TRANSFORMING PRODUCT ORIENTED BUSINESSES TOWARDS SERVICE PROVIDERS

a case study of service design at Siemens Cranes

Pavel Roudman
Delft University of Technology
Den Haag, December 2013
Colophon

Title: Transforming product oriented businesses towards service providers
Location: The Hague, The Netherlands
Date: 12-12-2013
Pages: 100 pages
Status: Final version

Author

Name: P.V. (Pavel) Roudman
Student number: 4056396
Email: proudman@gmail.com
University: Delft University of Technology
Faculty: Faculty of Technology, Policy and Management (TPM)
Program: Systems Engineering, Policy Analysis & Management (SEPAM)
Specialization: Transport, Infrastructure and Logistics (TIL)
Company: Siemens Netherlands, Project House Cranes

Graduation Committee

Professor

Prof. dr. Y. Tan
Professor at Delft University of Technology, section Information and Communication Technology, Faculty of Technology, Policy and Management, Delft, The Netherlands.

First supervisor

Prof. dr. W.A.G.A. Bouwman
Associate professor at Delft University of Technology, section Information and Communication Technology, Faculty of Technology, Policy and Management, Delft, The Netherlands.

Second supervisor

Dr. S.G. Lukosch
Associate professor at Delft University of Technology, section Systems Engineering, Faculty of Technology, Policy and Management, Delft, The Netherlands.

Third supervisor

Ir. S. Solaimani
PhD candidate at Delft University of Technology, section Information and Communication Technology, Faculty of Technology, Policy and Management, Delft, The Netherlands.

External supervisor

Ir. A. El Azzouzi
Service Manager at Siemens Netherlands, Project House Cranes.
Preface

With this thesis I conclude my academic experience as master’s student of TU Delft. This experience began at the TH Rijswijk which was an enjoyable and exciting period filled with many new learning opportunities. However, after completing my bachelor’s degree in industrial management, I did not feel fully saturated with knowledge or with expertise. It was this sentiment that led me to the idea of continuing in my studies by applying for a master’s degree. Although many of my fellow students and friend, who participated in the same study, chose a path in business management at Erasmus University, I chose a different one. During my master’s in Systems Engineering, Policy Analysis and Management, I had the opportunity to learn about -, and engage with different technologies relating to airports, nuclear power plants and other complex infrastructures. I also had the opportunity to increase my knowledge of process management and institutional related subjects, ultimately enriching and lifting my basic knowledge of management and engineering to a new level. This experience has made me feel more confident and content about my skills and knowledge. It was the constant presence and interaction with technology that made the entire experience worthwhile and I would definitely recommend any capable bachelor’s student to undergo the same experience.

As new business opportunities are bound to pursue, I would like to thank different people that made this experience an unforgettable event. I would like to thank my first supervisor Prof. Bouwman for constantly providing me with the feedback I needed. Professor Bouwman found the time, with a busy schedule, to provide me with the advice I needed. I would like to thank my Siemens supervisor Mr. A. El Azzouzi for the opportunity which allowed me to conduct this research at Siemens Cranes. Through this opportunity I have gained additional experience of service engineering at a large conglomerate. I would also like to thank my second and third supervisors Mr. Lukosch and Mr. Solaimani for their critical input during the initial - and concluding period of writing this thesis. Last put definably not least, I would like to thank all the students and friends who participated during brainstorm sessions and other activities which improved my understanding of the subject and increased the quality of the thesis altogether.

The Hague, December 2013
Pavel Roudman
Executive summary

Although in a service economy a large portion of the gross domestic product is the result of rendered services, some sectors or business clusters are only lately witnessing the emergence of service provisioning in their industries. In the case of Siemens Cranes, which primarily focuses on large crane projects and the sale of electrical subsystems, an increase in the need for additional service is currently being witnessed in the container cranes industry. Specifically, the end users, in this case the container terminals, are requiring additional service in order to improve their overall efficiency and effectiveness of their core business. Although selling both goods and services can be pursued by a single firm, providing services differs from selling goods. Providing services requires different strategies, processes and methods in order to develop, manage, sell and innovate services. The goal of this thesis is to increase the understanding of redesigning services by researching current business models and the needs of the end users in order to ultimately create a competitive service through the service dominant perspective. Based on the service dominant logic in order to design and manage services, a user centric design (UCD) methodology is chosen whereby the following main research question is answered:

“How can a firm, which operates in a goods dominant environment, redesign their services in order to meet the needs and expectations of the end users by adopting service dominant logic?”

Through the user centric design methodology, the services of spare parts and maintenance have been analyzed after which the service of spare parts has been redesigned by incorporating the needs and expectations of the end users. The methodology consists of three steps for information gathering, user need identification and envisioning & evaluation. Through information gathering the analysis of the business models and key stakeholders occurred. User need identification was incorporated to analyze the KPI and the need statements of the end users, while envisioning & evaluation was used to redesign the service of spare parts through the use of a service blueprint and its validation. Based on the specific analyses and the gained experiences of redesigning services at Siemens Cranes through the specified UCD, conclusions and recommendations were developed.

Although different methodologies can potentially lead to different service designs, the characteristics of the involved stakeholders and the type of service can influence the choice of methodology. Although, from the perspective of service dominant logic, co-creation and networked collaboration are essential for service design, the type of service and the power difference between the designer and the user can determine the method to be used. From the perspective of the goods - service continuum, based on service dominant logic, if a product is categorized as being a pure service, additional cooperation is needed in order to design a product which is in the service domain. Methodologies which are associated with participatory design allow the user to become a co-designer by contributing to the actual design process thereby increasing the co-creative character. In such cases, methodologies such as service blueprinting whereby the user and the designer design a service blueprint in collaboration, will prove to be beneficial. From the power perspective it can be concluded that if the agent has more power compared to the principal user centric design methodologies are suitable guidelines to redesign services based on the needs of the users. When the power balance shifts towards the principal, close collaboration is needed in order to pursue customer intimacy. It can therefore be stated that participatory design methods, such as service blueprinting are more appropriate.
For when less co-creation is required, a user centric design methodology is developed which incorporates the steps of information gathering, user needs identification and envisioning & validation as shown in Figure 1. For information gathering, the VISOR framework can be used to obtain an overview of current service issues, possible process optimization, or act as an indicator for operational issues witnessed by the user. Although a stakeholder analysis was originally conducted in this thesis, the analysis is less useful when a service is not seen as a complex sociotechnical system and where the designing firm is dominant within the supply chain. In that case, sufficient stakeholder information is already incorporated within the organizing model of the VISOR framework. For user need identification, the need of the end user as well as the KPI can reduce the redesign space. However if the end user does not have valid indicators, it is advised to limit the impact of the stated indicators for the redesign. For envisioning and validation, a service blueprint can be used as a graphical representation tool of the service processes and its validation.

