Optimization of total finished goods inventory management in decentralized organisation:
A Case Study on Atlas Copco Secoroc AB

Authors: Victoria Posazhennikova
Maria Kravchenkova

Master Program: ILSCM

Thesis credits: 30

Supervisor: Leif-Magnus Jensen

Jönköping: August, 2012
Acknowledgement

We would like to express our gratitude for precious guidance and support during the whole period of writing this thesis to our supervisor Leif-Magnus Jensen. We really appreciate his constructive comments and experience which helped us in conducting our research.

We also would like to thank all the participants of the research, especially, the Distribution Center manager Mats Persson, Purchasing and Logistics manager Anders Österberg and Global Inventory Control manager Kamiran Ertrushi, who devoted their time and efforts to provide us with necessary data and to share with us their practical experience. Without their contribution it would be impossible to accomplish this project.

And finally, we thank our friends and families for their support and motivation.

Victoria Posazhennikova & Maria Kravchenkova

August, 2012
ABSTRACT

Master thesis in International Logistics and Supply Chain Management

Title: Optimization of total finished goods inventory management in decentralized organisation: A Case Study on Atlas Copco Secoroc AB

Authors: Victoria Posazhennikova
Maria Kravchenkova

Tutor: Leif-Magnus Jensen

Date: August, 2012

Subject terms: Supply Chain Management; Inventory management; Decentralized organisation; Subsidiaries; Autonomous Decision-making; Sub-optimisation

Introduction: Nowadays firms must focus on maintaining healthy finished goods inventory stocks in order to be able to decrease inventory costs, meet customer requirements and to obtain competitive advantage. However large decentralized manufacturing companies often face the problem of sub-optimization in inventory management in subsidiaries due to several different reasons. As a result, company loses its competitiveness. Thus, there is a need to coordinate inventory activities of subsidiaries to prevent sub-optimization.

Purpose: The purpose of this thesis is to investigate whether coordination mechanisms highlighted in academic literature are used in practice on the example of manufacturing company with decentralized decision-making structure for optimization finished goods inventory stocks.

Frame of reference: This research is based on theoretical framework and empirical findings. Empirical data were collected through personal interviews and retrieved from organisational documents.

Methodology: The research strategy for this paper is a single case study. This strategy allows investigating topic in its real life context. The deductive approach is used for this research based on qualitative data. The major source of data collection was semi-structured interviews and the company's documents. For analysing data categorisation approach was applied.

Conclusion: The study found that most of coordination mechanisms presented in scientific literature are used in practice. To achieve better results these mechanisms should be applied simultaneously and consistently since they complement each other. We also observed that coordination mechanisms indeed give positive results and are able to optimize inventory management.
# Table of Content

1. INTRODUCTION ........................................................................................................... 8
   1.1 Background ............................................................................................................... 8
   1.2 Problem Discussion ............................................................................................... 9
   1.3 Purpose and Research Questions ........................................................................... 10
   1.4 Delimitations ........................................................................................................ 10
   1.5 Disposition ........................................................................................................... 11
   1.6 Definitions ............................................................................................................ 11

2. LITERATURE REVIEW .................................................................................................. 12
   2.1 Inventory Management .......................................................................................... 12
      2.1.1 The Role of Inventory ................................................................................... 12
      2.1.2 Inventory Management Issues in Companies with Multiple Sites of Finished Goods Inventory ........................................................................................................... 13
      2.1.3 Strategies Related to Finished Goods Inventory ............................................ 14
   2.2 Sub-optimization in Decentralized Organisations .................................................. 15
      2.2.1 Decentralised Organisation ......................................................................... 15
      2.2.2 Problem of Sub-Optimization ...................................................................... 16
   2.3 Overcoming Sub-optimization at Manufacturing and Distribution Sites .................. 17
      2.3.1 Supply Chain Focus in an Organization ....................................................... 17
      2.3.2 How to Achieve a Balance in Decentralized Organisation? ......................... 19
      2.3.3 Impact of Information Technology on Transparency and Companies Decision-making Structure ........................................................................................................ 22
   2.4 Summary ............................................................................................................... 23

3. METHODOLOGY .......................................................................................................... 25
   3.1 Research Strategy .................................................................................................. 25
      3.1.1 Case Study Research ..................................................................................... 25
      3.1.2 Case Study Design ....................................................................................... 26
   3.2 Literature Review .................................................................................................. 27
   3.3 Data Collection ..................................................................................................... 27
<table>
<thead>
<tr>
<th>Chapter</th>
<th>Section</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.3.1</td>
<td>Primary Data Collection</td>
<td>27</td>
</tr>
<tr>
<td>3.3.2</td>
<td>Secondary Data Collection</td>
<td>28</td>
</tr>
<tr>
<td>3.4</td>
<td>Data Analysis</td>
<td>29</td>
</tr>
<tr>
<td>3.5</td>
<td>Method Evaluation</td>
<td>30</td>
</tr>
<tr>
<td>4</td>
<td>EMPIRICAL DATA</td>
<td>32</td>
</tr>
<tr>
<td>4.1</td>
<td>Brief Facts about Atlas Copco Secoroc AB</td>
<td>32</td>
</tr>
<tr>
<td>4.2</td>
<td>ACS Inventory Management</td>
<td>33</td>
</tr>
<tr>
<td>4.2.1</td>
<td>The Role of Inventory: Market Competition and Customer Service</td>
<td>33</td>
</tr>
<tr>
<td>4.2.2</td>
<td>ACS Physical Distribution Structure</td>
<td>34</td>
</tr>
<tr>
<td>4.3</td>
<td>Logistics Importance Ten Years Ago and Its Development until Today</td>
<td>36</td>
</tr>
<tr>
<td>4.4</td>
<td>Activities Aimed to Optimise Total Inventory of Finished Goods in ASC</td>
<td>38</td>
</tr>
<tr>
<td>4.4.1</td>
<td>Changing towards SCM-Oriented Organisation</td>
<td>38</td>
</tr>
<tr>
<td>4.4.2</td>
<td>Autonomous Inventory Management and Sub-Optimization</td>
<td>39</td>
</tr>
<tr>
<td>4.4.3</td>
<td>Optimizing and Integrating Inventory Management at Sales Subsidiaries</td>
<td>40</td>
</tr>
<tr>
<td>4.4.4</td>
<td>Optimizing and Integrating Inventory Management at Production Companies and DCs</td>
<td>43</td>
</tr>
<tr>
<td>4.4.5</td>
<td>Optimizing Inventory Levels</td>
<td>43</td>
</tr>
<tr>
<td>4.4.6</td>
<td>Follow-up and Monitoring of Results</td>
<td>44</td>
</tr>
<tr>
<td>4.4.7</td>
<td>Creating Corporate Culture and Sharing the Same Values</td>
<td>45</td>
</tr>
<tr>
<td>4.5</td>
<td>Results of Centralization and Employees Opinions</td>
<td>45</td>
</tr>
<tr>
<td>5</td>
<td>ANALYSIS</td>
<td>47</td>
</tr>
<tr>
<td>5.1</td>
<td>Inventory Management in Decentralized Organisation</td>
<td>47</td>
</tr>
<tr>
<td>5.2</td>
<td>Reasons of sub-optimization of finished goods inventory</td>
<td>47</td>
</tr>
<tr>
<td>5.3</td>
<td>Coordination Mechanisms Used to Overcome Sub-Optimization</td>
<td>49</td>
</tr>
<tr>
<td>5.4</td>
<td>Summary</td>
<td>53</td>
</tr>
<tr>
<td>6</td>
<td>CONCLUSION</td>
<td>55</td>
</tr>
<tr>
<td>LIST OF REFERENCES</td>
<td>57</td>
<td></td>
</tr>
<tr>
<td>APPENDICES</td>
<td>64</td>
<td></td>
</tr>
<tr>
<td>Appendix 1: Interview Guide</td>
<td>64</td>
<td></td>
</tr>
<tr>
<td>Appendix 2: Factors Influencing Inventory Level</td>
<td>66</td>
<td></td>
</tr>
</tbody>
</table>
Appendix 3: Types of Organisational Structure .......................................................... 67
Appendix 4: Company's Documents are Used in the Research ........................................ 70

List of Figures

Figure 1: Distribution Network Models. Adjusted from Abrahmsson, 1992 .......................... 15
Figure 2: Structure of Functional Organisation .............................................................. 18
Figure 3: Structure of Matrix Channel Organisation ......................................................... 18
Figure 4: Location of the Headquarter, DCs and PCs ....................................................... 33
Figure 5: ACS's Simplified Distribution Network ............................................................ 34
Figure 6: Simplified Version of Physical Distribution in terms of Inventory Location ........... 35
Figure 7: Distribution Flows at ACS .............................................................................. 36
Figure 8: The Structure of Logistics Department. Year 2002 ........................................... 38
Figure 9: The Structure of Logistics Department. Year 2012 .......................................... 38
Figure 10: The Areas of Responsibilities of Central Logistics Department and CCs ............ 41
Figure 11: Example of Request and Shared Responsibilities under Co-Management .......... 41

List of Tables

Table 1: Control Mechanisms (Harzing & Sorge, 2003) .................................................. 19
Table 2: List of Interviews .............................................................................................. 28
Table 3: Factors influencing inventory level according to de Leeuw et al. (2011) ............... 66
Abbreviation List

ACS – Atlas Copco Secoroc AB

APS – Advanced Planning System

BLM – Business Line Manager

CC – Customer Center

CS – Consignment Stock

CW – Central Warehouse

DC – Distribution Center

GIC – Global Inventory Control

MRT – Mining and Rock Excavation Technique Division

MSD – Master Scheduling department

PC – Product Company

ROI – Return on Investment

ROA – Return on Assets

SCC – Supply Chain Concept

SCM – Supply Chain Management

SOP – Sales and Operations Planning

TID – Total Inventory Days

VMI – Vendor Management Inventory
1 INTRODUCTION

The purpose of this chapter is to present the background and the problem discussion of the study, followed by identifying the research gap and research questions.

1.1 Background

Inventory management is of high importance in the supply chain performance of a company (Rao & Rao, 2009). One of the drivers for attention to inventory is that inventory holding comprises of a significant cost in the supply chain (de Leeuw, Holweg & Williams, 2011). Research indicates that manufacturers and suppliers have over 60 days of inventory which implies a significant capital tied up. However, the firm has no return on its investment until inventory is sold (Rao & Rao, 2009).

Healthy and correct inventory can meet customer demand and enhance sales. Today firms spend a lot of energy on optimizing their inventory levels in order to decrease cost of doing business and enhance their return on investment or assets (ROI/ROA) often by decreasing inventory level (Langley, Coyle, Gibson, Novack & Bardi, 2009).

Usually manufacturing companies are organised as complex distribution networks that comprise manufacturing and distribution sites (Lee & Billington, 1992). This makes it difficult to maintain healthy inventory in subsidiaries located all over the world (Ibid). Droge and Germain (1998) in their research found out that the larger the firm: 1) the greater the span of control and the more layers in the logistics function; 2) the more decentralized decision making especially in the domains of delivery dates to customers and the number of finished goods warehouses. Consequently it is often difficult to coordinate such big organization. Therefore large companies tend 1) to have a written logistics mission and strategic plan; 2) to use integrative mechanism and to focus efforts on logistics strategy; 3) to hire highly qualified specialists (Droge & Germain, 1998).

This research is made in form of the case study on Atlas Copco Secoroc AB (ACS). ACS is one of the organizations experiencing the problem of achieving optimal inventory management at all subsidiaries. ACS produces tools for construction and mining industry and operates in more than 160 countries (Atlas Copco Secoroc, 2012). Due to their global sales the company has complex distribution network. It consists of several levels of warehouses: such as distribution centers and production warehouses on production level, central warehouses and local warehouses on market level and consignment stock on customer level. The inventory management historically was kept decentralized. However, several years ago ACS realized that the company became decentralized to such extent that it almost became uncoordinated. The company experienced high capital tied and maintained around 100 000 000 SEK of
obsolete and dying finished goods stock at warehouses all over the world, which implied high capital tied up.

1.2 Problem Discussion

Inventory control and inventory management theories are widely discussed in scientific literature (de Leeuw et al., 2011). However, the majority of inventory management studies mostly investigate manufacturing and procurement related processes with little focus on the management of finished goods inventory (Cachon & Olivares, 2010).

This study is focused on the management of finished goods inventory under decentralized policy in multinational manufacturing company.

In large multinational companies the structure of management is extremely complex (James, 1978). As managers removed far away from the decision-making point, in decentralized organisational structures they tend to delegate authority to company’s divisions (James, 1978). However, the divisions may have interests and viewpoints different from headquarters’ interests. Headquarters are concerned about the optimal result for the company as a whole while subsidiaries are more interested in optimizing their own performance (Picard, 1983; Pirttila & Niemi, 1996). Reluctance of subsidiaries to strive at the same as headquarter direction may lead to sub-optimization and depends on several factors, for example:

- **Wrong incentives.** General managers of sales companies are rewarded based on sales revenue, not for the healthy stock, production companies managers are rewarded based on output result (Kaiser & Young, 2009)

- **Fear of losing sales.** Finished goods stocks are used as a buffer against demand uncertainties and interruptions in deliveries (de Leeuw et al., 2011). Sales companies believe that maintaining high level of stock guarantees high service level. However, maintaining high inventory might be unnecessary and even damaging due to the risk of obsolescence, perishability and high capital tied up (Ibid).

