How to re-design Supply Chains more effective when a web sales portal is applied?

- Based on a web-sales implementation plan of Spare Parts in the Industrial Electronics Industry -

- According to confidential information the content of this version is limited -

Marc-Julian Herrmann

September 2011

Master’s Thesis in Logistics and Innovation Management

Supervisor: Lars Bengtsson
Examiner: Roland Hellberg
Abstract

The following thesis counteracts the relationship of Supply Chain Design (SCD) and web-sales\(^1\), and concentrates on the overall aim of “How to re-design Supply Chains more effective when a web sales portal is applied?”. In order to clarify this aim, following four research objectives are set:

1. How does e-commerce connect to Supply Chain Design in general?
2. What is required for a successful implementation of e-commerce?
3. What are the costs and benefits by implementing e-commerce?
4. Which potential risk factors in correspondence of the implementation of e-commerce may influence the whole SCD and e-commerce interaction process?

Previous studies have not discussed the interaction of e-commerce and supply chain design on operational level at all, which accounts for a large portion of interests these days. When looking at the research objectives they have been solved in three process steps.

First of all the general connection of e-commerce and Supply Chain Design had been analysed through an extensive literature review in form of i.e. suitable books and research papers. Results demonstrated that e-commerce helps to support and manage supply chain activities by offering relevant information. The connection between e-commerce and SCD insists of a close gearing. E-commerce helps to support and manage supply chain activities by offering relevant information about what kind of product is demanded, what is available in warehouses, which products are in the manufacturing processes, and which products will enter the physical facilities and customer sites.

Following, research objectives two to four had been identified for which a literature review has created a firm basis on the status quo of current research studies. Combined with findings of developing a web-sales implementation plan for a leading group in power and automation technologies this work-out has been used as empirical research on how a real life company is carrying out these objectives. This plan had been worked out on-side the company, data has been obtained through

\(^1\) “Web-sales” in this context is associated with selling and buying information, products, or services via computer networks (Strader & Shaw, 1997), in this research study it is identical to “E-commerce”.
interviews, observations, and internal system data. Requirements for a successful implementation of e-commerce are seen in strategic and organisational planning activities, as well as specific platform conditions. Concerning costs and benefits, monitoring and evaluating improvements, increasing customer satisfaction, and reducing order-cycle times stay in contrast to incidental fixed and variable costs which had been demonstrated through a detailed break-even analysis. Potential risk factors which had been identified can be countervailed through an appropriate risk management.

Thirdly, the overall research question of “How to re-design Supply Chains more effective when a web sales portal is applied?” had been solved based on intermediate results of step one and two, combined with the project work-out, providing informative and sufficient data. The result is that in a first step a clear picture of which products and spare parts will be sold has to be defined. Secondly a precisely inventory management - discussing which parts to hold in stock, where to stock them, and how much to hold in stock - needs to be worked out. And thirdly, after analysing the possible and most plausible inventory strategy, possible distribution varieties need to be analysed. The most appropriate solution for the case company is represented in an Inventory-Distribution-Matrix.

This research study has created a basis for the business unit of Power Electronics to improve possible efficiency. The knowledge and implementation steps operated for this implementation plan can be used for other business units in Switzerland and can be seen as a decision maker. Therefore this work-out has generated an enormous benefit for the case company. Instead of acting instinctively, decisions are based on qualitative and quantitative methodologies, data collection methods and data analysis techniques, and therefore follow a process strategy.

_Keywords:_ Web-sales portal; Electronic-commerce (e-commerce); Supply Chain Design (SCD); Spare-parts management
Acknowledgement

First and foremost I offer my sincerest gratitude to the ATPS Service Sales department and all individuals at ABB that have supported this work through investing their time, knowledge, experiences and interest. Without the information gained during my project work on-site of ABB Switzerland this Thesis would not have been realizable in this way.

I am especially indebted to Mr. [Name], for his advice, encouragement and support.

Furthermore I also thank the Steering Committee members, [Name], [Name], [Name], [Name], [Name], for their advice and support during the project and gate meetings.

I would like to express my special thanks to my supervisor Professor Lars Bengtsson, head of the division Industrial Engineering and Management at the University of Gävle, for his guidance and advice from the early project stages on and the opportunity to study in Sweden.

In addition I would like to thank all my friends, fellow students, professors, assistant lecturers, and employees of the University of Gävle who have made every day enjoyable and fun, even during the cold and tough winter time.

Last bit not least I wish to thank my parents Werner and Ulrike, my brothers and sisters Sebastian, Christoph, and Desireé, as well as my grandfather Walter for supporting and encouraging throughout all my studies at the University.

Marc-Julian Herrmann

Turgi, September 2011
Table of Contents

Abstract .......................................................................................................................... 2
Acknowledgement ........................................................................................................ 4
Table of Contents .......................................................................................................... 5
Table of Figures ............................................................................................................ 7
List of Tables ................................................................................................................ 8
List of abbreviations .................................................................................................... 9

1. Introduction .............................................................................................................. 10
   1.1 Background ........................................................................................................ 10
   1.2 Purpose ............................................................................................................. 11
   1.3 Research scope and value .................................................................................. 13
   1.4 Thesis outline and time schedule ..................................................................... 13

2. Theoretical Framework ............................................................................................. 15
   2.1 E-commerce ...................................................................................................... 15
   2.2 Supply Chain Design ....................................................................................... 17
   2.3 Inventory Management ..................................................................................... 19
   2.4 Cost-benefits of e-commerce .......................................................................... 20
   2.5 Risk factors of e-commerce ............................................................................ 21
   2.6 Summary ........................................................................................................... 23
   2.7 Need for empirical research ............................................................................ 25

3. Methodology ............................................................................................................ 27
   3.1 Introduction ........................................................................................................ 27
   3.2 Research Plan and Process .............................................................................. 30
   3.3 Data analysis ...................................................................................................... 36
   3.4 Research quality ............................................................................................... 36
      3.4.1 Validity ...................................................................................................... 36
      3.4.2 Reliability ................................................................................................. 37
      3.4.3 Limitations ............................................................................................... 38

4. Case realisation and analysis .................................................................................... 40
   4.1 Background of ABB Switzerland ..................................................................... 40
      4.1.1 Current situation ....................................................................................... 41
Table of Figures

<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>E-commerce benefits</td>
<td>21</td>
</tr>
<tr>
<td>2</td>
<td>Gate Model - Time schedule</td>
<td>31</td>
</tr>
<tr>
<td>3</td>
<td>Interviews and observations</td>
<td>32</td>
</tr>
<tr>
<td>4</td>
<td>Current spare parts ordering and purchasing process</td>
<td>42</td>
</tr>
<tr>
<td>5</td>
<td>Parts OnLine user interface example</td>
<td>45</td>
</tr>
<tr>
<td>6</td>
<td>Service OnLine Information Architecture</td>
<td>47</td>
</tr>
<tr>
<td>7</td>
<td>Service OnLine SWOT analysis</td>
<td>48</td>
</tr>
<tr>
<td>8</td>
<td>UNITROL 5000 components</td>
<td>50</td>
</tr>
<tr>
<td>9</td>
<td>UNITROL 5000 Orders quantity vs. Turnover</td>
<td>52</td>
</tr>
<tr>
<td>10</td>
<td>Inventory analysis - Alternative 1</td>
<td>54</td>
</tr>
<tr>
<td>11</td>
<td>Inventory analysis - Alternative 2</td>
<td>54</td>
</tr>
<tr>
<td>12</td>
<td>Inventory analysis - Alternative 3</td>
<td>55</td>
</tr>
<tr>
<td>13</td>
<td>Alternatives overview</td>
<td>56</td>
</tr>
<tr>
<td>14</td>
<td>UNITROL 5000 installed basis</td>
<td>58</td>
</tr>
<tr>
<td>15</td>
<td>Supply Chain varieties</td>
<td>59</td>
</tr>
<tr>
<td>16</td>
<td>FIPSE process structure</td>
<td>60</td>
</tr>
<tr>
<td>17</td>
<td>DELCE process structure</td>
<td>61</td>
</tr>
<tr>
<td>18</td>
<td>Rhenus process structure</td>
<td>62</td>
</tr>
<tr>
<td>19</td>
<td>Cost and time overview</td>
<td>63</td>
</tr>
<tr>
<td>20</td>
<td>UNITROL 5000 turnover &amp; revenue analysis</td>
<td>68</td>
</tr>
<tr>
<td>21</td>
<td>Break-even analysis (1)</td>
<td>69</td>
</tr>
<tr>
<td>22</td>
<td>Break-even analysis (2)</td>
<td>70</td>
</tr>
<tr>
<td>23</td>
<td>SOL break-down structure</td>
<td>72</td>
</tr>
<tr>
<td>24</td>
<td>SOL Implementation plan</td>
<td>73</td>
</tr>
<tr>
<td>25</td>
<td>Goals and deliverables</td>
<td>81</td>
</tr>
<tr>
<td>26</td>
<td>Inventory Management key factors</td>
<td>82</td>
</tr>
</tbody>
</table>
Figure 27: Customer Service Chart ................................................................. 84
Figure 28: Max. Profit Contribution ................................................................. 84
Figure 29: UNITROL 5000 including the functional units ............................... 95
Figure 30: UNITROL 14300 Zermatt Design ................................................. 95
Figure 31: Project Chart (ABB) ....................................................................... 99
Figure 32: Project Chart (Thesis) ..................................................................... 100
Figure 33: ABB Switzerland Organisation chart ............................................. 101
Figure 34: UNITROL 5000 – Pareto Analysis .................................................. 102
Figure 35: UNITROL 5000 – Order Quantity vs. Turnover .............................. 103
Figure 36: UNITROL Top 30 Turnover vs. Planned delivery time .................... 104
Figure 37: FIPSE order handling ..................................................................... 105

