and re-tested or accepted. (Bryman & Bell, 2011)

Induction is the opposite of deduction; induction is the creation of theory through conclusion drawn from empirical data. (Bryman & Bell, 2011)

Using a deductive scientific approach the paper first gathered a theoretical foundation from existing theory and tested the theories whilst gathering empirical data in order to see a possible pattern to strengthen the theory.

2.3 RESEARCH STRATEGY

Quantitative researches are usually based on surveys in order to be able to quantify data when collecting and analysing data from a broad selection, where several different analyses do not occur. Common traits are artificially created environments where theories can be tried and replicated in order to reach generalization and causality, all because the focus is to be able to transfer the result from sample/selection to the broad population. (Bryman & Bell, 2011; Eliasson, 2010)

A qualitative research strategy is more adaptable and suitable in studies of a specific empirical environment. Usual approaches are interviews and observations where the focus is words and not quantifying of data. The strategy is, unlike quantitative research, suitable for smaller selections and a more in-depth research. Data can be gathered until it is deemed complete and it is usually the large picture that is important. (Bryman & Bell, 2011)

This thesis will use qualitative and quantitative research strategy to generate information to locate the future CDC. The authors will prioritize the qualitative factors which match BILTEMA’s criterions for decision-making, but will also complement the qualitative research methodologies with quantitative methods (central of gravity). The qualitative research mainly focused on benchmarking IKEA seeing as BILTEMA currently does not have a CDC.

Regarding the second question about the CDC’s material management, research information and inspiration will be founded on interviews and benchmarking studies at IKEA DC Torsvik. The paper seeks to create the best basis for decision-making about e-business implementation and how to implement it for BILTEMA. The
2.4 RESEARCH DESIGN

With an in-depth research on a specific organisation, a case study is preferable. This kind of study can focus on a case or several cases. With multiple case studies, it is several cases, as the name implies. What is important before doing a case study is to decide what the research should be about. A case needs and should be studied in-depth in order to minimize the risks for building and presenting a wrong picture. The case needs a deep investigation in order to point out the problem and the goal of the research. Case studies are characterized as flexible and specifically adaptable to its environment in the case, which creates a close relationship with reality and practice, although it is hard to create a generalization to a major population. (Bryman & Bell, 2011)

The research design follows benchmarking practice seeing as studies are made at different companies and evolved into a kind of best in practice. The research goes much in-depth into IKEA’s distribution organisation but parts of BILTEMA’s distribution organisation were also investigated in order to create the most suitable suggestion. The investigation was conducted in accordance with a benchmarking method.

2.4.1 BENCHMARKING

Process benchmarking: According to Stapenhurst (2009), there are different types of benchmarking projects; process-benchmarking, facility-benchmarking, product/service-benchmarking, activity-, functional-, generic- and project-benchmarking. Process benchmarking focuses on processes such as purchasing, warehousing, maintenance etc. where the whole or a part of the process can be benchmarked, and it allows for studies of processes that can be performed cross-industry. By benchmarking the whole process it becomes clear how activities interact and the likeliness of changes and their effects.

Facility benchmarking: One alternative possibility to benchmarking part of the company or a process is to benchmark the whole facility. The advantages of this are the possibility to compare total cost/hours required to produce one unit and unclear workload and task responsibilities. It involves looking at different activities in the
process and facility. Benchmarking a whole facility can become a huge task and therefore it is often only benchmarked at a higher strategic level. What can also be done is to perform several benchmarking studies at the same time but on different activities or just simply to limit the scope of the study. (Stapenhurst, 2009)

When deciding who to benchmark the standard practice is to benchmark toughest competitors or industry leaders, by benchmarking competitors the business can identify weaknesses and strengths in the business and can thus adapt and improve. Benchmarking is not supposed to be a field trip in order to have a pleasure trip, but rather a planned research in order to improve and get a new source of ideas, information, methods and practices. Benchmarking can be done on all levels from facilities to long-term strategies. Long-term strategies, investigates core competences, product development, delivery and service. There are different methods of approach in benchmarking one of them is;

One-to-one; is when a bench-marker visits a subject. The concept behind it is to find out what organisation that is best at performing the part of the business that is the benchmarking focus. Visit the best in practice organisation in order to ascertain their performance superiority and learn how they do it in order to improve the current practice and implement this improved practice in to the organisation. The one-to-one benchmarking process looks as following;

1. Determine the objectives: Identify best practices that lead to superior performance in selected area, data gathering might not be necessary in order to efficiently perform a benchmarking. When visiting multiple subjects for benchmarking it becomes increasingly important to investigate and research the same areas in order to see a pattern of excellence in their business performance.
2. Identify and rank potential target organisations: Identifying the targets are in some circumstances easy as they might be obvious. Other sources of information to identify targets are magazines, books and personal experiences. Useful criteria for ranking potential targets are; performance level, similarity, commercial considerations and location.
3. Determine information and data requirements: Document what is to be learned and what information that is needed. Requires insight into the benchmarking business weakness, processes and overall organisation.

4. Contact target: With established information and research area, the business approaches the organisations that are interesting to benchmark. It is important to be clear of what areas that are of interest to benchmark so that the target business are able to prepare the necessary papers, data and people in order to satisfactorily perform the benchmark.

5. Complete visit: It is of outmost important in this step to follow codes of conduct such as punctuality, politeness, respect of secrecy and integrity as well as be prepared to share data, information and knowledge about one’s own organisation.

6. Analysis and reporting: The benchmarking organisation is to write a complete report regarding shared information, conclusion of the organisation and recommendations for next step in the improvement project. It is important to offer the target of the benchmark the possibility of receiving a copy of the report. (Stapenhurst, 2009)

The thesis benchmarking

By using benchmarking, a plan was created for BILTEMA in order to establish a customer distribution centre through investigating their possibilities using case studies and benchmarking at different businesses and compare these against each other. Benchmarking has been made at IKEA, Retlog and BILTEMA Department stores in order to learn and plan how to do e-commerce business. By comparing with IKEA, which has many different retail stores already, a suitable plan for establishing a CDC at BILTEMA was developed. This plan covers the Nordic region (Sweden, Denmark, Norway and Finland) and will be presented later in this paper.

Choice of benchmarking method

The thesis has benchmarked using both process and facility benchmarking. The authors visited IKEA, Retlog and BILTEMA Department stores in Växjö and Ljungby, in order to understand the process of how BILTEMA can implement an efficient material management as well as why IKEA established the CDC in Jönköping. Furthermore the authors followed the One-to-one benchmarking method
in order to structurally benchmark the subjects. Using the steps of benchmarking, following was benchmarked:

1. **Determined objectives:**
   - Warehouse location
   - Material management

2. **Identify and rank potential target organisations:**
   - IKEA CDC
   - Retlog
   - BILTEMA Department store

3. **Determine information and data requirements:**
   - **Warehouse location**
     - Labour availability: found through the amount of inhabitants and interviews
     - Accessibility: maps, interviews and distances
     - Close to Supplier; maps, interviews and distances
     - Close to customer; maps, interviews and distances
     - Opportunity for expansion; increasing sales and growth markets, internet and interviews
     - Close to other companies and competitors; interviews and municipal information
     - Economies of scale; interviews
     - Facility related costs; interviews and cost information for every area
     - Environmental impacts; interviews
   - **Material Management**
     - Receiving; interview, visit
     - Storage planning; interview, visit
     - Buffer zone; interview, visit
     - Design of picking area; interview, visit
     - Order picking; interview, visit
     - Picking methods; interview, visit
     - Packaging; interview, visit
4. **Contact target:**
   - IKEA CDC
   - BILTEMA
   - Retlog

5. **Complete visit:**
   - **IKEA CDC**
     Following the visit to IKEA CDC. After having completed the visit IKEA CDC was asked if all was information that was acceptable to present and publish. All questions about the visit and BILTEMA's organisation were answered.

   - **Retlog**
     After having completed the visit IKEA CDC was asked if all was information that was acceptable to present and publish. All questions about the visit and BILTEMA's organisation were answered.

   - **BILTEMA Department stores**
     After having completed the visit IKEA CDC was asked if all was information that was acceptable to present and publish. All questions about the visit and BILTEMA's organisation were answered.

6. **Analysis and reporting:**
   The finished analysis and report was sent to BILTEMA for review.

The underlying categories were found through theoretical gathering before benchmarking.

### 2.5 RESEARCH ETHICAL CONSIDERATIONS

Everyone that are involved in research, interviewees, survey-respondents, more or less every person that has contributed to the empirical data and participated in the study, should always be aware of the purpose with the research and the purpose of their involvement. The researcher is also responsible for providing correct and non-
misleading information. The questions need to be straight, non-confusing, and not put the respondent into difficult situations. If the respondent starts to talk about sensitive contents regarding company secrets, the researchers are responsible to interrupt and direct the interview, all in order for the respondent to not regret the interview. All interviewees should be aware that their participation is optional and that they have to consent to participate. All information from participants should be handled with confidentiality and with respect from the author. Sensitive, personal information is not to be available for unauthorized persons. All data gathered is not to harm the participants of the research in any way or intrude on their personal life. All data information is only to be used in the purpose of the research, it is not to be distorted or altered. If any recording equipment is being used, the respondent has to be aware of it. Another way is to let the business and the respondents to be a part of the on-going research process. (Bryman & Bell, 2011)

All participants in this have been informed about the purpose of the report and why we want them to participate. There will not be any wrong information intentionally given to the respondents and they will not misunderstand the purpose of the paper. Therefore the survey’s data collection is only based on voluntary respondents and sensitive information will not be given out from the respondent. In beforehand the respondent will be informed about the opportunity to become anonymous. The collected data was only used for the report’s purposes and no other intentions. Recording devices was applied during the interviews and observations but were clarified informed to the respondents beforehand. In the end of the thesis BILTEMA will have full access of the report.

2.6 DATA COLLECTION

Primary data is absence information, which needs actions to collect and is usually provided by interviews or observations. The technique to accomplish interviews consists of several methods, such as structural, semi-structural or unstructured interviews. The different approaches to collect data or how to structure interviews depend on the survey’s purpose. Structural interview questions and subjects are already decided before the interview. The order of the decided questions and the opportunity for additional questions are flexible during the interview. The
disadvantage using structural interview is the decreased opportunity for the interviewed person to speak free and express own opinions. (Bryman and Bell, 2011)

There are two different methods about observations, direct and participating. Direct observations mean that the researcher only observes the research objects, processes or people, while participating in observations. The advantage of observations is the chance to create a wide and detailed survey about the studied object. On the other hand observations demand more time for the survey. (Yin, 2007)

Secondary data is information, which is already collected from previous researches, such as investigations from company’s research and development department or official statistics from the government’s survey. Advantage of collecting secondary data is reduced amount of time to do researches. On the other hand data could be difficult to understand because of lack of knowledge regarding to original survey. Difficulties for example understanding all mathematical calculations could appear. (Bryman and Bell, 2011)

According to Yin (2007) there are no specific guidelines to collect data. Application of multiple sources regarding to primary and secondary data increases the quality of the research. Björklund and Paulsson (2012) indicate that the choice of data collection method depends on the purpose of the survey and the different requirements from different situation. Common methods during case studies are interviews and combination of direct observations, which increase the information exchanges.

The choice of data collection methods is different in different researches, depending on the purpose. The report’s three chapters use both primary and secondary data to tackle the broad subject of BILTEMA’s implementation of e-commerce concerning warehouse location and material management. Information from the government statistics surveys has been reviewed. Different data from benchmarking of other companies have been used to gather the empirical data, because this report treats a future problem for BILTEMA and no existing data could be collect from BILTEMA.
Direct observations have been done during the research in the form of company visits. The interviewed person has explained the company’s overall business and showed us the warehouse and how the operational flow works in detail.

The authors have also sent out a survey to be able to create an understanding of what BILTEMA prioritize as the most important qualitative factors. Seeing as these are strategic questions, only managers where asked to complete the survey. The survey asked the subjects to rank the most important factor for the business from 1-3, 1 being the most important.

2.7 SELECTION OF RESPONDENTS

Random selection is a random unbiased and objective selection from a population, where everyone has the same chance of being selected. This random selection creates a greater likelihood of a generalization that can be applied to the population. A non-random selection on the other hand is not as likely to be transferable to the population and everyone in the population does not have the same chance of being selected. Snowball sample and convenience sample are two methods for selecting samples. Snowball sample is a sample that has been derived from previous samples. One sample creates contact to this new sample or previous sample gives the researcher an idea to contact a new person etcetera. Convenience sample is a sample where the selected respondents usually are knowledgeable about the field and or research field and that are accessible for the researcher. (Bryman & Bell, 2011; Eliasson, 2010)

This report has a specific problem and project to solve and research around, due to this, the sample selection method is going to be non-random with a convenience sample. The reason for this choice is that the project needs specific information and knowledge that are not acquirable through other samples but specific samples. The purpose of the research is to gather information from other e-commerce company/companies and plan the material management for BILTEMA.
<table>
<thead>
<tr>
<th>Interviewed persons</th>
<th>Company/Position</th>
<th>Date (2014)</th>
<th>Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atthage, Jonas</td>
<td>CEO of BILTEMA</td>
<td>14 Jan,</td>
<td>Personal</td>
</tr>
<tr>
<td>Brozén, Elin</td>
<td>CEO of East Sweden</td>
<td>25 Mars</td>
<td>Telephone</td>
</tr>
<tr>
<td>Dufva, Hanna</td>
<td>Chief of Sustainability of Örebro Municipal</td>
<td>16 April</td>
<td>Telephone</td>
</tr>
<tr>
<td>Granholm, Johan</td>
<td>Distribution Manager of Retlog</td>
<td>29 April</td>
<td>Mail</td>
</tr>
<tr>
<td>Hansson, Martin</td>
<td>CIO of Retlog (BILTEMA’s DC)</td>
<td>25 Mars, 23 April</td>
<td>Telephone</td>
</tr>
<tr>
<td>Helgesson Richard</td>
<td>Property developer of NCC</td>
<td>23 April</td>
<td>Telephone</td>
</tr>
<tr>
<td>Jansson, Ingemar</td>
<td>Marketing Manager of Business Region Örebro</td>
<td>23 April</td>
<td>Telephone</td>
</tr>
<tr>
<td>Jönsson, Göran</td>
<td>CIO of BILTEMA</td>
<td>14 Jan, 14 Feb, 4 Mars</td>
<td>Personal, Skype</td>
</tr>
<tr>
<td>Larsson, Karin</td>
<td>Environmental strategist, Halmstad municipality</td>
<td>7 April</td>
<td>Telephone</td>
</tr>
<tr>
<td>Larsson, Lena</td>
<td>CEO of HUI</td>
<td>24 Jan</td>
<td>Telephone</td>
</tr>
<tr>
<td>Oldén, Lennart</td>
<td>Environment inspector, Jönköping municipality</td>
<td>7 April</td>
<td>Telephone</td>
</tr>
<tr>
<td>Sylvan, Torgny</td>
<td>Environmental inspector, Linköping Municipality</td>
<td>16 April</td>
<td>Telephone</td>
</tr>
<tr>
<td>XXX</td>
<td>Store-worker BILTEMA</td>
<td>24 April</td>
<td>Personal</td>
</tr>
</tbody>
</table>

Table 2 Interviewed persons

2.8 ANALYTICAL METHOD

When analysing case studies with qualitative research, one common approach is to analyse data in many steps. One analysis leads to new studies being made, which in turn leads to more analysis. The purpose of case studies is to investigate process and compile gathered data into conclusions. Seeing as case studies often are hard to generalize, there are no specific rules for the analysis of interviews and observations. (Bryman & Bell, 2011; Yin, 2007)
According to Yin (2007) there is need for taking into account all different aspects of the study, empirical and theoretical. The paper needs to analyse the empirical data with theory and different empiric data against each other, as well as theory against theory in order to maintain a high quality of the analysis.

**Analysis method of warehouse location**

The first research question is divided in two parts; qualitative and quantitative. The qualitative part starts with a suitable theoretical framework regarding warehouse location, which contains of nine criterions. The second part consists of empirical findings from BILTEMA and the benchmarked company, IKEA. To create a complete picture of the impacting factors when decision-making of warehouse location, multiple factors regarding internal and external impacts have been considered. To fulfil external factors other sources such as municipals, Google Maps (2014), government statistics etc. has been contributed. The empirical findings have been presented with the same theoretical framework. The theoretical and empirical findings lead to an analysis. The quantitative part used mathematic formulas from different theoretical frameworks to locate the central of gravity. The empirical findings are made from different municipals, government statistics and RT90 2.5 gon V as coordinate measurement standard. The analysis uses the theoretical and empirical findings to conclude the mathematic formula in order to locate the central of gravity location.
Chapter 3. Warehouse location

Research question 1: Where should Biltema place their future CDC in Sweden in order to implement the company’s e-commerce?

3.1 Theory

3.2 Empirical findings of Biltema, IKEA and secondary data sources

3.3 Analysis

3.3.1 Qualitative analysis - Comparison of theoretical and empirical findings
3.3.2 Quantitative - Comparison of theoretical and empirical findings
3.3.3 Summary of analysis

6.1 Conclusion

Figure 4 Analysis model of Warehouse location

Analysis method of warehouse location
The second research question is thoroughly qualitative. The qualitative part starts with a theoretical framework regarding Material Management and contains four major areas. The empirical basis consists of empirical findings from BILTEMA and a benchmarking of IKEA. To create a complete picture of how the material management is to be developed, different methods for material management have been considered. Most empirical data is derived from IKEA and one visit with clarifying interviews and emails. The empirical findings have been presented with the same theoretical framework. The theoretical and empirical findings lead to an analysis of different considerations for material management. A summary of the different analysis was further developed into a conclusion of how the Material Management
should be developed at the future CDC.

**Chapter 4. Material Management**

*Research question 2: How should the material management at the future CDC operate?*

- 4.1 Theory
- 4.2 Empirical findings of IKEA and Biltema

**4.3 Analysis - Comparison of theoretical and empirical findings**

Differences, difficulties and potential working improvements are determined through observations from interviews and a preferred operation are to be presented.

- 6.2 Conclusion

---

**2.9 QUALITY CRITERION**

The research quality could be measured by its trustworthiness, reliability and the grade of support for the results from the used data. According to Yin (2007) are case studies relied on concept validity, internal and external validity and reliability. Concept validity means that the correct concept is identified and the concept also represents the studied subject, which is most common during case studies. The concept validity increases when more sources are being used during data collection or if the interviewed persons could review the summaries of the meetings or during the survey. The internal validity during case studies means that certain circumstances lead to other circumstances and the relation could not be coincidences. To increase the trustworthiness multiple sources could be used such as theory supports and models illustrating the contexts. External validity is abilities to adapt generalizations to the
specific case study. Case studies usually fail regarding to the external validity and
generalization to fixed populations. (Bryman and Bell, 2011) Reliability means the
surveys’ trustworthiness and differences of results if the case study would have been
performed in another way or time. Occasional incidence should not influence the
survey’s results. To guarantee and increase the reliability during data collection the
researcher have to clarify the proceeding processes to achieve results. (Björklund and
Paulsson, 2003)

To increase the survey’s concept validity the researchers applied different theoretical
and empirical sources to collect data. The theoretical context is collected from several
sources and is mainly based on new theoretical findings to ensure the accuracy of the
studied subject, which is based on e-businesses. The empirical data is likewise
collected from different sources to guarantee the trustworthiness. Interviews from
strategic to operational level are essential to produce an overall view of the company
and ensure consistent results. Detailed data regarding to the operational level within
the department stores are furthermore important and sensitive information from the
strategic level is also significant.

To ensure the empirical data from BILTEMA’s strategic level are reliable and
accurate, continuous dialogs have been completed with Göran Jönsson (BILTEMA
CIO). The empirical data from the operational level have been secured from the
department stores’ logistics managers Hansson, Granlund and anonymous sources.
### Summary of the thesis’s choice of method

<table>
<thead>
<tr>
<th><strong>Scientific View</strong></th>
<th>Positivism and hermeneutic</th>
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<tr>
<td><strong>Scientific approach</strong></td>
<td>Deductive approach</td>
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<td><strong>Research strategy</strong></td>
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<td><strong>Research design</strong></td>
<td>Multiple case studies and Benchmarking</td>
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<tr>
<td><strong>Research ethical considerations</strong></td>
<td>Demand of reliable information, consent, confidentially and use</td>
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<tr>
<td><strong>Data collection</strong></td>
<td>Theoretical review from literature and scientific articles. Empirical gathered from interviews and observations</td>
</tr>
<tr>
<td><strong>Selection of respondents</strong></td>
<td>Non-random convenience sample</td>
</tr>
<tr>
<td><strong>Analytical method</strong></td>
<td>The first RQ consist of qualitative and quantitative warehouse location factors to analysis the future CDC. The RQ’s analysis consists of Material management theory and information from the benchmarked company.</td>
</tr>
<tr>
<td><strong>Quality criterion</strong></td>
<td>Concept validity, internal and external validity and reliability</td>
</tr>
</tbody>
</table>

Table 3 Summery of the thesis's choice of method
3. Where should BILTEMA place their future CDC in Sweden in order to implement the company’s e-commerce?

This chapter includes theoretical framework, empirical findings and analysis of the first research question. The theoretical framework consists of qualitative and quantitative factors for selecting warehouse location. The factors are gathered from several different authors’ opinions. The empirical findings required a wide aspect from different stakeholders. To gather the information, different sources has been used; BILTEMA Retlog, the benchmarked company (IKEA DC Torsvik), different municipals for the chosen region, specialized literature, Google Maps (2014) and statistics from government organisations. The chapter ends with an analysis and a conducted table.

3.1 THEORETICAL FRAMEWORK

There are different important factors to be considered to select the warehouse location. According to Nahmias (2009) factors based on qualitative factors and quantitative calculations needs to be considered to identify the warehouse location. The combination and prioritization of the qualitative and quantitative methods depends on company’s preferences and long run strategies. Hong (2007) adds that every independent firms and branches of companies are different, and should have their own preferences. Himola and Lorentz (2010) have a theoretical goal for warehouse location as quoted: “Every plant should be located at the point of profit maximization”. The authors also mean that the decision of choosing a suitable warehouse location has become an important factor to support the overall business strategy, regarding short and long run strategies. Nahmias (2009) discuss that the warehouse location decision, depends on the purpose of the warehouse and the facilities main task. If the warehouse’s tasks include production, the decision of localisation should consider the distance to the supplier of raw materials. The productivity for the production relies on the supply of raw material and a short distance can increase the production’s efficiency. Should the decision of warehouse location only concern warehouse activities, excluding the production part, the distances to suppliers and customers are the most important factors. They are important because of the opportunity to lower distribution costs and increase the customer distribution service.
3.1.1 QUALITATIVE FACTORS
The qualitative methods use different external factors that affect a company’s decision-making about warehouse localisation. The methods are not to be calculated and quantifiable by nature. The factors also affect companies differently depending on the business strategies that the company has, and their priorities. (Nahmias, 2009)

3.1.1.1 LABOUR AVAILABILITY
The availability of labour forces at the selected location should be prioritized to support hiring competent personnel for the warehouses’ daily operations. The chosen location should have enough supply of labour, to meet the company’s demand for personnel. (Himola and Lorentz, 2010; Awasthi et al., 2010) Himola and Lorentz (2010) and Ashrafzadeh et al. (2012) continue with the factor and stress the fact that the level of competence may vary in different regions and is a crucial factor. MacCarthy & Walailak (2003) highlighted the importance of low labour turnover rate. This factor may also vary in different regions and a detailed governmental statistical investigation, may shed light on the subject of labour turnover rate in different regions. The localisation of a warehouse depends on whether the company prioritizes competent labour, having a great supply of labour, having a low labour turnover rate or all underlying factors.

The potential growth for a population is also a factor that should be considered. It affects the supply of labour in the long run for the companies invested capital at the chosen location. Therefore in a long term perspective for a company, the supply of labour, that is affected by the population and income growth rate, is an important factor, and should be carefully investigated. (Melo et al. 2008) The market supply of labour forces is also connected to the salary rate. Shortage of labour increase the salary rates and the salary rates decrease if the supply of labour increase. Parkin et al., (2011) Hong (2007) explains that small logistics companies have the tendency to become more sensitive to labour cost than larger firms.