- **Lack of knowledge, awareness and skills to optimize stock** (Pickard, 1997).

Fugate et al. (2006) state that coordination mechanisms within supply chains are well-documented in the literature. The researchers investigates corporate control between firms within supply chain but control within single company is not researched in their study. Loppacher et al. (2010) examine key aspects that affect headquarters-subsidiary relations in the context of similar culture among the business units. However, they do not touch the subject of finished goods inventory management in units with diverse culture. Harzing and Sorge (2003) examine practices of corporate control exercised by country-of-origin company towards its subsidiaries but without focus on inventory management. De Leeuw et al. (2011)
discuss the impact of decentralized control on inventory level. But their work is more about automobile industry and relations between manufactures and distribution dealers. According to Fugate et al. (2006) despite of control mechanisms are widely discussed in the literature from viewpoint of different disciplines, not so much attention paid on what mechanisms are used in practice and what is the result of their implementation.

1.3 Purpose and Research Questions

The purpose of this thesis is to investigate whether coordination mechanisms highlighted in academic literature are used in practice on the example of manufacturing company with decentralized decision-making structure for optimization finished goods inventory stocks. In order to accomplish this purpose, the following research questions will be answered in this paper:

RQ1. What coordination mechanisms can be used to overcome problem of sub-optimisation of finished goods inventory in decentralized system?

RQ2. How are these mechanisms implemented in practice?

1.4 Delimitations

Due to time constraints and broad area of the topic being examined this thesis has following limitations:

- The focus of the study is to investigate how to achieve common approach in inventory management of finished goods in manufacturing company with decentralized decision-making structure. The main concern is to show how inventory theory is working in real life context in one particular company from the perspective of management style. Due to constraints of research scope, the company examined in this paper was not compared with other companies. Accounting and financial aspects are also not covered in this research.

- Theoretical framework represents general aspects of inventory management and decision power distribution within the company. However, theory related to inventory costs and profit is excluded from the literature review.

- Empirical part is mostly performed by interviews with managers at the head office in Sweden. Only two interviews were conducted with the company’s subsidiaries: one in Sweden and one in US. Therefore the collected data mainly represent viewpoint of the headquarters.

- Conclusions are made on the base of managers’ judgments and experience within the company’s context. As range of products and, thus, inventory decisions vary from company to company, the findings of this paper will not be applicable in other industries, such as apparel industry, perishables, etc.
1.5 Disposition

This study consists of six parts. The first chapter introduces the background of studied subject, problem discussion along with purpose of the thesis and research questions. In the second chapter, theoretical framework represents previous studies on finished goods inventory management and organisational structure including aspects of decentralized control. The third chapter outlines the research methods chosen for this study. The fourth chapter discusses empirical findings collected through interview and company’s documentation. In the fifth chapter the collected data is analysed and connected with theoretical framework. The sixth chapter presents answers for the research questions and ideas for future research.

1.6 Definitions

**Customer Center** is the same as sales subsidiary. Customer Centers take care of local marketing and have market knowledge, convey customer demands (volumes, product range, etc) to the Product Companies as well as developing the customer base.

**Product Company** is a production subsidiary that manufacturers and stores products.

**Consignment stock** is defined as stocked owned, and most often managed, by Atlas Copco, but held at customer location. The inventory remains under ownership of Atlas Copco until the customer is ready to use it. The customer does not pay for the product until it is removed from the consignment stock.

**Excess stock** defines as the quantity in stock that exceeds the excess limit (Syncron SCP v 5.6., 2006).

**Healthy stock** consists of parts for which current stock is not considered in excess or obsolete (Syncron SCP v 5.6., 2006).

**Obsolete stock** is parts for which there has been no demand over the last 24 months or at least 24 periods of historical demand is available (Syncron SCP v 5.6., 2006).
2 LITERATURE REVIEW

This chapter presents theoretical framework of finished goods inventory management in decentralized organisation. We start with discussion why maintaining healthy inventory is important for organisation and provide a brief review of strategies for finished goods inventory. Then we discuss the reasons of sub-optimisation of inventory stocks in decentralized organisation and what steps the company can undertake to solve this problem. The types of organisational structures and control mechanisms are described in this part. Finally, we show the interconnection between transparency, IT and coordination within the organisation.

2.1 Inventory Management

2.1.1 The Role of Inventory

According to APICS Dictionary (2011), inventory is “stocks or items used to support production (raw materials and work-in-process items), supporting activities (maintenance, repair, and operating supplies), and customer service (finished goods and spare parts)”. Inventory management is strategically important in three main areas: customer service (fill rates), cash flow (working capital management) (Augustine, Huff, Lockman, MacLean & et al., 2004), and competitive advantage (Jones & Riley, 1987).

Large manufacturing companies are interested in effective inventory management because maintenance of inventory ties large amount of capital. Taticchi et al. (2010) state that inventory in a typical manufacturing company accounts to about one third of the owned assets. However, firms that invest in inventory have no return on net assets until the inventory is sold (Rao & Rao, 2009). Furthermore, high inventory level does not guarantee good service. Due to impact of uncertainty some items might be overstock and other understock which leaves the customer still waiting for the delivery (Lee & Billington, 1992). Moreover, obsolescence and perishability is not a seldom problem when dealing with inventory (de Leeuw et al., 2011).

Some researchers consider inventory as a muda (waste) and all efforts are directed on minimizing inventory in the supply chain (Womack & Jones, 2003). Reduction of inventory is considered to lead to productivity growth (Lieberman & Demeester, 1999). Baganha and Cohen (1998) believe that inventory used wisely as a buffer against demand uncertainty can be advantageous as it reduces fluctuations in production levels. Inventory also protect against stock-outs (lack of availability). Stock-outs lead to lost
sales, backorder costs, delayed cash flow and, as a result, lost customers. Inventory provides product availability which is a key indicator of customer service (Dubelaar, Chow & Larson, 2001). Langley et al. (2009) states that investment in inventory can add value by reducing costs in areas such as manufacturing and transportation, or increase sales through better customer service. The same idea is confirmed by Williams and Tokar (2008).

Recent research by Eroglu and Hofer (2010) concludes that there is an optimal level of inventory beyond which the marginal effect of decrease in inventory on financial performance becomes negative. Therefore, companies need to develop effective inventory management policy to achieve optimal and healthy inventory stock.

### 2.1.2 Inventory Management Issues in Companies with Multiple Sites of Finished Goods Inventory

As inventory is a necessary cost that firms cannot avoid it is very important to manage inventory correctly to justify this investment (Apics, 2010). Today the difficulties with managing inventories come from the fact that most manufacturing companies are structured as networks of manufacturing and distribution sites. Lee and Billington (1992) call such networks within one single company as supply chain. The simplest supply chain consists of one site that performs manufacturing and distribution, while more complex supply chain consists of multiple sites that may be scattered around the world. Such complex supply chain is more difficult to manage than a simple supply chain, since the inventory stockpiles at various locations have complex interrelation (Lee & Billington, 1992). However, effective and efficient management of inventory throughout the supply chain significantly improves customer service (Lee & Billington, 1992) and lower total supply chain costs (Fugate, Sahin & Mentzer, 2006).

Inventory management concerns with (1) understanding customer service requirements, (2) defining where to position inventories and how much to stock at each point, given such variables as supply and delivery lead-times, supply and demand uncertainty, lot sizes and product variety (Rumyantsev and Netessine, 2007), as well as (3) developing management policies and procedures (Jones & Riley, 1987, Langley et al., 2009; Janiga, 2005).

The supply chain overall performance is based on the joint performance of all sites, however commonly each sites is managed by fairly autonomous team with own objective and mission. Thus inventory management of each site might be different which result in inefficiencies for the whole supply chain (Lee & Billington, 1992).
2.1.3 Strategies Related to Finished Goods Inventory

In this part we will present different strategies associated with inventory management at manufacturing and distribution sites.

There are two different strategies related to finished goods inventory holding at manufacturing sites: make-to-stock (MTS) versus make-to-order (MTO) (Wanke & Zinn, 2004; Picard, 1983).

MTS decisions refer to decisions to produce finished goods to stock based on planning and forecasts. Under make-to-order production starts when a customer order arrives. (Zaerpour, 2008). In regards to MTS vs. MTO decisions there are a number of variables related to them such as obsolescence, perishability, lead time ration, as well as coefficient of variation of sales. The higher the risk of obsolescence and perishability the more likely the company will make to order. The smaller the lead ratio (quotient of the delivery time over the supply lead time), the higher requirement for short delivery time and the more stable sales pattern the more likely the company will produce a product to stock (Wanke & Zinn, 2004; Zaerpour, 2008).

Academic literature also presents two strategies concerning distribution of finished goods inventory: centralized and decentralized distribution network. Inventory location decision is affected by cost coefficient of variation of sales, inventory turnover and delivery time (Wanke & Zinn, 2004).

Decentralized distribution network implies storing products in multiple locations. It refers to a hierarchal distribution system consisting of several levels of warehouses in different markets (Wanke & Zinn, 2004). Decentralized structure offers flexibility and higher level of customer service (Ibid). It allows proximity to the end customer and, therefore, facilitates secure and short delivery (Ibid). Under this structure the demand pooling is limited and, hence, the total safety inventory in the system tends to be larger (Goetschalckx, 2011).

Centralized distribution network implies that the physical distribution consists of one central distribution centre in one market and the deliveries go directly from the central DC to the customers (Abrahamsson, 1992). Centralization of complex distribution network can improve operational performance (Nair, 2005) by achieving economies of scale in holding costs (Berman, Krass & Tajbakhsh, 2011) and reduction of safety inventory due to the demand uncertainty of many customers is pooled together to create a more stable aggregate demand.

Lieberman and Demeester (1999) conclude in their research that inventory levels are not only dependent on physical aspects such as distribution models, inventory strategies and process characteristics, but softer aspects like the workforce effort and management style also have great impact.
2.2 Sub-optimization in Decentralized Organisations

2.2.1 Decentralised Organisation

Most of large manufacturing companies apply decentralized decision making structures (Lee & Billington, 1992). Under decentralized decision-making structures, headquarters delegate decision-making to subsidiaries (Pirttila & Niemi, 1996). This structure has two main characteristics (Ibid):

1) The firm is divided into business units or subsidiaries that make relatively independent decisions in their business activities;

2) Corporate headquarter of the firm to some extent has power over subsidiaries.

Decentralized organizations are usually regulated by a performance control system. It means that corporate headquarters develop performance standards for business units and the managers of business units are free to decide how to run their business in order to meet these performance standards (Ibid).

Decentralized decision-making structure has several advantages. First of all, organization is more flexible and takes into account circumstances that can only be visible at a point closer to operational level (Pirttila & Niemi, 1996). Secondly, employee search and act on information obtained and thus are likely to be motivated to gather information because they exercise decision-making power. In addition, there are fewer opportunities for information distortion as decision-makers gather information themselves (Wong,
Ormiston & Tetlock, 2011). Thus, managers can come up to better solution and make more appropriate decisions.

Among the disadvantages of decentralized decision-making process Fugate et al. (2006, p. 129) mention "sub-optimal performance, resulting in an inefficient allocation of scarce resources, higher system costs, compromised customer service, and a weakened strategic position". Decision making in decentralised organisations is bound to be sub-optimal due to subsidiaries are more concerned about the performance of their own business rather than thinking about the result for the company as a whole (De Leeuw et al., 2011; Lee, & Billington, 1992).

2.2.2 Problem of Sub-Optimization

We have briefly mentioned that in complex supply chain networks, commonly each sites is managed by fairly autonomous team with own objectives and that one of the drawbacks of such management is sub-optimization (Lee & Billington, 1992). There are several reasons for sub-optimization listed below.

In decentralized company each division may have its own objectives and performance measures different or even conflicting with the company’s overall performance (Lee & Billington, 1992; Fugate et al., 2006). Even in case when performance measurements are designed and obligatory for the whole company, these metrics may not be monitored regularly (Lee & Billington, 1992).

De Leeuw et al. (2011) made a research on the impact of autonomous control on finished goods inventory level in automotive industry and found that local dealers who are financially responsible for ordering, maintaining and selling the stock, often make sub-optimal decisions, rather than thinking of global optimum for the supply chain. One of the reasons for this is the fear of losing sales. Dealers believe that customers do not want to wait and, therefore, the dealers maintain high inventory level. They are convinced that having wide choice available for customers is a competitive advantage. This idea was reflected in previous research by Chen et al. (2005) and Rajagopalan and Malhotra (2001).

De Leeuw et al. (2011) analyzed why subsidiaries’ decisions are sub-optimal and found that subsidiaries’ management is more sales oriented which implies that they strive to provide high level of service at excessive costs. Also the marketing function has significant influence on finished goods inventories and commonly has little incentive to reduce stock levels (de Leeuw et al., 2011).

Sub-optimization often occurs because of lack of proper rewarding system. For example, managers may be rewarded for the reported profits but not for healthy inventory. As a result sales companies tend to increase inventory level in order to increase customer service and avoid stock outs. High receivables and high inventories lock up cash in working capital. However this issue can be solved by providing proper reward system.
incentives and making “people aware that there is more to sales than booking the deal” (Kaiser & Young, 2009, p. 3).