List of Tables

Table 1: Comparison between Qualitative and Quantitative Research .......... 28
Table 2: Alternative key figures ........................................................................ 57
Table 3: Rhenus key figures ............................................................................ 62
Table 4: SC varieties - pros & cons ................................................................. 64
Table 5: Inventory variant Matrix ..................................................................... 65
Table 6: SOL implementation fixed costs ....................................................... 67
Table 7: SOL implementation variable costs .................................................. 68
Table 8: Organisational structure .................................................................... 97
Table 9: Life-Cycle Plan .................................................................................. 98
List of abbreviations

ABB: Arsea Brown Boveri ................................................................. 43
APICS: American Production and Inventory Society ..................... 19
ATPS: Department of Power Electronics and Medium Voltage Drives .......... 40
B2B: Business-to-Business ............................................................... 21
BOL: Business OnLine ................................................................. 43
EDI: Electronic Data Interchanges .................................................... 15
IM: Inventory Management ............................................................ 19
IT: Information Technology ............................................................. 15
PDT: Planned Delivery Time ........................................................... 52
POL: Parts OnLine ................................................................. 43
RFQ: Requirements for quotation .................................................. 41
SAP R/3: ERP Software ................................................................. 35
SCD: Supply Chain Design ............................................................... 11
SOL: Service OnLine ................................................................. 43
SWOT: Strength-Weaknesses-Opportunities-Threats Analysis ............... 13
TPL: Third Party Logistics Provider ................................................. 60
1. Introduction

The research study derived by a project work-out of ABB Switzerland with the aim to increase effectiveness in execution processes. Investigations of how web based service sales of spare parts and services in general shall be implemented to optimise sales and execution processes as well as how a web portal must be designed, operated and maintained was worked out precisely. The outline of this project underlined the challenging research outcome and was giving an important case context.

With the title “How to re-design Supply Chains more effective when a web sales portal is applied – based on a web-sales implementation plan of Spare Parts in the Industrial Electronics Industry”, the following Master Thesis will support the lack of knowledge between this interaction in the sector of logistics. The thesis has been worked out within the Division of Power Electronics at ABB Switzerland in combination with the Industrial Engineering and Management department at the University of Gävle, in the period of April until September 2011.

1.1 Background

In today’s rapidly growing and unprecedented challenges of global and competitive market conditions manufacturing industries are undergoing global transformations. Based on the increase of market globalisation, limitations in budgets, shorter product life cycles, and increasing competitive markets, companies have forced to focus on fast deliveries and high service expectations to meet customer demands, as well as to increase effectiveness in execution processes (Tejeida-Padilla et al., 2010).

This research study shall investigate of how to re-design Supply Chains more effective when a web sales portal is applied based on the spare parts business in the Industrial Electronics Industry with the result of optimising sales and execution processes by considering functional analysis and criteria. The question of the thesis emerged from the case company, requiring the creation of an implementation plan for e-commerce in the spare parts business to strengthen its market positions in the area of High Power Rectifiers. In consideration of an appropriate product choice, potential inventory and distribution varieties, as well as to assess potential risks. As a result of
that, the aim is to provide a solution that will help to understand how to re-design Supply Chains more effective when a web sales portal is applied.

At this point it is necessary to explain the terms “e-commerce” and “Supply Chain Design”. “E-commerce” in this context is associated with selling and buying information, products, or services via computer networks and therefore seen as a future trend (Strader & Shaw, 1997). Addressing the needs of organisations, retailers, and customers to decrease costs while improving the quality of goods and services and therefore resulting as a global endeavour in multi-national corporations (Murillo, 2001). “Supply Chain Design” (SCD) in conjunction to the following research study is principally concerned with the optimisation of Logistic Networks and Processes to decrease transport and handling costs, stock of inventory, lead time as well as to increase the supply chain reliability and availability. In addition, successful integrated SCD will improve the company image through higher service levels. The main goal will be seen in generating higher market shares and therefore to increase sales and profit margins. Internet technologies enable companies to shift their manufacturing and supply chain operations from the traditional integration to a global enterprise and business focus (Lee J., 2003). Through this revolution process, information is transmitted between sellers and buyers resulting to ease the accessibility of data. Furthermore, the information flow will be processed and converted into new designs to generate more effective supply chains.

1.2 Purpose

After reviewing the literature various researchers claim that there is a high demand on extensive research to increase the understanding effect and interaction between SCD and e-commerce. As a result the main research question of “How to re-design Supply Chains more effective when a web sales portal is applied?” emerged. This is specifically analysed in connection to the development of a web sales implementation plan for the UNITROL 5000 (see Appendix: Figure 29), “the most powerful product in the series of excitation systems” (ABB ATP, 2004).

To achieve this overall research and project aim in the spare parts business it is necessary to carry out and focus on the following research questions:
1. How does e-commerce connect to Supply Chain Design in general?
2. What is required for a successful implementation of e-commerce?
3. What are the costs and benefits by implementing e-commerce?
4. Which potential risk factors in correspondence of the implementation of e-commerce may influence the whole SCD and e-commerce interaction process?

First of all the general connection and interaction between E-commerce and Supply Chain Management and SCD has to be identified to set up a basis for the further research objectives.

Secondly, relevant fundamental requirements for a successful implementation of e-commerce have to be investigated. The general objective of Supply Chain Design (SCD) is the strategically configuration and optimisation of all procurement, production and distribution functions of the company. General tasks of SCD are long-term planning, modelling and optimisation of corporate material, goods and information flows including the interaction with suppliers as well as customers. From the case companies point of view a general benchmark and SWOT analysis of existing web sales applications of the ABB group, including the identification of possible implementation options have to be carried out. The benchmark analysis will be based on internal application solutions. Strengths and weaknesses of these applications have to be compared. Resulting opportunities and threats have to be recorded in correspondence to the power electronics spare parts business.

Following costs and benefits have to be analysed affecting the implementation and maintenance. Additionally, the break-even point concerning the costs for implementing e-commerce and its supply chain has to be determined which is seen as the most important aspect of the managerial point of view.

Furthermore, influential risks which may occur during the implementation of e-commerce need to be identified and evaluated. Potential risk factors affecting the spare parts or product groups business on the sales platform have to be analysed to enhance and develop the future process design.
1.3 Research scope and value

This Thesis will add value to the lack of knowledge between E-commerce and SCD on different ways. First of all, the theoretical framework (see Chapter 2) will explain a short overview by supporting a literature review about current web sales platforms, inventory management, distribution channels, costs and benefits, and risk varieties in e-commerce. Secondly, practitioners will be informed about the situation at the case company by analysing and realizing current and potential situations (see Chapter 4). By combining the literature related research with the project work-out the discussing analysis chapter (see Chapter 5) will assume the linkage and relation of e-commerce and supply chain design. This approach will therefore reinforce the theoretical and practical research knowledge. Hence, giving more attention to workable solutions of real problems instead of developing a model based on assumptions which are not in line with the reality in companies.

1.4 Thesis outline and time schedule

Chapter 1 (Introduction) presents an overall background of the research and project work-out. Following the purpose of the research will be discussed, by focussing on theoretical and practical objectives of the work-out. In addition, the scope and time schedule of this study will be clarified.

The Theoretical Framework (Chapter 2) reviews previous research on e-commerce, supply chain design, inventory managements, costs and benefits in e-commerce, potential risk factors and the gap of current literature research in the field of e-commerce and supply chain design. A brief summary will outline the most relevant points found in literature.

Chapter 3 (Methodology) represents the research strategy and process. In addition, data collection techniques will be demonstrated. The research quality aspect of the thesis will be supported by discussing validity, reliability and limitations.

Chapter 4 (Case realisation and analysis) presents the breakdown of the practical case, including background information of ABB Switzerland, SWOT analysis of existing ABB service platforms, product and inventory analysis, distribution analysis, risk assessment, and analysis of appropriate e-commerce implementation steps.
The *Discussion and further research* (Chapter 5) section constitutes the results of the thesis by answering the research questions. General project and research limitations are discussed and achievements for further research provided.

Chapter 6 (*Conclusions*) presents the conclusions of the thesis work-out.
2. **Theoretical Framework**

Referring to the research objectives of this study, this chapter will first explain the needed background of e-commerce and supply chain design. Following the terms and definitions of inventory management, costs and benefits of implementing e-commerce, and risk factors will be stated. The following theoretical framework will create the basis to answer the theoretical focused research questions as mentioned in chapter 1.2. The theoretical framework was carried out by reviewing and analysing relevant literature.