3.1.1.2 ACCESSIBILITY
Generally the transport accessibility is the most important factors in the selection of warehouse location. It is critical to have access to the warehouse (Durmuş & Turk, 2012; Hong, 2007). Having the right conditions for entering or leaving the warehouse
is a competitive advantage. The country’s or region’s infrastructure is also included in this criterion. Infrastructure is commonly regarded as; road, rail, sea and/or air connections to the warehouse and opportunities for intermodal transportation. The accessibility of various transportation modes refers to highways, ports, terminals, railways and airports. The well-developed infrastructures affect the distribution efficiencies in terms of reduced time waste, transportation costs and delivery-delays. (Hilmola & Lorentz, 2010; Awasthi et al., 2010, Kuo, 2010; Alberto, 2000) Awasthi et al. (2010) and Church et al. (2004) also highlighted the importance of other services, provided by the government, which require well-developed infrastructure to the warehouse; one example is regarding the safety of the warehouse, which is provided by the police and the fire department. Furthermore an efficient emergency response, provided by the ambulance, requires well-developed road connectivity to the warehouse.

3.1.1.3 CLOSE TO SUPPLIER
Nahmias (2009) points out that low distribution costs are an important factor for choosing warehouse location. It is important that the warehouse is close to the main supplier for reduction of transportation costs. The ordering time could become shorter due to reduction of transportation time as well. Other advantages such as reduced risk of stock-outs could be attained as better solutions for shortage-prevention, due to varying customer demand, can be implemented. (Hilmola & Lorentz, 2010; Awasthi et al., 2010).

3.1.1.4 CLOSE TO CUSTOMER
The distances to customers should not be underestimated. It is important that warehouses are close to distribution hubs and terminals; otherwise it will lead to increased transportation costs for deliveries to the customers. (Hilmola and Lorentz, 2010; Awasthi et al., 2010) Another important factor to place the warehouse close to the customers is the opportunity to provide higher and more consistent deliveries to end customers. (Awasthi et al., 2010) There are customer satisfaction surveys that have underlined the importance of correct handling of order complaints from; notably late, incomplete orders and deliveries containing wrong items. It is important to recognize and prioritize incorrect customer orders. (Colla & Lapoule, 2012) Alberto, (2000) defines an aspect of logistic service, which is flexibility. Flexibility is the ability to make urgent deliveries when orders requires fast operational activities, such
as special request or changes from the customers concerning orders, delivery or routine changes. Gunarsakran et al. (2002) means that e-commerce companies’ logistics flexibility is an increasingly critical factor to success, because competing with lower prices is not enough. The company also has to deliver the order to the customers quickly to be considered as a viable alternative instead of the traditional department stores.

3.1.1.5 OPPORTUNITY FOR EXPANSION
The knowledge and predictions about the growth of the company’s main customers is an important factor. The potential growth of the market and its expected growth rate are crucial factors for companies when deciding the warehouse location, all in order to reach the highest profit from invested capital. It is possible to predict and forecast the growth before deciding the localisation of the warehouse, although it might not be entirely accurate. (Melo et al., 2008)

The selected location should have the opportunity to expand the storage area for future possible extensions of the warehouse facility. In terms of; further rental of storage area, building new sections for the warehouse or the opportunity to purchase more land. (Hilmola & Lorentz, 2010; Lumsden 2012; MacCarthy & Walailak, 2003) Awasthi et al. (2010) points out that the demand variability of customers could vary in the future. The opportunity to increase warehouses’ and infrastructures’ capacities in terms of expanding the facilities or increase connectivity is therefore important aspects for the company’s future business development.

3.1.1.6 CLOSE TO OTHER INDUSTRIES AND COMPETITORS
MacCarthy and Walailak (2003), Melo et al. (2008) and Hong (2007) argues the advantages of placing warehouses close to the company’s competitors and other supporting industries to attain economies of scale in different operational activities. This creates opportunities for collaboration with competitors and other industries in order to develop new ideas and strategies together. The companies could save time and money through the closeness to other businesses. Colla and Lapoule (2012) agrees with this strategy for selecting warehouse location and named it as warehouse density measured simply by number of warehouses per square kilometres. The concentration of warehouses in certain location proves the attractiveness of the location.
3.1.1.7 ECONOMIES OF SCALE
Nahmias (2009) and MacCarthy & Walailak (2003) explain the advantages a company could obtain if establishing the warehouse close to the company’s other departments and divisions. Placing warehouses close to the company’s other functions may result in a better integrated organisation and provide the opportunity to reach economies of scales. Economies of scale mean personnel and competence exchanges between divisions. The company could also lower the transportation costs if the divisions have material exchanges. Hong (2007) also mentions the opportunity for technology supports from the firm’s headquarter in case of business system errors. The headquarters IT-department will be able to help the warehouse, to solve technical problems, much faster.

3.1.1.8 FACILITY RELATED COSTS
Colla & Lapoule (2012) explain that generally land prices increase significantly if warehouse are close to hubs, airports, highways or terminals. The authors concluded that when the distances decrease to highways, airports the land prices will increase. However, the reduction of distance to rail and port will not affect the price on land and rental prices. They do agree that the market prices are dependent on the demand and supply of the regions land.

Alberto (2000) as well as MacCarthy and Walailak (2003) suggest that the construction of the facilities would be a substantial investment. The land acquisition, water supply, waste treatment, stability of electricity and telecommunication and rail supply depends on the geographical area but are all necessities when establishing a warehouse. The costs could vary differently in different regions for both operating cost and start-up costs, but will consist of certain expenses and investments capital.

3.1.1.9 ENVIRONMENTAL IMPACTS
According to Awasthi et al. (2010) and Ashrafzadeh et al. (2012) the impact of environmental factors regarding pollutions are factors that should be considered. Different regulations from the government and environmental fees are also significant costs for the company. Future government regulations and/or other development plans within the region should also be considered during the research process. Alberto (2000) found in his research that pollution regulations, closeness to disposal plants and local taxations is among others the most important factors within the environmental impact factor.
<table>
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<th>Qualitative factors</th>
<th>Sub factors</th>
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<td>Transport opportunity, infrastructure, time waste, higher costs</td>
<td>Durmuş and Turk, (2012); Hong, (2007); Hilmola and Lorentz (2010); Awasthi et al. (2010); Kuo (2010); Alberto, (2000); Church et al. (2004)</td>
</tr>
<tr>
<td>Close to supplier</td>
<td>Transportation cost, shorter ordering time, reduce risk of stock-outs, shorter presentation time</td>
<td>Nahmias, (2009); Hilmola and Lorentz, (2010); Awasthi et al., (2010); Özcan et al., (2011)</td>
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<tr>
<td>Close to customer</td>
<td>Transportations cost, consistency of delivery to customers, opportunity to compensate delivery problems, flexibility, quicker deliveries</td>
<td>Hilmola and Lorentz, (2010); Awasthi et al., (2010); Colla and Lapoule, (2012); Alberto, (2000); Gunarsakran et al., (2002)</td>
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<td>Close to other industries and competitors</td>
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<td>Nahmias (2009); MacCarthy and Walailak, (2003); Hong, (2007)</td>
</tr>
<tr>
<td>Environmental impacts</td>
<td>Pollutions, future considerations, closeness to disposal plants and tax.</td>
<td>Awasthi et al., (2010); Ashrafzadeh et al., (2012); Alberto, (2000)</td>
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**Table 4 Summary of qualitative factors**
3.1.2 QUANTITATIVE FACTOR (CENTRE OF GRAVITY METHOD)

The centre of gravity method is a quantitative method to make calculations for a company’s decision-making of warehouse location. It supports the qualitative factors to choose a suitable location for a warehouse, production unit and/or distribution centre. The method concerns transportation costs, which considers closeness to the company’s suppliers and main customers. The advantage of the method is its simplicity in handling many supplier and customers at the same time; however, the method has difficulties when it comes to accounting for the company’s qualitative factors. The method complements the qualitative factors for warehouse localisation. The result after calculations will most probably, locate the warehouse between the suppliers and customers. The required data for the calculating the centre of gravity model varies but some of them are; quantity of goods, cost of transportation, distances between locations, geographical conditions, time as well as customer service. (Grant et al., 2006; Olhager, 2000) Other required quantitative data are the different positions in a coordinate system (X, Y) for all customers and suppliers. Furthermore the total number of customers at different locations and the total volume of goods from the supplier to the desired warehouse location (Xw, Yw), determines the relative importance of the customers and suppliers. (Nahmias, 2009)

3.1.2.1 CENTRE OF GRAVITY – ONE TERMINAL, SEVERAL CUSTOMERS

The efficiency in a distribution system is dependent on where the breaking of bulk occurs, as well as where the terminals are located. A variable that is outside the company’s control is customer demand and the customers’ location. Qualitative factors are more important when deciding the location of a terminal for distribution in a country. However, in order to find the central point between all the customers, the centre of gravity method is very useful. One method is using the amount of inhabitants in every area, and that area’s coordinates. By focusing on finding the central point between every customer, the most optimal point is found. (Lumsden, 2012)

One centre of gravity method is one terminal – many customers, according to this formula the optimal point can be calculated accordingly;
The method gives the customers different importance depending on the demanded volume and amount of goods/products from the customer. And the optimal location for the terminal has to be calculated one at a time. (Lumsden, 2012)

Although this localisation optimizes the location of where to locate the terminal the need and the customers location changes over time which mean that the localisation of the terminal should not focus solely on quantitative method. Instead more focus should be given to qualitative factors. (Lumsden, 2012)

By further weighting all customers as 1, the customers become equally important. As such, the focus of the calculation becomes customer-coordinates. Next step is to sum up all the coordinates and creating a mean value by dividing the summed up X and Y coordinates by the total amount of customers. (Nahmias, 2009)
3.2 EMPIRICAL FINDINGS

The magazine Intelligent Logistik (Nr: 6-7, 2013) and Top 25 Logistics Locations (2014) has listed several top locations in Sweden to have companies’ warehouses. Among these locations are Norrköping, Jönköping, Örebro, Halmstad and Gothenburg. BILTEMA’s current organisation structure includes a DC in Halmstad, which is by the harbour close to the west coast of Sweden’s second largest city, Gothenburg. BILTEMA also has an existing, unused, warehouse in Linköping, located only thirty minutes from Norrköping. BILTEMA encourages an investigation of Halmstad and Linköping because of the advantages of already established facilities. (Jönsson, CIO of BILTEMA 2014-02-14)

The following region will be investigated: Halmstad, Linköping, Jönköping and Örebro.

3.2.1 QUALITATIVE IMPACTS

3.2.1.1 LABOUR AVAILABILITY

Halmstad:

The total population of Halmstad is about 94 000 people. The population growth rate of Halmstad has barely increased with 1 per year during the last three years (Halmstad Municipal, 2014) and about 5% of Halmstad’s total population works within the transport and logistics sector. (SCB, 2012)

![Figure 6 Population development of Halmstad](image)
According to Hansson (CIO of Retlog, 2014-03-25) Retlog has not perceived any difficulties to find relevant labour workforce within the region. It is believed that the supply of labour, as well as competent labour, should not become a problem for the company during the next years. The labour turn-over rate has not been a problem for Retlog, but on the other hand the salary for warehouse employees might be considered comparatively higher than other regions in Sweden, according to Lönestatistic.se (2014).

**Linköping:**
The total number of population for Linköping’s municipal are about 150 000. (Linköping, municipal, 2014) According to Intelligent Logistik (2013, Nr 6-7) there is good labour availability within Linköping region (Östergötland region). Another article from Intelligent Logistik (2014) also mentioned the region’s leading university education that provides the region with relevant competences. Lönestatistik.se (2014) means that the average salary for warehouse workers is considered low in Östergötland Region in Sweden. According to Linköping.se (2014) About 4% of the total population works within logistics and transport sector in the Linköping.

During the next three years the migration to the region will probably become stabilized because of the difficulty in finding suitable accommodations. The construction sector’s projects have reduced and more extensive projects do not seem to be available. Another factor that affects the migration to the city is caused by decreasing amount of university students and a negative migration to neighbouring regions such as Sweden’s capital city, Stockholm. (Linköping, municipality, 2014)

Forecast of population development within the municipals for 2013-2022, age 25-65
Figure 7 Population development of Linköping
Jönköping

According to Jönköping municipality’s statistics the population growth rate has been 1% per year, in average the past years. The forecast also indicates that this development will continue to grow. The graph below shows the population growth rate, forecasted to the year 2022, but the forecast to year 2016 is more accurate, and it indicates a population growth of 3.3% per year. The population’s migration to and from the region has become a trend during the past years. The reason for the increased rate is mainly caused by the increasing amount of university students in the city. The total population of Jönköping is about 130 000 and almost 7% of the population works within transport and logistics sector. (Jönköping municipality, 2014) Intelligent Logistik (Nr 6-7, 2013) also highlighted the high level of competence the people have for warehouse related jobs within the region. Another advantage a warehouse employer would benefit from in locating a warehouse in Jönköping is the low turnover rate of employees. People within the region have the tendency of staying with a job, which creates an opportunity for businesses to maintain competence within the company. According to (Lönsestatistik.se, 2014) the salary rate in this region is considered high compared to Östergötland (Linköping) region, but low in comparison to Halmstad region. (Efn.se, 2014)

There are about 4500 employees within Torsvik region who work within the logistics sector. This industry is undeniably important to the region. The companies within this region are not only providing job opportunities for the region, but also create further jobs through sub-contractors. Some figures point to one job adding up to a total of three jobs in the end. (Efn.se, 2014)

BILTEMA prioritize a low personnel turn-over rate for the company since the company wants to keep competences within the organisation for further development (Atthage, CEO of BILTEMA, 2014-01-28) The university of Jönköping provides supply chain education in order to create a supply of relevant competences for the region’s logistical development. (Hj.se, 2014)
Örebro
The total population of Örebro were about 139,000 inhabitants at the end of 2012 and the population forecast predicts that the growth will continue and reach 156,000 inhabitants before the year 2022. The graph below only illustrates labour forces between 20-59 years old, which is about 80,000 inhabitants during the year 2022. The municipality does not see Örebro’s growth of labour workforces as high during the next years, when comparing inhabitants under the age of 20 and inhabitants that are older than 64 years. (Figure 10)

The regions logistics jobs are constantly increasing. Posten AB’s recently built terminal in Hallsberg and expanded the regions logistical area with 62,000 square metres and created about 350 new jobs during 2013. The logistical labour market has therefore been strengthened compared to the other regions in Sweden. (Intelligent Logistik, top 25, 2014) The region also provides relevant academic logistics educations at the region’s university and a great supply of labour forces. Jansson (Market Manager of Business Örebroregionen, 2014-04-23) further argues that businesses in the Örebro region have not experienced any difficulties in finding competent labour.

About 5 % (Örebro.se, 2014) of the total working force is working within the transport and logistics sector in Örebro, and the labour cost for warehouse co-workers are also considered low in the region. According to Lönestatistik.se (2014) the wages is ranked among the lowest in Sweden.
3.2.1.2 ACCESSIBILITY
According to Intelligent Logistik (2013) one of the most important factors in establishing a CDC is locating close to logistics hubs, terminals and distribution networks such as Jönköping, Norrköping, Malmö/Helsingborg, Stockholm or Gothenburg.

Halmstad
Halmstad is a city on the west coast, south of Gothenburg and north of Helsingborg (Figure 11).

From E6 the road stretches from Malmö, past Helsingborg, Halmstad, Falkenberg, Varberg, Gothenburg, up to Oslo in Norway. Transports from Sweden to Norway are mainly by train from Halmstad to Oslo. Besides having a port for receiving goods from Asia, roads that are well connected to Denmark and Norway, the roads connect a large portion of the Swedish west coast. (Jönsson, CIO of Retlog, 2014-03-21; Hansson, CIO of Retlog, 2014-03-25; Google Maps, 2014)

Looking at the map Copenhagen to Oslo is a non-stop highway, but to reach Stockholm trucks need to go on route 25 before heading out on the highway E4. From Stockholm, boats to Åbo in Finland are accessible from Norrtälje and the North of Sweden is accessible following highway E4. Halmstad is also situated along the railway running from Oslo to Copenhagen, past many Swedish cities. 8 million out of
26 million Nordic citizens’ are living along the west coast from Copenhagen to Oslo (E6) (Sydsvenskan.se, 2013).

The major cities along the coast are Oslo, Gothenburg, Halmstad, Helsingborg (connection to Helsingoer as well), Malmö and Copenhagen. These cities are easily reached from Halmstad. (Halmstad.com, 2014)

![Google Maps (2014), road connection Halmstad](image)

BILTEMA’s current inbound transports from suppliers in Asia and in Europe are by sea and roads, the goods are received in Halmstad. The reason why the Distributions centre (Retlog) was built in Halmstad was because of lower facility costs and less traffic congestions comparing to Gothenburg. BILTEMA does not use railway transports but for transports to Norway. (Jönsson, CIO of BILTEMA, 2014-03-21)

Most transports go by road to warehouses in Sweden, Denmark and Finland. Halmstad DCs are relatively close to one of the major highways in Sweden, E6 and have a short distance from E4. (Hansson, CIO of Retlog, 2014-03-25)

**Linköping**
Linköping is a city east of Vättern, north east of Jönköping and south-west from Stockholm. The city is located close by Norrköping and is located just east of the middle of Sweden (figure 12).

Linköping is on highway E4 that runs from Copenhagen to Stockholm, north up on the Swedish east coast or ship to Finland. Oslo and Norway can be reached when using highway E18. In order to reach Gothenburg the drivers need to drive on route 40, with lower speed and higher risk of traffic congestions due to construction work. (Hansson, CIO of Retlog, 2014-03-25; Google Maps, 2014) A positive aspect is that this route 40 is partly being turned into highway with continuous improvements (Trafikverket.se, 2014).

A decision to place the Customer Distribution Centre in Linköping has the addition that the DC in Halmstad will break bulk and send road transport to Linköping, which will create an unnecessary transport. (Jönsson, CIO of BILTEMA, 2014-03-04)

Linköping has great connections from Copenhagen to Stockholm by train but trains to Oslo are not connected. However Linköping is located in the middle of a wide network of railways. The recently reconstructed harbour in Norrköping also provides the region with benefits such as modern freight equipment. (Hansson, CIO of Retlog, 2014-03-25)
Jönköping

Jönköping is a city in the middle of Sweden, straight east from Gothenburg and on the south tip of Vättern (Figure 13).

Jönköping is connected to Gothenburg by route 40 that is slow but gradually expanding. In order to transport goods to Oslo from Jönköping, the truck have to take route 47 to Uddevalla after which it has to turn on to highway E6 to Oslo. Jönköping is in the middle of Sweden and is situated on highway E4 that runs from Stockholm to Helsingborg, where it connects with E6 down to Copenhagen. Train connections from Jönköping are not straight connected; instead the train has to change directions and consequence. (Trafikverket.se, 2014)

According to Andersson (Process Developer, IKEA Torsvik, 2014-01-28) the choice to place IKEA CDC in Jönköping was because of its location in the middle of Sweden, its widely built distribution network as well as having access to replenishments within the same area. IKEA DC Jönköping and CDC are neighbours that make the replenishments easier than sending for them from Älmhult DC.
Örebro
Örebro is a city that is in the very centre of Sweden and situated west of Stockholm and east from Oslo. Two highways connect in Örebro, E 18 that goes from Oslo to Stockholm and E 20 that runs from Gothenburg to Stockholm. Örebro is also close to E 4 that is a highway connecting Stockholm with Helsingborg and Malmö after having used route 50. Any transports from Halmstad to Örebro needs to pass route 25 before heading north on E4 and then turning on to route 50 after which the route turns on to E20. (Figure 14) (Jansson, marketing manager, Business region Örebro, 2014-04-23)

Hallsberg is an area very close to Örebro that has among the north of Europe’s best railway connections, the railway is called Bergslags-diagonal and runs from Mjölby to Harnös Harbour. (Jansson, marketing manager, Business region Örebro, 2014-04-23) Trafikverket has also decided to expand the railway connections in Hallsberg with double railways in order to make goods transport easier. Thus transportation to Örebro and beyond will become easier and more accessible. (Trafikverket.se, 2014)
Running parallel to the railway there is a national route called Route 50 which is also being expanded in order to increase accessibility. (Jansson, marketing manager, Business region Örebro, 2014-04-23)

According to Intelligent Logistik Örebro-region (including Hallsberg) is the second best logistical region after Gothenburg with the biggest kombi-terminal and one of Sweden’s biggest air freight hubs. (Intelligent Logistik, 2014)

![Google Maps (2014) - Road connection of Örebro](image)

**3.2.1.3 CLOSE TO SUPPLIER**

**Halmstad**

Placing the CDC close to BILTEMA would create security of supply for the CDC. The CDC would easily solve any supply issues arising from demand-variability seeing as any possible inventory shortages could be eliminated, due to decreased replenishment time. By placing it close to the DC, the distance for transporting goods would be relatively low, compared to placing it anywhere outside Halmstad. Furthermore, the cost for outbound transportation can be considered high as they, on average, have replenishments once a week for every department store. (Hansson, CIO of Retlog, 2014-03-25)
According to Hansson (CIO of Retlog, 2014-03-25), another factor that is influenced by placing the CDC in Halmstad is storage. Products that are to be sent to the CDC can be directly transported to the CDC instead of being stored temporarily at the DC.

Andersson (Process Developer IKEA Torsvik, 2014-01-28) says that IKEA CDC was situated in the same compound/area as IKEA DC Jönköping, because IKEA wanted a secure supply for the CDC if a demand fluctuation occurs. The CDC would be able to receive fast replenishments of goods, thus reducing the risk of inventory shortages.

**Linköping**
Placing the CDC in Linköping is a far distance from Halmstad (supplier) compared to locating a future CDC in Halmstad or Jönköping. The time to transport goods to the CDC from the DC is long. As a result, the security of supply might be reduced with a higher risk of inventory shortage as a consequence. The distribution cost will increase for transports from the DC to the CDC. (Hansson, CIO of Retlog, 2014-03-25)

**Jönköping**
Jönköping is an acknowledged hub for distribution in Sweden with many terminals and logistics service providers. As such there are possibilities to lower some distribution costs due to a greater amount of service providers. Jönköping is also relatively close to Halmstad and replenishments, relative to Linköping, and thus has a reduced risk of inventory shortages as well. The ordering time from BILTEMA DC is lower than Linköping but higher than Halmstad. (Hansson, CIO of Retlog, 2014-03-25)

**Örebro**
Situating the CDC in Örebro is the farthest distance from Halmstad. The time for replenishment is longer and the security of supply might be radically reduced with an increased risk of inventory shortage. As a result BILTEMA would have to increase the inventory levels and safety stock levels in order to avoid potential inventory shortages and sales loss. Another cost would also be the increased transportation cost from Retlog to BILTEMA CDC. (Hansson, CIO of Retlog, 2014-04-23)
3.2.1.4 CLOSE TO CUSTOMER

Halmstad

8 million out of 26 million people are living along the path from Oslo to Copenhagen according to Kinhult (Sydsvenskan.se, 2013). This is about a third of all the inhabitants in the Nordic countries and Halmstad is right in the middle of them. By being in the middle of the inhabitants, Halmstad is able to supply customers with orders and products, relatively fast. The backside is the increased distance from customers in the eastern part of the Nordic countries, such as east Sweden and Finland. The distance will most likely increase delivery time to the customers. In conclusion the transportation costs will both increase and decrease at the same time but it is hard to predict whether it will increase or decrease more on average. (Hansson, CIO of Retlog, 2014-03-25)

Linköping

Linköping is close to the biggest city in Sweden, Stockholm. Stockholm has also got good connections to Finland, a big market for BILTEMA. From Linköping the east part of the Nordic countries customer have good supply coverage, but at the same time create longer distances and delivery time to Norway, Denmark and western Sweden. (Google Maps, 2014) Linköping is also located close to Norrköping, a major distribution hub that got the highest rating in Intelligent Logistik’s listing of places in Sweden to locate a CDC (Intelligent Logistik, 2013). Hansson believes that flexibility might become a crucial factor, and in order to create flexibility BILTEMA needs access to major distribution networks, which Linköping can be considered to have being close to Norrköping.