There might be different procedures which imply that subsidiaries works in different ways therefore it is difficult to achieve coordination and unified way of working (Lee & Billington, 1992).

Picard (1983) mentions lack of skills as another problem of giving full autonomy to subsidiaries. Lack of knowledge and skill can also result in sub-optimization.

Another prerequisite of sub-optimization is that to develop appropriate corporate control within decentralized MNC may be challenging because the company's subsidiaries are located in different societies, societal contexts and, in the case of acquisitions or mergers, in different corporate culture (Harzing & Sorge, 2003).

2.3 Overcoming Sub-optimization at Manufacturing and Distribution Sites

2.3.1 Supply Chain Focus in an Organization

Integrated supply chain management allows firm to identify and reach the optimal inventory levels (Bowersox, Closs & Cooper, 2002). However, to achieve integrated supply chain traditionally structured companies often need to restructure its organization towards a supply chain management oriented structure (Ibid).

Traditionally companies are non-SCM oriented companies. Non-SCM oriented organization is an organization where an SCM department does not exist or only exists as a sub-department of other functional departments such as production and marketing (Bowersox et al., 2002). Finished goods inventory in this type of organization usually is responsibility of marketing/ sales department (Kim, 2006). As marketing is only concerned about making sales focus on inventory management is minimal, which may lead to much incorrect, obsolete and excess inventory (de Leeuw et al., 2011).

Kim (2006) reviewed different organizational structure in terms of logistics function and came to conclusion that functional and matrix channel organizations types of organizations are best organizational types for the efficient management of SCM activities. The reason is that in such organizational structures SCM department maintain a sufficient level of balance with other functional areas while it efficiently controls, adjusts and integrates various SCM activities.

Functional organization is organization that has an SCM department. This department has an equal hierarchical position with existing functional department. Such department takes a significant part of
responsibilities for SCM activities including finished goods inventory management (Bowersox et al., 2002).

Figure 2: Structure of Functional Organisation

In *Matrix channel organization* SCM department has an equal position with other functional departments and focuses on coordination and connections with other functional departments for efficient operation of SCM activities rather than direct control of SCM activities (Kim, 2006).

Figure 3: Structure of Matrix Channel Organisation
These two types of organizational structures allow companies to integrate supply chain activities and as consequence minimize sub-optimization (Kim, 2006). As inventory management is a part of supply chain activities restructuring of non-SCM oriented organization towards SCM oriented organization might positively affect inventory management.

2.3.2 How to Achieve a Balance in Decentralized Organisation?

Decentralized structure is rarely implemented in its pure form (Pirttila & Niemi, 1996). In practice managers tend to balance extreme decentralization (Ibid) and try to some extent coordinate logistics decisions through formal (bureaucratic) and informal (cultural) coordination mechanisms (Loppacher, Cagliano & Spina, 2010). Harzing and Sorge (2003, p.198) use term “corporate control mechanisms” and define it “as the instruments that are used to make sure that all units of the organization strive towards common organizational goals”. Table 1 shows major types of control mechanism summarised by Harzing and Sorge (2003).

Table 1: Control Mechanisms (Harzing & Sorge, 2003)

<table>
<thead>
<tr>
<th>Personal/Cultural (founded on social interaction)</th>
<th>Impersonal/Bureaucratic/Technocratic (founded on instrumental artefacts)</th>
</tr>
</thead>
</table>
| **Direct/Explicit**                                | Centralization
|                                                 | Direct supervision
|                                                 | Expatriate control
|                                                 | Standardization
|                                                 | Formalization
| **Indirect/Implicit**                             | Socialization
|                                                 | Informal communication
|                                                 | Management training
|                                                 | Output evaluation
|                                                 | Planning

Direct personal control

*Centralization* refers to the degree of decision-making autonomy that subsidiaries have within the company (Harzing & Sorge, 2003). MNCs tend to centralize strategic and key decisions (Loppacher et al, 2010). They decide whether decision authority belongs to headquarters or delegated to subsidiaries (Olson, Slater & Hult, 2005). Centralization is more preferable in stable, non-complex environments where there is no need to solve non-routine problems (Ibid). In contrast, decentralized system is applicable in dynamic and complex environments where the company has to come up with new ideas and adapt quickly for changing situations (Ibid). Decentralized system also provides decision power to managers who are close to the problem (Ibid).

*Direct supervision* refers to the degree of personal monitoring from headquarters towards subsidiaries (Harzing & Sorge, 2003).
Expatriate control means that headquarters assign a manager from head office to subsidiaries to assure that headquarters’ policies are properly performed (Harzing & Sorge, 2003). Expatriate managers have a role as controllers, experts and communicators of organizational culture (Harris & Holden, 2001). Head office sends expatriate managers to subsidiaries in order to coordinate worldwide activities, to transfer specific knowledge and to make sure that company’s policies are performed in proper way (Ibid).

**Direct impersonal control**

Standardization refers to what degree policies under which subsidiaries are supposed to operate are standardized (Harzing & Sorge, 2003). Standards are often used for coordination and control (Brunsson & Jacobsson, 2000). Decision makers can avoid mistakes if they follow established standards (Ibid). Having standards in organisation makes it easier to implement orders and directives throughout the business units (Ibid).

Formalization calls for to which extent rules and procedures are written down in the documents thus leading to standard routines (Martinez & Jarillo, 1991). To achieve better coordination, company may increase its degree of formalization as the objective of formalization is to coordinate activities and reduce variability in behaviour by routinizing repetitive activities and transactions (Olson et al., 2005). Written down rules and procedures enable managers to organise their activities according to company’s policies thus increasing efficiency and decreasing administrative costs (Ibid). However, formalization of policies and procedures does not create an environment for new, creative approaches and does not encourage making innovative decisions (Ibid). High degree of formalization is appropriate for stable environments where tasks are repetitive (Ibid). In complex and dynamic environments, where the company should respond rapidly for changes and be flexible, degree of formalization is lower (Ibid).

**Indirect impersonal control**

Output evaluation (or performance control) means to what extent headquarters execute evaluation of the results of subsidiaries (Harzing & Sorge, 2003). Output control deals with measuring performance using qualitative or quantitative indicators (Loppacher et al., 2010). Loppacher et al. (2010) summarises three key measurements used to monitor performance: (1) financial performance or, in other words, returns on investments; (2) resource utilization, which means the exploitation of materials, labour and outsourced services; and (3) quality, refers to customer service level (delivery delays, stock-outs, etc.).

It is important to recognize that inventory has to be managed from a system wide perspective, in which the trade-offs has to be measured systematically and accurately. Chae (2009) recommends two layers of performance measurement to monitor inventory at different locations: primary and secondary. The primary metrics reflect a company’s overall supply chain performance. These metrics should be
frequently monitored by top and middle managers. The secondary metrics is set to explain why the primary metrics are high or low and present a comprehensive overview of supply chain. In terms of inventory performance metrics Chae (2009) suggests total inventory days of supply (TIDS) as a primary metric. This metrics as primary metrics is also suggested by Lambert and Pohlen (2001), however Chae (2009) is incorporating in this metrics not only the amount of inventories within a company, but the total inventories within one’s supply chain network. TIDS can be calculated by dividing the dollar value of total finished goods for a particular month by the daily average costs of goods sold. As a secondary metrics Chae (2009) suggests days of finished goods at sales subsidiaries and manufacturing subsidiaries; and rate of obsolete inventory. This metrics is important since it measures the inventory level at each of the sales and manufacturing subsidiaries and could be used to understand potential issues relevant to the TIDS.

It is also critical to measure the obsolete inventory level at each sales subsidiary. Obsolete inventory is defined as inventories that have been at a subsidiary for more than a certain period (e.g., 60 days). These slow moving or excess inventories implies high inventory carrying cost and to sell such inventories is not an easy task. Generally, obsolete inventories are the main reason of increase in the total cost of inventory. To reduce the overall cost of inventory companies have to regularly monitor the obsolete inventory level to deal with it in a more proactive way (Chae, 2009).

Planning refers to what degree headquarters developed detailed planning, goal setting and budgeting system, schedules including well-defined goals on strategic and operational level (Harzing & Sorge, 2003).

Indirect personal control

Socialization implies developing corporate culture and main values across all subsidiaries in the company (Harzing & Sorge, 2003). Martinez & Jarillo (1991) relate process of socialization with the development of an organisational culture, the same objectives and values throughout the whole company. This can be achieved by training headquarters and subsidiary managers and fostering the transfer of managers across different departments, caring about their career paths, and establishing proper rewarding system (Martinez & Jarillo, 1991). Baliga and Jaeger (1984) state that the consensual decision making makes managers from different units to cooperate with each other about organisational issues. This leads to systematization of cultural value and as a result to strengthening of corporate culture. Baliga and Jaeger (1984) also emphasize the importance of selection of employers. Candidates for job positions should have skills and knowledge necessary for the job and also willingness to be a part of corporate culture in this organisation (Baliga & Jaeger, 1984).
Informal communication shows whether executives of subsidiaries and headquarters communicate each other through formal or informal communication channels (Harzing & Sorge, 2003). It complements formal communication through establishment of informal and personal contacts among managers from different departments throughout the whole company. This can be made by organising “corporate conferences; management trips; personal visits; transfers of managers; etc.” (Martinez & Jarillo, 1991, p.432). Informal communication is not arranged around one specific problem, thus it is very indirect method of coordination (Ibid).

International management training implies development of international trainee programs where executives from different subsidiaries and headquarters exchange company-specific knowledge. Baliga and Jaeger (1984) state that training is important for cultural control in organisation. In order to be functional workers, managers should know not only set of rules and regulations but they should learn to be a part of corporate control system, share the corporate values and exchange with company’s specific knowledge (Ibid).

Among other ways to deals with drawbacks of decentralization is specialization (Olson et al., 2005). Specialization is defined as the degree to which tasks are divided between the units in the company in terms of required knowledge, skill, and experience and the degree to which managers are given an authority to select the best approach for task completion (Ibid). The company can overcome lack of skills and knowledge by increasing degree of specialization. According to Olson et al. (2005) higher level of specialization increases capacity for adjustments and foster developing new logistics solutions. This is because specialists understand problems clearly, adjust quickly in dynamic environments, and find out new ways of doing things compared with "generalists" (Daugherty, Chen & Ferrin, 2011). Studies have shown that large organizations tend to have higher level of specialization (Dröge & Germain, 1998). Multiple specialized companies are now changing organizational structure by moving from hierarchical position to relationship based on core competencies. That means that decision making is now moved to specialists (Hoek, Commandeur & Vos, 1998).

2.3.3 Impact of Information Technology on Transparency and Companies Decision-making Structure

To achieve integration in the supply chains in order to minimize sub-optimization companies need to achieve transparency (Wadhwa, Mishra, Chan & Ducq, 2010; Dreyer, Alfnes, Strandhen & Thomassen, 2009).

Transparency can be achieved by utilizing information technology (IT) (Auramo, Kauremaa, & Tanskanen, 2005). Nowadays advanced information technology (IT) allows companies to gain control over their supply chains which could not be predicted before (Hoek et al., 1998). IT allows companies to monitor inventory at different locations and incorporate even temporary stocking location into
monitoring of the inventory (Ballard, 1996; Kärkkäinen, et al., 2010). IT also enables companies to centralize key data and link it efficiently to enable quick access to accurate information (Lee & Billington, 1992). Key data may include forecasts, inventory status at all sites, production plans, etc (Ibid). In order to avoid sub-optimization, availability of information and incentives should be coordinated in such a way that managers will make decisions in alignment with company’s interest (Funda & Robinson, 2002). Moreover, it is not only important to achieve transparency but also act on information. Wadhwa et al. (2010) highlighted that cooperation together with information transparency synergistically influence a company performance.

Furthermore, inexpensive wired and wireless communication such as e-mail and mobile devices make it easier for agents to communicate with each other (Bloom, Garicano, Sadun & Reenen, 2009). Hock et al. (1998) state that coordinating technologies facilitate reconfiguration of managerial decisions. With help of IT organizations are now moving from functional management to process management. Today traditional formal structures could be disintegrated but integrated management is still will be in place by use of coordinating technologies. Those decisions that previously have been decentralized could be easily centralized due to the easy of accessing necessary information, but also decision that was previously centralized could be delegated to those who are closer to the problem (Bloom et al., 2009). In general, researcher states that spread of intranet networks tends to centralize decision-making (Ibid).

2.4 Summary

Inventory management is strategically important in three main areas: customer service (fill rates), cash flow (working capital management) (Augustine et al., 2004), and competitive advantage (Jones & Riley, 1987).

Today the difficulties with managing inventories come from the fact that most manufacturing companies are structured as networks of manufacturing and distribution sites located around the world. These sites are managed autonomously pursuing their own objectives and missions. Thus inventory management of each site might be different which result in inefficiencies for the whole supply chain (Lee & Billington, 1992).

Most large manufacturing companies apply decentralized decision making structures (Lee & Billington, 1992). Under decentralized decision-making structures, company consists of: (1) headquarters who develop company’s strategy and mission; and (2) subsidiaries that make relatively independent decisions in their business activities (Pirttila & Niemi, 1996).