When additional co-creation is required, a service blueprint methodology is developed, see Figure 2. The methodology consists of six steps which result in the creation of a service blueprint. The first step is to decide on a goal for the service blueprinting session. Afterwards, the initiator can involve internal customers in the session, or customers and partners from the value chain. When the initial preparatory steps are completed, the actual service blueprinting session can commence. The session starts with an introduction into the subject of service blueprinting. Familiarization of the technique is achieved by creating a simple service system through service blueprinting. Afterwards the actual service blueprinting session can commence by engaging in interaction with the invitees through which a service blueprint will emerge that is based on the input of stakeholders. The last step is to adjust the process or technique for when additional blueprinting sessions are needed in order to design a definitive service blueprint.
In addition, the following points of reflection were discussed:

- Based on service theory and the experience gained from this research, it is still unclear on what level of user participation and co-creation is needed to redesign a service;
- Based on the gained experience in research techniques, using the service blueprint as a graphical representation tool to analyze service processes is more beneficial than a flow chart;
- Conducting an international service design process through multiple countries can be problematic due to the language - and cultural gaps. Participation of local branch offices can be an aiding asset in such occasions.
# Table of Content

Colophon ........................................................................................................................................... i
Preface .................................................................................................................................................. iii
Executive summary .............................................................................................................................. iv

## 1 Introduction ................................................................................................................................. 3
  1.1 The shift from manufacturing towards service provisioning .................................................. 3
  1.2 The consequences of servitization .......................................................................................... 4
  1.3 The aim of this thesis ............................................................................................................... 4

## 2 Research Design ......................................................................................................................... 5
  2.1 Problem formulation ............................................................................................................... 5
  2.2 Research formulation .......................................................................................................... 7
  2.3 Project deliverables ............................................................................................................. 9
  2.4 Research relevance ............................................................................................................ 9
  2.5 Outline of the thesis ......................................................................................................... 10

## 3 The Theory of Service .............................................................................................................. 11
  3.1 Defining products, goods and services .............................................................................. 11
  3.2 The difference in paradigm for offering products and providing service ......................... 14
  3.3 Design methodologies for services ................................................................................... 16
  3.4 The process of service innovation ....................................................................................... 19
  3.5 Performance measurement systems .................................................................................... 21
  3.6 Business Models ............................................................................................................. 22

## 4 The Case of Siemens Cranes .................................................................................................... 24
  4.1 Siemens AG .................................................................................................................... 24
  4.2 Siemens Cranes ............................................................................................................... 25
  4.3 The scope of the case ....................................................................................................... 28

## 5 Research Methodology .............................................................................................................. 30
  5.1 Phase 2: Redesign efforts for services .............................................................................. 30
  5.2 Redesign philosophy ....................................................................................................... 34
  5.3 Data collection methods .................................................................................................. 34
<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td><strong>Section 1: Information Gathering</strong></td>
<td>39</td>
</tr>
<tr>
<td>6.1</td>
<td>Analysis of the business models through the VISOR Framework</td>
<td>39</td>
</tr>
<tr>
<td>6.2</td>
<td>Assessment of the stakeholders through the stakeholder analysis</td>
<td>46</td>
</tr>
<tr>
<td>7</td>
<td><strong>Section 2: User Need Identification</strong></td>
<td>53</td>
</tr>
<tr>
<td>7.1</td>
<td>Key performance indicators of the container terminal operators</td>
<td>53</td>
</tr>
<tr>
<td>7.2</td>
<td>Need statement of the container terminal operators</td>
<td>55</td>
</tr>
<tr>
<td>8</td>
<td><strong>Section 3: Envisioning and Evaluation</strong></td>
<td>63</td>
</tr>
<tr>
<td>8.1</td>
<td>Comparison between the issues of section 1 and section 2</td>
<td>63</td>
</tr>
<tr>
<td>8.2</td>
<td>Service blueprint for the redesigned spare parts service</td>
<td>65</td>
</tr>
<tr>
<td>8.3</td>
<td>Service blueprint for the life cycle status service</td>
<td>67</td>
</tr>
<tr>
<td>8.4</td>
<td>Validation of the service blueprint</td>
<td>69</td>
</tr>
<tr>
<td>9</td>
<td><strong>Conclusions and Recommendations</strong></td>
<td>73</td>
</tr>
<tr>
<td>9.1</td>
<td>Business models of spare parts and maintenance services</td>
<td>73</td>
</tr>
<tr>
<td>9.2</td>
<td>The interests, objectives and issues of key stakeholders</td>
<td>74</td>
</tr>
<tr>
<td>9.3</td>
<td>The key performance indicators of the maintenance organization</td>
<td>75</td>
</tr>
<tr>
<td>9.4</td>
<td>The need statement of container terminal operators</td>
<td>76</td>
</tr>
<tr>
<td>9.5</td>
<td>The redesigned spare parts service</td>
<td>78</td>
</tr>
<tr>
<td>9.6</td>
<td>Validation of the redesigned spare parts service</td>
<td>79</td>
</tr>
<tr>
<td>9.7</td>
<td>Answering the main research question</td>
<td>80</td>
</tr>
<tr>
<td>9.8</td>
<td>Recommendation for user centric redesign</td>
<td>82</td>
</tr>
<tr>
<td>9.9</td>
<td>Recommendation for redesign through service blueprint</td>
<td>83</td>
</tr>
<tr>
<td>10</td>
<td><strong>Reflection</strong></td>
<td>85</td>
</tr>
<tr>
<td>10.1</td>
<td>Reflecting on the research literature</td>
<td>85</td>
</tr>
<tr>
<td>10.2</td>
<td>Reflecting on the research technique</td>
<td>87</td>
</tr>
<tr>
<td>10.3</td>
<td>Reflecting on the research response</td>
<td>87</td>
</tr>
<tr>
<td>10.4</td>
<td>Reflecting on the research results</td>
<td>88</td>
</tr>
<tr>
<td>11</td>
<td><strong>Annexes</strong></td>
<td>95</td>
</tr>
<tr>
<td>11.1</td>
<td>Annex 1: Interview questionnaires</td>
<td>95</td>
</tr>
<tr>
<td>11.2</td>
<td>Annex 2: Overview of interviewed Global Container Terminal Operators</td>
<td>100</td>
</tr>
</tbody>
</table>
## List of Figures