### 2.1 E-commerce

The evolution of the early e-commerce activities can be traced back to the 1970s with the beginning of electronic data interchanges (EDI) and the starting of computer to computer communications and bringing together key databases for interactions. Technically sophisticated forms of EDI were replaced in 1995 by the internet (Murillo, 2001). Today, much of the reluctances to e-commerce interfaces with other organisations are breaking down (Lancioni, Smith, & Oliva, 2000).

Referring the definition of Rogers et al. (1993) e-commerce is primarily concerned with buying and selling activities through the internet, including transactions as order placing, making payments, and tracking deliveries. E-commerce transactions can be remote individually by having access to electronic information, products or services. These transactions require human interactions within a client or server based environment. This can be supported via internet, intranet, or extranet (Rodgers, Yen, & Chou, 1993; Gunasekaran & Ngai, 2004). E-commerce in general can be seen as a contact-driven process since the client needs to get in touch with the company. To support this process, competencies and resources in network structures have to be shared, and communication and coordination needs to be maintained. Information technologies (IT) act as a key role for improving communication and coordination by acting as an enable pulse (Love, 1996). The focus of e-commerce is based primarily on the customer side whereas stakeholders such as employees or suppliers play a more or less incidental role (Rodgers, Yen, & Chou, 1993).
E-commerce in general will lead to high efficiency, as processes compared to traditional ordering are taking less time and costs. Thereby companies will improve their profitability and will receive a competitive advantage on the market place.

To master the right strategy and the right SCD, Daniell (2006) defines the most important trends affecting today’s businesses, which can be drawn to e-commerce. By the global use of improved technology and flexible business strategies a company is able to act more effective by understanding the predictable market trends. The predictable knowledge of how to understand market trends may decrease risk and create new opportunities for future decisions.

In addition it is important to concentrate on the development and continuous improvement of e-commerce as mentioned by Aldin et al. (2004). He figured out, that marketing channels between manufactures, suppliers and customers have attracted a growing demand in the field of B2B context. In which E-commerce provides a step-to-step development of customer services and process optimisation by refinement and repositioning. Both categories are discussed out of the marketing functional point as well as the supply chain process way. Refinement is seen as creating value out of the value chain, out of an inter-organisational view. Hereby e-commerce will perform cost-saving methods for a more competitive pricing strategy. Due to automatic data generation, organisations will perform higher utilisation rates and increases the customer services by the increase of organisational response. Repositioning is described as an internal and external strategy to create co-produced value. Customers and suppliers are seen as a whole system. Within this system, e-commerce offers the opportunity for a close co-operation and therefore to decrease delivery-times and the time-to-market. Additionally it will be easier for geographical or product range expansions by re-evaluating the positioning. Both strategies operate most important for the business development of e-commerce. The whole business development with e-commerce is defined as a three-phase model. Starting with the implementation, the organisation will enhance internal efficiency. Phase two deals with the integration for all parts of the company, by changing processes for a higher integration. Going over to phase three, by redesigning internal and external structures, products or processes, to reach new market segments (Aldin et al., 2004).
Electronic market places defined by von Hartmann (2010) are also known as e-commerce or e-business. These internet based market places enable purchasing or selling of goods or services by requiring a high degree of standardisation (Poon & Joseph, 2000; Von Haartman, 2010). Clemente et al. (1998) agrees with this view and adds low customer involvement, easy distribution channels, and a high brand value of the products or services as suitable characteristics of online transactions.

Concerning the security aspects of web-sales programmes, Perry and Bodkin (2002) figured out that today’s advanced software developments enable customers to buy and sell products under secured aspects. As a result of that, electronic markets have gained increasing importance for world wide transactions. The identification of its major success factors have become a centre of attention in the e-commerce sector (Standing et al., 2006).

### 2.2 Supply Chain Design

The further developments of supply chains over the years have been slow. Organisations developed individual processes of their supply chains beginning firstly with the optimisation of transportation systems before going over by integrating warehousing, stock inventory of finished goods, material handling, customer service, packaging and finally raw material inventory. Main goals of optimising supply chain processes are multi-dimensional with the aim of minimising costs, increasing service levels, improving information flows, and optimising flexibility in terms of delivery and response time (Lancioni, Smith, & Oliva, 2000).

In this context, the general objective of Supply Chain Design (SCD) is the strategically configuration and optimisation of all procurement, production and distribution functions of a company. General tasks of SCD are long-term planning, modelling and optimisation of corporate material, goods and information flows including the interaction with suppliers as well as customers. Even though, SCD has its own corporate characteristics, decisions and reorganisation arrangements have a significant impact to the internal processes.

The aim of a successful SCD is to find the perfect logistics- and production structures regarding to the own corporate strategy of the company. The decisions in this area
have a long-term effect and they open or close the strategic success potential for the company. SCD includes the interaction with suppliers as well as customers. Even though the SCD has this corporate character, the decisions and reorganisation arrangements have a significant impact to the internal processes.

The overall framework of supply chain design by Seuring (2009) belongs to five strategic decision fields which form the skeletal structure. These consist in Products & Services, Partners & Partnerships, Plants & Stocks, Processes & Planning and Control these fields form the basis of the product-relationship-matrix, combined with the two supply chain dimensions – configuration and operation. In the authors view, this framework will help to consolidate the theory of Swift-Even Flow and the theory of performance frontiers. The swifter and faster the flow of materials and information’s combined with the aim to reach the maximum performance of manufacturing units is seen as a role model.

Supply Chain Design (SCD) in general can be divided into the two main fields’ coordination and design. In this context, coordination is the ways of optimising the existing supply chain by inter alias improving communication and control. It follows that SCD is concerned with the strategic level of supply chain management and deals with the question of “What should the overall supply chain look like?” (Von Haartman, 2010).

The commencements of SCD are going back to the extensions of the manufacturing strategies for which they were seen to support the organisation or business unit strategy (Skinner, 1969). Two main types’ efficiency and flexibility are set against each other. In the opinion of Skinner (1969), efficiency is put on a level with lean. Here the focus is set on low costs by optimising time, inventory, and resources. The market demand should be relatively predictable a stable and is primarily based on mass markets with a degree of customisation or differentiation. Flexibility equates to responsiveness or agility by focusing on the speed level. Short delivery times or fast product development times are part of this type of supply chain. The market aspect is based on unpredictable and unstable demands and therefore will be most suitable for innovative products being fast on the market (Von Haartman, 2010).
2.3 **Inventory Management**

Toomey (2000) references the definition of Inventory Management (IM) to the American Production and Inventory Society (APICS) by defining Inventory management as an enhancement of business management. Focussing on planning and controlling inventories, the main aim of inventory management is to keep up a specific stock level of defined products or items. In addition, Bowersox et al. (2009) requires keeping the service commitments for the customers on a certain level and therefore agrees with the objectives specified by Frazelle (2002):

“…to determine and maintain the lowest inventory levels possible that will meet the customer service policy requirements stipulated in the customer service policy.”

Inventory management is therefore targeted to meet the customer demand by providing enough products. Simultaneous the inventory management aims to increase the financial return on inventory. Bloomberg et al. (2002) in contrast states that inventory management primarily deals with uncertainties in demand which sequels Bloomberg’s (2002) definition in the broadest sense.

Planning and controlling of inventory management after Bowersox et al. (2009) and Muckstadt & Sapra (2010) is concerned with the following three basic questions:

1. Which items and how much of them should be on stock?
2. Where to store them?
3. How is the re-order point defined?

In this context, the planning stage deals with the question of which items should be kept on stock and which specific stock level should be defined. Subsequently the place where to stock the items has to be defined. The third question is concerned with the re-order point, of when to order in which order quantity.

These questions are closely concerned with the overall research aim and the implementation of e-commerce. The initial question is about which items or spare parts should be provided to the customer to fulfil the customer needs. Furthermore, the whole distribution site and supply chain processes have to be determined.
2.4 Cost-benefits of e-commerce

Following, costs and benefits of e-commerce in general will be stated. In this connection, different costs for the whole implementation process can be divided into fixed and variable costs. Fixed costs can be defined as (Lucey, 2002):

“A cost which is incurred for an accounting period, and which, within certain output or turnover limits tends to be unaffected by fluctuations in the levels of activity (output or turnover).”

The key point of this definition is that fixed costs are time related, and unaffected by changes in the volume of activity, costs can be expressed as constant.

Variable costs in contrast are clearly related to the business volume. If the volume increases, variable costs will increase (Keefe & Dittmer, 2009). Examples of variable costs are raw materials, sales commissions, production wages, carriage or packing costs.

When concentrating on the cost aspect, the tied-up capital of stock inventory plays the major role. After Jonsson (2008) this capital is affecting the cash flow and solvency of an organisation. Invested capital could also be invested in another and more effective way, therefore too much tied-up capital in inventory and arising capital commitment costs may hinder an organisation to invest in other sectors.

Compared to the tied-up capital, transportation costs are seen as less significant (Frazelle, 2002; Jonsson, 2008). But in this case it always depends on the product itself. If the products or spare parts will have an extremely high value, the tied-up capital and the capital commitment costs will be extremely cost-intensive.

Total inventory costs, including inventory carrying costs, cost for personnel, space used for stock and offices to manage inventory, play a major role in the cost aspect (Frazelle, 2002).