Decision making in decentralised organisations is bound to be sub-optimal due to subsidiaries are more concerned about the performance of their own business rather than thinking about the result for the
company as a whole (De Leeuw et al., 2011; Lee, & Billington, 1992). Due to several reasons, sub-optimization problem may occur (Lee & Whang, 1999).

The problem of sub-optimization can be solved by setting a supply chain management department that would be responsible for coordination of different supply chain activities within the organization (Kim, 2006). Bowersox et al. (2002) suggest two types of organizational structures best suitable for supply chain oriented organisation: functional and matrix channel organizational types.

Some authors suggest to some extent coordinate decentralized inventory decisions through control mechanisms (Pirttila & Niemi, 1996; Harzing & Sorge, 2003; Loppacher et al., 2010). These control mechanisms are divided into four main groups: (1) direct personal control; (2) direct impersonal control; (3) indirect impersonal control; and (4) indirect personal control (Harzing & Sorge, 2003; Loppacher et al., 2010). Olson et al. (2005) also considers specialization as a way to deal with drawbacks of decentralization.

Dreyer, et al. (2009) state that insufficient information sharing and transparency is a key issue for companies that strive to increase coordination and integration in their supply chains. IT facilitates transparency and coordination for efficient implementation of various supply chain processes (Auramo et al., 2005).

In the analysis part of this research we will focus on how control mechanisms mentioned in the scientific literature are implemented in practice in the context of inventory management. We also will discuss the interrelations of control mechanisms, transparency and IT systems.
This chapter presents methodology approach used for this study. The chapter starts with discussing case study strategy selected to carry out the research and what data collection techniques were used. The chapter closes with description of data analysis and research credibility.

3.1 Research Strategy

3.1.1 Case Study Research

Case study is widely used for research in the social sciences and international business (Vissak, 2010). Case study approach is applicable for investigation of a particular phenomenon in its real-life context with defined boundaries of interest, such as an organisation, industry or specific type of operation (Ellram, 1996; Yin, 1994; Eisenhardt, 1989). This type of research answers for “how” and “why” questions and allows considering a situation from multiple perspectives (Vissak, 2010; Saunders, Lewis & Thornhill, 2009). Case study approach provides new empirical insights for an already researched topic and enables to study change processes in its dynamic development (Halinen & Törnroos, 2005; Yin, 1994; Eisenhardt, 1989).

Case study research strategy serves for various goals, such as theory generation, testing, refutation, refining, and prediction (Vissak, 2010; Eisenhardt, 1989). In addition, this method is applicable if current viewpoints seem to be in conflict with each other (Eisenhardt, 1989). Kjellen and Söderman (1980) list other reasons for conducting case study, for example, to evaluate a case, or to help companies to change (cited in Gummesson, 2000).

A case study method was selected for this paper because this research enables to be close to the studied situation (Halinen & Törnroos, 2005). This method also provides with possibility to collect data from different additional sources including annual reports, corporate homepages, etc (Ibid). Moreover case studies are useful for deep investigation dynamic and complex areas - like, business networks and headquarters-subsidiary relationships (Vissak, 2010). Our research deals with coordination mechanisms in manufacturing company with decentralized decision making structure.

Case study approach does not dominate in logistics research. However, literature review showed that case study is a useful for logistics and supply chain management research and this method is increasingly applied (Ellram, 1996; Halldörsson & Aastrup, 2003; Vissak, 2010; Pedrosa, Näslund & Jasmand, 2012).
3.1.2 Case Study Design

A single case study design is chosen for this research. This means that collection of data is made for one study of the unit of analysis (Yin, 1994). The unit of analysis in our research is represented by an organization. A single case study is applicable when the goal is to investigate an extreme or unique case, an application of well-formulated theory, or analysing a phenomenon that had little attention before (Ellram, 1996; Saunders et al., 2009). Also single cases give a possibility to examine situation in-depth and to provide deep understanding (Saunders et al., 2009). The focus of this research is on manufacturing company with decentralized decision making structure and on the development of regulation mechanisms within this company regarding to inventory management.

Case studies can be used for conducting exploratory, descriptive or explanatory research (Yin, 1994). Exploratory research answers question ‘how or why is something being done?’ Thus, a case study approach would be preferable as it provides deep understanding of the phenomenon and its context (Ellram, 1996; Saunders et al., 2009).

There are two general approaches in scientific research: inductive and deductive research approaches (Spens & Kovács, 2006). The deductive approach is used for this research. With this approach a theory and hypothesis are developed in academic literature and the purpose of the research is to test this theory (Saunders et al., 2009).

There are two methods used for conducting research: quantitative and qualitative methods (Spens & Kovács, 2006; Mangan et al., 2004). Quantitative methods collect numerical data, while qualitative methods deal with non-numerical data (Spens & Kovács, 2006; Eisenhardt, 1989). While conducting case study research, both qualitative and quantitative methods may be used, however, case study is mostly associated with qualitative data (Williamson, 2002). Qualitative method allows understanding of the situation from insight (Naslund, 2002), i.e. “from the point of view of the individuals who are directly involved in the activities which are to be studied” (Denzin & Lincoln, 1994, cited in Naslund, 2002), and provides an understanding of relationships or complex interactions (Ellram, 1996). Since one of the authors of this paper is working directly with inventory activities in Distribution Center of studied company, qualitative method will be useful for our research.

Despite of deductive research may be associated with collecting quantitative data (Yin, 1994; Saunders et al., 2009), some authors argue that qualitative methods can be used (Hyde, 2000; Bitektine, 2008). They suggest to perform theory testing by using the pattern-matching technique. According to Bitektine (2008), pattern-matching in a single case study with qualitative data can be done by a comparison of patterns derived from academic literature with observed outcomes. In our research we will investigate
how control mechanisms highlighted in scientific literature are working in practice in the context of inventory management.

3.2 Literature Review

Reviewing literature gives good understanding of previous research and helps to identify and analyse important factors and relationships within investigated situation (Gummesson, 2000; Saunders et al., 2009). Theoretical framework helps to design empirical studies and analysis, and provides security and focus for research (Simons, 2009; Saunders et al., 2009; Halinen & Törnroos, 2005).

This research was started with reviewing literature and proceeded with developing empirical studies and analysis based on theoretical framework. The major source for searching relevant literature is University’s library catalogue and studying materials provided by the company. The search of relevant literature was done by using search terms: ‘supply chain management & coordination’; ‘inventory management & coordination/control’; ‘multinational corporations & coordination/control’; ‘organizational structure & decentralized organizations’; ‘decentralized control & inventory’; ‘corporate control’; ‘headquarters-subsidiary control’; ‘IT & supply chain management’; ‘performance measurement & supply chain’.

3.3 Data Collection

3.3.1 Primary Data Collection

Four data collection methods are often applied for conducting case study research: interviews, questionnaires, observations and document analysis (Simons, 2009; Saunders et al., 2009; Williamson, 2002). Interviews are a major source of data collection for qualitative case study (Yin, 1994). This method gives a possibility to discuss the issue with the “right” person” and insures complex and complete responses (Vissak, 2010; Williamson, 2002).

Data collection for this research was made through semi-structured interviews. In semi-structured interview researcher develops a preliminary list of topics and questions to be covered, however the questions can vary according to the context of interview and participant’s responses (Saunders et al., 2009; Yin, 2011). Semi-structured interviews are applied when the aim of research is to understand participant’s personal experience and perspective on the topic (Simons, 2009; Saunders et al., 2009). This method gives an opportunity to discuss the situation in more depth and helps to reveal important issues that previously were not considered (Saunders et al., 2009; Simons, 2009).

For this research, participants were chosen depending on their position, main responsibilities and experience in inventory management or related activities. Interview guide was designed according to
theoretical framework and was edited for each manager. Preliminary list of questions were sent to the participant in advance in order to be sure that the respondent has necessary information on this topic (for interview questions see Appendix 1). As some managers are working in different departments, semi-structured interview were useful to understand better different perspectives they have on managing inventory and delegating authority. All interviews were audio-recorded to ensure accuracy of data collection (Yin, 1994). The copies of interview transcripts are sent to the participants for final checking (Saunders et al., 2009).

Table 2: List of Interviews

<table>
<thead>
<tr>
<th>Position of interviewee</th>
<th>Interview</th>
<th>Location</th>
<th>Date</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manager of Distribution Center</td>
<td>Semi-structured, face-to-face</td>
<td>Fagersta, Sweden</td>
<td>16/03/2012</td>
<td>1h40min</td>
</tr>
<tr>
<td>Global Inventory Control Manager</td>
<td>Semi-structured, face-to-face</td>
<td>Fagersta, Sweden</td>
<td>19/03/2012</td>
<td>1h30min</td>
</tr>
<tr>
<td>Transport Manager</td>
<td>Semi-structured, face-to-face</td>
<td>Fagersta, Sweden</td>
<td>20/03/2012</td>
<td>1h</td>
</tr>
<tr>
<td>Purchasing and Logistics Manager</td>
<td>Semi-structured, face-to-face</td>
<td>Fagersta, Sweden</td>
<td>22/03/2012</td>
<td>1h30min</td>
</tr>
<tr>
<td>Business Line Manager (Down-the-Hole products)</td>
<td>Semi-structured, face-to-face</td>
<td>Fagersta, Sweden</td>
<td>21/03/2012</td>
<td>1h</td>
</tr>
<tr>
<td>Transport and Logistics Manager</td>
<td>Semi-structured, telephone</td>
<td>Fort Loudon, US</td>
<td>26/03/2012</td>
<td>1h</td>
</tr>
<tr>
<td>Business Line Manager</td>
<td>Semi-structured, telephone</td>
<td>Stockholm, Sweden</td>
<td>23/03/2012</td>
<td>1h10min</td>
</tr>
<tr>
<td>Inventory controller</td>
<td>Semi-structured, face-to-face</td>
<td>Fagersta, Sweden</td>
<td>27/03/2012</td>
<td>1h20min</td>
</tr>
<tr>
<td>Ex-employee in procurement department</td>
<td>Semi-structured, face-to-face</td>
<td>Fagersta, Sweden</td>
<td>26/07/2012</td>
<td>1h15min</td>
</tr>
</tbody>
</table>

3.3.2. Secondary Data Collection

Secondary data is a data that obtained by other researcher for other purpose (Saunders et al., 2009). Secondary data was also analysed for this research. The documents were retrieved from internal database that includes studying materials, presentations, workshops, application instructions, polices and reports (for names and types of documents see Appendix 4). Secondary data analysis helps to interpret the context of interview data and contributes to better understanding of organisational culture and policies (Simons, 2009).
3.4 Data Analysis

The aim of data analysis is to provide an understanding of phenomenon, its context and the relations between them (Yin, 1994). The strategy of data analysis helps to identify what to analyse and demonstrates that data collection techniques are suitable for examined phenomenon (Ibid).

The application of qualitative data collection techniques causes a vast quantities of complex and non-standardised information that need to be managed and controlled (Collis & Hussey, 2003; Robson, 2007; Saunders et al., 2009). There is no one agreed method for dealing with qualitative data (Robson, 2007). However, many researchers concur that collected data should be reduced, structured and reorganised for further conclusions (Saunders et al., 2009; Miles & Huberman, 1994; Boeije, 2010).

**Categorisation (grouping) of meanings** is one of the approaches applied for analysing qualitative data (Saunders et al., 2009; Robson, 2007). This approach involves: generating categories; unitising data, which means to attach relevant pieces of data to the devised categories; searching for relationships in reorganised data and developing new categories for revealed patterns; and, finally, formulating and testing theories in order to make valid conclusions (Saunders et al., 2009). For the purpose of this research, data collected from interviews and company’s documents was summarised and divided into units. These units of data were grouped into relevant categories derived from theoretical framework (Ibid). Thus, reorganised and reduced data allowed revealing relationships and interactions between categories that lead to developing propositions. In order to make valid conclusions, theoretical propositions were tested by searching alternative explanations (Ibid).

Among different analytical techniques for analysing qualitative data the method of *data display and analysis* is chosen for this paper. According to Miles and Huberman (1994), the process of analysis involves three procedures: data reduction, data display and drawing and verifying conclusions.

Data reduction is the process of summarising, sorting and organising key data collected through interviews and field notes (Simons, 2009; Miles & Huberman, 1994). Data reduction for this research was based on questions derived from literature review and was made through summarising and categorising the answers (Miles & Huberman, 1994). Then data was displayed through diagrams and networks (Ibid). This helped to see the situation, to identify important relationships and trends, and assisted the last step - drawing conclusions (Miles & Huberman, 1994; Saunders et al., 2009; Simons, 2009).
3.5 Method Evaluation

There are two main criteria of the research quality: validity and reliability (Boeije, 2010). Yin (1994) suggests four tests for evaluating quality of case study research: construct validity, internal validity, external validity and reliability.

**Construct validity** refers to determining correct operational measures for the concepts being examined (Yin, 1994; Boeije, 2010). This criterion is closely related to data collection procedures (Ellram, 1996). Ellram (1996) proposed three elements to strengthen construct validity: using multiple sources of evidence, establishing a chain of events, and having key informants review the case study research.