<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Recommendation for user centric design methodology</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Recommendation for service blueprinting. Source: adapted from Bitner (2008)</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Rich picture of the problem statement</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Overview sub-questions</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Structure of the thesis</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Goods-service continuum</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>The typology of services. Source: adapted from Katzan (2011)</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>The different types of Product Service Systems. Source: adapted from Meier and Roy (2010)</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Service Encapsulation. Source: adapted from Howells (2001)</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>The lifecycle of service. Source: adapted from Katzan (2011)</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>A generic NSD process with methods. Source: adapted from Salvendy and Karwowski (2010)</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Generic User Centered Design process. Source: adapted from ISO 9241-210:2010</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Evolutionary search for innovation. Source: adapted from Chae (2012)</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>Dimensions of service innovation. Source: adapted from Nam and Lee (2010)</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>Leading and lagging measures. Source: adapted from Smith and Mobley (2008)</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>Business model concept. Source: adapted from Gordijn (2005)</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>Siemens strategy. Source: adapted from Siemens (2011)</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>Market channels of Siemens Cranes</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>Global market share harbor cranes</td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>IST and SOLL focus. Source: adapted from Siemens (2012)</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>Different types of harbor cranes</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>Current services. Source: adapted from Siemens (2012)</td>
<td></td>
</tr>
<tr>
<td>26</td>
<td>Case scope of the research</td>
<td></td>
</tr>
<tr>
<td>27</td>
<td>User Centric Design approach. Source: adapted from Maguire 2002</td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>Research method section 3. Source: adapted from Bitner and Ostrom 2008</td>
<td></td>
</tr>
<tr>
<td>31</td>
<td>Data collection methods</td>
<td></td>
</tr>
<tr>
<td>32</td>
<td>Pro’s and con’s of maintenance strategies. Source: adapted from CHOA (2002)</td>
<td></td>
</tr>
<tr>
<td>33</td>
<td>Simplified organizing process for maintenance services</td>
<td></td>
</tr>
<tr>
<td>34</td>
<td>Current (IST) service blueprint for maintenance services.</td>
<td></td>
</tr>
<tr>
<td>35</td>
<td>Simplified organizing process for direct spare parts sales</td>
<td></td>
</tr>
<tr>
<td>36</td>
<td>Current (IST) service blueprint for spare parts services.</td>
<td></td>
</tr>
<tr>
<td>37</td>
<td>Overall view of internal &amp; external interfaces</td>
<td></td>
</tr>
<tr>
<td>38</td>
<td>Key stakeholders</td>
<td></td>
</tr>
<tr>
<td>39</td>
<td>Interests, objectives and issues of key stakeholders</td>
<td></td>
</tr>
<tr>
<td>40</td>
<td>Difference between availability and reliability. Source: adapted from Sutton 2010</td>
<td></td>
</tr>
<tr>
<td>41</td>
<td>Difference between MTTR &amp; MTBF</td>
<td></td>
</tr>
<tr>
<td>42</td>
<td>Causal diagram linking issue source, issue impact, KPI and solution</td>
<td></td>
</tr>
<tr>
<td>43</td>
<td>Example of non-critical subsystem reducing availability</td>
<td></td>
</tr>
<tr>
<td>44</td>
<td>Decision tree of principal &amp; agent</td>
<td></td>
</tr>
<tr>
<td>45</td>
<td>Decision tree of principal &amp; agent with increase information symmetry</td>
<td></td>
</tr>
<tr>
<td>46</td>
<td>Redesigned service blueprint of the spare parts service.</td>
<td></td>
</tr>
</tbody>
</table>
Figure 47: Service blueprint for life cycle status services obtained through the life cycle status module. 67
Figure 48: Used User Centric Design methodology ............................................................... 73
Figure 49: Level of co-creation and the methodologies ............................................................ 81
Figure 50: Recommendation for user centric design methodology ............................................ 82
Figure 51: Service blueprinting. Source: adapted from Bitner (2008) ......................................... 83
Figure 52: Customer Order Decoupling Points Model. Source: adapted from Olhager (2012) .......... 85
Figure 53: Example for pereto efficiency for service providers and customers ......................... 86
Figure 54: Organizing model for spare parts services based on flow chart technique .................... 87

List of Tables
Table 1: Trend of global servitization in firms. Source: adapted from Neely (2007) ....................... 4
Table 2: Interview subjects for section one, Siemens NL ........................................................... 36
Table 3: Interview subjects for section two, Global Terminal Operators ........................................ 36
Table 4: Total container throughput for 2009. Source: adapted from Rodrigue (2011) ................... 47
Table 5: Classification of different global terminal operators. Source: adapted from Mori (2006) ...... 48
Table 6: KPI of Container Terminal Operators. Source: adapted from Zijverden & Negenborn (2012) . 48
Table 7: The results of the data gathering phase for Need Statement and KPI ................................. 53
Table 8: Purchasing Portfolio Matrix. Source: adapted from Kraljic (1983) ................................. 60
Table 9: Findings of VISOR framework analysis, service blueprint analysis and actual service issues ...... 63
Table 10: Alternative revenue streams for life cycle services ...................................................... 68

List of Abbreviations

<table>
<thead>
<tr>
<th>B2B</th>
<th>Business-to-Business</th>
<th>OEM</th>
<th>Original Equipment Manufacturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>B2C</td>
<td>Business-to-Consumer</td>
<td>PLM</td>
<td>Product Lifecycle Management</td>
</tr>
<tr>
<td>CRM</td>
<td>Customer Relationship Management</td>
<td>PSS</td>
<td>Product Service System</td>
</tr>
<tr>
<td>CTO</td>
<td>Container Terminal Operator</td>
<td>RMG</td>
<td>Rail Mounted Gantry</td>
</tr>
<tr>
<td>EUNA</td>
<td>End User Notification Administration system</td>
<td>RTG</td>
<td>Rubber Tired Gantry</td>
</tr>
<tr>
<td>G-D logic</td>
<td>Goods-Dominant logic</td>
<td>SCM</td>
<td>Supply Chain Management</td>
</tr>
<tr>
<td>IPSS</td>
<td>Industrial Product Service System</td>
<td>SCOOS</td>
<td>Siemens Cranes Online Ordering System</td>
</tr>
<tr>
<td>KPI</td>
<td>Key Performance Indicators</td>
<td>S-D logic</td>
<td>Service-Dominant logic</td>
</tr>
<tr>
<td>MTBF</td>
<td>Mean Time Between Failure</td>
<td>SE</td>
<td>Systems Engineering</td>
</tr>
<tr>
<td>MTTR</td>
<td>Mean Time To Repair</td>
<td>SI</td>
<td>System Integrator</td>
</tr>
<tr>
<td>NPD</td>
<td>New Product Development</td>
<td>STS</td>
<td>Ship to Shore</td>
</tr>
<tr>
<td>NSD</td>
<td>New Service Development</td>
<td>UCD</td>
<td>User Centric Design</td>
</tr>
</tbody>
</table>
PHASE 1: Research Formalization

Chapter 1 - Introduction
Chapter 2 - Research Design
Chapter 3 - The Theory of Service
Chapter 4 - The Case of Siemens Cranes
Chapter 5 - Research Methodology
1 Introduction

In the modern world, an economical shift has taken place which has gradually changed the structure of the macro, meso and micro environment towards a more service orientated economy (Chae, 2012; Kindström, Kowalkowski, & Sandberg, 2012; Ma, Tseng, & Yen, 2002; Menor, Tatikonda, & Sampson, 2002; Piccoli, Brohman, Watson, & Parasuraman, 2009). The shift has been an ongoing process which has transformed agricultural and mining based societies, noted as the primary sector, towards manufacturing orientated societies, which in turn has become the secondary sector. Through continuous technological advancements, changing production quality, reduction in transaction costs through development of infrastructure, utilities and regulatory frameworks, manufacturing has become a sophisticated production mechanism (Memedovic & Iapadre, 2009). However, the second half of the previous century, the rise of the service sector had become a reality. The literature refers to this process as “tertiarisation”. Timmer and Akkus (2008 p. 2) have stated that this “structural transformation is experienced by all successful developing countries.” Currently services can be seen as a dominant economic activity which has overtaken the manufacturing sector. The importance of services has thus increased tremendously. The European Commission (2009) has stated that in the period between 1995 and 2007 nearly all EU27 employment growth was the result of the service sector. In the European Union nearly 155 million employees were active in the service sector alone, which represents 69.2% of all employments. These employees generated around 71.6% of the gross value of the European Union. It has therefore been stated that the shift to the service sector has ultimately transformed the European economy into a “service economy”.

1.1 The shift from manufacturing towards service provisioning

The reasons for the shift from manufacturing towards services can be partially explained by the decrease in the price of goods while the demand for services with higher income elasticity is growing. This has partially created a dependency between different sectors on the service market, see Figure 3. For the manufacturing sector for instance, the creation of complex systems with an extensive life cycle required additional business-to-business (B2B) services to maintain continuous operations. The service portfolio supplies the service provider with a higher margin compared to suppliers of other product types. Additionally, services provide a more stable source of income and are categorized by being less sensitive to economic fluctuations. Taking a marketing perspective into consideration, orientation on services can increase the general sales of products by creating a customer lock-in, while at the same time increasing product adaptation and strengthening customers confidence and suppliers credibility (Salonen, 2011).
1.2 The consequences of servitization

Structural transformation affects actors on a firm based level. Product-centric firms have in the past relied on methods and strategies to develop, manufacture and sell goods. Classical strategies would enable firms to compete based on, for instance, advanced technologies, or by maintaining a low selling price. However in current industrial markets it is becoming more difficult to obtain technological superiority within the globalized environment or to maintain market position through cost leadership (Salonen, 2011). In the changing economic environment where services are becoming more dominant, a transition is taking place which enables and empowers firms to be more competitive and gradually adapt to the transition towards a service environment through service adaptation (Yoon, Kim, & Rhee, 2012). This paradigm shift is known as “servitization” and requires new strategies, new organizational structures and new skills (Kindström et al., 2012; Neely, 2008). Service based strategies can be very useful during this process and can provide a solution for establishing a competing strategy (Salonen, 2011). As seen in Table 1, already many Western countries have undergone servitization, while developing countries such as China still rely on manufacturing for their competitive advantage.