Jönköping

Being rated top five in Intelligent Logistik’s (Nr 6-7, 2013) list of best warehouse location, Jönköping has great connections to customers. Jönköping is located in central of Sweden and according to Hansson (CIO of Retlog, 2014-03-25) it is also a great place for BILTEMA as it has great connections to Denmark that is a growing market as well as being in the middle of Sweden’s three largest cities. Being farther from Norway than Halmstad and farther from Finland than Linköping is on the downside. As Jönköping is a major distribution hub BILTEMA might have the greatest flexibility to handle e-commerce orders in Jönköping, compared to Linköping
Hansson (CIO of Retlog, 2014-03-25) believes that flexibility might become a crucial factor, and that to create flexibility BILTEMA needs access to major distribution networks, which gave Jönköping region the advantages to placing the CDC.

In an interview with EFN (2014), Rickard Torell (Chief of IKEA DC Torsvik), explains that one of the major reasons for establishing in Jönköping, is the geographical location in the middle of Sweden. From Jönköping IKEA is able to easily supply Stockholm, Gothenburg, Malmoe and Copenhagen. Jönköping also has well-established connections to Finland and the North of Sweden.

IKEA chose to locate their CDC in Jönköping because of the ability to provide the major customers with their orders with essentially the same delivery speed. Some differences might occur depending on how far north the customer lives or if the customer lives on an island, such as Gotland. (Andersson, Process Developer IKEA Torsvik, 2014-01-28)

**Örebro**

Receiving second best location for warehouse location in Sweden from Intelligent Logistik (2014) makes Örebro a great location for placing a warehouse. From Örebro most customers in the Nordic countries are reachable and situating the warehouse in a centre between all customers has the added benefit of reducing customer delivery transport costs, faster deliveries in general and a possible increase in flexibility. (Hansson, CIO of Retlog, 2014-04-23) Furthermore, from Örebro it is also relatively easy to deliver to Oslo, Stockholm and Gothenburg. It takes just above 4 hours to Oslo, 2 hours to Stockholm and 2 hours 45 min to Gothenburg, using road carriers (Google Maps, 2014).

With Örebro having great logistical connections in general to a majority of the big cities in the Nordic countries, it is logical that the flexibility is also a degree higher. As Hansson (CIO of Retlog, 2014-03-25) earlier mentioned, with the relatively high
degree of uncertainty it becomes increasingly more important to locate close to great infrastructure.

3.2.1.5 OPPORTUNITY FOR EXPANSION
According to Jönsson (CIO of BILTEMA, 2014-01-14) BILTEMA believes that they have a potential to increase their market share of the Danish market in the future. The statistics report from Posten.se (2014) indicates that the strongest country purchasing using e-commerce within the Nordic countries is Norway. The average e-commerce purchases per person per year sums up to 8002 SEK from Norway, and the lowest amount is from the Finish (5250 SEK per person per year). The behaviour to purchase online is similar within the Nordic countries, which include Sweden, Denmark, Norway and Finland. About eight out of ten has purchased online during 2012, which is shown by the map below by Posten.se (2014). The research also shows the Norwegian consumer behaviour. The most popular country for Norwegians to purchase online from is Sweden after the British, American and German market. This might be because of the relatively higher prices for products from Norwegian companies and a possible exchange rate profit from purchasing from other countries. Another survey made by Bring.se (2014) indicates that the reasons for Norwegians to purchase online instead of traditional physical visits to department stores are the cheaper prices and better delivery options.

Figure 14 E-commerce Nordic countries
Halmstad

Halmstad is geographically located by the E6 route that is connected to the west part of Sweden. The region is connected to the highway, route E6 that runs from Oslo, Norway through the western part of Sweden, passing cities like Gothenburg, Halmstad, Helsingborg and Malmö and using a bridge connects to Copenhagen and Denmark.

The opportunity to reach several regions and markets can be considered high, now and in the future. In order for BILTEMA to meet a future e-commerce demand from Norway and Denmark, Halmstad can be considered a good location for locating a CDC. (Hansson, CIO of Retlog, 2014-03-25)

According to the article by Intelligent Logistik (Top 25 logistic locations, 2014) Halmstad is one of the top ten regions to operate a logistics business. One of the advantages of establishing in the region is the availability of land close to the harbour for businesses to establish logistics operations. The opportunities for companies to establish or expand their organisations are great. Another advantage is the organisation Hallands Hamnar, which is constantly developing and negotiating for
better conditions and further expansion of the connectivity to the east part of Sweden (Hallandshamnar.se, 2014).

Building a future CDC in connection to the existing DC that is operated by Retlog, is an opportunity for BILTEMA should the e-commerce function be located in Halmstad, although it might be deemed inappropriate to integrate the existing DC with the CDC. The opportunity for expansion for the DC or CDC becomes restricted should the warehouses become integrated. This means that if the future CDC is placed in Halmstad, BILTEMA will most likely either build a separate warehouse or rent an existing warehouse. Hansson (CIO of Retlog, 2014-03-25)

Linköping

Linköping is located between Norrköping and Jönköping. The supply of land within the region can be considered good, which makes the area attractive for companies to invest and establish businesses. The recently built harbour in Norrköping creates opportunities for the region to handle bigger material flow and meet higher future demand. (Top 25 logistic locations, Intelligent Logistik, 2014)

Hansson (CIO of Retlog, 2014-03-25) does not think the Östergötland region will increase during the next coming years in terms of market demand. Every region in Scandinavia has its potential to grow and it is hard to predict which area is more appropriate to invest in.

One of the upcoming biggest investments made by the government at a national level is in the region between Stockholm to Linköping. A double railroad track is going to be constructed between these cities. (Regeringen.se, 2014) The double railroad covers several major cities and regions. The project starts 2017 and is planned to be finished by 2028. The project will be one of the improvements that are undertaken to create better connectivity in the region. (ostlanken.se, 2014)

Jönköping
The land availability can be considered high for the logistics industry in Torsvik. The rent is a bit lower in comparison to other regions in Sweden. (Intelligent Logistik, nr: 6-7, 2013)

The discussion related to the expansion and development of intermodal terminals and the region’s infrastructure is important for decision-making for the logistics investors. This question has been discussed and driven by IKEA as well as several other companies within the Torsvik region, but they have not succeeded in creating any intermodal terminals yet. Rickard Thornell (the chief of IKEA DC Torsvik) highlights the importance of creating better capacity in the intermodal terminal for the future logistics sector for LogPoint and the significance in locating near heavier industries to become efficient. (Svensknäringsliv.se, 2014)

Different projects driven by LogPoint such as well-equipped truck parking places and railways are being processed. During the end of 2013 a meeting with numerous larger companies and municipal representatives has been about questions regarding infrastructures. The infrastructure that has been discussed is a new intermodal terminal in Torsvik and to develop the railway from Linköping – Jönköping – Borås (Götalandsbana). (Logpoint.se, 2014)

According to Jönsson (CIO of BILTEMA, 2014-02-14) Danish market is growing the fastest of the Nordic countries, because of BILTEMAs recent entrance into the market. Hansson (CIO of Retlog, 2014-03-25) also added that the Danish and Finish market is expanding but is still small in comparison to the Swedish or Norwegian market.

Örebro

Posten AB has built a new terminal in Hallsberg to meet an increasing demand for single package handling in the region. The terminal that was built is 62 000 square metres of new logistical areas for the region. (Intelligent Logistik, top 25, 2014) The opportunity for expansion in this region can be considered high since many businesses choose to invest in this region. Among the investors is the Norwegian company XXL that recently established a Nordic DC and Wurth that has built a warehouse. Posten’s
terminal investment also increases the opportunity to meet increasing customer demand in the future. (regionorebro.se, 2014)

Jansson (Market Manager of Business Örebroregionen, 2014-04-23) mentioned the good availability of land within the Örebro region. The construction companies require a certain size to construct new warehouses and invest in projects within the region. The region is also prepared to meet higher material flow since the government has made the project named Berglagsdiagonalen. The E20, E18 and route 50 are going to be expanded through the construction of more lanes along the road in the next five years, in order to reduce traffic congestion and create better transportation flow.

3.2.1.6 CLOSE TO OTHER COMPANIES AND COMPETITORS

Halmstad
There are several larger companies in the Halmstad region, such as Martin & Servera, which is Sweden’s biggest restaurant supplier, Getinge gruppen that develop medicine technology, Albany International which is a supplier for paper industries and Retlog which is BILTEMA’s Distribution Centre. (Halmstad.com) Larger logistics providers within the region are DHL Freight, Bring Cargo International AB and Schenker AB. (Eniro.se, 2014) According to the article from Intelligent Logistik (Top 25 logistics locations, 2014) a new collaboration between the municipalities Halmstad and Varberg created the area with the name Hallands Hamnar (Halland’s Harbours). The purpose of the organisation is to reach economies of scale benefits and drive projects regarding infrastructure issues more efficient (hallandshamnar.se, 2014).

BILTEMA does maintain extensive collaborations with other companies or competitors in terms of joint distribution or sharing warehouse areas. Internal collaborations only exist within Retlog’s warehouse in the Halmstad Region, in terms of personnel exchanges and co-distribution of goods, although two out four of Retlog’s warehouses are located close the harbour, which require some degree of collaboration with the organisation Halland’s Harbours. (Hansson, CIO of Retlog, 2014-03-25)

Linköping
There are numerous companies within the Linköping/Östgöta region. Among other industries, there are; Ericsson AB, Scan AB, Attendo, Veolia Transport, Stadium, Cloetta, IKEA, Arla Food AB. (Linköping.se, 2011) LSPs are also well established within the region such as Bring, Green Cargo, Servistik AB, Schenker AB, Sweco, Jetpak, DHL and Retlog AB. (Eniro.se, 2014)

Collaborations are constantly being improved between different companies within the region through organisations such as Östsam and EastSweden. The two organisations are partners, which coordinate the regions governmental organisations and different companies. (Intelligent Logistik, Top 25 location, 2014) Brozén (CEO of East Sweden, 2014-03-25) means that companies could reach better decision regarding investment within the region. An example is the investment-decision made by Stadium to locate the company’s warehouse in the region.

Companies could benefit from utilizing the local industry in decision-making by using the university to do marketing analysis, which the university has executed before. The university can also provide research in infrastructures and the development of possible ways to more efficiently use infrastructures. Further theses researches can benefit the businesses by better creating a basis for decision-making of future investments. The region also collaborates between businesses to discuss infrastructure investments. One great advantage is the simplicity in calling organisations to meetings in order to discuss important questions.

Jönköping

There are several multinational companies within Jönköping region. Besides IKEA’s Customer Distribution Centre and Distribution Centre, other companies such as Elgiganten, Husqvarna, Arla Foods and KIA are present. Other businesses in the region are LSPs such as Bring, Posten, Schenker, DSV and DHL, most of which are located in the Torsvik area. (Lokaler.se, 2014; Barnarp.se, 2014). According to Svensknäringsliv.se (2013) there exists a close collaboration between IKEA Torsvik and LogPoint. LogPoint is an organisation that was founded by Jönköping and Vaggeryd municipalities. The purpose of the organisation is to promote, execute and further develop the logistic region of Torsvik. For example LogPoint works with
issues regarding road signs to be visible for ease of guidance to the logistics region. Other, more important questions are the expansion of intermodal terminals.

Larger businesses within the area have long collaborated with each other. Meetings, coordinated by LogPoints to gather companies such as IKEA, Electrolux, Elgiganten, Aditro, Alumeco, Nedis and several others, are continuously being planned and executed. The meetings are organised in order to bring up discussion topics regarding infrastructure development and issues, for the region. (Logpoint.se, 2014)

Örebro
Larger companies such as Atlas Copco Rock Drills AB, Procordia Food AB, Wurth Svenska AB, Proffice and Sverige AB are based within the Örebro region. Other businesses are LSPs within the region such as; Posten AB, DHL Express and Bengts Åkeri AB Örebro etc. (Örebro.se, 2014)

According to the article from Intelligent Logistik (Top 25 logistics locations, 2014) collaborations between municipalities within the Örebro region created the organisation called Örebronregion. The organisation comprises of the regions ten municipalities, which are: Askersund, Hallberg, Hälefors, Karlskoga, Laxå, Lekeberg, Lindesberg, Ljusnarsberg Nora and Örebro. The purpose of the organisation is to create and benefit from economies of scale as well as drive projects regarding infrastructure development more efficiently. (Businessregionorebro.se, 2014) One example of where businesses have benefitted from collaborating and achieving economies of scale benefits is from Jansson (Market Manager of Business Örebronregionen, 2014-04-23), he says that several LSPs such as Schenker and Ahlsell, AGS, Bengts Åkeri and Posten are collaborating on many projects regarding joint distributions.

3.2.1.7 ECONOMIES OF SCALE
IKEA has established their CDC in Jönköping in the same area as the established DC in Jönköping. They established a CDC and a DC in the same area in order to support each other’s functions and to secure supply. The DC is able to support, learn, cooperate and solve problems that occur at the CDC and vice versa. Continuing on, another effect is the increased security of supply and the lower transportation costs,
from not having to replenish inventory from the DC in Älmhult. (Andersson, Process Developer IKEA Torsvik, 2014-01-28)

Halmstad
BILTEMA’s DC (Retlog) is located in Halmstad. The Retlog division consist of four warehouses within the same region. Two of them are mainly handling freight goods from East Asia and the other two are handling goods from Europe. To utilize personnel efficiently, Retlog has created a staffing pool to optimizing and meet the warehouses’ workload variations. (Hansson, CIO of Retlog, 2014-03-25)

BILTEMA’s head office is located in Helsingborg, which is relatively close to Halmstad compared to Linköping and Jönköping. By locating close to the HQ in Helsingborg, BILTEMA can create the opportunity to simplify support and problem solving as well as other technical difficulties. (Hansson, CIO of Retlog, 2014-03-25)

Linköping
BILTEMA has a department store in Linköping and used to have the company’s DC in Linköping. The distance from Halmstad and all the supporting functions as well as the DC makes it difficult to establish a CDC in Linköping and has a negative impact on the communication with the HQ and the DC. It takes about three hours to drive to Linköping from Retlog (DC), which might negate an establishment of a CDC in Linköping (Google Maps, 2014). Having the CDC close to a warehouse might ease the establishment, as the warehouse might be able to support the CDC. (Hansson, CIO of Retlog, 2014-03-25)

Jönköping
In relation to Linköping, Jönköping is closer to Halmstad and in extension, easier to; support when having variations in demand, replenish inventory, as well as help solve technical problems. Jönköping also has a department store that might be able to support an establishment of a CDC. The shorter distance to the head office simplifies control and support from the head office (about two hours) (Google Maps, 2014). Jönköping is not as optimal as Halmstad considering closeness to major functions and knowledgeable warehousing personnel. (Hansson, CIO of Retlog, 2014-03-25)
Örebro
The only existing function is the department store in the region. The distances to the companies’ other divisions are about 370 km (Retlog in Halmstad) and 445 kilometres (headquarter in Helsingborg). (Google Maps, 2014)

3.2.1.8 FACILITY RELATED COSTS
Sweden in general has great supply of water, well-established waste treatment, secure electricity supply, and secure communications as well as stable road and rail communications. Seeing as the supply and security of the functions, generally do not differ depending on the location in Sweden, they are not interesting factors that influence facility costs. (Hansson, CIO of Retlog, 2014-03-25)

In a warehouse rent comparison between Halmstad, Linköping, Jönköping and Örebro, Halmstad was found to be the cheapest with about 200 SEK/square meter, Jönköping was second cheapest with about 400 SEK/square meter and Linköping was most expensive with a rent of about 600 SEK/square meter. Although prices may vary, it indicates that the cheapest place to establish a CDC is in Halmstad. (Samples of rental objects, Objektvision.se, 2014)

However Linköping already owns a warehouse facility in Linköping and could eliminate huge investment costs, but still needs refurbishments for a future CDC. (Hansson, CIO of Retlog, 2014-03-25; Jönsson, CIO of BILTEMA, 2014-03-04)

Another aspect to consider is that Helgesson (Property developer, NCC, 2014-04-23) informs us, when asked the question where it is cheapest to rent a warehousing facility, that there are no significant difference in price for an equal warehousing facility in any of the cities.

Halmstad
With the establishment of a new CDC in Halmstad a large initial investment is needed in order to create a new well-functioning operation. A complete new facility with electricity, sewage and water supply has to be built. Halmstad has great connections to roads, railway and airport and the well-established infrastructure. As such it is
cheaper and more convenient to establish a CDC in Halmstad compared to Jönköping in terms of warehouse rental and/or land procurement costs, as well as initial facility and equipment cost. There still are rental and investment costs in building a CDC in Halmstad that are relatively higher compared to Linköping that has an existing unused facility. (Hansson, CIO of Retlog, 2014-03-25)

**Linköping**

Establishing a CDC in Linköping significantly reduces the investment costs for BILTEMA, seeing as they will not have to invest in a completely new warehouse. The costs are most likely going to be in the warehousing equipment, such as picking cases, trucks, forklifts etc. Hansson (CIO of Retlog, 2014-03-25) considers the existing building suitable for establishing a CDC but it is relatively old and in need of refurbishment. There is a relatively small need for plumbers, electricians or even contracting work, which is required to a greater extent when investing and building a new facility for warehousing.

**Jönköping**

Compared to Linköping, where a comparatively small investment is needed, establishing in Jönköping is expensive. As with Halmstad, BILTEMA needs to cover construction costs for a new CDC with water, electricity, sewage as well as equipment such as forklifts. Buying land and building a new CDC is considered less than in Halmstad, although it depends on where to build in Jönköping as well. Seeing as Jönköping is one of the major distribution hubs in Sweden it might be expensive to construct a new CDC in Jönköping. (Jönsson, CIO of BILTEMA, 2014-03-04)

**Örebro**

Compared to Linköping, where a comparatively small investment is needed, establishing in Örebro is expensive. In the case of an establishment of a warehouse in Örebro, BILTEMA needs to cover construction costs for a new CDC with water, electricity, sewage as well as equipment such as forklifts. The cost for buying land and building a new CDC is considered less than in Halmstad. Seeing as Örebro is the second best distribution hub in Sweden it is more expensive to construct a new CDC in Örebro. (Jönsson, CIO of BILTEMA, 2014-04-23; Intelligent Logistik, 2014)
3.2.1.9 ENVIRONMENTAL IMPACTS

Currently there are investigations into a possible implementation of kilometre-tax. This would dramatically affect the cost of transports for road carrier companies, according to Sveriges Åkeriföretag (2014).

The taxation regulation would increase the price per kilometre substantially and it will become a major factor for where to place the CDC. This is depending on where the CDC is located in relation to the customers and the DC. (Sveriges Åkeriföretag, 2014).

**Halmstad**

According to Halmstad municipality’s environmental strategist, Karin Larsson (Halmstad municipality, 2014-04-07), there is no municipal taxation or regulations that significantly affect warehousing. Their work is mostly environmental information-spreading and consulting businesses to improve their sustainability. The regulations that exist are mostly on where businesses are allowed to build, and waste handling. Waste handling is also on a national level so there is a low degree of local regulation. Placing the warehouse in Halmstad creates closeness to supplier but on the other hand the distance to the customers increase, as such the cost of transports from DC decreases but the cost of the delivery to customers increases (Google Maps, 2014).

**Linköping**

There are no municipal laws, regulations or taxations concerning the environment. Linköping works with spreading information and helping different businesses with questions regarding how to be more environmentally friendly and improve their business towards better sustainability. (Sylvan, environment protection inspector, Linköping Municipality, 2014-04-16) Placing the CDC in Linköping creates a greater distance from the DC but places the CDC in the middle of the customers, which, on average, creates a smaller distance to the customers (Google Maps, 2014).

**Jönköping**

According to Jönköping municipality’s environmental inspector, there is no taxation or regulation that significantly affects warehousing. The environmental department of the municipality work mostly with information-spreading and consulting. The
municipality also with measuring particles in the air, which is their most important work. Although they work with measuring particles, the regulations that exist are mostly on where businesses are allowed to build. (Oldén, environment inspector, Jönköping municipality 2014-04-07) Placing the CDC in Jönköping creates a greater distance from the DC, but not as big of a distance as from Linköping. On the other hand the distance to the customers is on average greater than from Linköping (Google Maps, 2014).

Örebro

Besides helping with consultation when building a warehouse and how to water can run easier, waste disposal and where to place the warehouse in the area, Örebro municipality cannot regulate, tax or fine any warehouse for environmental considerations other than what has already been decided on a national level. Inner-city time-limitation for transports inside the city is a municipal regulatory possibility but does not affect the placement of a warehouse. (Dufva, manager for the unit of sustainable growth, Örebro municipality, 2014-04-16) Placing the warehouse in Örebro places Örebro in the middle of Sweden and closer to customers in Stockholm and Gothenburg but further away from Halmstad and the replenishment. Through shorter distances to customers one might assume that the average amount of omission from transportation is reduced (Google Maps, 2014).

According to Jansson (market manager, Business region Örebro, 2014-04-23) there is a European Union environmental project called Greener logistics. This project involves several businesses to work proactively towards a greener supply chain, this project supports the increased usage of sustainable fuel, better insolation, more efficient road carriers etc., in order to become a greener logistics region.
<table>
<thead>
<tr>
<th>Qualitative factors</th>
<th>Halmstad</th>
<th>Linköping</th>
<th>Jönköping</th>
<th>Örebro</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labour availability</td>
<td>(+)Good labour availability, low turn-over rate for Retlog (-)High labour cost, absence of university education</td>
<td>(+)Low labour cost, good labour availability, relevant competences (-) Stabilized population growth, few road construction projects in process</td>
<td>(+)Good competences, available workforce, low turn-over rate, population growth, medium labour cost</td>
<td>(-) Stabilized population growth (+) Strengthened labour market because of investments, academic logistical workforces, low labour costs</td>
</tr>
<tr>
<td>Accessibility (inbound and outbound)</td>
<td>(+)Retlog’s current DC, good connection Cph-Oslo (E6), Covers 8 million west coast citizens, (-)Route 25 and road changes requires to reach Sthlm (E4).</td>
<td>(+)Highway E4 connection Cph-Sthlm and ship to Finland. Oslo by E18. Recently built harbour (-)Gothenburg by route 40 but potential for further construction projects.</td>
<td>Connection to Gbg by route 40. To Oslo route 47 – changes to E6. Cph-Sthlm on highways, IKEA convenience replenishment.</td>
<td>(+) Biggest air freight hub in Sweden, greatest goods railway, projects to expand capacity for railway transports, E18, E20 connecting in Örebro. Thus connecting Norway, Stockholm and Gothenburg. (-) Connections to Denmark.</td>
</tr>
<tr>
<td>Close to supplier</td>
<td>(+)DC is located in Halmstad, low transportation costs, short lead time, highest security of supply</td>
<td>(-)Far distance to supplier, high transportation cost, long lead time, lowered security of supply</td>
<td>(+)Relatively close to supplier, reduced risk of stock-outs.</td>
<td>(-) Farthest from supplier, high transportation costs, high risk of shortage, long lead time.</td>
</tr>
<tr>
<td>Close to customer</td>
<td>(+)Serve a third of the customers (-)Increased distance to the east part (Sw, Fi)</td>
<td>(+)Close to Sthlm and Fi, closeness to hub (-)Increased distance to No, Dk and West Sw.</td>
<td>(+)Close to the largest cities in Sw, middle part of Sw. High flexibility,</td>
<td>(+) Great connections to capital cities of Sweden and Norway. Close to Gothenburg. In the middle of the Nordics inhabitants. Lower distribution costs to customers.</td>
</tr>
<tr>
<td>Opportunity for expansion</td>
<td>(+)Road connection to E6, opportunity for expansion to meet markets. (+) Available of land in the region, modern harbour in the region to meet future demand</td>
<td>(+)Available of land in the region, modern harbour in the region to meet future demand</td>
<td>(+)Several infrastructure projects have been discussed and are in the middle of processing.</td>
<td>(+) Recently built terminal from Posten, good availability of land, several on-going infrastructure projects</td>
</tr>
<tr>
<td>Close to other industries and competitors</td>
<td>(+)Collaboration with other municipals (Hallandshamnar),</td>
<td>(+)Collaboration, Östsam, EastSweden, university</td>
<td>(+)Logpoint gathers companies for meetings to</td>
<td>(+) Good collaboration between municipals and</td>
</tr>
<tr>
<td></td>
<td>collaboration with the other warehouses between Retlog’s facilities</td>
<td>discuss questions regarding infrastructure.</td>
<td>freight companies</td>
<td></td>
</tr>
<tr>
<td>--------------------------------</td>
<td>---------------------------------------------------------------------</td>
<td>-----------------------------------------------</td>
<td>-------------------</td>
<td></td>
</tr>
<tr>
<td>Economic of scale</td>
<td>(+) Retlog has created a staffing pool for personnel exchange, closeness to head office (Helsingborg)</td>
<td>(+) Existing unused warehouse facility, previous DC/warehouse facility, existing department store. (-) Far from supplier (DC Retlog)</td>
<td>(+) Closer to the supplier compare to Linköping, relatively close to the head office</td>
<td></td>
</tr>
<tr>
<td>Facility related costs</td>
<td>Cheaper investment and rental cost than Jönköping but more expensive than Linköping</td>
<td>(-) Expensive rental/investment costs (+) Already existing facility</td>
<td>(-) Expensive rental/investment cost</td>
<td></td>
</tr>
<tr>
<td>Environmental impacts</td>
<td>No significant effect on warehouse location can be found in municipal regulations. Consultation work.</td>
<td>No significant effect on warehouse location can be found in municipal regulations. Consultation work and building regulations.</td>
<td>No significant effect on warehouse location can be found in municipal regulations. Water draining system inspections.</td>
<td></td>
</tr>
</tbody>
</table>

Table 5 Summary of empirical findings
Prioritization of BILTEMA’s qualitative factors

The following prioritization of qualitative factors were concluded. The subjects that performed the ranking were from strategic management level. (1-3, 3 being the most important)

After having compiled surveys from Jönsson (CIO of BILTEMA, 2014-04-29), Hansson (CIO of Retlog, 2014-04-29) and Granholm (Distribution Manager of Retlog, 2014-04-29) the following table was created.