According to Lancioni et al. (2000) the implementation of e-commerce will have many benefits for improving the service level and reduce costs (see Figure 1).
Gunasekaran et al. (2004) states that the increased popularity of e-commerce is due to the multitude of operational benefits through optimised purchasing processes. A major factor is seen by cost savings resulting from shorter order cycle times, reduced paper transactions, and stock reduction through fast transmission of purchase order related information. In addition, e-commerce will provide the opportunity for supplier-buyer partnerships through the establishment of potential business-to-business (B2B) communication networks.

### 2.5 Risk factors of e-commerce

The term of “risks” started to become popular in economics during the 1920s, since it got used in theories of decision making processes in economics, finance, and science (Ngai & Wat, 2004). The Business Dictionary (2011) defines the term of “risk” as follows:

“A **probability or threat of damage, injury, liability, loss, or other negative occurrence that is caused by external or internal vulnerabilities, and that may be neutralised through pre-emptive action.**”

Current literature has not agreed on a general definition of e-commerce risk but information security is seen as a widely recognised risk aspect (Viehland, 2001).
After Ngai and Wat (2004) risk factors associated with the development of e-commerce can be divided in technical and organisational dimensions.

As defined by Greenstein and Vasarhelyi (2002) technical risks in the view of e-commerce are examined as the possibility of losing confidential data through the use of programmes that financially or physically harm organisations. In this context, McEachern (2001) features the term “cyber risks” to define any risks associated with e-commerce, involving destruction and manipulation of web pages, unauthorised access to customer data, copyright violation or disputes of access.

Organisational risks are based on negative impacts of managing businesses itself or when developing or operating e-commerce strategies (Viehland, 2001). These risks are associated with the direct or indirect loss to organisations in developing, planning, analysing, designing, and implementing e-commerce projects (Ngai & Wat, 2004).

Despite the benefits as discussed in chapter 2.4, Min and Galle (1999) consider the aspects of security, legal, and financial problems as a main barrier of the implementation of e-commerce. In their point of view, the success of e-commerce depends on the degree of acceptance and the extent of participation between suppliers. Building trust, confidence, and security are seen as important factors of success.

Costs for implementing and maintaining e-commerce are always seen with a high risk since a new situation concerning the technology will be adopted. A company or business unit has to determine if it is convenient to handle the new situation. Therefore various studies have to be taken to validate the capabilities of the organisation. Under Rogers et al. (1993) critical success factors are seen in the mission, vision, flexibility, as well as security aspects which have to be taken into consideration.

Further on, the implementation of e-commerce can generate fundamental changes for inter-organisational processes by reshaping the buyer-supplier relationships, reaching new market segments, or improving core business processes (McIvor, Humphreys, & Huang, 2000). Wang (2000) agrees with this opinion and argues that the most critical and challenging aspects of implementing e-commerce are seen in
the redesign of organisational structures. Just the fully organisational support will enable a successful implementation of e-commerce.

Martinsons (2006) highlighted that the most important failure factors of e-commerce firms, and faced up the lessons learned of this dilemma. To obtain high market potentials on a strategic view, he defines the way of success in – innovation, business intelligence, strategic planning, socialising, and well-balanced business development. Martinsons strategy is easier said than done, the reality will bring unaffected effects. Especially for the growing status, as mentioned by Aldin et al. (2004), E-commerce makes it possible to generate fast money for innovative products or ideas. But the competitors are already waiting to copy these ideas. Many companies will win the market share not only by its innovative products but also by their flexible internal and external corporate structures.

Sharp (2006) sees the risks of e-commerce operations in the technical requirements. Compared to traditional sales and operation systems, e-commerce operation systems are usually more complex. For implementing these systems successfully, considerable effort and expert knowledge is needed. Many organisations therefore face the decision to outsource specific system processes. These outsourcing decisions might bring additional system design and construction risks.

2.6 Summary

It is relevant to summarise the main information written in the theoretical review chapter. Therefore, this sub-chapter will contain the most important aspects and conclusions out of the literature review which will help to compare the literature review with the empirical research (see Chapter 5).

Referring to various authors, E-commerce enables purchasing and selling activities through the internet and is seen as a contact-driven process which will lead to high efficiency and improve organisations profitability through automatic data generation. In addition E-commerce will increase customer’s services by increasing the organisational response.
The implementation of e-commerce and its continuous improvements for developing customer services can be seen as a step-by-step process based on competencies and resources which have to be shared with the customer. This will result in re-structured network and communication processes compared to the traditional purchasing and selling processes. The mission and vision for implementing e-commerce is an important aspect since the process is long-term oriented and therefore will have an impact on the organisations strategy.

SCD provides the general objectives of optimising procurement, production, and distribution functions of an organisation with the aim of minimising costs, increasing service levels, improving information flows, and optimising flexibility in terms of delivery and response time. Investigations demonstrated that decisions made in SCD processes rather have strategically oriented effects. Decision and re-organisation arrangements will have strong impacts on internal processes.

Inventory management is focussed on planning and controlling inventories with the aim to increase financial return on inventory and simultaneously to meet the customer service policy. Various authors agree on a certain process, concentrating on three basic questions:

1. Which items and how much of them should be on stock?
2. Where to store them?
3. How is the re-order point defined?

Literature concerning costs of e-commerce broadly concentrated on the aspects of tied-up capital of stock inventory which is playing a major role in affecting the cash flow and solvency of an organisation. Transportation costs in contrast are seen as less significant. Benefits in e-commerce are primarily operational based. Optimised buying and selling processes will have a positive aspect on shorter order cycle times. Further on, fast transmissions of order related information will reduce the stock level. In addition various authors defined that the customer service level will be increased by providing 24/7 worldwide customer service.
Risk factors of e-commerce in general can be divided in technical and organisational risks. Technical risks present the possibility of losing confidential data through the use of programmes that financially or physically harm organisations. Organisational risks are associated with the direct or indirect loss to the organisation. Implementing e-commerce can generate fundamental changes for inter-organisational processes and structures which may harm the buyer-supplier relationship. Literature studies advised to decrease the risk in technical and organisational aspects where expert knowledge is needed. Hence, many organisations face the decision to outsource specific processes.

Resulting, that organisations have to provide a project leader who has the ability and knowledge to transform the vision into reality as well as to improve the whole electronic transformation. This leader is responsible to develop a plan including milestones to achieve this transformation (Marzulli, 2000). Deviations between actual and planned targets have to be discussed in a project team. Additionally the organisation needs to have the ability to create flexible e-commerce solutions to be competitive for future changes and to be able in periods of growth (Rogers et al., 1993).

2.7 Need for empirical research

Research study-collaborations in Supply Chain Management and e-commerce have grown dramatically in the past decade as companies enlarged and intensified their operations by improving service levels and dynamic market needs (Balakrishnan & Geunes, 2004). Therefore, much literature can be found in these separate areas. Nevertheless, these studies mainly focused on business development activities, global and country specific developments or technically oriented solutions. Additionally a high variety of various research journals either focuses on just informative or too theoretical oriented tasks. Concerning Murillo (2001) extensive research such as the interactions between e-commerce and supply chains as well as implementation implications have to be examined (Aldin et al., 2004) in the research area.
The lack of knowledge of the research point of view and the specific need of this interaction in the sector of logistics from the case companies' side have reasoned the focus of this study. Since profitably work in operational e-commerce is missing and will provide research opportunities in the future (Boyd & Bilegan, 2003). For the case company it is a very important task in combination with the development of an implementation plan for spare parts web-sales as already mentioned in the previous section. Furthermore the thesis will help the company on a global level about which tasks have to be considered by creating an effective SCD through e-commerce. In particular the research on SCD will concentrate on the configuration of logistic networks and processes, stock of inventory, and distribution channels through the interrelation of e-commerce.
3. Methodology

This chapter presents and outlines the methodology used in this thesis. To satisfy the specified objectives and research questions appropriate for research papers, more detailed information will be stated. Therefore this methodology chapter is divided into four sub-sections – Research strategy, research process & methods, data analysis, and research quality.

3.1 Introduction

The following chapter will explain the key elements of what the specific research objectives of the empirical research study will relate to. Its aim is to explain detailed research aspects relating the theoretical and practical issues for the research strategy. To meet the specified and goal-oriented objectives, the research methodology introduction covers what approaches will be adopted to cover the overall research strategy, and data analysis techniques (Karami, 2007). Furthermore, used approaches will be stated and benefits of why choosing them will be presented. The research quality chapter will examine the validity and reliability of the thesis in order to evaluate the quality of the theoretical and practical research studies.

In case of giving an overview about empirical research the two categories qualitative and quantitative have to be defined.

Qualitative research involves several methods of data collection which may or may not be measured or quantified, its focus is based on information quality rather than its quantity (Murray & Hughes, 2008). These methods mainly consist of in-depth interviews, focus group discussions, field observation, or case studies (Wimmer & Dominick, 2006; Murray & Hughes, 2008). Boxill et al. (1997) specifies qualitative research as an approach or attitude of gathering data by which the questioning approach varied and agrees in regard to Wimmer (2006) and Murray (2008). Quantitative research in contrast is about quantifying relationships between variables (Nykiel, 2007). Measurements or statistical analysis of phenomena will be involved for this research category by using methods such as statistical modelling, datasets,
experimental design or statistical computing (Murray & Hughes, 2008). This method also involves standardised and static data questioning such as Internet or mail surveys. Biggam (2008) differentiates that qualitative research is linked to in-depth studies answering the “why” questions whereas quantitative research answers the “how” questions.