1.3 The aim of this thesis

Changing business aspects in order to create, manage and sell additional services is not a self-evident task. Different perspectives, paradigms and approaches are needed in order to bring movement to encrusted firms which rely on legacy processes that were solely developed for use at production based firms. This thesis aims at confronting these issues by redesigning services from a customer centric perspective and focusing on a future service provisioning. In order to research this subject and the issues which partitioning firms face, a case study is carried out at Siemens Nederland N.V. at the sub division of Siemens Cranes.

Siemens has incorporated a new strategy which focuses on innovation and customer intimacy in order to compete with other electrical components manufacturers. Siemens Cranes focuses on delivering Siemens product towards the cranes market. While previously, the focus of Siemens Cranes lay in the selling of electronic equipment, the acquisition of new crane projects, as well as the handling of warranty related issue, in additional, it now aims at providing after sales services. However, Siemens Cranes is currently not able to utilize the full potential of their services to the customer. The possible changes which are required in designing or redesigned additional services remain unknown, but are needed in order to be fully able to satisfy the needs of the customer and implement the desired strategy. Without these essentials, it is difficult for Siemens Cranes to position their service portfolio on the competitive market and offer that what the customer truly needs. By researching current business models and design processes which are focused on service provisioning, a firm which is traditionally goods centric, but has aspiration for transforming towards a service provider, will manage and sell additional services, while enabling developing of new services in the process.

Table 1: Trend of global servitization in firms. Source: adapted from Neely (2007)
2 Research Design

As seen in the previous chapter, the process of servitization is an ongoing process which changes the focus towards service provisioning. Alterations from one focus, to another, can have a tremendous effect on the way a firm interfaces with its own business components or how it acknowledges its customers. The following chapter clarifies which possible complications can arise when such a transformation occurs within a certain firm. The aim of the chapter is to identify possible issues associated with the subject, gaps in knowledge and to formulate the contribution to the scientific and business perspective. In order to define the scope of the problem, a rich picture is created which depicts current complications of servitization at a firm level. Afterwards, a research design consisting of certain steps in order to complete the stated goal is presented.

2.1 Problem formulation

As previously stated in the introduction, in current business undertakings, it is difficult to gain competitive advantages through cost leadership or technological superiority. Ever changing needs of the customer require producers to develop new products while faster innovation cycles and the pressure of economic uncertainties are evident. In such occasions, providing services which conform to the need of the customer is essential, especially while the development of servitization is ongoing. However, due to the commissioning phases of servitization, different production firms are rearranging their resources in order to offer services to the user market.

For the formulation of the problem, a rich picture is constructed which houses all relevant system elements and relations between them, see Figure 4. The rich picture is represented as a matrix which distinguishes both the meso- and micro economic environment on the one hand and interpretation of the goods and service domains on the other. The rich picture depicts the differences noticed within the meso- and micro environment, for a typical manufacturing orientated firm which produces and sells goods compared to a firm which devotes its energy towards service provisioning. Within the meso level, different market forces are active which stimulate the supply and demand, such as customers, suppliers, strategic partners and various other supply chain entities. The micro level focusses on the concept of the firm and addresses internal and controllable forces which contribute to the mission and vision of the firm, such as corporate structure, divisions and associated firm policies.

The Meso environment

From the manufacturing perspective, a supply chain consists of isolated firms which deliver raw material or semi-finished goods whereby the manufacturing firm can produce a finished good to be used by the customer. The interaction between the supply chain entities can therefore be defined as a simple network where value is gained through the exchange of goods. This changes when a firm engaged in service provisioning to its customers. In such cases the supply chain becomes a value creating network where collaboration and co-creation is actively encouraged and where more value adding components are added to the process. The interaction is seen as a more sophisticated network typology whereby value is gained through the use of a product rather than the exchange of it. Changing from a goods mindset towards service orientation is however not a simple task which can be performed without critically reassessing the corporate structure, strategies, processes and methods in order to develop, manage, sell and innovate services (Blankson & Kalafatis, 1999; Jaw, Lo, & Lin, 2010; Kowalkowski, 2010;
The Advisory Committee on Measuring Innovation in the 21st Century Economy, 2008; Vargo & Lusch, 2004). Changes should also be made to the individual firm represented by the micro environment.

The Micro environment

When observing the micro environment from the perspective of a manufacturing firm, it should be noted that only tangible resources are used. The output of innovation is dominantly technology based, whereby the manufacturing firm only uses internal resources at its disposal. The resources rely only on standard and traditional corporate policies. These environment characteristics are evident in companies where only fragments of customer need are defusing into the firm. Changing towards service provisioning changes these characteristics due to the need to significantly increase the diffusion rate of the need of the customer into the manufacturing firm. To enable this transformation, resources in the form of knowledge and skill are required to engage in innovation which is primarily non-technological in
nature. Furthermore, due to the broad meaning of co-creation and networked collaboration, innovation is more open, allowing external resources to contribute the innovation efforts. In addition, different employment functions are observed within the corporate structure.

Although service innovation is a field where currently researchers are addressing various issues, there is a lack of theoretical frameworks and practical approaches which makes it problematic for researchers and practitioners to address the difficulties of service innovation when a firm changes its perspective from product selling towards providing service. A theoretical gap is noticed when dealing with the development of new services (Hertog, 2010). While the production and manufacturing firms develop products through the use of matured product development processes and methods, service development relies on processes and methods which are in their infancy stages. Furthermore, many of the proposed methods have been developed with only technological development rather than non-technological innovation in mind. The aspect of co-creation and networked collaboration, which can bring service alignment with the need of the customer, are not fully implemented within the methods.

### 2.2 Research formulation

The previous chapter delineated the main subject in the field of service design. Scientific and business relevance was clarified with regards to manufacturing firms who, due to different circumstances, aim to provide services for their user market. The aim of this research is to support these manufacturing firms into transitioning towards a service orientated organization by redesigning services through incorporating customer needs into the design process. To properly address this issue the following main research question has been formulated:

“How can a firm, which operates in a goods dominant environment, redesign their services in order to meet the needs and expectations of the end users?”

To answer this research question, a service redesign is proposed based on sequential design steps as shown in Figure 5.

**Design step 1 - Information gathering:**
The information gathering step focusses on gathering information which will be vital for the consecutive service redesign. However, before different stakeholders are assessed, an analysis needs to occur which gathers information on the current service designs. The following informative design questions are noted:

“What business models are currently implemented for the services of spare parts and maintenance in the container handling cranes industry?”
To be able to redesign services in a coherent and integrated manner, a closer look needs to be given to the current business logic behind the services. When this is known, possible areas which need specific attention due to possible business alignment issues and elements for improvements will be considered for the redesign process.