**Multiple Data Sources**, or triangulation, is the use of different data sources or techniques within one study (Ellram, 1996; Saunders et al., 2009). Triangulation is applied to reveal interviewee’s bias and to ensure that researcher understands the correct meaning of collected data (Ellram, 1996; Saunders et al., 2009). In this paper, triangulation is done through interviewing multiple informants with various viewpoints on the problem (managers working in different departments), and combination of different types of company’s documents including presentations, studying materials and reports (Ellram, 1996; Williamson, 2002; Vissak, 2010).

The second element of construct validity - *establishment and maintenance of a chain of evidence* - demonstrates the possibility to follow the logic of reasoning through the whole paper. The draft of this paper, including research questions, research draft and questionnaires, were reviewed by supervisor and ten colleagues for logical flow, clarity and editorial corrections (Ellram, 1996).

**Draft review by key informants** means that case study report is reviewed by key informants for ensuring that the case story is correct (Ellram, 1996, Vissak, 2010). One top-manager from the studied company reviewed the final version of this paper, and findings and conclusions of the research were discussed with him in order to obtain his opinion if empirical findings and research results are correct (Collis & Hussey, 2003; Boeije, 2010).

**Internal validity** is concerned with whether established relationships between concepts are correct (Boeije, 2010). This criterion is mainly used for explanatory case studies. Since the purpose of this research is exploration (Yin, 1994; Ellram, 1996), internal validity is not considered for quality evaluation.

**External validity** reflects how accurate results presented in the study (Ellram, 1996) and, thus, whether study’s findings are transferable to other context or, in other words, whether generalisation is possible (Yin, 1994; Miles & Huberman, 1994). As the primary goal of single case studies is to get deep understanding of the phenomenon, this type of research provides limited ability for generalisation.
(Ellram, 1996; Vissak, 2010). Therefore, reasonable generalisation from this study is narrowed down to manufacturing companies that deal with headquarters-subsidiaries relations under decentralized policy.

**Reliability** is demonstrating whether the process of the study is consistent over time and across methods, and whether the procedures of study can be repeated with the same results (Yin, 1994; Miles & Huberman, 1994). The objective of reliability is to minimize inaccuracy and biases in the research (Yin, 1994). There are tactics to strengthen reliability of case study: use of a case study protocol, and development a case study data base (Yin, 1994; Ellram, 1996). A case study protocol established for this study includes data collection techniques, case study design and questionnaires. All interviews are recorded and interview transcripts are verified by participants. All printed materials provided by the company, such as presentations, written training guides, reports and other internal documentation, are included in the database (Ellram, 1996). Thus, reliability is increased with the possibility to follow research process and to repeat the study anticipating the same results.
EMPIRICAL DATA

This chapter combines information collected from the interviews. It is organized as follows: general information about the company, identifying the problem of sub-optimisation and description of activities tailored to achieve coordination and optimisation of company’s total inventory of finished goods.

4.1. Brief Facts about Atlas Copco Secoroc AB

Atlas Copco AB was established in 1873 in Stockholm, Sweden. Its main business areas are: compressor technique, industrial technique, mining and rock excavation technique, and construction technique. Atlas Copco AB is present in more than 170 counties and has 37500 employees in 86 countries (Atlas Copco Secoroc, 2012a).

Secoroc AB was acquired by Atlas Copco AB in 1988. Headquarter of Atlas Copco Secoroc AB (ACS) is located in Fagersta (Sweden). ACS belongs to Mining and Rock Excavation Technique (MRT) division within Atlas Copco AB. The strategy of MRT business area is to provide complete drilling and rock excavation solution, with drilling and rock excavation machinery, a complete range of related consumables and service through a global network (Atlas Copco Secoroc, 2012a).

ACS has production centers (PC) in Sweden, USA, China, India, South Africa, Australia, and Canada. Every production center has a small warehouse connected to it (Atlas Copco Secoroc, 2012a). All the production facilities except South Africa were acquired by ACS through acquisition for the reason to get access to technology or certain market. Every location produces different types of products (Manager of Distribution Center, personal communication, 2012-03-16).

There are two large distribution centers (DC) storing and shipping ACS’ products: one in Sweden and one located in South Africa (Figure 4). ACS also shares DCs with other
companies operating under Mining and Rock Excavation division, for example DC in US, Canada and China.

Figure 4: Location of the Headquarter, DCs and PCs

ACS has sales representatives at 74 customers centers (CC) located in different countries. The major role of customer centers is to combine ACS’ global thinking with local activity. This implemented by taking care of local marketing and having market knowledge, conveying customer demands (volumes, product range, etc) to the production centers as well as developing the customer base. Some CCs are responsible for only one country while other CCs are responsible for group of countries (Atlas Copco Secoroc, 2012a).

4.2 ACS Inventory Management

4.2.1 The Role of Inventory: Market Competition and Customer Service

ACS owns around 33% of the market share. Its biggest competitor is Sandvik Mining and Construction AB who owns 31 % of the market. 36% of the market share belongs to other small competitors. Competition in this industry is fierce; several Chinese companies are now appearing on the market offering decent quality products for cheaper prices. Most of the products that ACS manufactures can be bought at competitors and there is only a small part of assortment that belongs to ACS’ unique products. These products could not be bought somewhere else therefore, there is a high pressure to have such products available on the shelves.
ACS’s customers who are mostly construction and mining sites are more sensitive to quality of products and timely deliveries than to price. Customer are losing enormous amount of money if operations are stopped. That is why they are often turning to competitor if their supplier cannot deliver orders in time.

To provide high service to customers and to protect against uncertainties in supply, and demand ACS maintains inventory at different locations.

All products that are manufactured by ACS are divided into two categories: make-to-stock (MTS) and make-to-order (MTO). Make-to-stock products according to ACS stockholding policy should be items that have a frequent and relative stable demand and several different customers. Some critical items could be also be classified as make-to-stock items. Slow-moving items, items that are sold only to one specific customer center and perishable items are classified as make-to-order items. The purpose of stockholding policy is to provide high service to the customer with lowest possible inventory levels (Atlas Copco Secoroc AB, 2010-01-07).

4.2.2 ACS Physical Distribution Structure

As was mentioned above ACS finished goods inventory is stocked at different locations to provide high service to customers and guard themselves against uncertainties. There are approximately 400 stocking locations that ACS operates (Global Inventory Control Manager, personal communication, 2012-03-19). A simplified version of ACS’s distribution network is shown in the Figure 5.

![ACS's Simplified Distribution Network](image)

Figure 5: ACS's Simplified Distribution Network

It consists of Product Company (PC), distribution center or production center warehouse, customer center’s warehouses and customers. By a customer we mean either external distributors, agents, or e-
commerce who are buying ACS’ items for reselling to end users; or end users such as construction sites and mines who actually utilize the product in its operations.

The normal distribution flow starts with PC. As soon as a PC produces a product it is delivered to either a DC connected to a manufacturing facility or PC’s warehouse. It should be mentioned that DCs and PCs warehouses have the same function to store and efficiently deliver products where it is needed. The difference between DC and PC’s warehouses is that DC is much bigger in area and the number of products stored. From the DC/PC’s warehouse the products are delivered to various customer centers, where they are temporary stored at customer centers’ warehouses and then sold to end users or external agents, distributors or e-commerce.

![Diagram of Physical Distribution in terms of Inventory Location](image)

**Figure 6:** Simplified Version of Physical Distribution in terms of Inventory Location

Furthermore, large ACS’ customers may operate under a vendor management inventory (VMI) contract. This means that ACS is placing a consignment stock (a container) at the customer site. ACS owns the stock, administers it and is responsible for refilling it. The customer is then paying for the product when it is taken out for the use. In the case of consignment stock, the product goes from a customer center warehouse to a consignment stock and then it is taken out by the customer (Manager of Distribution Center, personal communication, 2012-03-16).
In the Figure 6 a simplified version of physical distribution in terms of inventory location is presented.

In reality ACS network is much more complicated since it is adjusted to every region. For example in case of European customers, products are often delivered directly from the DC Fagersta to the consignment stocks or to different customers. In the case of overseas countries for example Japan, there is a center warehouse connected to the Customer Center where the products are delivered from for example DC Fagersta and then from central warehouse they are distributed to local warehouses, consignment stocks or final customers. In some countries there could be several central warehouses (Global Inventory Control Manager, personal communication, 2012-03-19). On other hand, there is only one central warehouse for all European countries which is Distribution Center in Fagersta. Instead every country has several local warehouses. For example CC in Sweden has local warehouses located in Gothenburg, Stockholm, Skellefteå, and Kiruna (Business Line Manager, personal communication, 2012-03-21). Sometimes the products bypass customer centers’ warehouses and shipped directly to customers. Different distribution flows are showed in the Figure 7.

4.3 Logistics Importance Ten Years Ago and Its Development until Today

Historically, sales subsidiaries and product companies manage their inventory autonomously. What products to store at subsidiaries’ warehouses were decided by subsidiaries’ managers.

Ten years ago the main ACS problem was a lack of capacity and all efforts were directed on trying to cater increasing demand. There was no sufficient information system that would be capable to monitor and manage inventory levels. There was even no Central logistics department that would be in charge of coordination of inventory management and optimizing finished goods inventory stocks at the company’s subsidiaries. And there was in general lack of knowledge of inventory management and lack of educated people within logistics. Logistics was only associated with shipping and storing products and was located on the lower hierarchical position compared to marketing and production department (Manager of Distribution Center, personal communication, 2012-03-16).
Product Companies was only concerned about minimizing their backorders, while Customer Centers, focused on providing high service to the customers, were interested in maintaining high level of stock to guard themselves against uncertainties in supply (Purchasing and Logistics Manager, personal communication, 2012-03-19). Unfortunately often they did not have the right stock and despite high level of inventory the service level was low (Manager of Distribution Center, personal communication, 2012-03-16). Today size of obsolete and excess ACS finished goods inventory located all over the world amounts to 100 MSEK (Manager of Distribution Center, personal communication, 2012-03-16).

Since then the company has undergone considerable changes and restructuring that highly effected total inventory management.

During the past ten years ACS experienced considerable growth. ACS acquired five Product Companies in different countries to increase its product range and get access to the markets.

In 2006 ACS invested in new information system. The old Enterprise Resource Planner system Dialog was changed to more efficient MOVEX. Moreover, the same year ACS started to set-up inventory management system Supply Chain Concept (SCC). It became a standard system in the Secoroc division. Today it is installed and successfully used for managing inventory in 17 Customer Centers that responsible for 80% of sales and in all Product Companies. SCC allowed the company to improve visibility. Service levels are now could be clearly defined which facilitated monitoring of PC and DC stocks. SCC also allows controlling and optimizing stocks. It automates routines (SCC refills the inventories according to predefined service level), balance flow through the entire supply chain, and lower transport cost by minimizing break down deliveries.

Moreover, 54 CCs are using business system called Business Planning and Control System (BPCS). By using BPCS it is possible to supply inventory data and analyze it in other IT applications such as QlickView. QlickView is an intelligent tool that extracts information from ERP system MOVEX and allows company to make fast and visual in-memory analysis. ACS continuously works on improving transparency. Their next goal is to set up a simplified version of SCC for non-SCC countries and develop an excess ordering report (Global Inventory Control Manager, personal communication, 2012-03-19).

ACS has also heavily invested in increasing production capacity. In 2001 ACS invested 100 MSEK in machinery (Atlas Copco AB., 2001, April 27). In 2008 ACS invested 250 MSEK (SVT.se, 2008, February 12) and in 2011 additional 450 MSEK (Atlas Copco Secoroc AB., 2011, February). Improved capacity gave results and today the company is able to deliver products faster and therefore, focus is finally directed on optimizing inventory stocks and streamlining inventory management at different stocking locations.
Furthermore, ACS focuses on employing people with relevant university degree. And develop competences and skill of its employees (Purchasing and Logistics Manager, personal communication, 2012-03-19).

4.4 Activities Aimed to Optimise Total Inventory of Finished Goods in ASC

4.4.1 Changing towards SCM-Oriented Organisation

Figure 8: The Structure of Logistics Department. Year 2002

In the past ten years logistics received much bigger focus in the organization. Today logistics department is located at equal hierarchical positions with other functional departments such as production, marketing and finance. Logistics department grew and now contains several sub-departments that work with different aspects of supply chain management. Logistics department role is nowadays to manage, control and integrate various supply chain activities. The growth of logistics department was associated with increase of awareness in the organization about the importance of effective supply chain management (Manager of Distribution Center, personal communication, 2012-03-16).

Figure 9: The Structure of Logistics Department. Year 2012
One of the most important sub-departments located under Logistics department at Headquarter is Master Scheduling department (MSD). MSD was created in the year 2007 to coordinate production, marketing and logistics efforts. MSD carries out monthly Sales and Operations Planning (SOP) meeting. These meetings are set to bring together production, marketing and logistics managers to decide which products at what tact to produce.

The tact is decided based on sales forecasts. Business Line Managers of 30 CCs (30 CC is responsible for 90% of sales volume), 4 times per year provide all PCs with a market forecasts. Product Line Managers bring up the forecasts on monthly SOP meetings. The use of market forecasts allows to adjust production capacity (before, capacity was changed after series of complaints and drop of sales); to give better forecast to suppliers; and to better monitor PCs action as they have to follow SOP decisions. SOP meetings contribute to better match between supply and demand and better focus on customer needs (Purchasing and Logistics Manager, personal communication, 2012-03-19).