There are both advantages and disadvantages to qualitative and quantitative research. A short comparison between both research approaches is considered in Table 1.

```
<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Can increase researcher’s depth of understanding the action under investigation.</em></td>
<td><em>Sample sizes are sometimes too small to generalise proper data.</em></td>
</tr>
<tr>
<td><em>More flexible and allows the researcher new areas of interest.</em> (Wimmer &amp; Dominick, 2008)</td>
<td><em>Data reliability can be a problem, since single observers or interviewees may influence collecting data.</em></td>
</tr>
<tr>
<td><em>Can be used at different phases of investigation.</em> (Boxill et al. 1997)</td>
<td><em>If the research is not planned properly the project may produce no value.</em> (Wimmer &amp; Dominick, 2006)</td>
</tr>
<tr>
<td><em>The use of numbers allows greater accuracy in reporting results.</em> (Wimmer &amp; Dominick, 2008)</td>
<td><em>Research methods (e.g. surveys) have low response rates and difficulties of accessing special groups.</em> (Amedeo et al. 2009)</td>
</tr>
<tr>
<td><em>Mail surveys or e-surveys are inexpensive to run.</em> (Amedeo et al. 2009)</td>
<td><em>After the process has been initiated it is relatively inflexible by changing e.g. structure or form.</em></td>
</tr>
<tr>
<td><em>Results are statistically reliable.</em> (Nykiel, 2007)</td>
<td><em>The design, data collection and analysis requires a structured scientific approach.</em> (Boxill et al., 1997)</td>
</tr>
</tbody>
</table>
```

Table 1: Comparison between Qualitative and Quantitative Research

One of the great advantages in quantitative techniques is seen that it can increase the researchers’ depth of understanding attitudes or motivations of the phenomenon under investigation (Wimmer & Dominick, 2006; Boxill et al., 1997). Further on it can be used during different phases of investigation and therefore is defined as more flexible as quantitative research. However, there are some disadvantages associated since sample sizes with a too small lot size does not generalise proper data.

Advantages in quantitative research can be seen in the accuracy in reporting results based on numbers and therefore underline statistical based reliability. Additionally it
can be stated that this method is less expensive through the usage of existing datasets. Whereas disadvantages mainly focus on inflexibility and low response rates through accessing groups (Amedeo et al., 2009).

The empirical research methodology used in this Thesis can be seen as qualitative research techniques by setting the main focus on the case study. A case study in general is used when investigating individuals, groups, events or organisations to understand and explain action. This definition is consistent with the case study focussing on the company organisation, specific departments, project and product groups, processes as well as individuals. On a more formal way, Yin (2002) defines a case study as following:

“A case study is an empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident.”

The demonstrated definition highlights the real-life context of a case study and therefore defers from other strategies such as experiments or survey techniques by using case studies in the research, various authors recommend using manifold sources of data to afford triangulation of the phenomenon. Triangulation will support the reliability and validity of the research study (Blaikie, 1991; Creswell & Miller, 2000). The input of company data furthermore will result in a practical and operative oriented thesis work out as defined in the purpose.

Experimental techniques as described by Wimmer and Dominick (2006) differ in the phenomenon of its laboratory environment compared to the real-life context of case studies. The difference between case study and survey techniques is defined by the authors that surveys try to define the phenomenon by bordering the study constrict enough to limit the number of variables which have to be examined. In-depth interviews as addressed by Saunders et al. (2009) should be considered in every research approach, allowing the interviewee to talk free by stating open questions as well as to ask more specified and closed question to focus more precise on the relevant topic. Open questions are generated to stimulate the interviewee to provide more developmental and comprehensive answers with the aim to detect alignments or facts as mentioned by Grummitt (1980) in Saunders et al. (2009). Specific and
closed questions in correspondence will be set up to gain specific information or underline facts and figures. Another useful technique in collecting information is seen in group discussions, with the aim to discuss public opinion about products or services. Interviews can be beneficial in situation when it is implausible to get access to information by using observations or questionnaires (Blaxter et al., 2006). Yin (2002) underlines the importance of interviews in combination with case studies, by telling that this is the most important source to gain information.

Depending on the form of the research question, different control of events and focus areas is required (Yin, 2002). The research in this thesis project tries to understand of how to re-design Supply Chains more effective when a web sales portal is applied by trying to extent a new research area.

3.2 Research Plan and Process

As mentioned before the fundamentals for the research questions rely on a literature review. Therefore relevant literature was analysed carefully. This was done to generate a basic knowledge about the research topic in general and find out the gap of research detected by former researchers. This first step is needed to develop specific research ideas (Voss et al., 2002).

Books for this area were mainly used to create the necessary knowledge, detect topic related definitions and create an extensive overview about appropriate models. Most of the books were found in the library of the University of Gävle and the ETH Zurich. Some books were searched over the Google books webpage to get a wide range of sufficient information.

Scientific articles used for the theoretical research were found from various internet databases (i.e. Emerald, Google Scholar, IEEE Xplore, ISI Web of Science, ScienceDirect or SpringerLink). To find relevant subject related articles, key words such as “E-Commerce AND Supply Chain Design”, “Business development AND E-Commerce”, “E-Business AND Supply Chain Management”, “E-Commerce AND Logistics”, “E-Commerce”, “Pricing AND E-Commerce”, “Web-sales”, were used to be more effective and efficient during the findings phase. At this juncture high cited articles were preferred to underline the reliability of the given information. In a second
step, high cited articles with relevant information based on the abstract, introduction, and conclusion were saved and grouped together in groups such as e-commerce in general, supply chain design, supply chain development, success factors of e-commerce or risk factors in e-commerce. In a third step, the articles were read.

Examples of these include: notable journals such as “International Journal of Production Economics” or “Harvard Business Review”; or highly cited articles such as “What is the right supply chain for your product? (Fisher, 1997)” or “E-business and Supply Chain Management: An overview and framework (Johnson & Whang, 2002)”.

To follow the complex research strategy for solving the project work-out in the case company, a project plan was set in the start-up phase. This plan was following the procedures of the ABB Gate Model (see Figure 2). The Gate Model ensured visibility and accountability for the management and provided management assurance and support for the milestones within the project work-out. For each of the defined milestones, a gate meeting in front of the Steering committee (see Appendix - Table 8: Organisational structure) was performed. During these meetings, committee members were informed about the current project situation.

![Gate Model - Time schedule](image)

Open-ended questions were discussed and variations recorded. Main intermediate results, further information, as well as open issues and questions were discussed weekly in the core team and presented and argued during the Steering committee meetings (see Appendix - Table 8: Organisational structure).
The information output of the meetings was recorded in writing and the data of interviews was documented. This was done to counteract the risk of data loss in the information flow.

For all interviews, the combination of structured open-ended and closed questions was done to get specific answers and to get information to support the own process and redevelop new ideas. An overview of conducted and planned interviews and observations is demonstrated in Figure 3. Structured interviews were used to gain exact answers to the given topic or situation. By combining closed with open-ended questions, the researcher was able to assure specific answers on the one hand and also will receive helpful ideas and useful knowledge of the interviewee on the other hand. For the sake of formality and non-disclosure agreement, no names of persons are notified in this research study work-out.

Not directly involved stakeholders were also interviewed during the research process to get a comprehensive understanding about the products, internal procedures and processes and supply chains. Their information worked out as supplementary information and conducted as cross check underlining findings and results.
By the fact that not all questions and answers were useful by carrying out interviews, data from the case company had to be used. These include for instance product and process data which got analysed to achieve valuable information needed for empirical research. The research strategy for this project can be seen as defined by Yin (2002), by representing a way of collecting and analysing empirical data, and therefore matches with Biggam (2008) who describes research strategy of how to intend implementing the research study.

As already mentioned in the introduction chapter and stated by Murray (2008), approaches for empirical research normally fall into one of the two categories – quantitative or qualitative research. Practical research work on operational level used in this case study is mainly based on qualitative research. The ABB case study is the fundament and main driver for the given research activities. This particular case company will underline of how to re-design Supply Chains more effective when a web sales portal is applied from an operative and more practical oriented view which is also seen as a major gap in the research activities. The practical part will avail oneself of the theory and research objectives mentioned in the previous chapter. Form the case company point of view the research connection is focussed on the development of the “Web sales implementation plan for the UNITROL 5000”. The department of Service Sales in the sector of power electronics was concerned about how to optimise the sales processes in the spare parts business. Strategic goals required sales growth of 100% in between the next five years, with the same number of sales employees. To pursue this goal, the product group of Power electronics has to implement an online platform to optimize the processes through a potential preoccupation of e-commerce and therefore resulting in a change of its existing Supply Chain Design. The management team defined the most important objectives which have to be examined and taken into consideration regarding the structure and organization of a possible web-sales implementation and the associated most effective supply chain design.

In this conjuncture this research work will support the management with reasonable information and conduce to the management as final decision maker for further electronic sales processes. The whole practical research study is based on action research, whereby the author and researcher is involved in the project he wants to
solve as defined by Cunningham (1995) in Biggam (2008). As stated before, most data required for the whole project work out was collected through interviews, observation and organisational reports.