“Which interests, objectives and issues do stakeholders in the supply chain of container handling cranes have with regards to the services of spare parts and maintenance?”

Designing services means that input of end user is crucial in for its success. In order to specify how stakeholders are affected by the introduction of redesigned services, it is vital to understand their value adding capability, their current position within the supply chain and how they interaction with the end user. By specifying these characteristics, an overview of interests, objectives and issues will allow the service to be redesigned which can cope with these characteristics.

**Design step 2 - User need identification:**
The user need identification step focusses on gathering the needs and expectations of the end user. With the input gathered from the previous design step, the end users can indicate future needs and expectations. However, before the extraction of needs and expectations can occur, it is important to understand the performance indications of firm concerning the services. The following design questions relating to the identification of user need are noted:

“Which key performance indicators do the end users of crane handling cranes employ to assess the services of spare parts and maintenance?”

Knowing which key performance indicators are deemed to be of importance for the end users can be beneficial for the design process. Knowing how performance is measured, and what systems are in place which are tasked with measuring the indicators, will ensure that the service will be geared towards the improvement of such indicators.

“What are the current and future needs and expectations of the end users with regards to the services of spare parts and maintenance?”

When the key performance indicators are known, it is paramount to understand the actual need of the end users. Gathering both current and also possible future needs and expectations, will allow the design of services which are more in line with future markets.

**Design step 3 - Envisioning and evaluation:**
After the needs of the users are identified, the envisioning of the service can commence. By incorporating the interests, objectives, issues together with performance indicators and the needs of the end user, an overall design can be created which increases the value of the service for the end user. Afterwards, validation will be conducted to ensure that the design meets general criteria. The following design questions relating to the envisioning and evaluation of the design are noted:

“Which service processes should be redesigned in order to comply with the needs and expectations of the end users?”
Having the needs of the user embedded within the process of developing new services can have an impact on how the firm interacts with its users. Envisioning a redesigned services in order to integrate user needs within the service will improve the overall value to the end user and increases the perceived service quality currently offered.

“Which alterations to the design can be made in order to validate the redesigned services?”

It is vital to have controlling mechanisms put into place which give feedback on the result of the redesign efforts. By validating the redesigned services, the service processes can be reevaluated based on the redesigned service processes therefore confirming that the redesign satisfies the business logic and the stated user needs.

2.3 Project deliverables

The project deliverable is in a form of a design report. The main subjects which will be represented within the report is based on the outcomes of the separate redesign steps and which ultimately lead to the creation of a redesigned service. The conclusions will concern the methods used for service design based on the discussed approaches. The report consists of the following elements:

- Literature study on the subject of service design and innovation;
- Business model analysis which depicts the current business logic;
- Stakeholder analysis which characterizes the interaction of supply chain actors;
- Need statement and KPI analysis which delineates the needs and expectations of the end users;
- Redesigned blueprint of a service;
- Recommendations which aid in the improvement of methods currently used by Siemens Cranes.

2.4 Research relevance

This thesis report has relevance in both the scientific-, as well as business domain. Scientific relevance is crucial for improving current understanding of service related subject, while business relevance aims to contribute to practical understanding of service science for public, private and societal understanding alike. It is the interaction between the scientific community and the practical domain which can contribute to a full understanding of service design. It is by transposing scientific knowledge and ideas towards practical understanding by practitioners through which applicability can be improved.

Scientific relevance

From the scientific perspective, this thesis will contribute to the current collection of service science and knowledge. In addition to an overview of current advancements in service science, the thesis examines the discrepancies which exists between scientific knowledge, their extracted recommendations, and relates them to the social dimension. Due to exposed discrepancies, new scientific views can be created which are more in line with current and future realities.

Business relevance

From the business perspective, this thesis provides Siemens Cranes with an alternative method of designing or improving services by developing service from a user centric dimension. This will allow Siemens Cranes to develop future service which are more customer orientated and provide more value to the customer. Additionally, the proposed recommendations will provide firms, who find themselves in a goods dominant confinement or are balancing between the goods dominant - and service dominant
dimension, with applicable changes in design methodology which can improve their service provisioning and experience of the customer.

2.5 Outline of the thesis

The proposed research is divided into 3 phases, see Figure 6. Phase 1: Research formalization defines the premises of the research. A total of 4 chapters are incorporated into this phase, including this chapter and the previous chapter. In the previous chapters, an overview with argumentations was presented which stated that in general, services are becoming an important element in business transactions. Chapter 3 examines current service theory, focusing on service science, service design & innovation, business modeling and performance measurement. In the chapter, the term service is defined and knowledge is shared on how service, design and provision is managed. With this information a better understanding is created with regards to the differences and similarities of services and goods. Chapter 4 states the premise of the case by defining the current strategies and portfolio of Siemens and Siemens Cranes to ultimately define the scope of the research. By doing so, focus is given specifically to the services which are analyzed in this research. The scope of the case reflects on two specific services, spare parts - and maintenance services which will be analyzed in the following chapters. Chapter 5 defines the methodology on which the proposed research will be based on by stating the redesign methodology, redesign philosophy and the methods for data collection.

Phase 2: Redesigning effort for services, consists of 3 chapters which are subsequently the steps undertaken to analyze and redesign the two services. Chapter 6 concerns the first step of the user centric design approach where information gathering occurs through a business model analysis and a stakeholder analysis. Chapter 7 concerns the step of user need identification whereby the need statement and KPI’s related to the end users are analyzed. Based on the results, one service will be designated for a redesign. The redesign will be the final step of the user centric design approach and involves envisioning of the service through a service blueprint and its validation.

Phase 3: Conclusions & reflection, consists of the final chapters of the thesis. Chapter 9 consists of the conclusions and recommendations, while the final chapter is reserved for reflection concerning service theory, research techniques and research response.
3 The Theory of Service

In the following chapter scientific knowledge on the subject of products, services, service development and service innovation is discussed. The aim is to explore possible knowledge gaps and clarify scientific and business relevance with the aim of scoping the proposed research. The context of the research is based on marketing and design perspective which directly relate to service. First, different product types, such as physical goods and services, are defined and discussed. Due to the blurred co-existence between physical products and services, different relationships between them are clarified. Afterwards, different paradigms which govern both products is analyzed. In addition, several service design methodologies are discussed whereby service innovation is paramount. The chapter concludes with business modelling and key performance indicators within the context of service provisioning.

3.1 Defining products, goods and services

In broad terms, a “product” can be seen as “anything that can be offered to a market for attention, acquisition, use or consumption that might satisfy a want or need” (Kotler & Armstrong, 2011, p. 224). The concept can be seen as an umbrella term which houses different concepts and notions such as goods or services or even events, places, persons and ideas. Products can be divided into consumer and industrial products. The difference is solely based on the perceived purpose be it for the consumer use or for use in a business environment. An industrial product is defined as a “product bought by individuals and organizations for further processing or for use in conducting business” (Kotler & Armstrong, 2011, p. 227). There are three different types of industrial products. Material and parts consists of raw materials, manufactured materials and parts. For these types of products, additional services and pricing are important factors in contrast to branding and advertising. Capital items can be seen as buildings and processing equipment such as industrial machinery. Supplies and services entail supplies, repair and maintenance items. Services can include maintenance and repair services and advisory services which are usually supplied under contract (Kotler & Armstrong, 2011, p. 228). Industrial products are furthermore characterized by direct and intense manufacturer- customer cooperation. Additionally the development time of industrial products is considerably longer and produces more complex end-products (Elfvengren, Kärkkäinen, Torkkeli, & Tuominen, 2004).