<table>
<thead>
<tr>
<th>Qualitative factors</th>
<th>Key-factors</th>
<th>Rank (1-3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labour availability</td>
<td>Workforce, competence, turn-over rate, potential of growth, labour cost</td>
<td>1, 2, 2 (1.67)</td>
</tr>
<tr>
<td>Accessibility (inbound and outbound)</td>
<td>Transport opportunity, infrastructure, time waste, higher costs</td>
<td>2, 2, 2 (2)</td>
</tr>
<tr>
<td>Close to supplier</td>
<td>Transportation cost, shorter ordering time, reduce risk of stock-outs</td>
<td>3, 3, 3 (3)</td>
</tr>
<tr>
<td>Close to customer</td>
<td>Transportations cost, consistency of delivery to customers, opportunity to compensate delivery problems, flexibility, quicker deliveries</td>
<td>2, 1, 1 (1,33)</td>
</tr>
<tr>
<td>Opportunity for expansion</td>
<td>Expected market growth rate, extension of storage area, land availability, infrastructure in the future</td>
<td>2, 3, 3 (2,67)</td>
</tr>
<tr>
<td>Close to other industries and competitors</td>
<td>Collaboration, research and development with other companies in the same region (Competitors/DHL, Hallandshamnar etc.)</td>
<td>1, 1, 3 (1,67)</td>
</tr>
<tr>
<td>Economic of scale</td>
<td>Close to other divisions to reach economic of scale, personnel and competence exchanges</td>
<td>2, 3, 3 (2,67)</td>
</tr>
<tr>
<td>Facility related costs</td>
<td>Land, facility, electricity, water, waste, telecommunication costs</td>
<td>2, 1, 1 (1,33)</td>
</tr>
<tr>
<td>Environmental impacts</td>
<td>Pollutions, future considerations, closeness to disposal plants and tax.</td>
<td>1, 1, 1 (1)</td>
</tr>
</tbody>
</table>

Table 6 BILTEMA’s rating of the qualitative factors
3.2.2 QUANTITATIVE METHOD

Centre of gravity - One terminal, several customers
BILTEMA has customers from every part of the Nordic countries. Having a broad customer base, BILTEMA assumes that the company’s products are also demanded online. The company assume that the product demand within the e-commerce business will be about the same for all regions, seeing as there has not been established a specific region where customers have a higher demand for BILTEMA’s products. (Jönsson, CIO of BILTEMA 2014-03-04)

Assuming that all inhabitants in the Nordic countries are potential e-commerce customers, the customer base can be found by using every country’s Bureau of Statistics for population. By using random sample of postcodes in Sweden, following variables for the specific postcode were derived. The Swedish population are gathered by postcodes. Contrary to Sweden; Denmark, Finland and Norway’s population are distributed by counties. The following tables illustrate examples of the empirical findings for a random region’s population of Sweden, Denmark, Norway and Finland by postcode or counties. Furthermore the method assumes that the countries customers’ preferences, buying power and economic cycle/situation are the same. Thus cost becomes equal to 1.

<table>
<thead>
<tr>
<th>§</th>
<th>X-coordinate</th>
<th>Y-coordinate</th>
<th>Inhabitants</th>
<th>Costs</th>
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<td>Stockholm</td>
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<table>
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<td>Østsjælland</td>
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<td>6136360</td>
<td>237 468</td>
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<thead>
<tr>
<th>Region</th>
<th>X-coordinate</th>
<th>Y-coordinate</th>
<th>Inhabitants</th>
<th>Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Norway</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oslo</td>
<td>1217354</td>
<td>6654525</td>
<td>634 463</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Region</th>
<th>X-coordinate</th>
<th>Y-coordinate</th>
<th>Inhabitants</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Finland</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Päijänne-</td>
<td>2030001</td>
<td>6841133</td>
<td>202 548</td>
<td>1</td>
</tr>
<tr>
<td>Tavastlands</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 7 Example of empirical findings in each region
3.3 ANALYSIS
According to Nahmias (2009) the combination and prioritization of the qualitative and quantitative methods depends on the company’s preferences and long run strategies. Hong (2007) adds that every independent firm and branch of companies is different and should have their own preferences. Therefore preferences from BILTEMA’s different management levels are significantly important for deciding the future CDC location.

3.3.1 QUALITATIVE
The analysis of the qualitative factors will be based on findings from empirical studies. These findings have been found through the use of the theoretical framework, presented in the beginning of this chapter. The regions that are the papers focus of study are; Halmstad, Linköping, Jönköping and Örebro. Furthermore, the authors have taken into account the different preferences from BILTEMA’s management of the qualitative factors.

3.3.1.1 LABOUR AVAILABILITY
The availability of labour forces should be prioritized to support the warehouse’s daily operational activities. The geographic location should have enough supply of labour forces to satisfy the company’s demand for labour. (Himola and Lorentz, 2010; Awasthi et al., 2010) The four cities’ municipalities have made forecasts for population growth for the working forces, and the results show a steady growth for Jönköping and Halmstad, but stagnated growth for Linköping and Örebro. Linköping has the most citizens of the four cities followed by Örebro, Jönköping and Halmstad. The total labour-force working within the logistics and transport sector varies between 4-7% in these cities. Another factor to consider is the warehouse co-workers’ wages should be considered as it is deemed an important factor. As such, Halmstad is considered as the most expensive region for hiring warehouse co-workers, Jönköping as medium high and Linköping and Örebro as low. (Lönestatisitk.se, 2014). The authors believe that another aspect to consider besides supply of labour-force and the cost of wages, is that the region is able to supply relevant competence.

There have been different investment projects in the studied regions. Posten AB has recently built a terminal in Örebro that provides 62 000 square metres of logistical area which furthermore creates hundreds of jobs. This means that the regions
logistical market will therefore become strengthened, and indicates a possible supply of competent personnel. (Intelligent Logistik, top 25, 2014) Jönköping has a big logistical area (Torsvik) that has attracted more than 4500 employees. Furthermore, for every new employee of the 4500, another three jobs are believed to be created through sub-contractors and suppliers. The logistical sector is therefore significantly important for the region. (Efn.se, 2014) The authors believe these are important factors to attract new logistical competent labour-force to the region, where their competences have an opportunity to develop.

The competences may vary in different regions and it is also one of the most important factors to be considered. (Himola and Lorentz 2010; Ashrafzadeh et al., 2012). According to Hansson (CIO of Retlog, 2014-03-25) Retlog has not perceived any difficulties in finding competent labour-force within the region and does not believe that there will be difficulties in finding relevant labour-force in the studied regions (CIO of BILTEMA and Retlog, 2014-03-25). Intelligent Logistik (top 25 locations, 2014) mentions that both Linköping and Örebro provide its region with relevant labour-force, through higher educational logistics programmes. Jönköping also has competent labour-forces as a competitive advantage, which is provided by the University of Jönköping. The authors believe that higher education provides the opportunity for long-term development for any given region’s logistics industry. For a successful establishment of a CDC, BILTEMA needs to consider possible future improvements, regarding logistical innovations and improvements. Furthermore an establishment in a region with a university, which provides continuous research development, should be regarded as attractive.

MacCarthy and Walailak (2003) highlighted the importance of low labour turn-over rate. This factor may also vary depending on regions within a country and a detailed investigation in terms of government statistic reports may shed light on the factor. Whether the labour turn-over is high or low depends on the company’s prioritization of retaining competent personnel and the supply of labour-force. The magazine intelligent logistics (top. 25 locations, 2014), Atthage (CIO of BILTEMA, 2014-01-28) and Hansson (CIO of Retlog, 2014-03-25) also highlighted the importance of low labour turn-over rate. Jönköping has low labour turn-over rates according to the magazine, Intelligent Logistik (top 25 locations, 2014) and Halmstad also has low
labour turn-over, according to Hansson (CIO of Retlog, 2014-03-25). The authors believe that the labour turn-over rate should be prioritized seeing as high turn-over rates create a loss of competence. The invested resources regarding personnel education will be in vain. The opportunity for further business development from knowledgeable and experienced personnel will therefore also be reduced or limited.

**Reflections/analysis**

The supply of labour-force is considered approximately the same, for the studied regions. Relevant competence level is also about the same in these regions except from the absence of a university education in logistics in Halmstad. The availability of labour forces is not prioritized by BILTEMA (1,67; 3 being the highest). Since the importance of keeping competent labour forces within the company is of major importance, Halmstad is considered to have disadvantages regarding competences. Jönköping has the advantage seeing as the region has the lowest labour turn-over rate. Regarding the matter of labour wages, Jönköping has more expensive labour-force, which is a disadvantage, than Örebro and Linköping, but an advantage that Jönköping has is that the population growth is forecasted to be highest in Jönköping compared to the three other regions during the upcoming years. Seeing as BILTEMA prioritize low labour turn-over, Jönköping can be regarded as the most preferable region. The table below indicates that the “labour availability” is ranked low by BILTEMA, the additional point (Selected City) is awarded for being the most suitable location in regard to the factor. Further reason is to be able to quantify the factors and the amount of won factors in order to simplify the identification of the most optimal location of a future CDC.

<table>
<thead>
<tr>
<th>Chosen cities for the Qualitative/quantitative factors</th>
<th>Reason</th>
<th>Selected City(points)</th>
<th>BILTEMA Rank of factors</th>
<th>Sum of points per factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jönköping Labour availability</td>
<td>• Low labour turn-over, university education, high population growth • Closely related to “economies of scale”</td>
<td>1</td>
<td>1.67</td>
<td>(1+1.67) 2.67</td>
</tr>
</tbody>
</table>

Table 8 Sum of points – Labour availability
3.3.1.2 ACCESSIBILITY
Hilmola and Lorentz (2010), Awasthi et al. (2010), Kuo (2010) and Alberto (2000) all agree that accessibility is an important factor. A high degree of accessibility can be argued for any given location with highway connections, airports, harbours, and railways. A location with good possibilities for intermodal transportation is even better for locating the warehouse. Another factor that is considered important to Awasthi et al. (2010) and Church et al. (2004) is the availability of public services such as police and fire department. Seeing as Sweden has a broad network of these services and widely developed road connection throughout the country, the authors do not believe there is a need to consider public service availability.

Halmstad is a city that has varying modes of transport, from sea to air, although BILTEMA mainly recognizes railways, harbours and highways as the most important transportation channels. (Jönsson, CIO of Retlog, 2014-03-21; Hansson, CIO of Retlog, 2014-03-25) Highway E6 runs from Copenhagen to Oslo and thus covers a majority of the western part of the Nordic countries, the down side is the relatively bad connections to Stockholm and the distance from the east part of the Nordic countries. Having located BILTEMA DC in Halmstad was mainly due to a less congested city compared to Gothenburg and a relatively well-established harbour. (Jönsson, CIO of Retlog, 2014-03-21; Hansson, CIO of Retlog, 2014-03-25) The authors believe that Halmstad is a suitable location for warehousing from BILTEMA’s perspective. Seeing as BILTEMA receives a majority of their deliveries from Asia at the harbour, there is an opportunity to eliminate temporary storage at the DC and directly move the goods to the CDC if it is located in Halmstad. Furthermore E6 runs from Copenhagen to Oslo, which has great connectivity to two out of four capitals in the Nordic countries.
Linköping, that is one out of four possible locations, is closer to the east part of the Nordic and closest to the capital of Sweden. Norway can be easily reached by driving on highway E18. Linköping does not have a harbour but does have great railway connections from Norrköping. Copenhagen and the south of Sweden can be reached through railway connections and highway connections on highway E4 that runs down to Helsingborg. From Helsingborg the road carrier just needs to turn on to highway E20 in order to reach Copenhagen. The cities that are less well connected to Linköping are Halmstad and Gothenburg (see figure 18). (Jönsson, CIO of Retlog, 2014-03-21; Hansson, CIO of Retlog, 2014-03-25) The authors argue that Linköping is a relatively good location for locating a CDC in terms of connections towards three out of four capital cities, Stockholm and Copenhagen through the use of E4 and further on E20, Oslo is reachable through E18. As such Linköping has a relatively great hub of connections throughout the Nordic countries. On the other hand Linköping has poor connectivity to Halmstad (supplier) and to most part of the west coast of Sweden.
Jönköping is the third of the possible locations and is closer to the west of the Nordic countries than Linköping. From Jönköping the South part (Copenhagen, Helsingborg and South part of Sweden) is well connected by highway E4 as well as well connected to Stockholm using the same road (see figure 19). Jönköping like Linköping has good railway connections, the downside of locating in Jönköping is the difficulty of reaching Norway, but on the other hand Jönköping was chosen as a logistical location to establish IKEA’s CDC because of its geographical location in the middle of Sweden (Andersson, Process developer, IKEA Torsvik, 2014-01-28). The authors think that Jönköping is well connected to Stockholm and the south part of the Nordic countries through the use of E4. As such Jönköping has connectivity to two out of four capital cities, but better connectivity to Gothenburg and the west of Sweden, than Linköping. Seeing as Jönköping is more central than Linköping it has a relative advantage considering replenishment from Halmstad (supplier).
Örebro is the fourth city and the second best logistical location of Sweden for warehouses (Intelligent Logistik, top 25 best locations, 2013). The city is in the centre of all customers in the Nordic countries. From Örebro it is relatively easy to deliver to the major cities, Oslo, Stockholm and Gothenburg. Highway E18 runs from Oslo to Stockholm and E20 runs from Gothenburg to Stockholm, furthermore it is a relatively short distance to E4 that connects to Helsingborg and in extension Copenhagen (see figure 20). (Jansson, marketing manager, Business region Örebro, 2014-04-23) The difficulties lie in the replenishments from Retlog (BILTEMA’s DC) as road carriers from Halmstad have a less straight delivery route. Besides having great road connections to the customers in the Nordic countries, Örebro also has great railway connections. There is railway connections running from Stockholm almost all the way to Norway and Bergslagsbanan runs from Mjölby to Harnös Harbour. That will benefit the region with more transportation options and more frequent goods train departures (Jansson, marketing manager, Business region Örebro, 2014-04-23). Another positive factor for the transportation and accessibility is the proposed improvement and expansion of the railway connections in Hallsberg (Trafikverket.se, 2014). The authors believe that Örebro has great connectivity, because two important highways cross, E20 and E18. E20 connects Gothenburg and Stockholm and E18 connects Oslo and Stockholm. As such the supply from east to west is relatively
secured. With the Bergslagsbanan being expanded, the possibilities for faster, cheaper and easier transports are increased.

Figure 19 Google Maps (2014) - Road connection Örebro

**Reflections/Analysis:**

The different locations each offer different advantages within the accessibility factor. Linköping has a relative advantage in supply towards customers in the eastern part of the Nordic countries but lose the accessibility from Halmstad (supplier). Örebro has a relative advantage towards customer deliveries to Oslo, Gothenburg and the eastern part of the Nordic countries, but disadvantages to deliver to the south of the Nordic countries. Seeing as Denmark is a relatively new market with a lower degree of demand, it is more important to prioritize Norway, Sweden and Finland. In the future the slightly worse location towards the south of the Nordic countries might create a potential loss of sales. BILTEMA considers accessibility to be of medium importance as it is ranked 2 (3; being the highest). This consideration is taken into account when the author’s decide a warehouse location. The factor is important but not the most important of the qualitative factors. The table below indicates that the “accessibility” factor is ranked medium by BILTEMA, the additional point (Selected City) is awarded for being the most suitable location in regard to the factor. Further reason is to be able to quantify the factors and the amount of won factors in order to simplify
the identification of the most optimal location of a future CDC.

<table>
<thead>
<tr>
<th>Chosen cities for the Qualitative/quantitative factors</th>
<th>Reason</th>
<th>Selected City(points)</th>
<th>BILTEMA Rank of factors</th>
<th>Sum of points per factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Örebro  Accessibility (inbound and outbound)</td>
<td>• Good connection to bigger markets, NO, SE and FI and supplier (Retlog)</td>
<td>1</td>
<td>2</td>
<td>(1+2) 3</td>
</tr>
<tr>
<td></td>
<td>• Closely related to “close to customer” and “close to supplier”, “opportunity for expansion”</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 9 Sum of points - Accessibility

3.3.1.3 CLOSE TO SUPPLIER
According to Nahmias (2009) one important part of being able to reduce costs, is to locate the warehouse close to suppliers in order for transports to become shorter. By placing the CDC in Halmstad transports are likely to become much shorter for replenishments (Hansson, CIO of Retlog, 2014-03-25). Another benefit from placing the warehouse in Halmstad is that deliveries can be sent directly to CDC instead of being temporarily stored at the DC. Furthermore the closeness to the supplier (DC) reduces the risk of stock-outs and it becomes easier to meet customer demand variations (Hilmola and Lorentz, 2010; Awasthi et al., 2010). This is supported by Hansson (CIO of Retlog, 2014-03-25) and Andersson (Process Developer IKEA Torsvik, 2014-01-28) that stress the fact that locating a CDC close to the supplier (DC) can easily solve any supply issues arising from unknown demand, seeing as any possible inventory shortages, possibly, can be reduced, as the replenishment time might be significantly decreased.

Placing the CDC in Jönköping, Linköping or Örebro has a dramatic effect on the security of supply from DC as the distance grows larger. The replenishment time is increased with increased risk of shortages as a result. Furthermore the transportation costs become higher as the distance between DC and CDC becomes larger. (Hansson, CIO of Retlog, 2014-04-23; Hansson, CIO of Retlog, 2014-03-25)

Reflections/analysis:
From the closeness to supplier perspective, the most optimal location for locating a CDC is in Halmstad just next to the DC. Placing the CDC in Halmstad creates benefits that range from reduced costs, security of supply, shorter replenishment time and reduced temporary warehousing at the DC. Other areas that might be affected by locating a CDC far from the DC is that the inventory levels might rise due to the fact that the CDC does not want to risk stock-outs. The benefits from locating the CDC close to the DC are reduced, if not eliminated; the farther away from Halmstad the CDC is located. This is the single most important factor to consider when choosing where to establish a CDC, it was ranked 3 (3 being of highest importance). Seeing as all shipments arrive to Retlog first and are not sent straight to any department stores, it is important to keep the CDC close, in order to maintain lower inventory with a higher replenishment rate. (Hansson, CIO of Retlog, 2014-03-25) The table below indicates that the “close to supplier” factor is ranked highest by BILTEMA, the additional point (Selected City) is awarded for being the most suitable location in regard to the factor. Further reason is to be able to quantify the factors and the amount of won factors in order to simplify the identification of the most optimal location of a future CDC.

<table>
<thead>
<tr>
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<th>Reason</th>
<th>Selected City(points)</th>
<th>BILTEMA Rank of factors</th>
<th>Sum of points per factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Halmstad Close to supplier (Retlog), secured supply, reduced transportation and lowered inventory</td>
<td>• Closeness to supplier, “close to customer”, “economies of scale” in terms of personnel, “accessibility”</td>
<td>1</td>
<td>3</td>
<td>(1+3) 4</td>
</tr>
</tbody>
</table>

Table 10 Sum of points - Close to suppliers

### 3.3.1.4 CLOSE TO CUSTOMER
In order to reduce costs, increase flexibility and more consistent deliveries to end-customers, it is important to locate a CDC close to logistical hubs and terminals (Hilmola and Lorentz, 2010; Awasthi et al., 2010). Continuing on the locating of a CDC “close to customers” has the added consequence that the customers are able to receive fast deliveries on incomplete orders, seeing as it is critical for an e-commerce company (Colla and Lapoule, 2012). Flexibility has also come to be one of the most important e-commerce abilities a company has to attain. Flexibility is the ability for adapting to fast deliveries, meeting special requests, changes in deliveries or routines.
Many e-commerce businesses have to meet the demand for fast deliveries in order to be an alternative to traditional department stores (Gunarsakran et al., 2002).

According to Kinhult (Sydsvenskan, 2013), the Swedish West coast has about 8 out of 26 million living in the Nordic countries from Oslo to Copenhagen, and Halmstad is in the middle of the highway and the railways running along the west coast. But the customers in Finland and along the Swedish east coast have a rather low connection and a far distance from Halmstad, regarding the costs of transporting goods to customers it is rather difficult to see if it is more expensive to locate in Halmstad.

The most central part of Sweden is Örebro, which is located in the middle of Sweden as well as its inhabitants (Intelligent Logistik, 2014). As such, Örebro became a logistical hub for transports in Sweden. The difficulty of placing a CDC in Örebro is that there are no efficient transports or connections to Denmark but the connections to Stockholm, Gothenburg and Oslo are great, and from Gothenburg the transports are able to efficiently deliver to the South part of the Nordic countries.

Jönköping that is one of Sweden’s top five locations for placing a CDC is in this regard better to locate (Intelligent Logistik’s, Nr 6-7, 2013), is also a viable option. IKEA choose to locate one DC and their CDC in Jönköping due to the geographical location in the middle of Sweden, and they are able to easily supply customers in Stockholm, Gothenburg, Malmoe and Copenhagen (Torell, Chief of IKEA DC Torsvik, EFN 2014).

Linköping with its connections to Norrköping, that is a major logistical hub, has in extension great connections to distribute goods to customers in Finland, east coast of Sweden. On the other hand the distances to customers, in the south part and on the west coast, increase but the connections are still great to a majority of cities. (Intelligent Logistik, 2013; Google Maps, 2014)

Reflections/analysis

From the perspective of locating close to customers the geographically most optimal point would be Örebro as it is located in the middle of Sweden, but regarding the
connectivity to the south part of the Nordic countries it is not as optimal. Jönköping is considered a major logistical hub and has better connections to the south part of the Nordic countries and in extension to the customers. The market in Denmark is still small but steadily growing but considering the current location of the customers it is more important to be able to efficiently deliver products and customer orders to customers in Norway, Sweden and Finland. With this in mind the more optimal point for locating a warehouse is one with closeness to customers in Sweden, Norway and Finland, which makes Örebro the best location. According to Hansson (CIO of Retlog, 2014-03-25) and Jönsson (CIO of BILTEMA, 2014-03-25) the importance of closeness to customer was ranked 1,33 (3 being the highest) thus it is not important. Hansson (CIO of Retlog, 2014-03-25) says that “If we ship from Halmstad, Jönköping or Linköping or anywhere else in south/mid Sweden really doesn’t matter.” The table below indicates that the “close to customer” factor is ranked low by BILTEMA, the additional point (Selected City) is awarded for being the most suitable location in regard to the factor. Further reason is to be able to quantify the factors and the amount of won factors in order to simplify the identification of the most optimal location of a future CDC.