As illustrated in the project chart (see Appendix - Figure 32: Project Chart) more detailed, the research phase started in February 2011. During this study, relevant literature sources i.e. scientific journal articles and books were reviewed and analysed as already mentioned in the previous chapter. This literature review was done to provide a basis for establishing processes of the overall question of “How to re-design Supply Chains more effective when a web sales portal is applied?” as well as to create the sub-tasks needed to solve the overall research aim. When looking at the research questions, that have set for this study work-out, they could be divided into three process steps:

**Step 1 concerned with research question 1:**

1. *How does e-commerce connect to Supply Chain Design in general?*

   This research question was necessary to demonstrate the terms of e-commerce and Supply Chain Design as well as the connection to each other, with the main aim of explaining the definition and terms for the reader to follow the explanations for the later chapters. This theoretical focused research question was carried out by reviewing and analysing a number of literature sources, including reference to subject specific books, pertinent journals and reports, as well as contemporary conference publications.

**Step 2 consisting of research questions 2 to 4:**

2. *What is required for a successful implementation of e-commerce?*
3. *What are the costs and benefits by implementing e-commerce?*
4. *Which potential risk factors in correspondence of the implementation of e-commerce may influence the whole SCD and e-commerce interaction process?*

   To stay focused and represent the characteristics of an effective Supply Chain Design through e-commerce, the web sales implementation plan for the UNITROL 5000 is chosen as the main objective of the case companies view for this thesis and serves as elementary case analysis for this investigation in the
industrial electronics industry. A first step into this direction is based to create an internal benchmark and SWOT analysis of existing ABB service platforms. In order to collect sufficient data managers and stakeholders were contacted and interviewed. Following, telephone conferences with application and tool implementation managers were set up, as well as on-site interviews were conducted by the author in Helsinki at ABB Finland.

Within these research questions order quantities for each product of the UNITROL 5000 got screened out of the SAP R/3 data base to detect forecast data of how much spare parts will be sold in the next terms. This data can be used to detect the most effective inventory structure and will be a basis of calculating the break-even point.

The costs and benefits of implementing e-commerce for the case company have to be analysed in detailed. This analysis primarily focuses on the whole implementation and maintenance costs, based on the spare-parts of the UNITROL 5000. The data was mainly generated through interviews. In addition, purchasing prices for the UNITROL 5000 got analysed by data strained out of the internal SAP R/3 system. Sales forecasts got estimated by analysing the numbers of sales of the past two years. The break-even point will demonstrate of how much products have to be sold for retain earnings concerning the costs for the whole e-commerce implementation process.

Information concerning risk factors was mainly gained through interviews and literature review. How these interviews were performed and structured was already mentioned in the previous chapter.

As mentioned before, objectives two to four are considered to be the most relevant from the managerial point of view. The realisation of these objectives will be seen as empirical research on how a real life company is carrying out this interaction. Configuration, benefits, and value of a practical oriented research view will be seen as most important.

Step 3 concerned with the overall research aim:
A. How to re-design Supply Chains more effective when a web sales portal is applied?

To solve the overall research question, the questions of step one and two had to be discussed and analysed. Based on the intermediate results of the literature study combined with the work-out of the project, informative and sufficient data was given.

3.3 Data analysis

Collecting research data can be split up most frequently into the three technique categories - interviews, observations and questionnaires (Powell, 2004; Karami, 2007). By performing interviews, answers were given which supported the process work-out. Most of these answers were used directly for Chapter 4, the “Case realisation and analysis”, without further processing of the given information. Specific performance data which had to be detected in the internal SAP data system had to be analysed further on in order to create the exact data for the decision process.

In the following chapters, qualitative and quantitative data will be presented. Qualitative data mentioned by Murray and Hughes (2008) will primarily features studies based on attitudes, beliefs, or opinions. Whereas quantitative data is mainly demonstrated by using tables, charts, graphs or diagrams. Both types of data will support the research study.

3.4 Research quality

In the following chapter, fundamental criteria for evaluating the research quality will be discussed in terms of validity and reliability. Groth-Marnat (2009) declares the difference that the reliability states issues of consistency, whereas validity deals with the question of “what the test is to be accurate about”.

3.4.1 Validity

The term itself is defined as the “degree to which a test procedure accurately measures what it was designed to measure” (Business Dictionary, 2011). Validity is
seen as an important key for effectiveness, requiring quantitative and qualitative research (Cohen et al., 2007).

Groth-Marnat (2009) declares that all types of validity can be seen as a sub-category of construct validity. It involves theoretical knowledge of the attributes or the ability of being measured. Construct validity after Yin (2002) is used to establish the correct measurements on operational level for the concepts studied. He defines that the level of validity will increase by using multiple sources of evidence, having key informants review draft case study report, and by establishing a chain of evidence. His definition will underline the relation to the triangulation which will support the validity in research studies as described in the earlier study (Blaikie, 1991; Creswell & Miller, 2000). In both research studies triangulation was used. For the theoretical part different sources and authors were used. Data for the practical research study based on interviews was always collected from more than one person. Additionally, company data out of the SAP system was used to underline findings.

The research strategy chosen for this study appears to be appropriate and will give enough validity for the thesis research on the thesis work-out. Additionally, data collection techniques as described above are appropriate for the strategies which ensure validity.

### 3.4.2 Reliability

Reliability has different definitions in diverse fields of subject. In research studies it even differs in quantitative and qualitative research. A common definition can be adopted by Gatewood et al. (2008) who define reliability as “the degree of dependability, consistency, or stability of scores on a measure (either predictors or criteria)”. On a more practical view, reliability in research defined by Cohen et al. (2007) must demonstrate that if a specific research study will be carried out on a similar group of response, then similar results will be found.

For the theoretical research part, the use of books justified that they contain reliable information about a specific area, especially when well cited authors describe a specific topic in the same way. Further on, multiple editions of a book underline the evidence for correctness. The author Dawidowicz (2010) states that peer-reviewed
articles are in particular useful since they are written with the aim to be unaltered and objective.

For the practical part the author of this research study was engaged to analyse the possible web-sales opportunities for the case company. Including the evaluation of existing platforms and generate an implementation plan for the most efficient way. All these information gained during the project were used as a case study to prove the tasks and objectives of the management team. The collected data and information was acquired by being personal present in the department of Service Sales over a period of five months. During this time frame, it was possible to evaluate and work different SCD opportunities. Upcoming problems or open-ended questions were clarified in the weekly meetings or steering committee events. These problem solving potentials lead to reliable information of the project work-out. This case study allows focusing on the specific tasks and objectives defined by the management and to describe a phenomenon very detailed. On the other side, the described case study causes a lack in generalisability. The case might not be applicable for other companies or business units but it will support them by giving a framework of which factors have to be considered for the SCD through implementing e-commerce. Further on, since the data and information was gained just by one author, this might influence the outcome of the research study. Further on, being part or involved in the action research can be seen as a critical aspect. There will always be the question of objectivity and temptation of showing the researcher in a good light (Biggam, 2008). To demonstrate credibility, a relevant literature review, discussion of results, and reasonable conclusions will be stated. Anyhow, the practical research study is seen as a big advantage for the case company and will provide the management with a decision framework of how to re-design Supply Chains more effective by delivering an operative and practical oriented implementation plan for web sales.

3.4.3 Limitations

Yin (2002) states that all research methods have their limitations. A prevalent claim of case studies is seen in the aspect that it is difficult to follow systematic approaches in the research work-out. As mentioned about the high flexibility for qualitative research, this might affect the structure and therefore the performance of the whole study. On
the other hand strict boundaries may affect the performance on innovative and new ideas. The most suitable way between flexibility and strict boundaries has to be found.

Another limitation is seen by using just a single-case study for which the results are specifically (Kouhy et al., 2010), and therefore specifically based on the case company, in the specific field of industry, and in the prevailing environment. Therefore this research might not be generalised for all products or on a global level. In this case it will more work out as a support for companies out of a different industry or in a different country. Furthermore, case studies may be biased by the researchers’ proximity to the case situation in the collection and analysis of used data. To minimise this effect, used data was presented and critical discussed in the project group.

After clearance with the University of Gävle and the case company, this research study will be just available for the company. Based on the integration of secret operational data, the content and stated results will therefore not support a further research study, which is seen as the greatest limitation.
5. Discussion and further research

This chapter will discuss results presented in the previous chapter “Case realisation and analysis” in relation to the theory and literature review presented in chapter 2. In particular the research questions and the overall aim will be outlined. The final conclusions will be revealed in chapter 6.

According to the overall research aim of “How to re-design Supply Chains more effective when a web sales portal is applied?” it was necessary to carry out and focus on the four following research questions:

1. How does e-commerce connect to Supply Chain Design in general?
2. What is required for a successful implementation of e-commerce?
3. What are the costs and benefits by implementing e-commerce?
4. Which potential risk factors in correspondence of the implementation of e-commerce may influence the whole SCD and e-commerce interaction process?