Different sources of literature have indicated that a definition of the term “services” has been a challenge for researchers (Blankson & Kalafatis, 1999; Ng, Vargo, & Smith, 2012). Some researchers see services as “activities” and “benefits”, while others refer to them as “deeds” and “processes”. An early definition was given by the American Market Association which defined services as “activities, benefits or satisfaction which are offered for sale, or are provided in connection with the sale of goods”. Note that in their definition they explicitly state that a service can be provided in connection with goods. Kotler and Armstrong (2011 p. 224) have continued along the same line, but have added the characteristic of intangibility and ownership to the definition. They see service as “an activity, benefit, or satisfaction offered for sale that is essentially intangible and does not result in the ownership of anything”. Vargo and Lusch (2004 p. 2) rather specifically add knowledge and skills to the definition. They define it as “the application of specialized competences (knowledge and skills) through deeds, processes, and performances for the benefit of another entity or the entity itself”.

The definitions relate to different properties of services, it is therefore important to note the perceived differences between goods and services. The literature has defined key characteristics which can separate traditional goods from services. A service is intangible, meaning it cannot be stored, patented, readily displayed or communicated and is difficult to price accordingly. For services, production and
consumption are inseparable, whereby the leading consumer or other consumers are involved in the production process but where mass production is difficult to sustain. The previous characteristic is also referred to as the uno-actu-principle (Meier, Roy, & Seliger, 2010). Services are heterogeneous, whereby standardization and quality control are difficult to implement and perishable which indicates that it cannot be inventoried (Jaw et al., 2010; Zeithaml, Parasuraman, & Berry, 1985). However, some researchers such as Baaken, Leich, and Gokduman (2010) indicate that the previously observed differences between goods and services are, in reality, not always strictly present. For instance, services can create tangible results while some services can be presented in a standardized manner. Furthermore during the production process of a physical good, the customer can be involved in the production of value and additionally, not all tangible goods are imperishable. It has become difficult to really grasp the distinctive delineation between goods and services. Servitization created a complex transformation in the technological and institutional domains, which in turn has further blurred the boundary between goods and services (Memedovic & Iapadre, 2009). The blur between goods and services has resulted in the goods-service continuum, see Figure 7. Pure goods are for instance widely available natural resources such as sand or salt. When the characteristics of a product change, for instance from tangible towards intangible, the product leans more towards a service (Balin & Giard, 2006).

3.1.1 The typology of services

Literature distinguishes different varieties of services. For instance Katzan (2011) defines primary, secondary, facilitating and auxiliary services, see Figure 8. The primary service is considered to be the core service by which the service provider and client interact to create value. In industrial context, this can for instance be a maintenance service for a specific system. A secondary service is a service that is deemed to only exist to commit to and support the primary service. In the previous example this can comply with measuring and verifying different operational states of certain subsystems. Secondary services is referred to as supplementary - or referral services by multiple literatures. Facilitating services enable the users to make use of other services. This can for instance be the purchasing of tickets through a ticket services to a certain event. Auxiliary services are considered to be independent from the primary service and usually occur before or after the primary service. In the given example this can comply with a digital check-up to notify which issues are currently present within a specific system.

On a lower aggregate level, different service events can be categorized based on their modality, diversity, temporality, complexity and duration (Katzan, 2011). The modality configures the service event as either discreet or as continuous. Discreet service events can be implemented at discreet moments in time, such as the installation of a subsystem, while continuous events are active at a longer period of time, such as continuous monitoring services. Diversity specifies if the service can be performed by a specific provider, which is referred to as homogeneous or by different providers which conforms to heterogeneous properties. Temporality referrers to whether the client is actively
participating in the process. For instance, the installation of certain subsystems can be seen as an active engagement, while insurance services can be seen as strictly passive engaged by the client. Complexity specifies the degree of service complexity. Low complexity only requires a limited amount of functions, while high complexity requires multiple functions in order to complete the service event. The duration refers to the total time in which the service is in an active state.

3.1.2 The relation between goods and services

Although a difference between goods and services can be noticed, different schools of thought state that there are interdependencies between goods and services to such a level, that goods and services need each other to support, and facilitate the business process. Additionally the integration of products and services is becoming dominant in industrialized economies (Ng et al., 2012; Yoon et al., 2012). Due to servitization the phenomenon of “service encapsulation” has occurred, see Figure 10 (Howells, 2001). Physical products are encapsulated by services in order to supply additional offers to the final demand. This can occur in two distinct ways, whereby a physical product is combined with additional services that seek to compliment the product, or where the offer is not the physical product, but the goal that the physical product is to fulfill. Manufacturing firms, to which service encapsulation applies, traditionally create basic services such as maintenance, repair, monitoring and diagnostic services. Other researchers, such as Schweitzer and Aurich (2010), identify “extended products” and “product service systems” (PSS) which focus on coherent development of both products and services as a conjoint effort in developing a definitive product and business model, see Figure 9. The structure of an extended product corresponds with the previously defined phenomenon of service encapsulation. A specialized type of PSS, namely industrial-PSS (IPSS) inherently takes the life cycle-orientation towards the design of an industrial product and joint services (Schweitzer & Aurich, 2010). In such occasions, physical products and services are difficult to separate due to the tightly coupled character of the combination. IPSS rely on an extended value creation network that can comprise out of additional stakeholders such as suppliers and service partners who continuously aim at improving the functioning of the IPSS for the customer.

There have been many cases where companies have introduced extended products and PSS to their markets (Howells, 2001). For instance, in the car manufacturing business, the Fiat Group introduced financial - and insurance services for their Italian customers by creating the subsidiary Toro Assicurazioni, while its competitor Ford focused on car traveling services, financing, leasing and maintenance. In the cranes business, Liebherr developed service capabilities that would enable machinery to run remotely. Some industries took development further and created IPSS. For instance, firms in the aviation industry such as General Electric and Rolls Royce lease their aerospace engines per hours of flight, changing their attention from physical product to service. Maybe one of the most famous examples of IPPS implementation is Xerox, an American multinational for document management. Due
to the high selling price of their reprographic machines, which struggled with low reliability requiring many maintenance jobs, Xerox started to lease their products guaranteeing customers its functionality. The intention to change their focus from goods towards service was not the result of careful strategic planning, but more a necessity which was vital to maintain business continuity. It should however be noted that the change from selling products towards selling service is not as simple as following a checklist. There are for instance differences in paradigms between firms which are focused on manufacturing and selling a product and service providers.

3.1.3 The lifecycle of services

The life cycle of service consists of six different phases with distinctive processes, see Figure 11 (Katzan, 2011). Although a service can be engaged by different entities, such as an individual, governmental body or even a society, the perspective of the firm is chosen since the subject of the thesis reflects a firm environment. Thus the life cycle is reflected upon a firm specific level which starts at the service commitment phase. The phase reflects the commitment of the service provider to engage in a formal agreement with a client in order to provide a specific service. For example, the formalization of a contract with specific information concerning what service at which location under which conditions should be allocated. The provider agrees on the content of the service, rather than on the process. The next phase is that of service production. In this phase different processes and service infrastructures that relate to the service are provisioned in order to be able to provide the service to the client. Different back-office processes as well as auxiliary services are engaged in order to provide that what was decided in the service commitment phase. If this phase is successfully performed, less investment and acquisition is required from the service provider while client retention may be awarded. The phase of service availability reflects the time when the service is made available to the client. This phase concerns the planning and scheduling of possible service events after which the service delivery phase can begin. In this phase the actual primary service is offered by the provider to the client. Different resources are used to successfully deliver the service. By correctly using the resources, a more efficient or effective service experiences can be created for both provider as well as client. The next phase is that of service analysis. The phase confronts and measures the gained satisfaction and dissatisfaction of the client and reacts appropriately by changing the committed resourced. The value proposition is reevaluated in a constant basis during the delivery phase. The life cycle of service concludes with the service termination phase. This phase describes the discontinuation process of the service. If through service analysis the service is deemed to be not value adding, the service can be discontinued.