<table>
<thead>
<tr>
<th>Chosen cities for the Qualitative/quantitative factors</th>
<th>Reason</th>
<th>Selected City(points)</th>
<th>BILTEMA Rank of factors</th>
<th>Sum of points per factor</th>
</tr>
</thead>
</table>
| Örebro Close to customer                               | • Good connection to bigger markets, NO, SE and FI  
• Closely related to “close to supplier” and “accessibility”, “opportunity for expansion” | 1 | 1,33 | (1+1,33) 2,33 |

Table 11 Sum of points - Close to customer

3.3.1.5 OPPORTUNITY FOR EXPANSION

Before organisations choose warehouse locations the organisation should consider the potential for expansion in the region. Factors such as the location’s opportunity for expansions regarding market growth should be carefully studied before investing in a new warehouse. Market growth is possible to predict accurately before the decision-making, using statistics and other sources of information. (Melo et al., 2008) Sources from government statistics and logistic providers such as Posten and Bring indicate the strongest potential for growth, in e-commerce shopping, is the Norwegian market. (Posten.se, 2014; Brings.se, 2014) Norway has also the highest average of e-
commerce purchases per person per year, which sums up to about 8000 SEK compared to the Finish 5250 SEK. The research executed by Posten.se (2014) shows that the Norwegians purchased the most from the Swedish market within the Nordic countries. According to BILTEMA’s CIO (2014-01-14) the Danish market is the company’s future market for expansion, but the authors and Hansson (CIO of Retlog, 2014-03-25) argue that the Danish market is comparatively small to the Norwegian, Swedish and Finish markets for BILTEMA. The authors believe that the Norwegian market has the best potential of e-commerce growth according to surveys made by major LSPs and government statistics.

Theoretical reviews from Hilmola & Lorentz (2010), Lumsden (2012) and MacCarthy & Walailak (2003) highlight the opportunity for future expansion of a warehouse area. This opportunity is in need of land in order to be able to expand, as such land availability in a region is important for expansion. According to Intelligent Logistik (Top 25 logistic locations, 2014) Halmstad has available land, close to the harbour for logistic businesses to establish functions. Hansson (CIO of Retlog, 2014-03-25) also thinks the land availability is good, as the company’s current DC is based in Halmstad’s harbour, but the possibility of integrating the future CDC in the same building as the DC is considered to be inefficient. According to Intelligent Logistik (top 25 logistic locations, 2014 and nr: 6-7, 2013) Linköping and Jönköping also has good availability of land. The new established container harbour in Norrköping (close to Linköping) creates opportunities to handle bigger material flow regarding freight shipments. (Top 25 logistic locations, Intelligent Logistik, 2014) The industries within the Jönköping region also has an organisation for collaboration of logistics projects, among others projects, is one regarding a new intermodal terminal, but any conclusive decision has yet to be made (Logpoint.se, 2014). Örebro has a recently built intermodal terminal owned by Posten AB. Jansson (Market Manager of Business Örebroregion, 2014-04-23) argues that the land availability is good within the Örebro region.

Awasthi et al. (2010) underlined the opportunity to increase warehouse capacity but also indicates the importance to meet customers’ increased demand in terms of infrastructure improvements and expansions. The well-developed organisation Hallands Hamnar is constantly improving and working on future expansions of
infrastructure projects for the region. (Intelligent Logistik, Top 25 logistic locations, 2014) Hansson (CIO of Retlog, 2014-03-25) emphasizes the connectivity to the Norwegian and Danish market from Halmstad and sees the geographical location as a huge advantage for future expansion. Jönköping has the organisation Logpoint which is constantly developing new logistic solutions regarding infrastructure improvements (Svensknäringsliv.se, 2014). The government has recently decided to build a double railroad between the region of Stockholm and Linköping. These decisions are one of the biggest infrastructure investments, in modern time, undertaken by the government and are to be executed from 2017 to 2028. The project will achieve several benefits one which is improved connectivity to the regions harbours. (ostlanken.se, 2014) The project reconstruction of the Bergslagsdiagonalen has also recently been undertaken by the government to improve future infrastructure connectivity for the Örebro region. (Jansson Market Manager of Business Örebroregionen, 2014-04-23)

Reflections/Analysis:
Linköping, Jönköping and Örebro are perceived as attractive regions concerning the factor of land availability and opportunity to expand. Örebro may have the best connectivity to reach the Norwegian region and also has several recently established companies, among others the Norwegian sport company, XXL’s recently built Distribution centre. Posten’s recently constructed intermodal terminal also creates opportunity to meet potential increase of demand from the Norwegian region regarding e-commerce orders. This also corresponds to the prioritization from BILTEMA’s managements (2,67; 3 being the highest) The authors believe that the recently established intermodal terminal from Posten AB, compared to Norrköping’s recently established container harbour, is more relevant for a future CDC. It is more relevant seeing as BILTEMA will not change their inbound goods from Asia from a new harbour. The fact that BILTEMA’s current organisation consist of a DC (Retlog) in Halmstad that handles all inbound logistics from suppliers, the recently built container harbour in Norrköping would not be of any significant benefit to BILTEMA. Furthermore the decision regarding a new intermodal terminal in Jönköping has not been made yet. Therefore the authors think that Örebro has the best potential and opportunity to meet future increased e-commerce orders for BILTEMA, with the recent established intermodal terminal from Posten AB and the closeness to the Norwegian market.
The decision made by the government to construct a new railroad between Stockholm and Linköping brings several benefits for the region, but benefits regarding railway transportations for BILTEMA is not relevant seeing as the company’s transportation of goods are mainly performed by road carriers. The finishing date for the project is not until 2028 which create an irrelevant length of projection for the investment.

The table below indicates that the “opportunity for expansion” factor is ranked high by BILTEMA, the additional point (Selected City) is awarded for being the most suitable location in regard to the factor. Further reason is to be able to quantify the factors and the amount of won factors in order to simplify the identification of the most optimal location of a future CDC.

<table>
<thead>
<tr>
<th>Chosen cities for the Qualitative/quantitative factors</th>
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<th>Selected City(points)</th>
<th>BILTEMA Rank of factors</th>
<th>Sum of points per factor</th>
</tr>
</thead>
</table>
| Örebro Opportunity for expansion                     | • New intermodal terminal, closeness to expanding e-commerce market NO  
• Closely related to “accessibility”, “close to customer”, | 1 | 2.67 | (1+2.67) 3.67 |

Table 12 Sum of points - Opportunity for expansion

3.3.1.6 CLOSE TO OTHER INDUSTRIES AND COMPETITORS

The importance of placing the warehouse close to the company’s competitors and other supporting industries should not be underestimated. The opportunity for collaboration in order to develop new ideas or strategies, increase when collaborating companies are geographically close. (MacCarthy and Walailak, 2003; Melo et al., 2008 and Hong, 2007)

The four regions all have large companies established in the regions, which also creates a supply of LSPs that are available in the regions. BILTEMA’s DC is based in Halmstad, which has the opportunity for collaboration with other industries. Collaborations between municipalities in Halmstad and Varberg creates the area, Hallands Hamnar (Halland’s Harbours). (Hallandshamnar.se, 2014) Linköping region has the organisations Östsam and EastSweden, besides the collaboration organisation of Ostsam and EastSweden, Linköping University offers higher educations in logistics and supply chain management which can be of benefit to BILTEMA in an eventual
establishment of a CDC. (Brozén, CEO of East Sweden, 2014-03-25) Jönköping region has LogPoint, the organisation coordinates projects and improvements of infrastructure and is formed from other industries and municipalities in order to create a long lasting collaboration. LogPoint is expanding and can be considered to be a great initiative in order to further expand the region. For BILTEMA the organisation and factor can become important. (Logpoint.se, 2014)

Örebro has Business Örebroregionen. These organisations coordinate projects regarding infrastructure developments in municipalities and industries for further improvements. (businessregionorebro.se, 2014)

**Reflections/analysis:**

Every region has its own organisation created by municipalities and/or industries in order to organize and develop infrastructure projects, large LSPs as well as other large businesses within the regions. Despite the presence of these in Halmstad, BILTEMA has chosen not to collaborate with them; this as BILTEMA prioritizes collaborations relatively low. It has the priority of 1.67 with 3 being the highest. Instead, BILTEMA internally collaborates by utilizing current warehouses’ labour force in order to create a work pool. The work pool reduces labour demand variability and makes it possible to exchange personnel. The transportations are also internally collaborated between the warehouses to create efficient transport and replenishment. Two out of four of Retlog’s warehouses are based in the harbour of Halmstad (Hansson, CIO of Retlog, 2014-03-25). The authors believe that “closeness to other industries and competitors” is an important factor for BILTEMA DC’s future improvement and potential development. Therefore, the Linköping region is more attractive as it has a close collaboration with its university compared to other regions. This is beneficial as a university can provide knowledge and information to develop future logistics improvements. The example from Stadium where the university supported and provided information to locate the companies’ warehouse location indicates the valuable knowledge from a higher educational institution. Based on these facts, Linköping ought to be the better choice for locating a CDC. The table below indicates that the “close to other industries and competitors” factor is ranked low by BILTEMA, the additional point (Selected City) is awarded for being the most suitable location in regard to the factor. Further reason is to be able to quantify the factors and
the amount of won factors in order to simplify the identification of the most optimal location of a future CDC.

<table>
<thead>
<tr>
<th>Chosen cities for the Qualitative/quantitative factors</th>
<th>Reason</th>
<th>Selected City(points)</th>
<th>BILTEMA Rank of factors</th>
<th>Sum of points per factor</th>
</tr>
</thead>
</table>
| Linköping Close to other industries and competitors    | • Logistics providers, bigger industries, collaborated organisation, University education
• Closely related to “economies of scale”, “opportunity of expansion” | 1 | 1.67 | (1+1.67) 2.67 |

Table 13 Sum of points - Close to other industries and competitors

3.3.1.7 ECONOMIES OF SCALE
With placing a CDC close to other functions, such as HQ and DC, the company might be able to achieve economies of scale advantages. The closeness to other functions might result in a more integrated collaborative organisation where the functions are able to exchange competencies, personnel and routines. Further positive advantage is that an internal material exchange might reduce the amount of transportation. (Nahmias, 2009; MacCarthy & Walailak, 2003) Hong (2007) further explains that support in technology and solving technical difficulties are likely to be problem-solve faster with shorter distances from the functions, thus creating a more efficient organisation. IKEA established their CDC next to their DC in Jönköping because of the possibility to support each other's functions, another factor was that the CDC did not have to replenish inventory from Älmhult (Andersson, Process Developer IKEA Torsvik, 2014-01-28). Halmstad receives goods from Asia and Eastern Europe and this is handled by Retlog (BILTEMA DC) which consists of four divisions. Between these divisions, a staffing pool has been created in order to meet demand fluctuations from department stores. (Hansson, CIO of Retlog, 2014-03-25) Relatively close to Halmstad, compared to all other investigated cities, is the HQ in Helsingborg with technical support, marketing and customer service and top management. By having the HQ as close a simplification of support and problem solving as well as any other technical difficulties might be attainable. (Hansson, CIO of Retlog, 2014-03-25) Linköping used to have the HQ, the DC and a warehouse but chose to relocate the functions to Helsingborg and Halmstad, therefore there are no economies of scale to attain from locating a CDC in Linköping. Jönköping is in comparison to the other locations, except Halmstad, close to the major functions (Hansson, CIO of Retlog,
2014-03-25). It is about 2 hours’ drive from Helsingborg and the HQ (Google Maps, 2014). Örebro does not have any of BILTEMA’s support functions or storage facilities, BILTEMA has a department store that might be able to support an initial start-up of a future CDC, but no major functions are present. (Jönsson, CIO of BILTEMA, 2014-03-21)

**Reflections/analysis:**

The importance of the closeness to support functions, DC and management is considered high from BILTEMA’s perspective BILTEMA classifies the importance of economies of scale factor as rather high, (2.67; 3 being the best). IKEA also considered the economies of scale when they chose to establish their CDC close to DC seeing as they wanted to secure the supply. Because the support functions and management are all located in Helsingborg, and the DC in Halmstad, the most optimal location for establishing a CDC is Halmstad, for the factor of creating “economies of scale”. With the security of supply, the closeness of support and relative easy access to management there are opportunities for huge benefits. One benefit that might arise is the possibility to become a member of the staffing pool, by being a member of the pool it is possible to reduce the amount of personnel needed and instead use personnel from each other’s functions to support each other in the event of unpredicted demand variation. The table below indicates that the “economies of scale” factor is ranked high by BILTEMA, the additional point (Selected City) is awarded for being the most suitable location in regard to the factor. Further reason is to be able to quantify the factors and the amount of won factors in order to simplify the identification of the most optimal location of a future CDC.

<table>
<thead>
<tr>
<th>Chosen cities for the Qualitative/quantitative factors</th>
<th>Reason</th>
<th>Selected City (points)</th>
<th>BILTEMA Rank of factors</th>
<th>Sum of points per factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Halmstad Economic of scale</td>
<td>DC in Halmstad, HQ in Helsingborg Closely related to “close to other industries and competitors”, “close to supplier”, “labour availability” competence exchange</td>
<td>1</td>
<td>2.67</td>
<td>(1+2.67) 3.67</td>
</tr>
</tbody>
</table>

Table 14 Sum of points - Economic of scale

**3.3.1.8 FACILITY RELATED COSTS**

Land prices increase significantly when a warehouse is located close to logistical hubs, airports, highways and/or terminals. The closer a warehouse is to any of these infrastructures, the higher the price is. This is because demand is higher when the
distances decrease. (Colla & Lapoule, 2012) Constructing a building with water-pipes, waste treatment, stable electricity and telecommunication, is rather expensive and varies depending on regions for both start-up and operational costs. (Alberto, 2000; MacCarthy & Walailak, 2003)

Sweden has great supply of water, and stable connections regarding electricity and telecommunications. In terms of this it does not matter where to locate the future CDC in Sweden. (Hansson, CIO of Retlog, 2014-03-25) Comparing rent between the cities, Halmstad was found to be the cheapest place to rent a warehouse (samples of rental objects, Objektvision.se, 2014) although Helgesson (Property developer, NCC, 2014-04-23) stresses the fact that warehouse rent between the different cities, does not vary significantly. As such the authors assume that Halmstad has a slightly lower price for renting warehousing. Seeing as Jönköping is one of the major logistical hubs in Sweden it might be more expensive to establish a warehouse there (Jönsson, CIO of BILTEMA, 2014-03-04), Örebro is also considered one of the major logistical hubs and might also have a slightly higher price of rent and construction (Jönsson, CIO of BILTEMA, 2014-04-23; Intelligent Logistik, 2014). Seeing as there is already an unused warehousing facility in Linköping, BILTEMA would avoid larger investment costs by establishing a CDC in the existing warehouse. The investments will most likely be refurbishment, equipment and personnel. (Hansson, CIO of Retlog, 2014-03-25)

**Reflections/analysis**

Seeing as BILTEMA already has an established unused warehouse in Linköping it is the most optimal location to establish a CDC from the cost perspective. The cost will include investing in new equipment, refurbish and maybe extend the facility. BILTEMA ranks the facility related costs as 1,33 (3; being the highest) which indicates that BILTEMA does not consider investment costs and facility related costs as important as the other factors, when to considering the location for a CDC establishment. The table below indicates that the “facility related costs” factor is ranked low by BILTEMA, the additional point (Selected City) is awarded for being the most suitable location in regard to the factor. Further reason is to be able to quantify the factors and the amount of won factors in order to simplify the identification of the most optimal location of a future CDC.
3.3.1.9 ENVIRONMENTAL IMPACTS
Awasthi et al. (2010) and Ashrafzadeh et al. (2012) stress the importance of governmental and environmental fees as a significant cost for a business and future government regulations or other plans within the region needs to be considered during the investigation. Alberto (2000) found that the most important factors within the environmental factor are pollution regulations, closeness to disposal plants and local taxations. There are currently investigations into an increased kilometre tax that would increase the price for transportation per kilometre substantially. (Sveriges Åkeriföretag, 2014). There are no local regulations or taxation for transportation, the municipal environmental work is mostly regarding the consultation and information spreading about the importance of environmental factors. (Larsson, Halmstad municipality, 2014-04-07; Sylvan, environment protection inspector, Linköping Municipality, 2014-04-16; Oldén, environment inspector, Jönköping municipality, 2014-04-07; Dufva, manager for the unit of sustainable growth, Örebro municipality, 2014-04-16). According to Jansson (market manager, Business region Örebro, 2014-04-23) there is a European Union environmental project called Greener logistics which involve all businesses to work more towards using sustainable fuel, efficient road carriers etc., in order to become greener. This is not a regulation or taxation but an initiative for a sustainable future.

Reflections/analysis:
The environmental aspect received the lowest ranking of importance of the factors for establishing a CDC. BILTEMA ranked environmental impacts as 1 (3; being the highest and 1 the lowest). Seeing as there are no local difference in regulations and taxation, it has no impact on the decision of where to locate a future CDC. Therefore this factor will have no effect on the ranking as no city/region could be chosen. If Norway, Denmark and Finland had been candidates for establishing a CDC in, this might have received a higher ranking and differences in regulations would most likely...
have been found. The table below indicates that the “environmental impacts” factor is ranked lowest by BILTEMA, the additional point (Selected City) is awarded for being the most suitable location in regard to the factor. Further reason is to be able to quantify the factors and the amount of won factors in order to simplify the identification of the most optimal location of a future CDC. Seeing as there is no city that was found to be the most optimal, the potential points were disregarded.

<table>
<thead>
<tr>
<th>Chosen cities for the Qualitative/quantitative factors</th>
<th>Reason</th>
<th>Selected City(points)</th>
<th>BILTEMA Rank of factors</th>
<th>Sum of points per factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental impacts</td>
<td>No bigger differences</td>
<td>-</td>
<td>- (1)</td>
<td>-</td>
</tr>
</tbody>
</table>

Table 16 Sum of points - Environmental impacts

### 3.3.2 QUANTITATIVE
The amount of inhabitants in every area and the area’s coordinates, by just focusing on finding the central point between every customer, which results to the most optimal point. (Lumsden, 2012)

Using the statistics from all countries, and weighting all customers equally, e.g. the cost considers the same, $K=1$, and summing up all inhabitants in the countries. The sum of all weighted inhabitants and the sum of all inhabitants are the same ($\sum VK=\sum V=25\,394\,641$). Furthermore the authors assume that the countries customers’ preferences, buying power and economic cycle/situation are the same. Continuing on, all X- and Y-coordinates for the specific counties or postcodes are multiplied with the amount of inhabitants in the specific areas. The aggregated result, after multiplying coordinates with the cost and inhabitants, are presented below for both X- and Y-coordinates.

<table>
<thead>
<tr>
<th>Function</th>
<th>$\sum V*K$</th>
<th>$\sum V<em>K</em>X$</th>
<th>$\sum V<em>K</em>Y$</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sum</strong></td>
<td>25 394 641</td>
<td>37 092 405 312 765</td>
<td>167 360 684 861 554</td>
</tr>
</tbody>
</table>

Continuing on for all counties and postal codes, we derive the following sum for X/Y-coordinates for all Nordic countries. Through dividing the sum of all x-coordinates that has been multiplied with the total sum of population and costs, with the total amount of inhabitants for all the Nordic countries, gives us:

$$\frac{(\sum V*K*X)}{(\sum V*K)} = (Gx)$$
Through dividing the sum of all y-coordinates that has been multiplied with the total sum of population and costs, with the total amount of inhabitants for all the Nordic countries, gives us:

\[
(\sum V*K*Y) / (\sum V*K) = (Gy)
\]

The derived east and north coordinates in the yellow fields have been calculated as following. East: \(37\ 092\ 405\ 312\ 765/25\ 394\ 641 = 1\ 460\ 639\) and North: \(167\ 360\ 684\ 861\ 554/25\ 394\ 641 = 6\ 590\ 394\).

<table>
<thead>
<tr>
<th>Centre of gravity</th>
<th>1 460 639 (Gx)</th>
<th>6 590 394 (Gy)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inhabitants</td>
<td>East coordinate (X)</td>
<td>North coordinate (Y)</td>
</tr>
<tr>
<td>Sum</td>
<td>25 394 641</td>
<td>37 092 405 312 765</td>
</tr>
</tbody>
</table>

Table 17 East Coordinate divided by Inhabitants = Gx and North Coordinate divided by inhabitants = Gy

In order to find the average best X/Y-coordinates for the average inhabitant, the total sum of X/Y-coordinates are divided by the sum of the inhabitants. Looking at table 8, the centre of gravity for Nordic countries are Y: 1460639 X: 6590394 using, RT90 2.5 gon V as our coordinate measurement standard. The following location is derived from Google Maps (2014) and twcc.free.fr.

Using the website twcc.free.fr we derive that the preferable location is in Ervalla, Sweden, by using our new coordinates and search for that location. (Figure 21)
Figure 20 Twcc.free.fr - Showing central of gravity as Ervalla
Optimal location

After having found the optimal location using the centre of gravity method, the authors looked at where Halmstad, Linköping, Jönköping and Örebro were located in relation to the optimal location, Ervalla. Using Google Maps (2014) (Figure 22) the distances between the locations could be determined. The following distances were found:

- Ervalla – Halmstad: 413 km
- Ervalla – Linköping: 142 km
- Ervalla – Jönköping: 233 km
- Ervalla – Örebro: 20 km

Potential warehouse locations

Major Nordic cities

Centre of gravity
Reflections/analysis:
The closest city to Ervalla is Örebro with only 20 kilometres. The results were presented to BILTEMA and the managers were asked to rank its potential importance in the decision-making of the CDC localisation. BILTEMA found the importance to be of medium rank and received an average of 2 from management (3; being the highest). The authors believe that the strategic importance of locating in the centre of all customers/markets is significant for expansion and maintain high customer service. The table below indicates that the “centre of gravity” factor is ranked medium by BILTEMA, the additional point (Selected City) is awarded for being the most suitable location in regard to the factor. Further reason is to be able to quantify the factors and the amount of won factors in order to simplify the identification of the most optimal location of a future CDC.