Master scheduling department is now exists in every PC (Purchasing and Logistics Manager, personal communication, 2012-03-19). Work of MSD department contributes to maintenance of correct stock in ACS warehouses connected to production facilities.

To achieve transparency Global Inventory Control department was created in 2006. The department’s primarily focus was on installation and development inventory management system SCC. Today GIC main function is to manage and monitor the sales companies’ stock within Secoroc Division.

Moreover a special position (Inventory controller, personal communication, 2012-03-27) has been created primarily to control inventory at the DC located at Headquarter. Today Inventory Controller received global responsibilities such as standardizing DC/ PC inventory management routines, administration of global return and Return Policy and developing global workflows. Inventory controller is also responsible for documentation of different routines and making them available for all PCs and DCs through ACS’ internet portals.

4.4.2 Autonomous Inventory Management and Sub-Optimization

As was already mentioned amount of obsolete finished goods inventory located all over the world is about 100 MSEK. “This is the result of sub-optimal inventory management”, - states Purchasing and Logistics Manager (personal communication, 2012-03-22). Despite the fact that subsidiaries manager’s bonus based not only on sales revenue or productivity of the factory, but also on inventory targets such as TID some managers of the company’s subsidiaries are still not motivated to work with inventory management.
Purchasing and Logistics Manager (personal communication, 2012-03-22) mentioned that “some sales subsidiaries even tried to reach the target in an easy way by decreasing the level of healthy stock as it was hard to sell the obsolete. In many cases the result was that CCs were not able to cater demand and items had to be shipped by expensive courier”.

Purchasing and Logistics Manager (personal communication, 2012-03-22) has two explanations to this behaviour, “either subsidiaries are not interested in inventory management and only concerned with making sales or they do not have enough knowledge”. Manager of Distribution Center (personal communication, 2012-03-16) mentioned that General Manager prioritize sales targets before inventory management goal- “it was often if General Manager at CC does not make enough sales he gets fired if he has a lot of bad stock he only gets some scolding”.

Global Inventory Control Manager (personal communication, 2012-03-19) states that sales companies often do not have logistics department and often it is sales people who are responsible for managing inventory. Thus, they do not have awareness of benefits of inventory management.

Business Line Manager of CC Sweden in his interview says “lack of capacity at production made that we were steadily busy with chasing our backorders we did not have time to manage our inventory stocks” (personal communication, 2012-03-21).

Distribution Center manager had an explanation of a bad management of finished goods inventory by production companies (personal communication, 2012-03-16). He mention that first of all production companies did not have right routines in the production and when Headquarter tried to impose new routines production staff were reluctant to implement them. People who worked in a certain way many years are unwilling to change their way of working. For example, before many Product Companies used Excel Spreadsheet for registering different transactions. With the old system it was hard to monitor and manage inventory. When Headquarter installed ERP system MOVEX and SCC to improve among other inventory management people worked with the new system for several months and then reverted to the old way of working.

4.4.3 Optimizing and Integrating Inventory Management at Sales Subsidiaries

Today ACS with the lead of Central Logistics department directs much effort on optimizing inventories at the company’s subsidiaries. In 2010 ACS introduces Co-Management Project. The purpose of the project is to increase customer service, balance and optimize inventory in entire supply chain, establish standard ways of working, increase cooperation between the Headquarter of ACS and CCs, and achieve full visibility and transparency in the entire supply chain. Co-Management implies that the cooperation with all CCs is strengthened, but the form of cooperation may differ from CC to CC, depending in
specific circumstances. For some CCs GIC have a very tight cooperation and frequent communication. For other CCs GIC have the responsibility for stock replenishment. Co-Management is currently applies to all CCs using SCC system (Atlas Copco Secoroc, 2011-01-04).

For those CCs where GIC team takes over the responsibility for refilling CC’s central warehouses, CCs become only responsible for stock-taking, forecast provision and refilling of the local warehouses and consignment stocks. The areas of responsibilities are shown in Figure 10.

Figure 10: The Areas of Responsibilities of Central Logistics Department and CCs

GIC also updates and administrates the system SCC with focus on sales companies’ central warehouses. They revise stock data (lead times, re-order points and buffer stock) where it is possible, in order to reduce inventory. GIC is also responsible for set-up of stocking policies suitable for the CCs’ markets. Stocking policy guides sales company about what products should be stocked, in what quantities and how often they should be ordered (Fixed Order Quantity). Moreover, GIC is responsible for overview and adjustment of TID targets for all CC’s.

GIC continuously follows up inventory trends at customer centers. They periodically conduct Logistics Review meetings for CCs to exchange necessary information. The meeting follow standardized agenda. At every meeting sales company together with GIC review situation on the market, unhealthy stocks and actions to reduce such inventories, unique items that should be hold in stock, and historical data of CC inventory values and days.

Figure 11: Example of Request and Shared Responsibilities under Co-Management
After identifying obsolete and excess stock, CCs have to prepare action plan to reduce slow-moving items at their warehouses.

Except stock-taking, and administration and stock-replenishment of local warehouses sales companies are also responsible for updating and administrating the SCC system with focus on sales forecasts. They are also in charge of informing GIC about changes in the market. “Market can change overtime and it is an important factor for inventory management” says GIC Manager (personal communication, 2012-03-19). CCs have to provide information about changes in product trend, seasonally products, and products in campaign. Furthermore, CCs have to periodically update local system with information about stock data such as lead times, stock level, and customer demand.

GIC is not aiming to fully centralize inventory management since they are not able to handle such amount of warehouses and they simply do not have knowledge about local markets (GIC Manager, personal communication, 2012-03-19).

To increase awareness and level of knowledge about inventory management at sales subsidiaries GIC team conducts logistics workshops and trainings and provide education in inventory management system SCC for sales subsidiaries.

They are also responsible for creation and documentation of routines and processes and make sure that information is available and updated in ACS’ internet portals.

Purchasing and Logistics Manager (personal communication, 2012-03-22) believes in benefits of partly centralization of the inventory management of CCs’ stocks. GIC team is experts in inventory management and inventory analysis. They are able to derive necessary statistics and set appropriate performance indicators. GIC team is always up-to-date and have access to the latest information about PC/DCs.

Some sales subsidiaries are reluctant to decrease their inventory levels. DC Manager (personal communication, 2012-03-16) believes that years of capacity constraints and steady delay in deliveries resulted in sales companies’ mistrust in production companies’ ability to cater current demand. However, if a sales company does not cooperate, the GIC team have the authority to stop or cancel refilling orders. This measure was already implemented in practice (GIC Manager, personal communication, 2012-03-19).
4.4.4 Optimizing and Integrating Inventory Management at Production Companies and DCs

A lot of efforts are also directed on aligning inventory management at production companies and DCs. All PCs and DCs have to follow Global Stockholding policy. Stockholding Policy guidelines PCs and DCs which products should be made to stock and which should be made to order.

To achieve healthy and correct inventory and minimize amount of obsolete and excess stock at warehouses connected to manufacturing facilities a Product Revision routine was developed. It is performed quarterly with the deadline of last working day of each quarter. Product Revision is conducted by the function or person responsible for managing the inventory at PC/DC. Product Revision procedure implies that the responsible in question reviews the list of products that considerably increases or decreased in demand. The list of products is derived from inventory management system SCC. Together with marketing department, the responsibility for Product Revision have to determine which products should be kept in stock and which product should remain or become non-stocked (Atlas Copco Secoroc, 2012b).

Product Revision policy existed ten years ago, however, it was not much followed by Product Companies (Ex employee, personal communication, 2012-07-26). Today top management devotes efforts to ensure that policies are followed and if necessary Headquarter directs its resources to help subsidiaries to establish necessary routines. Inventory controller is set to be in charge of imposing this routine at every PC and DC. Nowadays Product Revision it is carried out at DC in Fagersta, Springs and PC in Fort Louden. ACS plans to set up product revision as a routine at all warehouses connected to manufacturing facilities at the end of 2013 (Inventory Controller, personal communication, 2012-03-27).

Purchasing and Logistics Manager (personal communication, 2012-03-22) also have periodical meetings with all Product Companies regarding inventory situation. These meetings also follow standard agenda. On the meeting the level of obsolete and excess stock and its trend at all PCs/DCs is discussed. Also all Product Companies have to present action plan for the obsolete and excess items. PCs and DCs can also ask for support from Central Logistics department. If Product Company would like to discuss some issues in more details they book a separate meeting with Logistics Developer Manager or the specialist in the Central Logistics Department that could solve the issue (Purchasing and Logistics Manager, personal communication, 2012-03-22).

4.4.5 Optimizing Inventory Levels

Optimization of inventory management often is divided in small projects. These projects have their own goal, plan of actions and time period after the end of the period ACS managers conduct evaluation. For example in January 2012 Atlas Copco Group Top Managers gave strict direction to decrease inventory
levels worldwide to improve situation with the cash flow. All investments have been stopped until the Board of Director would see some positive results.

ACS Central Logistics Department developed plan of action for decreasing inventory level at CCs warehouses to tackle the problem. CCs have together with GIC department review their inventory and implement reduction of inventory in three steps.

1) In the first step all slow-moving stock classified as make-to-stock at PCs and DCs has to be returned where it was bought. Also PCs and DCs have to review CC’s slow-moving stock classified as make-to-order and accept those items which have a demand.

2) The slow-moving items that cannot be returned back to production warehouses have to be put on Sell-Out.

3) At the end of Sell-Out period, unsold products have to be scrapped.

If CCs are not following such guidelines Center Logistics Department stops all deliveries until they see that CC is making efforts.

The goal of the project was not only to decrease excess and obsolete inventory in sales subsidiaries, but also to pool inventory to DCs and PCs warehouses. DC Manager (personal communication, 2012-03-16) points out that centralization of physical inventory at PCs and DCs warehouses proved to increase availability at distribution centers and PCs’ warehouses, which in terms contributes to more timely deliveries to customer centers.

In general the Headquarter only set goals for logistics subsidiaries in term of inventory management targets, but they almost never give any plan of actions for sales subsidiaries. Often subsidiaries are free to come with their own plan of actions, but Headquarter of course can provide support if subsidiary would ask for that.

4.4.6 Follow-up and Monitoring of Results

ACS continuously monitors and follows-up inventory levels trends at different stocking locations. The company uses TID as a KPI for measuring inventory management performance. Each PC, DC and CC has a target expressed in TID. The CCs are measured and classified based on their three months average TID. The countries are then divided in three groups based on value of TID. Green CCs are on or below target. Yellow CCs are above the target but less than 20%. Red are more than 20% above the target. Such classification helps inventory controller department to devote resources to control inventory where it is mostly necessary. The objective is that all CCs should be classified as green. Also aggregated TID is measured and monitored (Atlas Copco Secoroc AB., 2010-01-17).
However, this measure has downturns, since if price on the metal and thus, raw material increases, the production cost of the products increases as well, which means that it consequently impacts transfer price of the items and which leads to increase value of stock in the companies warehouses. Also exchange rates impact the value of inventory. Value of inventory impacts calculation of inventory days which becomes also larger. The more accurate result can be seen three months after recalculation of transfer prices (Purchasing and Logistics Manager, personal communication, 2012-03-16).

Furthermore, Logistic development manager monitors warehouses connected to manufacturing facilities on the amount of obsolete and excess inventory every month.

All the Product Companies warehouses are measured by the product availability. Product availability target for all Product Companies warehouses is 95%.

4.4.7 Creating Corporate Culture and Sharing the Same Values

It is very important to make people to buy the idea and work in the same direction. GIC Manager (personal communication, 2012-03-19) says that when working with subsidiaries they try to show that people working at central logistics department are not enemies, that they are colleagues and strive to achieve the common goal to satisfy their customers. The same approach is used when working with people from Product Companies.

Expatriate control is not used as a method to optimize inventory management. ACS has so called International Job Market. It gives opportunities to employees working at Atlas Copco AB apply for different position all over the worlds within the company.

Different, informal communication event or International Management Trainee programs are neither used by ACS.

4.5 Results of Centralization and Employees Opinions

Since the process of total supply chain management inventory optimization has started a lot of improvement has been observed. First of all inventory management system dramatically increased visibility and gave valuable tool for efficient inventory management. Co-Management project start to divide responsibilities and allocate them to specialists. We interviewed Business Line Manager for CC Sweden (personal communication, 2012-03-21) and he is positive to this division of responsibilities. He believes that such cooperation can contribute to better solution of today’s problems. As Co-Management is fairly new project he did not notice yet a drastic changes in the service levels, but he thinks that with time this structure will contribute to higher service levels and healthier inventory.
Transport and Logistics Manager (personal communication, 2012-03-20) at PC in Fort Loudon, US, is positive to more centralized structure. He states that Headquarter has a bird view perspective and has better knowledge to make decisions. He also states that the certain level of standardization at such big company is necessary to be able to monitor different units and make improvements. He believes that these two mechanisms can contribute to inventory stock optimization.

Project on decreasing inventory management gave the positive results. While before inventory levels steadily increased, today the trend has been changed and figures show decrease in aggregate TID from 196 days in March 2012 in the beggning of the project to 191 days in Jun 2012.