3.2 The difference in paradigm for offering products and providing service

The orientation of offering products and a service provider rely on two distinctive fundamental perspectives which have been categorized as product centered perspective and service centered perspective (Vargo & Lusch, 2004).
3.2.1 The product centered perspective

The classical goods centered view emerged out of the first and second economic sectors, see Figure 12. The economy revolved around material goods, where services are rarely mentioned in the context of an economic activity. The economic activity relied on value and utility creation during the production or distribution process. In order for the product to be successful in the market, it had to offer more value than the products of the competitor. In order for the firm to obtain the profit out of sales, different strategic, tactical and operational decision variables needed to be optimized in order to produce a standardized product. After production, the product would be stored and delivered when it was needed by the client. This way of looking at the fundamental process of adding value is more in line with current mass production thinking for commoditized products. Current Business-to-Business as well as Business-to-Consumer markets have already adopted more customer oriented approaches which stimulate customer interaction through relationship marketing (Ballantyne, Williams, & Aitken, 2011).

The product centered perspective is nowadays referred to by researchers as goods-dominant logic (G-D logic) or as industrial view/logic (Kowalkowski, 2010). The primary focus is to develop a product, either a physical good or a service, by using operand resources. Operand resources are those resources to which an operation is performed, usually natural resources, goods or other tangible means. Value is created by the producer which observes and targets the customer as an isolated entity and the rest of the supply chain as the structure which sole task is to deliver value-adding components. The notion of value is centered on “value in exchange” whereby value is indirectly obtained through the delivered product. The G-D logic is in essence a discriminatory paradigm since preference is given to goods while services are seen as a residual output.

3.2.2 The service centered perspective

A service centered perspective focuses more on social and economic processes which focus on constantly increasing customer value to gain satisfaction, see Figure 13. The firm develops core competences through knowledge and skills which can be used as potential competitive advantages. Customers would be able to obtain the services in exchange for remuneration. However, unlike the goods centered approach, close relationship with the customer is required to develop services based on the needs which are compelling to the customer and add value. When the service has been offered, it is in the interest of the firm to continuously improve the service by incorporating feedback mechanism into the development of new or improved services. The service centered view is more focused towards the customer and is more market driven compared to goods centered perspective. It is considered to be customer centric and requires the firm to learn from the customer and define them as co-creators (Vargo & Lusch, 2004).
The service centered orientation is referred by different researchers as the service-dominant logic (S-D logic). Looking through the perspective of a firm which conforms to S-D logic, goods and services are seen as means to provide the customer with service, whereby the physical product is the vessel of the rendered service. The firm assists their customers with their own value-creation processes. Unlike general believe, physical goods and services share the same importance within S-D logic, this suggests that unlike the G-D logic, S-D logic is a nondiscriminatory paradigm. Operant resources are committed to produce physical solutions and to develop services. The firm sees its customer rather as a co-creator of the service and the supply chain as the value creating network. The supply chain is thus seen as a “purposeful group of organizations creating social and economic goods or services through complex dynamic exchange of tangible and intangible value” (Allee, 2009 p. 3). Value is seen as “value in use” which considers direct transaction of customer needs in satisfaction when the service is consumed.

Nowadays firms operate through a hybrid model which uses different elements from both logics in order to produce value. It is however believed that S-D logic has a higher degree of value creation and should be embraced as the dominant paradigm (Winklhofer, Palmer, & Brodie, 2007). However changing from the goods-dominant logic to the service-dominant logic is not a simple task. It can radically change the business model and requires different operations. For instance, adding services has a tremendous impact on the sales force which is locked-in trough selling value in a product centric way. The sales force will require a different selling approach in order to provide the market with services. In some cases e.g., the change in perspective has resulted in the necessity to replace 50% of sales employees (McKinsey, 2003). The shift might also require expert service designers whose function will be to engineer new services in a co-creative manner (Kowalkowski, 2010). Due to the specific properties of service providing such as the need for co-creation and networked collaboration, different corporate structures, strategies, processes and methods are needed to develop, position, sell and innovate services (Blankson & Kalafatis, 1999; Jaw et al., 2010; Kowalkowski, 2010; The Advisory Committee on Measuring Innovation in the 21st Century Economy, 2008; Vargo & Lusch, 2004).

### 3.3 Design methodologies for services

It is important for firms to be innovative and to develop new goods and services in order to adapt to the changing market environment. Those firms which are able to bring products and services quicker in the market while satisfying the expectation of the customer are more competitive and enjoy more overall success (Murthy, Osteras, & Rausand, 2008, p. 22).

Numerous development processes have been developed for both physical products as well as services. In the field of product development, different strategies, methods and tools have been developed to aid in the design and engineering of products. New Product Development (NPD) aids in the process by contributing in the creation of a systematic approach in order to develop new products. The discipline sets out tasks and steps with combined means by which a firm transforms initial ideas towards mature products (Murthy et al., 2008). Successfully implementing NPD approaches can lead to market
expansion, and an increase in profits, creativity and leadership (Choi, Powell, & Cassill, 2005). Adapting structured NPD approaches in contrast to ad-hoc approaches increases the change for success of new products (Salvendy & Karwowski, 2010). Additionally, early implementation of NPD within the product development process can further increase the chances for success (Murthy et al., 2008, p. 22).

3.3.1 New Service Development

However as previously stated, a service has certain specialized characteristics which may differ from other product types. The characteristics have shed a light on alternative processes. Research has shown that during the phases of design and launch of a service, New Service Development (NSD) should be considered as an alternative to NPD, see Figure 14. Developing or improving services through NSD can be essential for increasing profitability through reduction of costs and for attraction new and existing customers by creating loyalty (A. M. Smith, Fischbacher, & Wilson, 2007). Additionally, NSD approaches create capacities and capabilities for further service development and provide a platform for future strategic planning. Although the benefits can increase the successfulness of service design, research has indicated that firms often do not adopt formal approaches which aid in the design process. A motivation to use NSD is coupled with the increase of technological breakthroughs and changing customer expectation. NSD approaches are needed in a world where trade is globalized and where countries with different cultures are conducting business. Services which have been developed in the past are becoming less adequate for the future needs and expectations of the customer. Cultural differences and the change in needs and expectations of customers make the process of developing new services more complex and require formalized processes.