<table>
<thead>
<tr>
<th>Chosen cities for the Qualitative/quantitative factors</th>
<th>Reason</th>
<th>Selected City(points)</th>
<th>BILTEMA Rank of factors</th>
<th>Sum of points per factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Örebro</td>
<td>The calculation indicates this location</td>
<td>1</td>
<td>2</td>
<td>(1+2)</td>
</tr>
<tr>
<td>Quantitative Method</td>
<td></td>
<td></td>
<td></td>
<td>3</td>
</tr>
</tbody>
</table>

Table 18 Sum of points - Centre of gravity
3.3.3 SUMMARY OF ANALYSIS
The qualitative and quantitative factors need to be considered in relation to BILTEMA’s prioritization and the authors’ quantified point allocation, for any given factor, in order to decide the warehouse location. Each factor is equal and the chosen locations receive 1 point. The presented table below shows the separated best locations for every qualitative and quantitative factors and their ranking from BILTEMA. (Table 19)

The environmental factor does not have any significant effect on the outcome on the decision of where to locate the CDC in the future. No differences between the four municipalities where found regarding the different environmental regulations and taxations. Furthermore BILTEMA does not rank the “environmental impact” high on their prioritization regarding the localisation of warehouse factors. The factor has thus been disregarded and receives zero points. (Table 19)

Linköping already has an established unused warehouse. As such, Linköping has the lowest costs for initial investments compared to the other locations. The other locations would have to construct new facilities from the foundation with investments in equipment, waste-treatment, water-supply, electricity and more. BILTEMA regards facility related costs as second to last in importance of the qualitative factors. Linköping receives 1 point for having the most suitable location for Facility related costs and 1, 33 as a result of BILTEMA’s ranking. (1+1, 33) (Table 19) Besides facility related costs, Linköping’s industries has the closest collaborations with the university, compared to the other regions. Otherwise there were no differences in the collaboration initiatives between the regions. Despite Linköping’s close relationship with the university, BILTEMA ranks the “close to other industries and competitors” factor as low in importance. Linköping receives 1 point for having the most suitable location for Close to other industries and competitors and 1, 67 as a result of BILTEMA’s ranking. (1+1, 67) (Table 19)

Labour availability is also considered by BILTEMA, to be of lower importance. (Table 19) Labour availability is the only factor that was found to be best in Jönköping of all the factors. Jönköping has an acknowledged university education, high population growth and low labour turn-over rate. The turn-over rate was the only
factor within labour availability that BILTEMA mentioned as important. Jönköping receives 1 point for having the most suitable location for Labour availability and 1, 67 as a result of BILTEMA’s ranking. (1+1, 67) (Table 19)

Seeing as the market in Norway, Sweden and Finland is bigger than Denmark. Örebro is a more suitable place to locate the CDC as the majority of customers are easier to reach from this region. As such it is in the centre of all of the Nordic countries’ inhabitants. Örebro receives 1 point for having the most suitable location for Close to customer and 1, 33 points as a result of BILTEMA’s ranking. (1+1, 33) (Table 19)

The quantitative factor cannot be analysed separately from the qualitative factors. Therefore the authors have added the quantitative factor as one of ten important factors together with the qualitative factors. The authors consider the quantitative factor as equal to the qualitative factors; as such the most suitable location receives 1 point for the quantitative factor. From the quantitative research Örebro is also derived as the closest to the centre of gravity, with only 20 kilometres in distance. Örebro receives 1 point for being the centre of gravity 2 points as a result of BILTEMA’s ranking. (1+2) (Table 19)

Örebro has greater connectivity to Oslo, Stockholm, and Gothenburg, Finland and with some difficulty Denmark. Örebro has also great potential for meeting the growing e-commerce market, especially in Norway. Posten AB recently established an intermodal terminal which benefits e-commerce. Örebro receives 1 point for having the most suitable location for Opportunity for expansion and 2, 67 points as a result of BILTEMA’s ranking. (1+2, 67) (Table 19)

Halmstad is in relation the most suitable location for securing supply and has the closest distance to the supplier (Retlog) as the future CDC would be located close to Retlog. Added benefits of locating in Halmstad are lower inventory and reduced transportation. Halmstad receives 1 point for having the most suitable location for Close to supplier and 3 points as a result of BILTEMA’s ranking. (1+3) Locating a CDC in Halmstad would increase the effect from economies of scale. The benefits would be the ability to support different functions with personnel from Helsingborg HQ, Halmstad DC and the future CDC. Added benefits are the competence and
personnel exchange. Halmstad receives 1 point for having the most suitable location for Economies of scale and 2, 67 points as a result of BILTEMA’s ranking. (1+2, 67) (Table 19)

From Halmstad the accessibility is favourable regarding the connections from Oslo to Copenhagen but worse towards the eastern part of BILTEMA’s current market. Which is the reason that Örebro with its more efficient connections from east to west of Sweden as well as Norway, is found to be the most suitable location regarding Accessibility. Thus Örebro receives 1 point for having the most suitable location for Accessibility and 2 points as a result of BILTEMA’s ranking. (1+2) (Table 19)

Örebro has met three out of nine qualitative factors plus the quantitative, central of gravity for demand.

**Customer orientated or secured supply?**

These qualitative factors are orientated towards expansion and customer focused strategies. This orientation is found from being close to both existing and potential of growth markets. However, Halmstad has met two out of nine qualitative factors, which are more prioritized by BILTEMA. Örebro’s has met three qualitative factors but with less prioritization by BILTEMA and one quantitative factor (Table 19). The qualitative factors of Halmstad have a core focus on securing supply in order to avoid stock-outs and prevent personnel demand variation by using the Retlog’s staffing-pool. The authors deem the expansion strategy and the secured-supply strategy as equally important for the company’s future e-commerce orientation. After having compiled all points, Örebro was found to score 12 points which, can be compared to Halmstad’s 7.67 points. (Table 20)
<table>
<thead>
<tr>
<th>Chosen cities for the Qualitative/quantitative factors</th>
<th>Reason</th>
<th>Selected City(points)</th>
<th>BILTEMA Rank of factors</th>
<th>Sum of points per factor</th>
</tr>
</thead>
</table>
| Jönköping Labour availability                        | • Low labour turn-over, university education, high population growth  
• Closely related to “economies of scale”. | 1 | 1.67 | (1+1.67) 2.67 |
| Örebro Accessibility (inbound and outbound)           | • Good connection to bigger markets, NO, SE and FI and supplier (Retlog)  
• Closely related to “close to customer” and “close to supplier”, “opportunity for expansion” | 1 | 2 | (1+2) 3 |
| Halmstad Close to supplier                            | • Closeness to supplier (Retlog), secured supply, reduced transportation and lowered inventory  
• Closely related to “close to customer”; “economies of scale” in terms of personnel, “accessibility” | 1 | 3 | (1+3) 4 |
| Örebro Close to customer                              | • Good connection to bigger markets, NO, SE and FI  
• Closely related to “close to supplier” and “accessibility”, “opportunity for expansion” | 1 | 1.33 | (1+1.33) 2.33 |
| Örebro Opportunity for expansion                      | • New intermodal terminal, closeness to expanding e-commerce market NO  
• Closely related to “accessibility”, “close to customer”, | 1 | 2.67 | (1+2.67) 3.67 |
| Linköping Close to other industries and competitors   | • Logistics providers, bigger industries, collaborated organisation, University education  
• Closely related to “economies of scale”, “opportunity of expansion” | 1 | 1.67 | (1+1.67) 2.67 |
| Halmstad Economic of scale                            | • DC in Halmstad, HQ in Helsingborg  
• Closely related to "close to other industries and competitors”, “close to supplier”, “labour availability” competence exchange | 1 | 2.67 | (1+2.67) 3.67 |
| Linköping Facility related costs                      | • No initially investment cost | 1 | 1.33 | (1+1.33) 2.33 |
| Environmental impacts                                 | • No bigger differences | - | - (1) | - |
| Örebro Quantitative Method                            | • Result of calculations | 1 | 2 | (1+2) 3 |

Table 19 Summary of analysis - Örebro has three major factors. Halmstad and Linköping have two major factors and Jönköping has one. The quantitative factor shows the centre of gravity close to Örebro.
<table>
<thead>
<tr>
<th>Qualitative/quantitative factors</th>
<th>Halmstad</th>
<th>Linköping</th>
<th>Jönköping</th>
<th>Örebro</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labour availability</td>
<td></td>
<td>2,67</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Accessibility (inbound and outbound)</td>
<td></td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Close to supplier</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Close to customer</td>
<td></td>
<td></td>
<td>2,33</td>
<td></td>
</tr>
<tr>
<td>Opportunity for expansion</td>
<td></td>
<td></td>
<td>3,67</td>
<td></td>
</tr>
<tr>
<td>Close to other industries and competitors</td>
<td>2,67</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Economic of scale</td>
<td>3,67</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Facility related costs</td>
<td></td>
<td>2,33</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Environmental impacts</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Quantitative Method</td>
<td></td>
<td></td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Total points:</td>
<td>7,67</td>
<td>5</td>
<td>2,67</td>
<td>12</td>
</tr>
</tbody>
</table>

Table 20 Total points for the different factors to the regions
4. How should the material management at the future CDC operate?

This chapter includes theoretical framework, empirical findings and analysis of the second research question. The theoretical framework consists of material management theories to handle goods flows for BILTEMA’s future Customer Distribution Centre. The material management will cover receiving, storage, order-picking and packaging. The fact that BILTEMA do not have an existing CDC is the empirical finding has also been based on the benchmarked company, IKEA DC, Torsvik. The chapter ends with an analysis and a conducted table.

Figure 22 Overview of the Material management chapter
4.1 THEORETICAL FRAMEWORK

MATERIAL MANAGEMENT

Gwynne (2013) means the purposes of warehouses may vary in different business strategy. It depends on what the warehouse strategy and purposes are. There are different variant of warehouse structures. It depends on the purpose of the warehouse and what kind of material flow it handles. Different purposes such as production unit with storage areas, facility that only handles bigger material flows to break bulks for further distribution to wholesalers or handling single packages to end customers. The authors mean that it depends on where the warehouse is active within the supply chain, which decides the warehouse activities and purposes.

According to Lambert and Stock (2001) and Gwynne (2013) material management consists of three main categories: handling, storage and exchange of information. These activities are further divided into subcategories. The handling category consists of four subcategories, which are receiving, storage, order-picking and packaging. The second category is storage which consists of further subcategories one of which is buffer stocks. The third category is the exchange of information that is the integrating link of the first two main categories.

![Theoretical model of Material management](image)

**Figure 23 Theoretical model of Material management**

4.1.1 RECEIVING

Receiving deliveries from suppliers are one of the first phases executed by the warehouse’s personnel. During the first phase many steps could also be included. A
general inspection of delivered goods will be performed. The inspection identifies quantity or quality differences of the arrival goods. The quantity differences are usually identified through the consignment note, but quality differentials are harder to identify at the receiving stage, except from visual differentials that are simpler to identify. These so called, hidden differentials are often discovered when the warehouse staff execute random sample tests or a total test of the received order. Otherwise the differentials will be discovered during later activities. During the receiving stage if differentials occur, documentation of those are significant for further reclams to suppliers. (Lumsden, 2012)

4.1.2 STORAGE
After clearances from the previous phase the delivered goods can now be placed at the picking or buffer zones. The storage location for the goods depends on what method of storage the warehouse is using. (Lumsden, 2012) There are different methods to store goods. A widely used method is the first in first out principle. The principle avoids incurrences by using older products before using the newer products. This can mean putting the new products behind the older goods. (Nahmias, 2009)

4.1.2.1 BUFFER ZONES
Buffer zones are built to reduce goods from the picking zones. The buffer zones could be used if the picking zones are full and no place to store the arrived goods. There are three kinds of buffer zones within a warehouse: Buffer zone aside of the main building, close buffer and pick zone buffer. (Lumsden, 2012)

- Buffer zone aside the main building is not closely connected to the picking zone and is usually placed in another building or location. This type of storage, stores larger deliveries from suppliers and goods are moved from this area when the picking zones become empty.
- The close buffer is placed close to the picking zone. The goods from this zone are not available for picking. To reach the goods from this zone, certain lifting equipment might be required, seeing as the goods are usually placed upon the picking zone.
The picking zone buffer is designed for picking customers’ orders and is suitable for daily picking activities. The personnel could pick orders from this zone and directly from the pallets.

4.1.2.2 DESIGN OF THE PICKING AREA
According to Lumsden (2012), the picking zone’s storage area, has three picking variants: low, high and station pick. Petersen (2002) also made an input regarding the picking frequency for different product range.

- Low pick – the personnel from the floor can pick every order without any help by trucks or lifting cranes. Equipment such as wagons or small trucks may be used for this order picking. This method is suitable when the consignment note consist of many order lines (articles), seeing as the method’s rely on quick picking approaches on the floor. Buffer storage is usually placed above the picking place due to the ease of access for replenishment when picking places run out of products.

- High pick – High picking means products placed on higher racks and equipment such as trucks could be used to precede the order picking. On the other hand, the warehouses may have already developed an automatized warehouse picking, which is computerized. The efficiency may vary with this method. The personnel picking becomes less efficient since the person has to use lifting cranes and trucks for order-picking, but if the warehouses are automatized, it may result in faster, more efficient order picking.

- Frequency pick – Depending on the frequency of the picks for certain SKU: s, (stock keeping unit) the storage of the picking area may have different outcome. For example products with high SKU: s with high frequent pickings should be placed close to the front of the picking zone, in order to reduce travel time.

4.1.3 ORDER-PICKING
Gwynne (2013) and Lumsden (2012) mean that there are several of order-picking methods to apply for warehouse operations. It depends on what kind of main activities warehouses or the businesses are acting within. Business forms such as e-commerce, retail stores or distributions centres all require different order-picking methods.
There are different kinds of order-picking methods and it varies greatly depending on the type of operation. The characteristics for the product being handled in warehouses are total numbers of transactions and orders, order line per order, quantity per pick, piece pick or full pallet pick etc. All factors will affect the decision on the best method for order-picking for warehouses. Several methods could be combined to satisfy the need to handle diverse products or order variants. (Piasecki, 2012)

Order-picking methods suggested by Gwynne (2013), Lumsden (2012) and Piasecki (2012) are presented below. The following picking methods are suitable for piece-and case-picking activities.

**Piece Picking**

The characteristic of piece picking methods is that orders require broken case pickings or packaging operations. These kinds of products usually have a large SKUs (Stock-keeping Unit), which may contain of thousands or tens of thousands of items and order-pickings usually consist of small quantities per pick. These kinds of operations generally have short cycle times and are also typical for catalogue companies and spare parts distributors. The most common storage method is fixed storage location for picking. (Piasecki 2012)

*Basic order-picking or individual picking strategy*

This method is commonly used for products, stored in fixed locations on static shelving or pallet rack. The order-picker only picks one order at a time and is usually performed by a picking chart/wagon/truck. The picking flow is optimized for the most efficient route that the picker ends up close to the starting point. The picking document should also be synchronized with the picking flow, e.g. sorted by the same sequence as the optimized picking route. Fast moving products should be stored close to the main picking aisles. Larger and bulk products should be strategic placed at the end of the pick flow. This method is recommended for operations with small total number of orders and high number of picks per order, because of the travel time considers high. (Piasecki 2012)

*Batch picking/multi-order picking in batch picking*
This method is suitable for order-pickings with low picks per order. Several orders are being grouped into small batches with the help of a consolidated pick list provided by the business system. The picker may use a picking chart containing with several cartons to prevent for mixing the orders. Depending on the size of batches the size of orders may vary from four to twelve order-lines, depending on the operations’ average picks. The method reduces travel time because of efficient order picking when pickers are already at the same picking zone. The disadvantage for this order-picking method is the waiting time for the logistics business system to gather enough orders to calculate an optimized route and efficient picking according the product range. The system must have enough orders/data for the order batching to become efficient. For this reason the method could cause delays and it is not suitable for same day shipping operations. (Piasecki 2012)

**Zone picking**

The picking area is divided into individual pick zones where the order-picker is responsible for certain SKUs within the zone. The order moves from one zone to another zone after the previous zone’s order-picker has completed his/her zones products. It is important to balance the number of order picks within the different zones to maintain a consistence flow. The method is also suitable for large numbers of orders and, low to reasonable picks per order. Specializations of the required picking techniques could be achieve through zone picking, for example automated material handling system and manual handling system in different zone. (Piasecki 2012) Zone picking has shown to reduce travel time in retrieving items from the storage to satisfy customer orders. (Petersen, 2002)

**Case Picking**

Warehouses that choose to practice case pickings have less diverse products compared to piece pick products, such as spare parts, with fewer SKUs and higher picks per SKU compared to piece picking. The case picking method also consists of base and zone pickings as the piece picking method. The batch picking method is excluded for case picking because of the bigger goods size. (Piasecki 2012)

**Base case-picking**
This is the most practiced method for operations suitable for case pickings. The goods are stored in pallets rack or in bulk on floor instead of static shelving. The pickers are picking one order at a time. (Piasecki 2012)

\textit{Zone picking}

The zone picking method has almost the same problem as the batch picking method. The size of the products and the number of units within the orders usually does not allow zone pickings. A picker with a truck or using other equipment has restricted ability to pick several larger products at the same, for the reason to reduce travel time. Zone picking may also be a method to use, if the order consists of small quantities per SKU, or if the order consists of enough cases to fill a whole pallet. (Piasecki 2012)

\subsection*{4.1.4 Packaging}

Lumsden (2012) divided the packing process into four sub categories: Packaging, handling, storing and document and routines.

\textbf{Packing} – wrap up the products and make sure that appropriate packing material is used, because of the third part logistics provider’s regulations of specific package materials or sizes. The product should be labelled with the customers address and the consignment note has also been place within the package. (Lumsden, 2012) Another important factor that this stage should include is neat packaging. Packages that include several products may cause difficulties to wrap together. The packed box with the whole order should make sure that products sticks together and do not have losing attachments, which causes damages during transportations. To prevent dishonest logistics providers from stealing products from the packed box, company’s own label and symbols of the packaging material are also important details. This also avoid incomplete returns from dishonest customers which have opened the package box and claim the e-commerce company for missing products within the box. Many e-companies may have the policy of no return if packages are opened. (Fan et al., 2013)

\textbf{Handling} – Avoidance of damage of the products to the end customers, right and suitable packing methods should be neat developed.
Storing – The product are wrapped but are not ready for further distribution yet. A safe place to store the packed products is required to avoid external damages.

Document and routines – Continuously documentation of the packaging process are required for further improvements and identification of lacks.
## Summary of material management

<table>
<thead>
<tr>
<th>Process</th>
<th>Activities</th>
<th>Literature review</th>
</tr>
</thead>
<tbody>
<tr>
<td>Receiving</td>
<td>Quality and quantity inspection, documentation for reclaims.</td>
<td>Lumsden, (2012)</td>
</tr>
<tr>
<td>Storage</td>
<td>Storage to picking or buffer zone. First-first-out.</td>
<td>Nahmias, (2009)</td>
</tr>
<tr>
<td>Buffer Zone</td>
<td>Aside, close or picking zone</td>
<td>Lumsden, (2012)</td>
</tr>
<tr>
<td>Design of the picking area</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low pick</td>
<td>Without any picking equipment, many order-lines</td>
<td>Lumsden, (2012); Petersen, (2002)</td>
</tr>
<tr>
<td>High pick</td>
<td>Requires equipment, computerized automatized,</td>
<td>Lumsden, (2012); Petersen, (2002)</td>
</tr>
<tr>
<td>Frequency pick</td>
<td>High SKU:s product with high picking frequency = close to the front of the picking zone</td>
<td>Lumsden, (2012); Petersen, (2002)</td>
</tr>
<tr>
<td>Order-picking</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Piece picking</td>
<td>Broken case pickings, packaging operations, large SKU:s, small quantity per pick, catalogue companies, spare parts, fixed storage</td>
<td>Piasecki, (2012); Lumsden, (2012); Petersen, (2002)</td>
</tr>
<tr>
<td>Basic</td>
<td>Fixed storage, one order at a time, chart, wagon, truck, optimized picking route, fast move products locates close to the main picking aisles. Few orders with high number of picks per order. High travel time.</td>
<td>Piasecki, (2012)</td>
</tr>
<tr>
<td>Batch</td>
<td>Low picks per order, consolidated picking system, picking chart with several cartons to pick, short travel time, requires many orders to reach efficiencies</td>
<td>Piasecki, (2012)</td>
</tr>
<tr>
<td>Zone</td>
<td>Divided order to pick in different zones, moves one pick zone to another, large number of orders, reduce travel time</td>
<td>Piasecki, (2012); Petersen, (2002)</td>
</tr>
<tr>
<td>Case picking</td>
<td>Less diverse products, few SKU, higher picks per SKU,</td>
<td>Piasecki, (2012)</td>
</tr>
<tr>
<td>Basic</td>
<td>Most practiced, stored in pallet racks or floor, one order at a time,</td>
<td>Piasecki, (2012)</td>
</tr>
<tr>
<td>Zone picking</td>
<td>Not suitable for case picking because of the size, hard to pick several orders.</td>
<td>Piasecki, (2012)</td>
</tr>
<tr>
<td>Package</td>
<td>Packing, handling, storing and documenting, wrapping, labelling, prevent damages.</td>
<td>Lumsden, (2012); (Fan et al., 2013)</td>
</tr>
</tbody>
</table>

Table 21 Summary of Material Management theories
4.2 EMPIRICAL FINDINGS

Since the thesis considers BILTEMA’s future CDC, the empirical findings will be based on the benchmarked company, IKEA. Other empirical findings regarding the current business’ material management are based on the department stores and the DC (Retlog).

Figure 24 Overview of IKEA CDC in Torsvik

4.2.1 RECEIVING

IKEA

Goods-transportation arrives from DC in Jönköping. Usually the goods are sent from DC in Jönköping as it is next door within the same area, but there are occasions when the transport comes from Älmhult DC. The goods arrive in the railway-receiving terminal or by road carriers. The goods are quality and quantity controlled and if the goods passed the first inspection it checks in to the business system with barcode scanners. The receiving function is responsible for breaking bulk after
quality/quantity assurance and storing these in different zones. (Andersson, Process Developer IKEA Torsvik, 2014-01-28)

If the quality or quantity of goods is incorrect, a claim is logged in the system towards the supplier or distributor and the product is logged into the system with adjusted quantity and the low quality products are sent to a special re-work division within the CDC, or sent to IKEA Fynd (Specialist campaign department within IKEA Department Stores) to sell at a lower price. (Andersson, Process Developer IKEA Torsvik, 2014-01-28)

**BILTEMA**

BILTEMA’s DC (Retlog) is currently handling the material supply to all the retail stores. The department stores are using the same business system that is integrated with Retlog. During the receiving routine within department stores, the quality and quantity assurances are not widely developed. The staffs usually controlled the deliveries visually and seldom check the quantity. When differentials do occur in the deliveries the staff will make complaint notification to send to the supplier (Retlog) for further reclams. When receiving goods from Retlog the products are instantly moved into the department stores’ shelves and the rest of the delivery goes into the buffer storage. (Anonymous department store co-worker of BILTEMA, 2014-04-24)

### 4.2.2 STORAGE

**IKEA**

After control, system check-in and break-bulk, the products are sent to storing in the warehouse. The policy to replenish is putting the old products at the front and new product in the back of the storage shelves. If the stocks are low at the picking zone they move the goods directly to the picking area instead of the buffer, in order to reduce additional movements of goods. Continuing on, IKEA tries to further reduce movements by storing products that are frequently ordered together; such as mattresses, beds and nightstands. By planning storage in this way IKEA tries to eliminate all unnecessary movements. IKEA continuously work with reducing inventory level in storage, especially for low demand products. (Andersson, Process Developer IKEA Torsvik, 2014-04-01)
BILTEMA
The buffer is mainly stored at BILTEMA’s DC. When the department stores’ inventory is depleted they order replenishment from the DC. The department stores try to hold lower stocks in order to reduce tied up capital and the storage area is also limited. The department stores have the policy of high exposure rate, which means that all the shelves in stores are filled up with recently delivered goods behind the older products. (Anonymous department store co-worker of BILTEMA, 2014-04-24)

4.2.2.1 BUFFER ZONES
IKEA
IKEA’s buffer zone for low flow products is located in Dortmund’s warehouse. This buffer lowers the risks of stock-out and covers the whole European region. IKEA CDC in Jönköping tries to keep a low amount of products in storage and try to minimize the amount of space for low flow products. The DC at Jönköping also stores buffers for the CDC and this products are of more high flow character. The advantages for keeping more high flow buffers at the DC in Jönköping are the closeness to the CDC for reduced replenishment time. (Andersson, Process Developer IKEA Torsvik, 2014-01-28)

The high flow products are of the opposite character. They have higher risk of stock-outs and are usually stored in the same building and are usually above the picking zone. IKEA CDC has developed a sophisticated automated system for storing and retrieving products from the buffer. The buffers are placed on high shelves and are in need of automated systems to replenish the pick zones. The buffers’ sizes are dependent on whether it is a low or high demanded product. (Andersson, Process Developer IKEA Torsvik, 2014-01-28)

IKEA CDC has a wide range of products and is expanding the range as well. With the growing quantity of orders, the storage has great need of automated pick zones. Highest turnover products are placed on ground floor and close to the pack board area which is close to the outbound area. The information for replenishment of the pick zone comes from when the picker depletes the stocks of products. The information
from the picker will register in the inventory business system and a signal will be sent to either the automated cranes or reach trucks driven by warehouse staff. When the staff receives the information (assignment) to replenish the pick zone they use reach trucks to transport goods from buffer storages. The advantage of using reach cranes, are the ability to reprioritize the replenishment of products, depending on the most critical product. The disadvantage of automated replenishment by cranes is the risk of prolonged waiting time. The automated crane could have several replenishment assignments on the line, which results in time waste. The advantage of using automated cranes, are the reduced labour costs, the possible reduction of inventory level in the pick zones. (Andersson, Process Developer IKEA Torsvik, 2014-01-28)

**BILTEMA**

BILTEMA’s buffer zone is located at the company’s DCs in Halmstad, one at the receiving port close to the harbour and the other one is located by the highway (E6). The DC at the harbour receives goods mainly from East Asia by freight and the DC at the highway receives goods from mainly East European countries. These DCs supply all department stores for BILTEMA. The company tries to have a high exposure rate at every department store, which means the end customer would not experience empty shelves. The department stores try to maintain filled shelves, which gives the department store a higher level of stocks.