When looking at the research questions, which have set for this study work-out, the first research question was briefly based on literature study. Therefore findings will be discussed based on literature outlined in chapter 2. Questions two to four were partly based on carrying out empirical research through the case study. Based on the intermediate results of the literature study combined with the work-out of the project, informative and sufficient data was given to solve the overall research aim.

5.1 Connection between SCD and e-commerce in general

A lot of research in the field of supply chain design concentrates on designing a supply chain out of the view of a given business or product strategy. The aim of a successful SCD as mentioned in chapter 2.2 is to find the most effective structures. On one site, this can be demonstrated for example with Fisher’s (1997) framework to find the right supply chain solution for each product or through the theory approach of Cuber et al. (2009) mentioning that the supply chain has to follow the overall strategy of the organisation by saying:
“The aim of a successful SCD is to find the perfect logistics- and production structures regarding to the own corporate strategy of the company.”

These two approaches are reflected in the bottom-up and the top-down approaches.

In the today’s flexible and fast acting business environment, e-commerce is focusing on effectiveness and efficiency. The increasing globalisation between supplier and customer will contribute a high pressure on profit margins. Interactions between the production, logistics, marketing and customers play an inalienable role in the business environment.

E-commerce consisting of buying and selling of products or services via electronic networks as stated in chapter 2.1. It is seen as a contact-driven process in which the customer is getting in touch with the organisation, for which information technologies act as a key role for improving the communication and coordination between customer and the organisation as stated by Love (1996). Hereby e-commerce will perform as a cost-saving method due to automatic data generation.

But this goal can be just achieved through a seamless connection with the whole supply chain design. By analysing e-commerce interacting with SCD the crucial driver for the overall cooperation can be seen in the implementation process. In this phase interfaces between e-commerce and the SCD will be generated.

As mentioned by Lancioni et al. (2000) electronic commerce helps to support and manage supply chain activities by offering relevant information about what kind of product is demanded, what is available in warehouses, which products are in the manufacturing processes, and which products will enter the physical facilities and customer sites. In addition, Zhao et al. (2002) detected that the coordination of sharing information and ordering processes has a significant impact on the SC performance, especially in terms of service level and total costs.

E-commerce supportive enterprise resource planning systems such as SAP connect not only internal functions within the organisation but also among the supply chain partners. Information such as order status, product schedules, or sales records can be shared and integrated to enhance supply chain or marketing processes (Overby & Min, 2001).
Electronic commerce businesses of components and spare parts have a significant impact of internal business processes and their customers. To enable growth markets for organizations, customer demands as well as an increasing effectiveness of execution processes have to be ensured. Common obstacles for the supply chain integration such as transaction costs, information availability, and challenges in the terms of management barriers are already dissolved in existing compositions (Johnson & Whang, 2002).

The connection between e-commerce and SCD insists of a close gearing. E-commerce provides the opportunity for an organisation to sell their products to a world wide market. Once a company has placed its products or services via e-commerce, it can expect growing sales volumes (Gunasekaran & Ngai, 2004). This requires an effective SCD which can meet the growing demand.

Implementing e-commerce will cause changes in the area of process structure compared to the traditional procurement methods used before. The cooperation is therefore seen as a main perquisite to be successful on a flexible and fast changing market place.

5.2 Requirements for a successful implementation of e-commerce

Sales of spare parts and components are a major contributor to Service Businesses. During the last 90 years a major evolution in our society, from being prevailing manufacturing based to being prevailing service-based, has been observed (Fitzsimmons & Fitzsimmons, 2007). E-commerce can support various activities along the supply chain especially in the information flow. Consequentially, organisations can achieve a more effective SC. In a lot of cases, companies sustain failures by implementing e-commerce. Primarily by having insufficient knowledge on what type of IT infrastructure or system requirements would be the most successful solution (Gunasekaran & Ngai, 2004). In this context the whole infrastructure includes the hardware, software as well as the correct interface structure between already existing systems.

Therefore, IT management concerning the implementation of e-commerce requires a systematic approach to be successful. Further on managing the implementation of
new technologies and infrastructures requires planning, developing, and implementation decisions targeting on the characteristics of predefined business processes and organisational objectives (Gunasekaran & Ngai, 2004).

Further on, the whole implementation process requires a project management approach with a defined team of specialists for the planning and implementation of the project. In this point of view top management support is essential in order to get moral support as well as financial and technical backup for the whole implementation process for achieving the predefined goals. (Gunasekaran & Ngai, 2004). Implementing e-commerce successfully for the project management team requires re-organising IT and information flow processes as well as configurations of hard- and software.

The information systems respectively the e-commerce platforms require high accessibility, compatibility, user-friendliness, stability and reliability (Cheng, Li, Love, & Irani, 2001). Reliability will bring trust to the customer while cooperating with an organisation and makes him believe to perform in the right order (Simpson & Mato, 1997).

The practical project realisation demonstrated that strategic planning is a critical task especially for creating an effective supply chain design. Companies bring into focus to improve their competitiveness by implementing e-commerce. This process requires setting up strategic planning with the objectives of developing long-term plans and changes within the organisation. Developing and planning strategies requires the involvement of the top management taking into consideration internal and external factors influencing the organisation.

According to the outcome of chapter 4.8 and the given break-even point, e-commerce will record results based on long-term considerations. The strategic planning of e-commerce in an organisation should therefore also support the long-term objectives and goals of the supply-chain management in terms of flexibility and responsiveness of changing market requirements (Gunasekaran & Ngai, 2004). For example, potential investments in e-commerce and re-engineering business processes, technology positioning and market orientations have to be implicated which requires strategic fitness of IT, as well as the availability of IT skills.
5.3 Cost and benefits by implementing e-commerce

E-commerce enables the organisation and buyer to track shipments more accurately. Lancioni et al. (2000) analysed that another important aspect in web sales is seen in the ability of a company to rate the performance of its processes such as on-time performances or stock levels by using e.g. the internet. Benefits of these monitoring and evaluating methods improve the overall quality of vendor performances with the results of decreasing costs, and improving the productivity of vendor operations.

Customers do not have to go the traditional process anymore by calling service representatives. Further on, it can create a strong product and service loyalty if it is used appropriately in the customer service area (Lancioni, Smith, & Oliva, 2000). With the information and solutions given through SOL, processes will be more efficient. Instead the field personnel have more time for customer needs. In addition, customers can register complaints and are able to request product information through the e-commerce platforms.

The reduction of the order-cycle time, defined as the time between the orders is placed and the time it is received by the customer will be reduced drastically. In addition, the use of e-commerce in order processing will reduce the error rate involved during order processes. Simple errors due to human mistakes in the traditional order process can be avoided.

Implementing e-commerce provides organisations the ability to offer their customers a higher service level by providing an additional flow of information. In addition, customer access on a 24-hour/7-day basis to handle all available functions will affect a higher service level.

Hoole (2005) found out that by simplifying and reducing the complexity in the supply chain the overall performance will usually be forced up. This can be seen by implementing e-commerce and will lead to a smooth processes structure, decrease in operating costs, contingent responsiveness and therefore result in an increase of customer satisfaction.

A successful implementation of e-commerce on the one side can decrease personnel costs through automated sales processes. Released resources can be used to
support the active life-cycle management and optimise customer relations. A further benefit of cost saving is the reduction of paperwork involved in traditional ordering processes through e-commerce. In addition, through the implementation of e-commerce customers are not anymore dependent about their own safety stock which has to be communicated precisely and result in an increasing service level.

However, costs have to be analysed accurately and play an important role as demonstrated in chapter 4.8. In the given project work-out the break-even point will be reached in about two years. Major cost aspects in this regard are seen in fixed costs for the whole implementation process and the high stock value with the aim to provide a high service level for the customer. The stock value will also influence variable costs such as capital commitment costs and its logistic costs. This cost structure will demonstrate the strategic orientation of the e-commerce implementation process. Further on, potential risk factors as demonstrated in the following chapter have to be considered, which might affect the whole implementation process in terms of costs, time, or resources.

5.4 Potential risk factors

As pointed out by Stoehr (2002), companies need to perform a sufficient risk analysis before engaging the e-commerce development. Techniques of analysing risks are powerful tools helping the management and project team to detect uncertainties. These techniques can be either qualitative or quantitative. Quantitative techniques primarily rely on statistical approaches, including e.g. fault tree analysis, Monte Carlo simulation, sensitivity analysis, or failure mode and effect analysis. On the other hand, quantitative techniques are related on judgements such as scenario analysis (Ngai & Wat, 2004).

The whole implementation process of e-commerce can compared with a project development. Many projects can not be completed in-time or within the planned budget. A proper risk-management can be seen as an essential element of project success and therefore will affect in creating an effective supply chain design (Stoehr, 2002). Without an appropriate risk management, achieved objectives of meeting sufficient sales volumes or the pre-defined return on investment, the whole project might fail.
Risks of inventory can be reduced when holding inventory further up the supply chain, because, a finished product is just one product, a semi-finished or module can be used perhaps in 10 products, raw materials can be covered into hundreds of products. Additionally the handling of obsolete material based on technical progress has to be determined in advance.

The risk factors associated with the implementation and development of e-commerce after Ngai and Wat (2004) divided in its technical, organisational, and environmental dimensions can be countervailed through a proper risk assessment which is useful to enhance success in the project implementation. Potential occurring risks can be recorded and counteracted by an appropriate action plan. A suitable risk management is therefore appropriate in order to ensure the success for the whole implementation of e-commerce.