The most striking change according to Business Line Manager for CC Sweden (personal communication, 2012-03-21) is the percentage of on-time deliveries from Product Companies. The company’s statistics also indicate improvement in product availability. For example, product availability at DC Fagersta increased from 80% in 2006 to 84% in 2012. Business Line Manager states that he would even prefer to decrease number warehouses in Sweden and implement more direct deliveries from DC Sweden to customer consignment stocks.

ACS sales showed positive result and company’s ability to cater demand. In the year 2002 companies turnover 1 526 051 KSEK and in the year 2011 the company’s turnover was 4 964 575 KSEK.
**ANALYSIS**

*In this part empirical data is analyzed based on the presented literature review. We explore what coordination mechanisms and with what result are implemented in decentralized organisation regarding to optimisation of inventory management.*

### 5.1 Inventory Management in Decentralized Organisation

Academic research emphasizes strategic importance of inventory management in such areas as customer service (Lee & Billington, 1992; Dubelaar et al., 2001) and cash flow (Augustine et al., 2004; Dubelaar et al., 2001; Eroglu & Hofer, 2010). Furthermore, efficient inventory management can be a company’s competitive advantage (Jones & Riley, 1987).

Today the difficulties with managing inventories come from the fact that most manufacturing companies are structured as networks of manufacturing and distribution sites. Moreover, commonly each site is managed by a fairly autonomous team which implies that inventory management of each site might be conducted differently. This results in inefficiencies for the whole supply chain (Lee & Billington 1992).

ACS organized as complex distribution network of manufacturing and distribution sites scattered around the world — in total ACS owns around 400 stocking locations. ACS’s organizational structure was highly decentralized. Each subsidiary managed its inventory autonomously. The result of such inventory management was 100 MSEK of obsolete and excess stock around the world and low product availability. ACS realized inefficiency of its inventory management and directed much effort on coordination of work of different units.

### 5.2 Reasons of sub-optimization of finished goods inventory

Literature highlights various reasons why autonomous subsidiaries tend to work in different ways. First of all, each subsidiary may have its own objectives and performance measures different or even conflicting with the company’s overall performance (Lee & Billington, 1992; Fugate et al, 2006). Or if goals are aligned they might not be monitored (Lee & Bellington, 1992). Sales companies also might be focused on sales and provide excessive service (de Leeuw et al., 2011). Also rewarding system might be skewed towards sales, but not healthy inventory (Kaiser & Young, 2009). Lack of skills and knowledge might be also a reason for sub-optimization (Picard, 1997). Moreover, subsidiaries might have different routines as they come from different societies, social context and corporate cultures (Miller, 1987; Wally & Baum, 1994; Rollison, 2008).
Interviewing ACS managers and employees we found some similar and some different reasons of sub-optimization compared with academic literature. Purchasing and Logistics Manager mentions that Customer Centers were mainly focused on providing high service to the customers and were interested in maintaining unnecessary high level of stock to guard themselves against uncertainties in supply. Excessive service as the reason of sub-optimization was highlighted by de Leeuw et al. (2011). Orientation towards providing excessive service by sales subsidiaries might be explained by the fact that consequences of low sales revenues for subsidiary manager are much stricter than for not achieving inventory management targets. Product Line Managers mention that General Managers could be fired for showing insufficient sales. Despite the fact that subsidiaries manager’s bonus based not only on sales revenue, but also on inventory targets such as TID some managers of the company’s subsidiaries are still not motivated to work with inventory management. Thus, although ACS has objectives and performance measures that aim to give CCs managers intentions to optimize their inventory, inventory management objectives were on lower position than sales objectives in the hierarchy. ACS rewarding system is skewed towards sales targets, which lead to sub-optimization. This was reflected by Kaiser and Young (2009). Thus, in order to minimize sub-optimization, inventory management goals should be on the same priority level as sales targets.

Empirical data shows that originally sub-optimization at ACS was also due to the inability to efficiently monitor subsidiaries as there was lack of information system. Such reason of sub-optimization was stated by Lee and Billington (1992), but today ACS continuously follows subsidiaries results using GIC team and Logistics Development manager.

On other hand, DC Manager states that despite high inventory the product availability at customer centre warehouses was low. This indicates that inventory is managed in a wrong way as research indicates that wise inventory management increase product availability and thus, enhance customer service (Dubelaar, Chow & Larson, 2001; Eroglu and Hoffer (2010). Consequently, inventory targets goals are not conflicting with the sales goals if inventory managed in the right way. Thus, Lee and Billington (1992) and Fugate et al. (2009) proposition that conflicting goals lead to sub-optimization is only partially correct in ACS’ case. This is because Customer Centers’ managers seemed to be not aware of benefits of correct inventory management and thus, perceive sales and inventory targets goals as conflicting when in reality they complement each other. Therefore, the problem of sub-optimization really lies in the lack of knowledge and awareness. Purchasing and Logistics Manager and GIC managers suggest that indeed lack of skills and knowledge in inventory management might be the reason of sub-optimization. Lack of skills and knowledge as the reason of sub-optimization was pointed out by Pickard (1997).

Another interesting explanation was mention by the Swedish Customer Center manager who states that due to the lack of capacity production centers could not deliver orders in time, thus, subsidiary managers...
devoted much time on chasing their backorders instead of optimizing its inventory. This statement could be interpreted as lack of resources directed on inventory management as limited amount of human resources is reallocated from managing inventory to chasing backorders and pressing the Product Companies to achieve timely deliveries. Lack of resources as the reason of sub-optimization was not mentioned in academic literature.

The fact that the organization experienced such tremendous growth during the past ten years also adds difficulties to coordination of different subsidiaries. As each of acquired subsidiary was an independent company with its own organizational culture, values and processes it is not easy to align and make all these new subsidiaries to work in ACS’s way. DC Managers noticed that people who worked in a certain way many years are unwilling to change their way of working. Thus, a difference in procedures is the reason for sub-optimization in inventory management at Product Companies. This reason of sub-optimization was showed by Wally and Baum (1994).

We can conclude that sub-optimization in inventory management throughout supply chain in one particular company can occur due to several reasons simultaneously.

5.3 Coordination Mechanisms Used to Overcome Sub-Optimization

Academic literature presents different coordination mechanisms that could be applied to streamline inventory management at company’s subsidiaries.

Kim (2006) highlights two supply chain management organizational structures that can efficiently optimized and integrate supply chain activities in the organization: functional and matrix channel organizations. Both of the structures characterised by existence of SCM department located on the same hierarchical position as other functional departments to maintain sufficient level of balance while it efficiently integrates and adjusts various SCM activities. Traditional companies do not have a supply chain departments or SCM-department exists as sub-department of functional department (Bowersox, Closs & Cooper, 2002) as the other functional departments are not SCM- oriented and not focused on integrating different SCM activities including inventory management, sub-optimization may occur (de Leeuw et al., 2009). Bowersox, Closs and Cooper (2002) states that to achieve integrated supply chain traditional non-SCM oriented companies have to undergone a restructuring. From empirical data we can see that historically ACS was non-supply chain oriented organization as per Bowersox, Closs & Cooper (2002). Ten years ago there was no Central logistics department that would be in charge of coordination of inventory management and optimizing finished goods inventory stocks at the company’s subsidiaries. There was in general lack of knowledge of inventory management and lack of educated people within logistics. Logistics was only associated with shipping and storing products. Moreover, logistics department was located on the lower hierarchical position compared to marketing and
production department. We can see that when the company realized the benefits of efficient SCM it started the restructuring towards more SCM-oriented organization. Logistics department was set at the same hierarchal level as other functional departments. New logistics sub-departments such as MSD and GIC departments have been created; furthermore, Inventory Controller position was set. MSD’s mission is to match supply and demand. They are responsible for capacity planning and strive to plan production according to forecasts provided from CCs. GICs mission is to optimize inventory at sales companies, while Inventory Controller is more focused on inventory management optimization at Product Companies. Logistics department role now is to manage, control and integrate various supply chain activities not only at headquarter, but also at Product companies and Customer Centers. Thus, we can conclude that ACS organizations reminds Kim’s (2006) functional organization as logistics department not only integrates, but controls and manages various SCM activities including inventory management. Thus, ACS efficiently utilized the benefits of right organizational structure to decreases sub-optimization.

Centralization is one of the mechanisms to increase coordination (Loppacher et al, 2010). Olson, Slater and Hult (2005) state that centralization suits to non-complex environments where there is no need to solve non-routine problems, while decentralization is efficient in dynamic and complex environments. ACS utilizes centralization for managing inventory at its subsidiaries to the level of central warehouse by implementing Co-Management project. From the central warehouses to consignment stocks inventory management is kept decentralized. Such degree of centralization can be explained that at central warehouse demand is more stable compared to local warehouses and consignment stocks, since demand pooling is applied. Demand pooling is applied due to the fact that products from DCs/ PCs warehouses usually firsts shipped to central warehouses and then distributed within the country (Berman, Krass, and Tajbakhsh, 2011). This means that headquarter is capable to manage inventory management to central warehouses itself. However, based on the empirical data we can conclude that to apply centralization the company first has to acquire visibility and transparency within company’s supply chain. For example, GIC department mission was first on developing and installation and development system SCC to gain transparency, now they work on centralization of sales subsidiaries inventory management, through taking over responsibilities for refilling central warehouses. Dreyer et al, 2009 also states that insufficient information sharing and transparency is the key issue for companies that strive to achieve coordination in their supply chains.

We can see that centralization relates to specialization. Specialists are experts in their specific area. They have knowledge and skills to manage different activities and can find better solutions (Olson et al, 2005, Green et al, 2005; Mintzberg, 1979). Again Co-Management project implemented by GIC is also to some degree reallocation of responsibilities to the ones that can perform them best. The reason why ACS apply centralization in term of refilling customer center warehouses is that often subsidiaries do not
have knowledgeable logistics people and salesman do not have knowledge in inventory management and mostly focused on making sales, this leads that they perceive inventory and sales goal as conflicting. Olson et al. (2005) state that company can overcome lack of skills and knowledge by increasing degree of specialization. GIC team is expert in inventory management, they have access to necessary statistics, and they are always up-to-date and have access to the latest information about PC/DCs. Therefore, they have all prerequisites to support subsidiaries in achieving optimal inventory levels. On other hand sales subsidiaries are experts in their own markets. They have market knowledge and able to provide GIC with good forecasts and information about market trends to adjust inventory levels to change in the markets. However, specialization cannot be an efficient mechanism without tight cooperation and continuous information exchange. To exchange information and stay up to date GIC and sales subsidiaries have periodical standardized meeting to update each other about current situation. Wadhwa (2010) also states that cooperation with transparency synergistically enhance company’s performance. Thus, we can conclude that to optimize finished goods inventory company-wide ACS effectively use mechanisms of centralization and specialization.

Planning refers to what degree headquarters developed detailed planning, goal setting and budgeting system, schedules including well-defined goals on strategic and operational level (Harzing & Sorge, 2003). ACS improves coordination through the small projects which has plan and special goal. In general Central Logistics department only set inventory goals for subsidiaries and customer they are free to develop their own plan of actions. This is a characteristic of decentralized organizational structure where corporate headquarters develop performance standards for business units and the managers of business units are free to decide how to meet the goals (Pertilla & Niemi, 1996). This way of working is logical since subsidiaries knows its market and products and can find better solution to achieve set targets.

Company can increase its degree of standardization meaning that every subsidiary has to follow and conduct standard policies and routines (Brunsson & Jacobsson, 2000). Standardization is a prerequisite to efficient monitoring of results. As everyone does in the same way it is easy to compare performances of different subsidiaries (Ibid). We can see that ACS devotes much effort to standardize its activities. GIC team works a lot on standardization of processes and procedures for sales subsidiaries’ inventory management. While Inventory Controller is responsible for standardizing DC/PC inventory management routines, administration of global return, and Return Policy and developing global workflows. Inventory controller at central logistics department right now works with Product Companies to impose Product Revision routines and make sure that all Product Companies implement it in the same way at the same time. Standardization at ACS is aimed to align subsidiaries’ actions and make them work in one direction. Brunsson and Jacobsson (2002) state that standards are often used to help decision makers to avoid mistakes. This is exactly why ACS is using standards. Thus, we can conclude...
that standardization as mechanism to make sure that all subsidiaries’ work in the same direction is used by the company.

Brunsson and Jacobsson (2000) state that standards in organization make it easier to implement orders and directives throughout the business units. However, empirical study showed that having standards does not guarantee that subsidiaries follow them. There must be continuous follow-up and control that subsidiaries really follow those policies otherwise they revert to their own way of working. In ACS case we also observed that if subsidiaries’ still do not want to cooperate headquarter takes strict measurement by stopping all deliveries to CCs until they see that the subsidiary obeys to headquarter directives.

Standardization cannot be achieved without formalization. Every subsidiary has to have access to policies and instruction about standard routines and procedures, which implies that all routines and procedures have to be document and made available on the company’s information portals (Martinez & Jarillo, 1991). Objective of formalisation is to coordinate activities and reduced variability in behaviour (Olsson, et al, 2005). ACS works a lot on documenting their routines and processes. Inventory controller and GIC team are responsible for documentation of different inventory management routines and making them available for all PCs, DCs and CCs. This routines and standards are aimed to align inventory management and direct it on achieving optimal inventory levels company-wide. Consequently, formalization is also utilized by ACS as mechanisms of coordination finished goods inventory management activities.