All the department stores have buffer storages to supply the stores’ shelves available for customers. The department stores have higher level of inventory for high flow products in order to avoid sales lost. In relation to high demanded products, the low demanded products are mainly stored at the DCs. The department store still keeps a lower quantity at stores. (Andersson, Process Developer IKEA Torsvik, 2014-01-28)

4.2.2.2. DESIGN OF THE PICKING AREA

*Since BILTEMA does not have single handling pick process routines, the empirical founding will only be based at IKEA Jönköping.*

**IKEA**

IKEA stores goods differently depending on the demand of the product. Higher pick frequency of the products creates the need to store the products more available for
pickers. Another impact of the design of the picking area is the order batching of products. To simplify and rationalize the picking process for orders that are composed with same product range/category, the picking zones are therefore designed with related products. For example customer that orders beds usually orders night stands, bed legs, and mattresses etc. Thus theses are stored together to optimize picking processes. IKEA tries to store as much of the goods in the automated cranes. When customer orders are received the automated crane transports the goods to the picking zone. 95% of the products within the crane have variable storage and 5% have decided storage, which consist of high flow products that require closeness to the pick zone. (Andersson, Process Developer IKEA Torsvik, 2014-04-01)

Low flow products are stored at higher level within the automated crane to distribute to the picking zone. If the goods are not stored in the automated crane it may require lifting cranes to reach and pick the products. High flow products’ pick zone design has the principle of high availability for pickers. (Andersson, Process Developer IKEA Torsvik, 2014-04-01)

Anderson (Process Developer IKEA Torsvik, 2014-04-01) also highlights the necessity to implement an automated system. It requires certain amount of customer orders to become profitable and framework regarding of package/pallet sizes to fit into the system. IKEA CDC receives 6000 parcel orders and 7000 home delivery orders every week. This compiles to a total amount of 2600 customer orders every day.

4.2.3 ORDER-PICKING

IKEA

IKEA has a wide product range consisting of different sizes of products and requires different handling processes during the order picking process. Depending on the order it requires different order picking methods. Orders received form the customer to IKEA CDC could vary from single products to several products. The orders usually consist of several and diverse products with the amount of between 9 to 10 order-lines. The products could consist of cases packed from the supplier or smaller pieces in same cases that requires pickings from opened boxes. IKEA CDC has two different
divisions to handle order-pickings; parcel package deliveries or home delivery by truck. (Andersson, Process Developer IKEA Torsvik, 2014-01-28)

*Parcel delivery*

The picking process starts with the picker receiving several order lists on the truck’s terminal computer. The picker received information from the automated crane that the goods have arrived at the picking zone and are available for picking. The picker sees the order lines for the orders and gathers several cartons on the truck. Depending on the product sizes and weight of the order, the picker uses the carton boxes to separate orders. The business system has calculated and optimized the order lists to achieve efficient picking routes. After finishing the picker route the picker delivers the products to the parcel packaging area. (Andersson, Process Developer IKEA Torsvik, 2014-04-01)

*Home delivery by truck*

The process begins with the picker receiving a single order on the terminal computer. An experienced picker goes through the order and directly recognizes how to build the pallet of goods and changes the information on the consignment note before performing the order-pick. The picker recognizes the size and the weight of the products, the pick zone and the amount of the quantity to pick. The review of the order is made because of some products do not fit in the pallets. Some articles have to be placed vertically instead of horizontally, such as household appliances and sofas, due to their bulkiness. The review of the order is also made because there is a weight limit for every pallet, which creates the need for using two or more pallets. This is noted by the picker from the beginning of the order to readjust the pallet at a later stage. It is also noted in order to eliminate unnecessary movement and transportations. An inexperienced picker perceives this as more difficult, because of the order consignment design is only based on the location of the products, independent of their sizes and weights. Therefore the pickers could not follow these order consignments without considering size or weights. After finishing the order-pick the picker delivers the pallet to the Goods Out area. (Andersson, Process Developer IKEA Torsvik, 2014-01-28)
When the picker has checked the order and chosen the appropriate pallet that is perceived to be needed for the order. The pallets are retrieved from one out of two packing stations. One is located at outbound area and the other one is located at the Bulky products area. The actual picking process begins after the retrieving the pallet. (Andersson, Process Developer IKEA Torsvik, 2014-01-28)

4.2.4 PACKAGING

IKEA

The two order types (parcel and home delivery goods) require different packaging processes, which result in two packaging stations.

Parcels packaging:

When the picker has picked the orders, the orders are transported to the pack board station. The orders are wrapped in different package material, depending on the nature of the products, by staff at the pack board station. The packaging staffs have to follow the agreed size and weight from the logistics providers. Which are DHL, Posten and Bring. The frame for the size and weight are 2 kg for parcels, 20 kg and 1, 5 metres for post packages and the goes by home delivery services. To stay within the frame and criterions leads to cost reductions for IKEA. Therefore the packers are constantly working to reduce the weight, size and bulkiness of the products. One of their aspects is also to keep the packages environmentally friendly, by not using excessive amounts of padding and box sizes, fewer resources are wasted. The products are wrapped and padded in order to avoid damages during the transportation processes. IKEA is also using own branded packaging material. The packages are labelled with information of destination and shipment number. (Andersson, Process Developer IKEA Torsvik, 2014-04-01)

When handling the packages before shipping it is important not to mistreat them. Some packages are fragile and needs extra carefulness when handling products such as glass and mirrors. IKEA tries to minimize potential harm by fragile-labelling most fragile products, extra padding to make sure that the fragile products are less likely to be harmed during transportation. After packaging, padding and moving the parcels to a safe storage area in order to avoid damages. The orders move to the Goods Out area for loading and further transportations. The areas are also divided into separate
delivery destinations, such as Stockholm and Gothenburg. (Andersson, Process Developer IKEA Torsvik, 2014-04-01)

Home delivery pallets packaging:
The picker leaves the pallet at the station. The packaging process for the pallet begins by putting the pallet on a plastic wrapping machine. This machine wrapped the pallet and the goods in plastic if the order consists of several different sized products. After eventual wrapping the pallet are labelled with information of the receiver of the goods, the picker and shipment number. (Andersson, Process Developer IKEA Torsvik, 2014-01-28)

After labelling the pallets are transported and placed on the Goods Out area for loading on to outbound transports. The finished orders are loaded into the service provider’s road carriers’ trucks. After the loading process the order shipping status will be updated and sent to the customers. (Andersson, Process Developer IKEA Torsvik, 2014-01-28)

One of the most important parts of IKEA CDC’s operations regarding both parcels and pallet handling operations are documenting activities from receiving to shipping. They document all variations in quality and quantity, regarding transports, inventory levels, customers demand etc. in order to maintain a high customer service, to continuously develop. (Andersson, Process Developer IKEA Torsvik, 2014-01-28)
## Summary of Material Management

<table>
<thead>
<tr>
<th>Process</th>
<th>IKEA</th>
<th>BILTEMA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Receiving</td>
<td>Quality and Quantity control break bulk, claim incorrect products, adjusted quantity, rework or IKEA Fynd.</td>
<td>Quality and quantity control low, visual control, no quantity control, instantly move products onto shelves, rest on buffer. Documentation</td>
</tr>
<tr>
<td>Storage</td>
<td>Front old products, low stock level - put up directly, reduce movement, planning storage.</td>
<td>Order replenishments when depleted, low stocks for low tied up capital in DC, high exposure rate – new products behind old.</td>
</tr>
<tr>
<td>Buffer Zone</td>
<td>Dortmund and Jönköping, low amount of low flow, high amount of High flow, replenishment time, high risk vs. low risk of stock out, automated system, automated pick zones, highest turnover on floor, signals to reach cranes for picking, reprioritizing route, risk of waiting time, time waste, reduced labour cost, reduction of inventory level, bed with nightstand.</td>
<td>Port and highway, supply all department stores, high level of stocks, high flow high stock level at Department store, low flow stored at DC, low quantity of low flow in store, car products – close to each other.</td>
</tr>
<tr>
<td>Design of the picking area</td>
<td>Customers’ order designed picking area, high rate of automated picking</td>
<td>-</td>
</tr>
<tr>
<td>Low pick</td>
<td>High flow products</td>
<td>-</td>
</tr>
<tr>
<td>High pick</td>
<td>Low flow products</td>
<td>-</td>
</tr>
<tr>
<td>Frequency pick</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Order-picking</td>
<td>Orders vary in character, depending on order for picking method, 9-10 order-lines; picker receives one or several orders, case packed or smaller pieces.</td>
<td>-</td>
</tr>
<tr>
<td>Parcel Delivery</td>
<td>Receiving several orders consist of smaller and lighter products, automated picking for availability, separated boxes, optimized picking route</td>
<td>-</td>
</tr>
<tr>
<td>Home Delivery by truck</td>
<td>Receiving single orders consist of larger, bulky and numerous products, pallet picking with truck, personnel adapted picking route</td>
<td>-</td>
</tr>
<tr>
<td>Packaging</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Parcels</td>
<td>Wrapped depending on nature, frame size and weights, environmental material, branded packaging material, labelled with destination and shipment information, fragile labelling and padding, divided into delivery destinations.</td>
<td>-</td>
</tr>
<tr>
<td>Home Delivery</td>
<td>Plastic wrapping, label with information, placed in Goods out area, update shipping status, documentation.</td>
<td>-</td>
</tr>
</tbody>
</table>

Table 22 Summary of empirical findings Material Management
4.3 ANALYSIS

BILTEMA does not have a current CDC that handle parcel orders or home delivery orders. Retlog’s material management is only based on handling pallets and breaking bulks, such methods are inappropriate for a future CDC. As such IKEA CDC’s picking methods where benchmarked in order to create an understanding of how BILTEMA can develop their internal material management for their future CDC.

4.3.1 RECEIVING

During receiving personnel inspect the delivered goods in order to identify quality and/or quantity variation. If there are differentials they are reported, but it is hard to discover hidden variations in quality. They are usually discovered at a later stage. Discovered differentials have to reported and documented. (Lumsden, 2012) IKEA CDC in Jönköping receives goods from IKEA DC Jönköping. The goods are quality and quantity inspected and if unapproved, the goods are logged into the system and adjusted for quantity or when the quality is unsatisfying, sent to either rework or IKEA Fynd to be sold at an adjusted price. (Andersson, Process Developer IKEA Torsvik, 2014-01-28) BILTEMA’s DC (Retlog) handles the supply to all stores and the stores do not control quantity or quality thoroughly, mostly all received goods are instantly moved on to the shelves and the rest into buffer storage. If differentials do occur, the department stores will send complaint notifications to Retlog for further claims. (Anonymous department store co-worker of Växjö BILTEMA, 2014-04-24)

Reflections/analysis

Receiving goods in a CDC has to have better routines than department stores. The quality and quantity control is needed in order to not deliver unsatisfying goods to the customer and might be prevented by early quality control. IKEA has understood the importance of quality/quantity control and are more thorough during receiving control. It is also easier to claim the supplier for delivering damaged goods the sooner the differential is discovered. But even though the quality might be lower on some products they are still able to sell them, although not at full price. BILTEMA does not have a bargain store like IKEA Fynd, as they do not sell slightly damaged goods. This makes it important for BILTEMA to develop a quality and reclaims routine.
4.3.2 STORAGE

Different methods of storing are represented in warehouses depending on the business activities (Lumsden, 2012). A widely used method is the first in first out principle, which avoids incurrences by using older products before using the newer products (Nahmias, 2009). The authors have identified this method represented in IKEA CDC Torsvik. (Andersson, Process Developer IKEA Torsvik, 2014-01-28)

Buffer zone

The meaning of buffer zones is to reduce goods from the picking zones. There are three kinds of buffer zones within warehouses: Aside the main building, close buffer and pick zone buffer. (Lumsden, 2012) IKEACDC Torsvik uses its aside buffer in Dortmund and IKEA DC in Torsvik to store low flow products. The Dortmund warehouse does not only benefits IKEA Torsvik, instead covers other regions in the European market to avoid stock-outs instead of waiting goods from the supplier. Bigger deliveries from supplier are also stored in Dortmund for IKEA DC and CDC in Torsvik. The close buffer is placed in the automated cranes and replenishes the picking zone when needed. IKEA CDC Torsvik’s pick zone buffer is also stored in the automated crane’s ground level with high flow products. Products with high turnover rate which could be reached quicker and transported to the picking zone. (Andersson, Process Developer IKEA Torsvik, 2014-01-28) BILTEMA uses the company’s current DC’s four warehouse facilities in Halmstad (Retlog) for receiving goods from Asia and Europe. The department store uses the DC as their aside buffer storage. Every department store has their in-house buffer at store, which could relate to the theories’ close buffer.

Design of the picking area

According to Lumsden (2012) storage area for the picking zone has three picking variant: low, high and station pick. Petersen (2002) also made an input regarding the frequency of pick for different product range. There are three storage areas for the picking zone: low, high and station pick, depending on the product range (Lumsden, 2012; Petersen, 2002). The order-pickers do not need any lifting cranes to reach products in the low picking zone. Equipment such as wagons or trucks is used for gathering smaller sizes of orders. IKEA uses the same way (wagon or trucks) to perform order-picks as theory mentioned. The goods are ready for pick after being
transported by the automate system to the ground level of the picking zone. The order-pickers use trucks to collect goods at the picking zone. The picking zones are designed and divided into customer orders. For example when a customer orders a bed, the person usually orders nightstands, bed legs etc. Petersen (2002) means that the method is suitable for many order lines, consisting of smaller products, because of the efficiency improvement in reaching ground level products. Buffer storages are placed above this low picking zone for simplified replenishment, but IKEA does not need to place the product above the picking zone, because the goods are transported by the automated cranes by received orders to the system. This means that the right amount of products have already been transported to the pick zone. Petersen’s (2002) high picking zone are therefore not relevant for IKEA, since the company uses a developed automatized crane to transport products to ground level for order-picking. Frequency pick zone is a zone that has goods with high frequency picks. This should be placed close to the front of the pick zone to reduce pickers travel time. Petersen (2002) Andersson (Process Developer IKEA Torsvik, 2014-01-28) say that IKEA’s frequency pick zone is placed close to the front of the pick zone as such it reduces the picking-time as a result of reduced transportation time for the pickers.

**Reflections/analysis:**

The authors has observed this method of first in first out principle in IKEA and sees the benefits reached from the principle, by avoiding incurrences but may cause additional movements of goods.

Buffer zone aside for IKEA CDC Torsvik are located in Dortmund and IKEA DC Torsvik and leads to several benefits, such as lower inventory level and free spaces for the picking zones to reach higher picking efficiencies. The close buffer and pick zone buffer divides the product range into low and high flow products which reduces transportation time for the prioritized products. The department stores use their current DC in Halmstad as their buffer.

The design of the picking area at the IKEA CDC Torsvik is not exactly the same as the theory mentioned by Lumsden (2012) and Petersen (2002). IKEA’s automated system is well-developed to transport goods to the picking area after received orders. The common factors with the theories are the low pick zone which is on the ground
level for the pickers and the first principles’ efficiencies of frequency picks. The frequency pick zone consists of goods with high turn-over rate, which are placed close to the pickers, in order to reduce transportation time. IKEA’s automated crane also places goods with high frequency close to front of the pick zone. For example popular product ranges are placed close to the pickers. In order for investments in an automated crane system to become profitable, companies need to have a certain amount of customer orders. IKEA CDC have 6000 parcel orders and 7000 home delivery orders every week which compiles to a total amount of 2600 customer orders every day. To reach high usage rate in the automated cranes, the nature of the products require certain size-frames that fits into the system. Anderson (Process Developer IKEA Torsvik, 2014-01-28) mentioned the company’s second principle for designing the picking area, which is placing complementing products within area. BILTEMA could apply the same principle regarding high flow products on ground level and low flow products on higher level.

4.3.3 ORDER-PICKING
Parcel delivery
The order-picking starts with the picker receiving several orders on the individual truck computer. The picker further receives information from the automated crane that goods are available for picking. The picker gathers several empty carton boxes on the truck. Depending on the product sizes and weights of the orders, the picker uses the carton boxes to separate orders. (Andersson, Process Developer IKEA Torsvik, 2014-04-01) This is in-line with Piasecki (2012) that explains the batch picking/multi-order picking in batch picking, a method for orders with a low amount of picks per order. Several orders are batched together and they are picked at the same time using a wagon and several cartons. The orders should have between 4-12 order-lines for this method to be efficient. A disadvantage for this method is the waiting time for system order-batching and thus can be inefficient for same-day shipping operations. Continuing on, the business system at IKEA CDC optimizes the picking route in order to create an efficient order-picking. Besides system waiting time created by order-batching, inefficiency might arise from several automated picks, consisting of several different products, which might create a queue at the automated cranes. (Andersson, Process Developer IKEA Torsvik, 2014-04-01)
Home delivery by truck

The picking begins with the receiving of one order on the terminal computer. An experienced picker directly recognizes how to build the pallet of goods and changes the consignment note before picking the order. The picker recognizes the size and the weight of the products, the pick zone and the amount of the quantity to pick. The review is made because some products do not fit in the pallets. Some articles have to be placed vertically instead of horizontally. The review of the order is also made because of weight limits, which create the need for multiple pallets. This is initially noted by the picker in order to adjust the pallet at a later stage. It is also noted in order to eliminate unnecessary movement and transportations. The consignment design is only based on the location of the products, independent of their sizes and weights. Therefore the pickers cannot follow these order consignments without considering size or weight. The picker delivers the finished pallet to the Goods Out area. (Andersson, Process Developer IKEA Torsvik, 2014-01-28) IKEA’s way of picking the larger products and orders agrees with Piasecki’s (2012) basic order-picking or individual picking strategy, which is a method where the picker only picks one order at the time usually using a chart, wagon or truck. The pick route is optimized and the documentation is synchronized with the pick route. In order to create a more efficient picking, the fast moving goods are in need of being placed close to the main picking aisles and larger, bulkier products are to be placed at the end of a pick route. This method is recommended for operations with a small number of orders and high number of picks per order. Furthermore the products and the way of picking can be related to Case picking. Case picking suits businesses that have less diverse products and usually larger. Fewer SKU’s and higher picks per SKUs and consists of Base case-picking and Zone picking. Base case-picking is for operations where goods are stored on racks or on the floor in static shelves and pickers pick one order at the time.

Zone pick is a method where the area is divided into individual pick zones where one picker is responsible for the zone. The order moves from one zone to another and the method is suitable for large numbers of orders and with low to reasonable amount of picks per order. (Piasecki 2012) Andersson (Process Developer IKEA Torsvik, 2014-04-01) cannot comment the efficiency of zone picking, seeing as IKEA CDC does not perform this type of picking-method.

Reflections/analysis:
Parcel delivery
IKEA CDC’s parcel picking usually works by first batching orders together in order to rationalize the picking. They pick single orders at a time but this is inefficient compared to batching, as it increases the travel distances and, in extension, time use is increased. In order for BILTEMA to create efficient picking, BILTEMA should consider batching together most parcel orders.

Home delivery
The Home delivery picking has a greater diversity of picking methods. When picking bulkier objects it is important for the picker to recognize the product and plan the picking accordingly, usually these orders are picked one at the time because of the bulkiness and in order to avoid picking wrong products or missing a pick. BILTEMA has smaller products in general compared to IKEA and a small amount of larger and bulkier products. As such, the range might be considered having greater variation of sizes than IKEA.

The authors found that the theory of zone picking by Piasecki (2012) was found to be irrelevant at IKEA CDC possibly because of the wide product range and the nature of the products.

4.3.4 PACKAGING
Parcels packaging
When the pickers have picked the orders, the orders are transported to the pack-board where it is wrapped in suitable materials depending on the nature of the products. The packaging staffs have to follow the agreed size and weight from the logistics service providers (LSP). (Andersson, Process Developer IKEA Torsvik, 2014-04-01) This is in accordance with Lumsden (2012) where the packaging should consist of wrapping up the products and make sure that appropriate packing material are used, because of the third part logistics providers regulations of specific package materials or sizes. For IKEA it also means that if orders can be made to stay within the criterions for parcels, cost-reductions and increased environmental responsibility-taking might be attained (Andersson, Process Developer IKEA Torsvik, 2014-04-01).
Besides wrapping and padding etc. in order to avoid damages during the transportation processes, the material is also branded in order to reduce the likeliness of dishonesty from LSPs and customers. (Andersson, Process Developer IKEA Torsvik, 2014-04-01) Fan et al. (2013) agrees with IKEA CDC’s packaging process at this stage and says that orders should be neatly packed. The packed box with the whole order should secure products together and eliminate loose attachments, which can cause damages during transportations. Further benefits from branded packaging material are to prevent potential dishonesty from LSPs. Continuing on; branded materials might reduce incomplete returns from potentially dishonest customers trying to take advantage of companies’ return policies. Many e-commerce businesses have the policy of no return if packages are opened. (Fan et al., 2013)

In order to avoid damages to the end-customers’ products, right and suitable packing methods should be developed. (Lumsden, 2012) IKEA works with avoiding damages through careful handling. Some packages are fragile and needs extra carefulness when handling products such as glass and mirrors. IKEA tries to minimize potential harm to these through fragile-labelling and extra padding. (Andersson, Process Developer IKEA Torsvik, 2014-04-01) Lumsden (2012) also agrees with this as the packing, wrapping and padding have to be adapted and appropriate depending on the nature of the product.

After wrapping, the orders are moved to a safe storage area where they are temporarily stored, waiting for further distribution. This storage needs to be relatively safe in order to reduce potential damages. (Lumsden, 2012) IKEA works with securing orders from damages, in accordance with Lumsden, by moving the parcels to a safe storage area in order to avoid damages. This temporary storage area orders move to the Goods out (GO) area for loading and further transportation. (Andersson, Process Developer IKEA Torsvik, 2014-04-01)

Continuous documentation of the material management process is required in order to further improve the operation and identify problems. (Lumsden, 2012) One of the most important parts of IKEA CDC’s operations regarding the material management is documenting all activities from receiving to shipping. IKEA documents all variations in quality and quantity, regarding transports, inventory levels, customer’s
demand etc. in order to maintain high quality service, as well as to continuously develop their organisation. (Andersson, Process Developer IKEA Torsvik, 2014-01-28)

**Home delivery pallets packaging**

At IKEA CDC the pallet is wrapped using plastic wrapping machines after completed picking, padding is also added in order to not harm the products. After wrapping, the pallet is labelled with information of the receiver, the picker and shipment number. (Andersson, Process Developer IKEA Torsvik, 2014-01-28) Lumsden (2012) agrees with IKEA CDC and stresses the point of packing, padding, wrapping as well as meeting the logistic service providers’ regulations of specific package-materials and sizes. Fan et al. (2013) further agrees and argues the importance of using branded plastic wrapping in order to avoid missing products and dishonesties from LSP and customers.

After labelling, the pallets are placed on the Goods Out area for loading and further transportation. After loading, the order’s shipping status will be updated and sent to receiver. IKEA prioritize careful handling and secure storing after packaging. (Andersson, Process Developer IKEA Torsvik, 2014-01-28) Lumsden (2012) agrees and stresses the importance of secure storage in order to avoid damages before shipping.

One of the most important parts of IKEA CDC’s operations regarding both parcels and pallet handling operations are documenting activities from receiving to shipping. IKEA documents all variations regarding quality/quantity, transportation, inventory levels, and customers demand etc. in order to maintain high service and continuous improvements. (Andersson, Process Developer IKEA Torsvik, 2014-01-28) Lumsden (2012) agrees with this and stresses the importance of constant documentation in order to improve and identify problems in the organisation.

**Reflection/analysis**

*Parcel delivery*

Different types of packaging materials are used and depend on the nature of the products ordered, such as sizes, weights, bulkiness etc. Like IKEA, BILTEMA will
have to follow agreements with logistic service providers and try to minimize, size, weight bulkiness in order to not exceed delivery frameworks. Further BILTEMA have to consider branded wrapping in order to minimize potential harm and dishonesty. IKEA has a Goods out area, where finished orders are stored, waiting to be loaded and shipped to customers. The area is a precaution for reducing potential harm.