**5.5 Re-design Supply Chains more effective when a web sales portal is applied**

The use of e-commerce is rapidly increasing in industrial organisations as well as in the spare parts business. Key ingredients for managing and creating the right SCD are based on a wide range of operating areas including purchasing, production scheduling, transportation, inventory, customer service, order processing, and supplier operations. Lancioni et al. (2000) mentioned that the ability to react quickly to market demands and changes by adjusting inventory, production, and transportation is necessary for being cost efficient and competitive. E-commerce compared to traditional sales will support these processes and will provide managers with actual information and figures which will further on enable to improve the profitability of supply chains and its SCD.

The implementation of e-commerce should follow the strategic objectives of the organisation. Yeh (2005) detected that cooperating organisations in this case the seller-buyer relationship must provide advanced knowledge when adopting electronic supply chain systems. This includes a structured plan, adjustment procedures, personnel training, achievable benefits and risks that may occur, as well as required resources. E-commerce releases communication and networking opportunities and
enables the possibilities of integrating partnering firms. This will affect increasing agility and reductions in cost.

The study work-out has shown and proven that e-commerce is an important communication link between sellers and buyers. Defined objectives for the case company as demonstrated in Figure 25 have been worked-out and proved by sufficient data. Mentioned deliverables can be reached by following the specified implementation plan (see Figure 24) under consideration of the management support.

For creating the most effective SCD the “Case realisation and analysis” chapter can be followed and by succeeding the organisational overall strategy. In a first stage and as demonstrated in chapter 4, the implementation of e-commerce and the associated SCD creation has to define a clear picture of which products and spare parts will be sold. In the second stage, the inventory management steps as shown in Figure 26 have to be worked out precisely. While working out the implementation plan, the practical case realisation demonstrated to follow a kindly different approach as mentioned by Bowersox et al. (2009) as mentioned in chapter 2.6. In a first stage it is most important to know, which parts to hold on stock. By not knowing at which distribution centre in Europe to stock them, it was not possible to define the specific stock level. Therefore it was appropriate to define the location and
afterwards the specific volume as mentioned in Figure 26. Different characteristics such as the market itself, costs, service level and lead time have influence on creating the inventory management steps. Market characteristics such as where the market and its customers are located as well as the service level have direct influence. The criticality for customers or the urgency in processing the goods for the customer has to be measured or identified and the frequency of purchase, about how often purchase orders for goods occur (Lee & Park, 2009). After Kotler et al. (1998) more frequently purchased goods are more likely successful in e-commerce.

![Figure 26: Inventory Management key factors](image)

After analysing the possible and most plausible inventory strategy, possible distribution varieties should be analysed. In reference to these analyses, possible
risks have to be detected. A cost-benefit analysis will underline the most appropriate solution.
The objectives and process structure was considered to be the most appropriate and relevant solution for the managerial point of view. Therefore they have to be worked out pertaining to the decision making process of implementing e-commerce and the resulting effect on the Supply Chain Design. The realisation of these objectives will work out as empirical research on how a real life company is carrying out this interaction.

5.6 Recommendations for further research

The following chapter will demonstrate recommendations for further research projects based on a lack of knowledge in literature and fields of interests of the case company.

This research study out of the practical view was focused on the UNITROL 5000, one specific product out of a specific business unit, which might bring a degree of bias distortion. The product itself has a high configuration variety with a low amount of standardised parts. From the company view thus might pose the question if products with a high degree of standardisation will have the same effect on inventory and distribution results.

A second recommendation for further research was already shortly mentioned in chapter 4.4. Due to the fact that the case company will increase the service level for the customer side through implementing e-commerce it would be interesting to know how much more the customer will be able to pay for the spare parts. Through implementing e-commerce customers not necessarily need own safety stocks anymore, affected through the case that the delivery time for strongly recommended spare parts can be provided in-between 24 hours Europe-wide. This will decrease tied-up capital and capital commitment costs customer as well as decrease the risk of keeping obsolete material through future technology on stock.

Based on the graphics related to von Haartman (2010) sales and therefore revenues will increase while increasing the customer service level (see Figure 27). However by trying to reach a customer service of approximately 100 percents, costs will increase
un-proportional to the revenue. Besides focussing on the case companies research aim, this topic might be discussed out of the literature view more detailed.

![Customer Service Chart](image)

**Figure 27: Customer Service Chart**

Discussions within the steering committee have arisen a third open-ended question which has a close connection to the forth recommendation and is demonstrated in Figure 28 - Under which customer service level a maximum profit contribution can be reached?

![Max. Profit Contribution](image)

**Figure 28: Max. Profit Contribution**

Further on, for this case study three different distribution varieties in Europe related to ABB FIPSE Helsinki, ABB DELCE Menden, and the internal logistics provider Rhenus Spreitenbach were analysed as the context was related to the European market. This raises the question from the company view if European logistic processes might have the same characteristics as locating a central warehouse in American or Asian countries or if this structure would be applicable in America or Asia as well.
6. Conclusions

The purpose for the following chapter is to present the final conclusions of the Master Thesis with the main research question of “How to re-design Supply Chains more effective when a web sales portal is applied?”, and sub-divided into four research objectives. At first a literature review was used to explain different terms and approaches concerning e-commerce and SCD. In addition, a case study with the main aim of creating an implementation plan for e-commerce underlined the findings.

1. How does e-commerce connect to Supply Chain Design in general?
A lot of research in the fields of supply chain design and e-commerce was found. However, the interaction between supply chain design and e-commerce discussed in literature is rare. Referring to various authors, E-commerce enables purchasing and selling activities through the internet and is seen as a contact-driven process which will lead to high efficiency and improve organisations profitability through automatic data generation. SCD in contrast is related to find the most effective logistics and production structures regarding to the corporate strategy of the company. As mentioned e-commerce helps to support and manage supply chain activities by offering relevant information about what kind of product is demanded, what is available in warehouses, which products are in the manufacturing processes, and which products will enter the physical facilities and customer sites. The connection between e-commerce and SCD therefore insists of a close gearing. Further on, both e-commerce and SCD are long-term. The mission and vision of re-designing the SC by implementing web-sales should therefore be strategically oriented.

2. What is required for a successful implementation of e-commerce?
As stated in the literature, the implementation of e-commerce and its continuous improvements for developing customer services can be seen as a step-by-step process based on competencies and resources which have to be shared with the customer. E-commerce can support various activities along the supply chain especially in the information flow. Implementing e-commerce requires a systematic approach to be successful. The project management team should consist of specialists for the planning and implementation of the project. In addition the top
management support is essential in order to get moral support as well as financial and technical backup for the whole implementation process for achieving pre-defined goals. The strategic planning of e-commerce in an organisation should support the long-term objectives of the organisation. Further on, the implemented e-commerce platform requires high accessibility, compatibility, user-friendliness, stability and to its customers.

3. What are the costs and benefits by implementing e-commerce?
E-commerce enables the organisation and buyer a high variety of benefits such as monitoring and evaluating improvements, increasing customer satisfaction, reduction in order-cycle times, or decreasing operating costs. However, incidental fixed and variable costs have to be analysed accurately. In this connection a break-even analysis as demonstrated is an sufficient tool especially for managerial decision making processes.

4. Which potential risk factors in correspondence of the implementation of e-commerce may influence the whole SCD and e-commerce interaction process?
Investigations demonstrated that decisions made in SCD processes rather have strategically oriented effects. Decision and re-organisation arrangements will have strong impacts on internal processes. The need to perform a sufficient risk analysis before implementing e-commerce is seen as important aspects. In this context the whole implementation process of e-commerce can compared with a project development. Many projects can not be completed in-time or within the planned budget. A proper risk-management can be seen as an essential element of the project success. Without an appropriate risk management, achieved objectives might fail.

5. How to re-design Supply Chains more effective when a web sales portal is applied?”. The general connection between e-commerce and SCD
For re-designing a more effective SC the “Case realisation and analysis” chapter can be followed. First of all the implementation of e-commerce and the associated SCD creation has to define a clear picture of which products and spare parts will be sold. Secondly a precisely inventory management has to be worked out focussing on following three basic questions:
1. Which parts to hold on stock?
2. Where to stock them?
3. How much to keep on stock?

And thirdly, after analysing the possible and most plausible inventory strategy, possible distribution varieties should be analysed. In reference to these analyses, possible risks have to be detected. A cost-benefit analysis will underline the most appropriate solution.

The demonstrated Master’s Thesis contributes to the knowledge in this area of research in mainly one aspect. Lack of knowledge and specific need in the area of “How to re-design Supply Chains more effective when a web sales portal is applied?” has been found. This thesis provides an overview about how e-commerce and SCD connect in general and what is required for a successful implementation by considering costs and benefits as well as potential risk factors, by combining both theoretical knowledge and case related observations.

From the case companies view this work-out provides specific knowledge about which tasks have to be considered on a global level by providing an implementation plan for spare parts web-sales. Results demonstrated that re-designing SC is more long-term oriented involving a variety of buyer-seller impacts and potential risks which will decrease through expert knowledge. Thus further research in this area from a more operative view is needed.
References