Moreover, coordination cannot be achieved without performance control (Lee and Bellington, 1992). It is not possible to make improvements if you do not know where you are on the performance scale. ACS continuously monitors and follows-up inventory levels for sales subsidiaries’ warehouses. Turnover in Days (TID) is used as a KPI for measuring inventory management performance. Each PC, DC and CC has a target expressed in TID. GIC department is for example responsible for monitoring sales companies’ warehouses. The CCs are measured and classified based on their three months average TID. The countries are the divided in three groups based on value of TID. Such classification helps inventory controller department to devote resources to control inventory where it is mostly necessary. Also aggregated TID is measured and monitored. To stay updated GIC periodically have Logistics Review meeting with CCs. This meeting follow standardized agenda where sales company together with GIC review situation on the market, unhealthy stocks and actions to reduce such inventories, as well as what unique items, and historical data of CC inventory values and days. Purchasing and Logistics Manager also have periodical meetings with all Product Companies regarding inventory situation. These meetings also follow standard agenda. On the meeting the level of obsolete and excess stock and its trend is discussed. Also all Product Companies have to present action plan for the obsolete and excess items. Product Companies can also ask for support from Central Logistics
department. Therefore, having right performance measurement and execution of frequent follow-ups is prerequisite for efficient coordination.

Another coordination mechanism mentioned in the academic literature is providing education for employees (Hennart, 1991). To improve inventory management ACS headquarter provided education in inventory management for headquarter and sales and manufacturing subsidiaries’ employees. For example GIC conducts logistics workshops and trainings and provide education in inventory management system SCC for sales subsidiaries. Inventory controller support Product Companies in imposing inventory management routines and procedures. Furthermore, ACS strives to employees staff with university degree in supply chain management. Moreover, ACS consults external firms that provide courses in inventory management. Also, ACS strives to employees people with university degree in supply chain management to work in logistics department.

Indirect/ personal mechanisms such as socialization, informal communication, and international management training described by Harzing and Sorge (2003) are not used by ACS for optimization of inventory management throughout the supply chain with exception of employing people with high education degree in logistics. Socialization and informal communication are indirect mechanism and may not have impact on inventory management. Furthermore, international management training may not be effective either as there are a lot more people involved in the inventory management than only managers. That is why ACS provides logistics workshops to all employees that deal with inventory. Neither is expatriate control mechanism where headquarters assign a manager from head office to subsidiaries in order to be sure that headquarters’ policies are properly performed (Harris & Holden, 2001) is used at ACS.

5.4 Summary

We can conclude that ACS had several causes of sub-optimization in inventory management highlighted in academic literature such as sales companies tend to provide excessive service, goals historically was not monitored, rewarding system is skewed towards sales, lack of knowledge and skills at subsidiaries management as well as different routines originated through acquisition of independent Product Companies. There is also one reason that was not mention in the previous research - lack of resources devoted to SCM. As there are several different reasons of sub-optimization, there are also different control mechanisms that can eliminate them. That is why the company utilizes several coordination mechanisms simultaneously; all of them were mentioned in academic literature. Analysis shows that the company restructured its organization towards more supply chain management oriented to coordinate and control various SCM activities including inventory management. Furthermore, ACS practices such control mechanisms as centralization and specialization in order to optimize inventory management at
sales subsidiaries. Centralization together with specialization directed to overcome lack of skills and knowledge in inventory management by reallocation of responsibilities. Standardization and formalization is used to align subsidiaries’ actions and eliminated mistakes of decision authority in terms of finished goods inventory management. Output control and transparency are directed on monitoring the subsidiaries inventory levels and inventory targets and controlling subsidiaries’ inventory management. Furthermore, ACS provides education in logistics and inventory management to employees to increase awareness of benefits of efficient inventory management. It is also sometimes used planning, but generally this mechanism is not utilized, for the reason that subsidiaries are closer to the problem and thus are able to come to better solutions. It can be observed that the mechanisms that ACS implement is often complement each other.

Several control mechanisms mentioned in academic literature are used in researched manufacturing company with decentralized system to optimise total finished goods inventory management. ACS does not practice direct supervision, expatriate control, socialization, informal communication and international management trainee mechanisms to optimized inventory management throughout the organization. Expatriate control is not used at all at ACS even in other areas not only logistics. Socialization and informal communication are indirect mechanisms and are not used as the strengthening of corporate culture does not directly affect inventory management. Informal communication does not either give a direct impact on finished goods inventory management. That is maybe why these two mechanisms are not utilized by ACS. Internal management trainee mechanism is also not used since not only managers, but also employees need to understand logistics and inventory management and thus, ACS provide the same education for its staff dealing with inventory.

Simultaneous utilization of control mechanisms used by ACS gives positive results. Due to efficient inventory management product availability increased from 80% in the year 2006 to 84% in the year 2012.Moreover, only from March 2012 to June 2012 Secoroc decreased its TID with 5 days which is great result. More striking is that sales are drastically increased from 1.526.051 KSEK in 2002 to 4.964.575 KSEK in 2011. That means that ACS is able to cater demand in efficient way and satisfy its customers.
CONCLUSION

The purpose of this thesis is to investigate whether coordination mechanisms highlighted in academic literature are used in practice on the example of manufacturing company with decentralized decision-making structure for optimization finished goods inventory stocks. In order to accomplish this purpose, following research questions will be answered in this paper:

**RQ1.** What coordination mechanisms can be used to overcome problem of sub-optimization of finished goods inventory in decentralized system?

**RQ2.** How are these mechanisms implemented in practice?

The study showed that ACS' main problems of sub-optimization lie in lack of awareness, skills and knowledge about inventory management at subsidiaries management. The main reason of sub-optimization at Product Companies is the differences in procedures. Almost all of the Product companies were independent organization before they were acquired by ACS. Imposing standard company’s routines and policies is a challenge since employees who worked in a certain way for many years are reluctant to change their routines. Lack of resources for inventory management optimization is also the reason for a bad inventory management. Thus, sub-optimization in inventory management at manufacturing company with decentralized distribution network can have several grounds.

Academic literature presents several coordination mechanisms such as establishing central logistics department that will be in charge of coordination of supply chain activities at different units, centralization, specialization, standardization, formalization, planning, output control, direct supervision, expatriate control international management training, and socialization.

The study showed that most of these mechanisms are used in practice for optimizing finished goods inventory and applied simultaneously. One of the reasons for this is because sub-optimization of inventory at different subsidiaries in the company are different, thus different coordination and control mechanisms must be applied to tackle problem of sub-optimization. Furthermore, these mechanisms are better to use simultaneously since often they complement each other and gives better effect. For example, centralization cannot be efficiently applied without first achieving transparency and information exchange. Standardization cannot be implemented without formalization. Furthermore coordination cannot be achieved without proper performance measurements and follow-up. Hand-off approach implies that subsidiaries often return to the old way of working. Furthermore, there will not be any improvements without first gaining awareness about benefits of inventory management at subsidiaries management. Thus, education and training is very important factor in achieving coordination.
We observe that, in practice, centralization implies that the company centralized its inventory management to certain level and divides responsibilities according to actors specialization. In order to coordinate inventory management companies uses standardized policies and routines. Even the follow-up is done in standardized way. This allows the central logistics department to easily compare work of different subsidiaries.

We also observed that coordination mechanisms indeed give positive results and are able to optimize inventory management. However, to restructure organization towards more supply chain management oriented organization and spread awareness about importance of efficient supply chain management and achieve optimal inventory management throughout the company's supply chain takes time. ACS is now on the right direction, but it will take several years to make all subsidiaries to manage its inventories in optimal for the total ACS supply chain way.

Future research can be done to prove present findings by quantitative data. This research can be extended through investigating financial performance. Another research can be conducted in order make comparisons of methods for overcoming sub-optimisation and implementing coordination mechanism between other manufacturing companies.
LIST OF REFERENCES:


APPENDICES

Appendix 1: Interview Guide

Information about interviewees

- Description of job positions and main responsibility
- How long the interviewees have been working in the company?

Company’s background

- Brief facts about Atlas Copco Secoroc AB
- History of ACS

Inventory management and physical distribution

- How the structure of ACS distribution network looks like?
- How many DCs/ production units the company operates in which countries?
- How many finished goods stocking location ACS has?
- Is there a central warehouse in all countries where ACS operates?
- What is the strategy for inventory stock-holding?

Customer loyalty

- What is important for the customer in construction and mining industry: price, quality, on-time deliveries or something else?
- Are customers loyal in this industry?
- How easy is it for the customer to switch to another supplier?

Decentralized decision making structure

- How finished goods inventory is managed centralized/ decentralized?
- Which inventory management decisions are taken by sales companies?
- Who is deciding which items should be stocked in CCs warehouses?
- Does production manage its inventory on its own or is it centralized?
- What inventory decisions should be centralized/ decentralized in the future?

Sub-optimisation in decentralized decision making structure

- Is sub-optimization of inventory management an issue for ACS?
If yes what are the reasons of sub-optimization?
What are the effects of sub-optimization?
What actions ACS has done to minimize sub-optimization?

**Supply Chain focus in an organisation**

- What role Logistics department had 10 years ago?
- Where in the hierarchical structure it was located?
- What is role of Logistics department today?
- Where in the hierarchical structure it is located?
- What was the structure of logistics department ten years ago?
- What is the structure of logistics department now?

**Coordination mechanisms**

- How much company works on standardization of inventory management procedures?
- To what extent the company uses formalization mechanism?
- Does ACS use direct supervision to control inventory management as subsidiaries?
- To what extent the company uses specialization?
- Employees that worked in the logistics department ten years ago were they specialist or generalist?
- Does ACS implement international management trainee programs to educate in inventory management?
- Does ACS use expatriate control as the mechanisms to decrease sub-optimization?
- Does ACS utilize mechanism of socialization and informal communication to align inventory management?
- Does Headquarter set goals for subsidiaries and provide them with the plan of actions?
- Who is deciding which KPI are used for different DCs?
- What performance measurements are used to evaluate inventory management at subsidiaries?
- To what degree performance of subsidiaries is monitored and followed up?

**IT and transparency**

- How transparent is the organization today?
- How transparent was the organization ten year ago?
- What is the role of IT systems in establishing transparency?
- Did transparency change the structure of decision making with inventory management?
Appendix 2: Factors Influencing Inventory Level

There are several factors that influence inventory level (De Leeuw et al, 2011). They are summarized in the table below. The first one is lead time - the longer the lead time, the higher inventory level (Silver et al., 1998, cited in de Leeuw et al, 2011). Inventory levels are also related to batch sizes. The larger the production batch size, the higher inventory level (Ibid). As inventory is buffer against uncertainty - the higher the uncertainty, the higher inventory level. Also factors such as seasonality, target service level, and product variety influence inventory level. Moreover, globalization creates increase in export over longer distances with less frequent shipments, which implies higher level of finished goods inventory (De Leeuw et al, 2011).

Hendricks and Singhal (2008) add that level of inventory may be a proxy of strategic choices that companies make in terms of how they decide to meet the needs of the market (cited in de Leeuw et al, 2011).

Table 3: Factors influencing inventory level according to de Leeuw et al. (2011)

<table>
<thead>
<tr>
<th>Factor</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lead-time</td>
<td>The longer the lead time the higher inventory level.</td>
</tr>
<tr>
<td>Batch size</td>
<td>The larger the production batch size, the higher inventory level.</td>
</tr>
<tr>
<td>Uncertainty</td>
<td>There are three types of uncertainty – supply uncertainty, internal process uncertainty and demand uncertainty. All of these forms of uncertainty entail higher inventory levels.</td>
</tr>
<tr>
<td>Seasonality</td>
<td>Greater seasonality leads to higher inventory level.</td>
</tr>
<tr>
<td>Target service level (product margin)</td>
<td>Higher inventory level is necessitated if customers are not willing to wait.</td>
</tr>
<tr>
<td>Product variety (batch size and demand variability)</td>
<td>The more different item a company produce the more variable demand for each item, which implies more changeovers in production. Higher variability in demand and more changeovers (meaning less productive time) will necessitate more inventory.</td>
</tr>
</tbody>
</table>
Appendix 3: Types of Organisational Structure

A Type: Non SCM-oriented Organisation

B Type: Functional Organisation
C Type: Matrix Channel Organisation

D Type: Process Staff Organisation
E Type: Integrated Line Organisation

President

SCM

IS/Engineering

Finance/Accounting

Manufacturing

Marketing/Sales

SCM activities:
- IS Planning

SCM activities:
- Order Processing
- Logistics Control

SCM activities:
- Production Planning
- Engineering
- Raw Material Procurement
- Domestic Transportation
- Plant Warehousing
- Raw Material Inventory Control

SCM activities:
- Forecasting
- Customer Services
- Field Warehousing
- International Transportation
- Finished Goods Inventory Control
Appendix 4: Company’s Documents are Used in the Research


Atlas Copco Secoroc AB. (2010-01-04). *Order to delivery, General, s.02*. Database. Fagersta: Atlas Copco Secoroc AB.