**Home delivery**

In comparison to parcel deliveries there are no maximum size, weight and bulkiness of an order or products in *home delivery orders*. Orders that exceed the agreed size and weight framework for parcel deliveries become *home delivery orders*. As such the packaging and wrapping of the order needs to consider the nature of the products and keep the order together. Branded wrapping is in this regard great for packing an order with reduced risk for damages from loose attachments as well as reduced risk for dishonest customers or logistic service providers. In the case of fragile products the orders are labelled fragile and extra padding is added, as well as the order being carefully handled when products are of a more sensitive nature.

As earlier mentioned BILTEMA should consider establishing a Goods out area where finished orders are stored, waiting to be loaded and shipped to the customers. The area is a further precaution for reducing potential harm to orders. Lastly constant documentation of differentials or variations is needed in order to be able to continuously improve the organisation and eliminate problems. Documentation is important to be able to adapt a large organisation like BILTEMA.
<table>
<thead>
<tr>
<th>Process</th>
<th>Activities</th>
<th>Empirical</th>
<th>Suggestion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Receiving</td>
<td>Quality and quantity inspection, documentation for reclaims.</td>
<td>• IKEA: Quality/quantity check, claim, rework, IKEA Fynd</td>
<td>Quality/quantity assurance, claim, rework, no BILTEMA Fynd,</td>
</tr>
<tr>
<td>Storage</td>
<td>Storage to picking or buffer zone. First-first-out.</td>
<td>• IKEA: First-in-first out-principle</td>
<td>First-in-first-out-principle</td>
</tr>
<tr>
<td>Buffer Zone</td>
<td>Aside, close or picking zone</td>
<td>• IKEA: Aside in Dortmund and IKEA DC in Torsvik, close at higher level in the automated cranes in IKEA CDC and pick zone buffer at ground level</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• BILTEMA ’s department stores sees Retlog as their aside buffer, close in-house buffer</td>
<td>Retlog aside buffer, same principle – close buffer at higher level and pick zone buffer at ground level.</td>
</tr>
<tr>
<td>Design of the picking area</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low pick zone</td>
<td>Without any picking equipment, many order-lines.</td>
<td>• IKEA: Ground level in the automated system</td>
<td>No automated system, ground level</td>
</tr>
<tr>
<td>High pick zone</td>
<td>Requires equipment, computerized automatized,</td>
<td>• IKEA: High level in the automated system</td>
<td>No automated system, higher level but requires equipment (lifting cranes)</td>
</tr>
<tr>
<td>Frequency pick zone</td>
<td>High SKU:s product with high picking frequency close to the front of the picking zone</td>
<td>• IKEA: Popular product range close to the pickers. Second principle is complementing product at the same area</td>
<td>No automated system, popular product range close to the pickers. Second principle is complementing product at the same area</td>
</tr>
<tr>
<td>Order-picking</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parcel Delivery</td>
<td>Non-bulky products, fewer orderliness, pick using cases, batch and single order, automated</td>
<td>• IKEA: Order-batching</td>
<td>Order-batching</td>
</tr>
<tr>
<td>Home Delivery by truck</td>
<td>Bulky, several order-lines, pick using truck, single order, automated</td>
<td>• IKEA: Plan picking, single order pick</td>
<td>Plan picking, single order pick</td>
</tr>
<tr>
<td>Package</td>
<td>Packing, handling, storing and documenting, wrapping, labelling, prevent damages.</td>
<td>• IKEA: Adapted packaging, branded wrapping, LSP framework, careful handling, safe storage area, continuous documentation for improvement</td>
<td>Adapted packaging, branded wrapping, LSP framework, careful handling, fragile handling, safe storage area, continuous documentation for improvement</td>
</tr>
</tbody>
</table>

Table 23 Summary of Analysis Material Management
5. CONCLUSION, CRITIQUE OF OWN WORK AND FUTURE RESEARCH

This chapter begins with presenting the thesis’ conclusions for each research question. Furthermore suggestions to BILTEMA will be presented followed by criticism of the thesis, socioeconomic aspect and finalized with suggestions for future research.

5.1 Where should BILTEMA place their future CDC in Sweden in order to implement the company’s e-commerce?

The qualitative factors that Örebro was found to be the most suitable region for are orientated towards expansion and customers. This orientation is found from being close to both existing and potential of growth markets. The authors deem the expansion strategy and the secured-supply strategy as equally important for the company’s future e-commerce orientation.

Furthermore, the quantitative factor should be seen as an indication of where to locate the CDC for BILTEMA, but does not take into account the qualitative factors and BILTEMA’s preferences.

Figure 25 Showing Örebro is the closest region to the central of gravity
From having concluded that Örebro receives 12 points and Halmstad 7, 67 points. The most suitable location is Örebro with its superiority in being close to customers, opportunity for expansion, accessibility and being located close to the centre of gravity of all of the Nordic countries’ inhabitants.

5.2 How should the Material Management at the future CDC operate?

Our suggestions for the operations of BILTEMAS future CDC’s Material Management consist of receiving, storage, order-picking and packaging. Qualitative and quantity assurance policies have to be established during the receiving. Differentials in quality and quantity should be claimed from the supplier (Retlog) and documented. Some product quality issues could be refurbishing at the established rework area. The “Fynd-concept” by IKEA is not suitable for BILTEMA, since some of the company’s products require flawlessness, such as car parts that cannot be sold with lower quality at a discount price. BILTEMA will use the principle of first-in-first-out regarding storing and uses Retlog as aside buffer. The close buffer and pick zone buffer will be placed at higher and lower level storage. Unlike IKEA’s design of pick zone, BILTEMA should not invest in an automated system. Instead the storage and picking should use manual handling to prevent uncertainties in future demand variations. The design of the picking area will locate the high flow products at the ground level and low flow products at higher level, which requires lifting crane to reach. Furthermore the design of the picking area will place complementing products at the same area. The well-developed picking area simplifies the order-picking by reducing travel time and distance. The order-picking for BILTEMA will be divided into parcel and home delivery categories. The parcel picking will use order-batching in order to increase efficiencies. Home deliveries require experienced order-pickers to plan the picking route. Single order-picking will be used for the majority of home delivery orders and after which the products will be transferred to the packaging area. Adapted packing and branded material will be used in order to reduce potential damages and added benefit of reducing dishonest behaviour from customer and LSPs. Fragile products will be labelled and extra padded. Furthermore the handling of products should strive for constant carefulness. BILTEMA will have to follow the LSP framework regarding size and weights regulations for the parcel packages. The order pallets regarding home deliveries have to be well-packed to prevent loose
products during transportation. After packing, wrapping and labelling the orders are to be transported to a designated storage area for outbound deliveries. Throughout the whole material management documentation is important for constant improvements and future development. The general material management for BILTEMA’s future CDC should consider following aspects. (Table 24)

<table>
<thead>
<tr>
<th>Receiving</th>
<th>Storage</th>
<th>Order-picking</th>
<th>Packaging</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quality/quantity assurance</td>
<td>First-in-first-out</td>
<td>Parcel - Order-batching</td>
<td>Parcel – LSP framework</td>
</tr>
<tr>
<td>Supplier claim</td>
<td>Retlog as aside buffer</td>
<td>Home – single picking, experienced order-pickers</td>
<td>Home –well-packed pallets.</td>
</tr>
<tr>
<td>Re-work/refurbish</td>
<td>Close buffer at higher level</td>
<td></td>
<td>Branded wrapping, padding, shipment labelling</td>
</tr>
<tr>
<td>No BILTEMA “Fynd”</td>
<td>Pick zone buffer at lower level</td>
<td></td>
<td>Fragile labelling - extra wrapping and padding</td>
</tr>
<tr>
<td></td>
<td>No automated system</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>High flow at lower level pick area and low flow at higher level pick area</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Product complementing design of pick zone</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 24 Table of conclusion for Material Management

5.3 REFLECTIONS AND CRITIQUE
Initially in the creation of this paper, some difficulties in narrowing down the problem occurred. Seeing as the paper was to cover the subject of different deliberations that exists in establishing a CDC for a multinational business like BILTEMA, there were many areas in which the thesis could have focused. There were many uncovered areas that could have been interesting to investigate but some restrictions were necessary. The narrowing down led to the paper becoming two parts in which any paper could have focused solely on one. But with the importance of covering the subjects in a more strategic view both were covered.

The paper was performed by two authors within time limits and predetermined seminars, thanks to the cooperation of BILTEMA, IKEA, municipality personnel, opponents, supervisor and examiner.
In hindsight the paper was developed with a greater focus on the localisation of the CDC than first intended although the focus turned out to be of great benefits to BILTEMA’s decision-making.

In order to further create legitimacy for the paper and the chosen Material Management, benchmarking at other e-commerce businesses would have been beneficial. A benchmarking of BILTEMA greatest e-commerce competitor, Skruvat.se would further have benefited the decision-making, seeing as the companies are competitors within the same market, this perceives as unethical research method. IKEA does not act within the same market and the company has a well-developed CDC that was applicable for BILTEMA’s future businesses. The critique for chosen IKEA as the benchmarked company is the amount of e-commerce orders. IKEA’s brand and customer segment is considerably larger than BILTEMA’s and the uncertainties regarding the company’s e-commerce business market have to be considered. Benchmarking the IKEA’s automated buffer storage or order-picking system may not become the most suitable aim. Furthermore the principle regarding the storage or pick zone design could be applicable.

5.4 THE THESIS CONTRIBUTION

This paper has contributed BILTEMA’s management with basis for deciding the localisation of a CDC and a basis for potential business development with another channel to end consumers. The consequence could be additional revenue from potentially increased sales, but also higher costs for BILTEMA with higher inventory levels, transport costs and greater complexity in the supply chain. This paper has also contributed to theoretical development of a CDC for e-commerce with basis in traditional warehouse localisation with empirical data from BILTEMA and IKEA. Furthermore, Material Management theory for CDC’s based on theories of traditional Material Management and benchmarking at IKEA CDC.

5.5 SOCIOECONOMIC ASPECTS

The conclusions presented in the thesis works as a basis for decision-making regarding the potential establishment of e-commerce business. The e-commerce
business should BILTEMA choose to establish it, will help to develop the chosen region and further compete with businesses within the same industry. An establishment of e-commerce might increase BILTEMA’s appeal for younger adults generally as a brand. Seeing as Skruvat.se has an expanding turnover and profit as a result of a working business strategy, BILTEMA should also be able to attract this market segment. Further, BILTEMA could possibly affect traditional buying behaviour to purchase online as an alternative.

If the online demand for BILTEMA’s products increases, further investments in the CDC will be needed if BILTEMA reaches daily orders of about 2600 orders (IKEA’s daily CDC-orders) they could consider investing in an automated system. An investment in an automated system could create profit for the chosen suppliers of the automated system and further increase incentives for the supplier to hire competent personnel.

Establishing a CDC has the added potential benefit of creating opportunity for customers, without car, to order and buy BILTEMA’s products online, seeing as BILTEMA usually establishes department stores outside urban areas.

Furthermore, competitors might start up e-commerce business and further create opportunities for customers, to purchase online. Another benefit would be if customers stopped driving to BILTEMA as a consequence of the establishment of a CDC. Emissions from cars might be reduced as a result of less customers driving and more deliveries from LSPs, seeing as LSPs have more efficient delivery routes.

5.6 FUTURE RESEARCH
In the future the environmental aspect might be more highly valued and is a factor that should be more widely considered. But as there have not been any conclusive results that might favour any region, this factor has no significant effect on the paper at this point.

During the course of the paper and the analysis of the Material Management part, the authors discovered that a deeper research into the nature of the products, market segment would have been of great benefit. Especially analysing the customer segment
at BILTEMA as well as different product-segmentation methods would have been interesting for decision-making of the potential establishment of e-commerce.

Future research should cover the importance of multinational businesses to create an integrated business system with live updates. From our research we came into contact with the difficulties that IKEA is facing regarding lagging in system-updates due to different systems that have to communicate with each other. As time has passed, the technological solutions at IKEA have become inefficient and almost too complex to fix. IKEA agrees with this to some extent as there has been previous projects concerning creating a global integrated system to rationalize the system-updating, which reduces order-lead time.

Our thesis covers the material management from receiving to packaging, but does not take into account different delivery options to end-customers. One such delivery option is Click and mortar, and focuses on delivering to customers using the existing sales channels, which is the department stores. There are several delivery methods and a research paper concerning different delivery options for e-commerce businesses would attract interest.

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**Doctoral Thesis**


**Specialist Literature**


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http://app.linkoping.se/statdok/sabok/70.pdf

Allocation of working forces of industry life
http://www.linkoping.se/Global/Om%20kommunen/Fakta%20om%20Link%C3%B6ping/Statistiska%20fakta%20om%20Link%C3%B6ping/Tabeller%20och%20diagram/Fickfakta%20svenska.pdf?epslanguage=sv

Lokaler.nu
Information of recently established warehouses in Jönköping
http://www.lokaler.nu/pdf/32088/laddaner

Logpoint.se
Business industries meeting, discussing infrastructure projects, 2013-12-10:

Building new equipped truck parking places:

Railway extensions:
http://www.logpoint.se/index.php/byggstart-for-fornbigangsspar-vid-torsvik/

Lonestatistik.se
Salary statistics of warehouse workers in Sweden
http://www.lonestatistik.se/loner.asp/yrke/Lagermedarbetare-1306

Motormagasinet.se
News regarding the investment and growth of spare parts online
http://www.motormagasinet.se/alla/skruvat-se-utsett-till-gasellforetag/

Nyhetsrummet.se
News about the investment and growth of a spare parts online business, skruvat.se
http://www.nyhetsrummet.se/nyhet/11990/scope-investerar-i-skruvat-se/

Objektvision.se
Samples of warehouse rental objects in Halmstad, Linköping, Jönköping, Örebro
http://www.objektvision.se/Beskriv/148001163?r=1:
http://www.objektvision.se/Beskriv/98190656;
http://www.objektvision.se/lagerlokaler/link%C3%B6ping,
http://www.objektvision.se/Beskriv/148002883

Örebro.se
Webpage for Örebro Municipality
http://pxweb.orebro.se/pxweb/sv/Befolkningsprognos/Befolkningsprognos__Kommu
n/Befprog13kontio.px/table/tableViewLayout1/?rxid=4e390c6f-4103-4b31-b2f2-
a6238d3087b4
Allocation of working forces of industry life
http://www.orebro.se/1812.html
Ostlanken.se

Information regarding the new railroad investment between Stockholm-Linköping
http://www.ostlanken.se/om-ostl%C3%A4nken/om-ostl%C3%A4nken

Regering.se

Biggest infrastructure investment by government. Decision of 2014
http://www.regeringen.se/sb/d/18460/a/238254

Regionorebro.se

Regional collaboration organisation for growth and sustainable development.
http://www.regionorebro.se/gronmeny/nyheterpress/nyheter/2014/2014/bastalogistikla
gorebroregionenpaandraplats.5.799c65b31439f82ed961bef.html
http://www.regionorebro.se/blameny/infrastrukturlogistik/godslogistik.4.3a1f197e112
e69dd7238000450.html

Svensknaringsliv.se

Swedish organisation for analysing growth, opportunities and news in Swedish
businesses.
http://www.svensknaringsliv.se/regioner/jonkoping/bakom-kulisserna-pa-
ikea_569303.html

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Newspaper from South part of Sweden, specific article about regional opportunities
and economic growth improvements.
Pia Kinhult, CEO of Region Skåne (2013)
http://www.sydsvenskan.se/opinion/aktuella-fragor/strackan-oslo-goteborg-malmo-
kopenhamn-kan-bli-en-arbetsmarknadsregion/

Trafikverket.se

Swedish governmental organisation responsible for research in infrastructure in
Sweden.
Trafikverket about route 40 (2014)
http://www.trafikverket.se/Privat/Projekt/Vastra-Gotaland/Vag-40-mellan-Dallebo-
och-Hester/
Interviewed person
Atthage, J., CEO of BILTEMA, 2014-01-14
Brozén, E., CEO of East Sweden, 2014-03-15
Dufva, H., Chief of Sustainability of Örebro Municipal, 2014-04-16
Granholm, J., Distribution Manager of Retlog, 2014-04-29
Hansson, M., CIO of Retlog (BILTEMA’s DC), 2014-03-25, 2014-04-25
Helgesson, R., Property developer, NCC, 2014-04-23
Jansson, I., Marketing Manager of Business Region Örebro, 2014-04-23
Jönsson, G., CIO of BILTEMA, 2014-01-14
Larsson, K, Miljöstrateg, Halmstad Municipality, 2014-04-07
Larsson, L., VD HUI, 2014-01-24
Oldén, L., Environment inspector, Jönköping Municipality, 2014-04-07
Anonymous Department Store-worker BILTEMA, 2014-04-24
APPENDIX 1 – Interview guide

Date: 2014-01-14
Persons: Atthage, Jonas – CEO of BILTEMA
        Jönsson, Göran – CIO of BILTEMA
Purpose: Identifying the problem and overview of BILTEMA
Questions:
  How does the organization works? Different division, department stores, DC, 
  workers, supplier, customer, market segment etc.? 
  Why does BILTEMA want to implement e-commerce business? 
  How does the market look like for the e-commerce business? 
  What product Ranges do BILTEMA have the most? Sizes or weights? 
  Why did BILTEMA establish the DC Retlog in Halmstad?

Date: 2014-01-24
Person: Larsson, Lena - CEO of HUI
Purpose: Indication of e-commerce development
Questions:
  How do you see the e-commerce market in the future and how has it developed?

Date: 2014-01-28
Person: Andersson, Lena - Process Developer IKEA Torsvik
Purpose: Benchmarking and overview of IKEA CDC
Questions:
  Why did IKEA establish e-commerce? 
  Why did IKEA establish the CDC in Jönköping? 
  Why did IKEA not establish the CDC in Älmhult? 
  Why did IKEA also establish a DC in Jönköping next to the CDC? 
  Has it been profitable? 
  How does the CDC work? 
  What are the most important factors to consider when establishing a CDC? 
  How does an order go from being placed to being delivered? (Order-
  Information-system and physical flow) 
  How does the material management in the warehouse work? 
  What equipment is utilized? 
  What could be better, what are the most extensive issues at the moment?

Date: 2014-02-14
Person: Jönsson, Göran - CIO of BILTEMA
Purpose: Delimitation of research area and focus on core issues
Questions:
  Has BILTEMA had any preceding ideas to establish e-commerce? 
  Why does BILTEMA want to establish e-commerce now? 
  Does BILTEMA have any idea of where they would want to establish a 
  CDC? 
  Why would BILTEMA want to establish the future CDC in this region?
How would the future CDC operate?  
What functions are to be established?  
What is the nature of the products that are most likely to be ordered online?

**Date: 2014-03-04**  
**Person:** Jönsson, Göran - CIO of BILTEMA  
**Purpose:** Investigate the consequences of locating a warehouse in the different regions  
**Questions:**  
Where should BILTEMA locate their CDC?  
What would be the consequences of locating in Linköping?  
What would be the consequences of locating in Halmstad?  
What would be the consequences of locating in Jönköping?  
What would be the consequences of locating in Örebro?  
Pros and cons of the different regions?

**Date: 2014-03-25**  
**Person:** Hansson, Martin - CIO of Retlog  
**Purpose:** Investigate the consequences of locating a warehouse in the different regions  
**Questions:**  
Where should BILTEMA locate their CDC?  
What would be the consequences of locating in Linköping?  
What would be the consequences of locating in Halmstad?  
What would be the consequences of locating in Jönköping?  
What would be the consequences of locating in Örebro?  
Pros and cons of the different regions?

**Date: 2014-03-25**  
**Person:** Brozén, Elin - CEO of East Sweden  
**Purpose:**  
**Questions:**  
How did your organisation work to maintain good collaborations between different stakeholders within the region?  
How are the competences within the region?  
What is the region’s strength?

**Date: 2014-04-07**  
**Person:** Larsson, Karin - Environmental strategist, Halmstad municipality  
**Purpose:** Investigating the extent of differences in municipalities control on environmental regulations and taxations  
**Questions:**  
Does Halmstad municipality tax and regulate environmental issues for businesses?  
Is there any added regulation or taxation on a municipal level?  
If yes, how and what?

**Date: 2014-04-07**  
**Person:** Oldén, Lennart - Environment inspector, Jönköping municipality  
**Purpose:** Purpose: Investigating the extent of differences in municipalities control on environmental regulations and taxations  
**Questions:**
Does Jönköping municipality tax and regulate environmental issues for businesses?
Is there any added regulation or taxation on a municipal level?
If yes, how and what?

Date: 2014-04-16
Person: Dufva, Hanna - Chief of Sustainability of Örebro Municipal
Purpose: Investigating the extent of differences in municipalities control on environmental regulations and taxations
Questions:
Does Örebro municipality tax and regulate environmental issues for businesses?
Is there any added regulation or taxation on a municipal level?
If yes, how and what?

Date: 2014-04-16
Person: Sylvan, Torgny - Environmental inspector, Linköping Municipality
Purpose: Investigating the extent of differences in municipalities control on environmental regulations and taxations
Questions:
Does Linköping municipality tax and regulate environmental issues for businesses?
Is there any added regulation or taxation on a municipal level?
If yes, how and what?

Date: 2014-04-23
Person: Helgesson Richard - Property developer of NCC
Purpose: Understanding the different price levels for building and renting a warehouse in the different regions
Questions:
Are there any larger differences in costs between the regions?
Is there any construction work for new warehouses presently?

Date: 2014-04-23
Person: Jönsson Göran - CIO of BILTEMA
Purpose: Follow-up questions on survey and qualitative factors
Questions:
What consequences on transportation costs and customer benefits and flexibility does an establishment of a CDC in Halmstad have?
What consequences on transportation costs and customer benefits and flexibility does an establishment of a CDC in Linköping have?
What consequences on transportation costs and customer benefits and flexibility does an establishment of a CDC in Jönköping have?
What consequences on transportation costs and customer benefits and flexibility does an establishment of a CDC in Örebro have?

Date: 2014-04-23
Person: Hansson, Martin - CIO of Retlog
Purpose: Follow-up questions on survey and qualitative factors
Questions:
What consequences on transportation costs and customer benefits and flexibility does an establishment of a CDC in Halmstad have?
What consequences on transportation costs and customer benefits and flexibility does an establishment of a CDC in Linköping have?
What consequences on transportation costs and customer benefits and flexibility does an establishment of a CDC in Jönköping have?
What consequences on transportation costs and customer benefits and flexibility does an establishment of a CDC in Örebro have?

Date: 2014-04-24
Person: - Anonymous Department Store-worker BILTEMA
Purpose: Understanding the nature of the product and quality management
Questions:
   How does your receiving work?
   Do you report variations in quality and quantity during receiving?
   Do you try to refurbish/rework faulty products?
   Does a majority of the products work to send by parcel and pick by hand?

Date: 2014-04-29
Person: Granholm, Johan - Distribution Manager of Retlog
Purpose: Gathering more data from knowledgeable personnel and management to answer the survey
Questions:
   What factors do you rank as most important?
   What factors do you rank as least important?
   (See survey)

APPENDIX 2 – Centre of gravity calculation data, Sweden

Due to the size of the data and the conversion difficulties, the calculation data derived from the Swedish population is supplied in excel spread-sheets, in a separate file.
APPENDIX 3 Centre of gravity calculation data, Denmark

Danmarks befolkningsspridning regionkoordinat 2014

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<th>Landsskap</th>
<th>Män</th>
<th>Kvinnor</th>
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11-3-2014 Danmarks Statistik, © www.statistikbanken.dk/FRLD113
Koordinaterna framtagna mha twcc.free.fr (2014-03-19)
RT90 2.5 gon V koordinater
### APPENDIX 4 Centre of gravity calculation data, Finland

Folkmängd efter - Landskap 2013, Folkmängd och förändringen av folkmängden och Kön

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Begrepp och definitioner
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Beskrivning
(http://tilastokeskus.fi/til/vaerak/laa_sv.html
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Kvalitetsbeskrivning

I statistiken används områdesindelningen för tidpunkten 1.1.2013.
## APPENDIX 5 Centre of gravity calculation data, Norway

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Kilde: Statistisk sentralbyrå  
Coordinates from every county (fylke) from twcc.free.fr
APPENDIX 6 Centre of gravity calculation of the Nordic countries

Due to the size of the data and the conversion difficulties, the calculation data derived from the whole population of the Nordic countries is supplied in excel spread-sheets, in a separate file.