The acknowledgement of customer needs and satisfactions has largely been neglected in the past. Currently, customers expect more, and especially, better services in order to be satisfied (Piccoli et al., 2009). In order to obtain satisfaction for an industrial service or product, the customer needs have to be aligned with the offered product. For industrial services, emphasis should be given to the need of the customer in the early parts of development (Elfvengren et al., 2004). From a S-D logic perspective it is however vital to address customer needs and expectation during the entire development process (Kowalkowski, 2010). Information concerning the present and future customer should be gathered from various sources in order to fully utilize the potential of the product and service. In order to obtain customer needs for industrial products & services, close cooperation with the customer is required and should be made into policy (Elfvengren et al., 2004). When the correct policy is executed, information related to certain needs can be successfully integrated within other business functions such as sales, marketing, R&D and after sales.
3.3.2 User Centric Design

Another similar method for designing services is known as User Centered Design (UCD), a generic process of which is depicted in Figure 15. The prescriptive approach is geared towards the identification and analysis of requirements and is described in the specifications of the ISO 9241-210:2010 standard for human-centered design for interactive systems (2010). UCD approaches are deemed to be successful for the collection and translation of user needs & requirements into fully functional services due to their attention to the user during all phases of the process (Maguire, 2002). The process relies on five principles:

- The design is based on the understanding of user, tasks and environment
- Users are involved throughout the entire design process
- Design process is iterative
- Design is based on the full spectrum of user experience
- Involved designers have multidisciplinary skills and perspective

The process for gathering requirements is centered on five different iterative phases. The first phase of the process is to plan the UCD process by arranging resources and involving users and designers into the upcoming design processes. The designer is defined as the stakeholder who is “professionally responsible for the design project and fulfills the function of architect of the design” (Simonsen & Robertson, 2013, p. 3). The user is defined as the stakeholder who will “interact with the design”. Afterwards, the context of use has to be specified by documenting, analyzing and understanding the way the user functions and organizes its tasks in relations to the designed solution and its environment. Specifying the user and organizational requirements will ensure that the service is designed based on user needs and expectations while organizational requirements are met. When a final set of requirements is defined, a new solution can be designed and evaluated based on the previously stated requirements. Many other UCD methodologies exist which incorporate different steps, or vary in the level of descriptiveness. A variation on the generic UCD process is the User Experience Professionals Association (UXPA) framework which houses the same level of descriptiveness but categorizes more on traditional systems engineering design steps such as analyze, design, implement and deploy phases. Another less prescriptive design process which allows for more flexibility within the choice of methodologies, is the UCD method proposed by Maguire (2002). For more information concerning this methodology, see chapter 5.1. All of the methodologies which are documented as UCD methodologies comply with the principles of the previously stated ISO standard.

3.3.3 Participatory design

In addition to design science and UCD, user involvement is also incorporated into the principles and practices of participatory design (PD). PD is defined as “a process of investigating, understanding, reflecting upon, establishing, developing and supporting mutual learning between multiple participants in collective, whereby the participants undertake the role of user and designer...” (Simonsen & Robertson, 2013, p. 2). Participatory design balances on two distinct dimensions which allow for both the user as well as the designer to learn from one another. From the perspective of the designer, due to the nature of the design process, the needs of the user is transferred to the product by incorporating different tools which enable the users to disclose their needs and expectations without the necessity to understand the technical language of the designer. From the perspective of the user, the needs and expectations are better formulated since the user is more aware of the technical possibilities of the
future product. The difference between UCD and PD is based on the way the interaction between the stakeholders occurs. In traditional UCD methodologies, the users is still observed as an isolated user intended to provide user factors for the designer. In PD, the user is seen a stakeholder during the process, actively becoming the designer.

### 3.4 The process of service innovation

In order for a firm to commit to selling services, constant innovation is required (A. M. Smith et al., 2007). To remain competitive and realize growth, a firm needs to offer new services that add value for the customer. It can even be said that the firms main objective must be geared towards service innovation (Chae, 2012). A comprehensive definition of innovation was given by The Advisory Committee on Measuring Innovation in the 21st Century Economy (2008, p. 3). They define innovation as “The design, invention, development and or implementation of new or altered products, services, processes, systems, organizational structures or business models for the purpose of creating new value for customers and financial value for the firm”. The definition implies that a process is responsible for developing different types of products or processes which bring new value to the customer. Explicitly defining service innovation has however been a more difficult endeavor (Baaken et al., 2010). Chesbrough (2010) defines service innovation as “making changes to products that cannot be touched”. This however implies that innovation can only come forth out of exciting services. Baaken et al. (2010 p.11) see service innovation as “... the development of service products which are new to the supplier”. There focus is solely based on the output of service delivery. Hertog (2010 p. 19) has defined a more comprehensive and prescriptive definition which takes different dimensions into consideration. He sees service innovation as “... a new service experience or service solution in one or several of the following dimensions: new service concept, new customer interaction, new value system/business partners, new revenue model, new organizational or technological service delivery system”.

Service innovation can be the result of different methods, whereby the search for innovations can occur through a “short walk” or a “long jump”, see Figure 16. Seeing innovation as a rugged landscape, short walks can be seen as gradual improvements or reconfiguration of a service, while long jumps are seen as a radical change in service elements. Short walks can improve exciting services, by for instance a slight increase in service performance, but restrict the service to radically evolve into a fully new service. Long jumps can overcome the “competency gap” and create a novelty service but have inherent risk. An approach would be to develop a strategy which combines both elements (Chae, 2012). A similar way of looking at different types of innovations can be through different innovation categories such as radical innovations which can bring a service revolution into the market and incremental innovations where service evolution will improve some service aspects (Menor et al., 2002).
3.4.1 Co-creation and network collaboration in service innovation

Studies in the early days of service innovation research suggested that product and service innovation were similar in nature, using the same theories and paradigm. Current researchers have formulated different views which acknowledge that fundamental differences between product and service based innovation exist (Kowalkowski, 2010). Service innovation involves non-technological as well as technological innovation and needs new methods to measure, predict and optimize services within a dynamic environment. Service innovation is categorized by two distinct dimensions of co-creation and networked collaboration, see Figure 17 (Kowalkowski, 2010; Nam & Lee, 2010). Co-creation is the ability to see the customer not as a static actor within the process, but as a dynamic partner who, through cooperation, adds additional value by participating in the development activities. Networked collaboration is the ability to develop relationships with other actors from the supply chain in order to transform their experiences and capabilities into service. When both dimensions are not fully exploited, conventional innovation is executed. This is the remnants of the G-D logic approach which manufacturing firms use to innovate their service. Due to the low degree of co-creation and networked collaboration, only internal sources for innovation are used. Collaboration-based innovation focuses on internal, as well as external sources to create service innovation. By combining external resources, the firm gains additional competences in order to develop new services, however the customer still plays a passive role during the process. Customer-orientated innovation is a customer centric approach which lets customers actively participate in the creation process. The firm acknowledges that the customer plays a vital and active role in the creation process of the service, thus increasing the value of service for the customer. The critical success factor for this approach is to access the correct customer needs. If both dimensions are fully exploited, service dominant innovation is carried out. Engagement with numerous actors results in a complete inventory of capabilities which can be committed in providing customer need.

Cooperating with customers and other actors from the vertical market is crucial for dealing with service innovation which is also reflected in the success factors for innovative services. While with tangible goods, quality is the most important success factor, service relies more on human resource, teamwork and user collaboration. It is even emphasized that the understanding of need is a far more important success factor for service than for innovative tangible goods (Alam, 2002). This would suggest that an open innovation strategy for service innovation is preferred. Different firms already cooperate for innovation purposes. Eurostat (2011) has estimated that between 2006-2008 one third of all innovative firms within the European Union have cooperated with other firms or public and private knowledge institutions, while two thirds only used internal resources. Although the conclusions stated above have been researched in the field of service innovation, there is still a lack in theoretical frameworks and practical approaches (Chae, 2012). It is therefore difficult to develop new services which fully address the needs of the customer.

Figure 17: Dimensions of service innovation. Source: adapted from Nam and Lee (2010)
3.4.2 Agency theory in relations to service innovation

Although cooperation between stakeholders is deemed essential for service innovation, agency dilemma’s may hinder this process. Also referred as principal-agent problems, the process of cooperation is disturbed when a contractor, also referred to as the agent, is contracted by a client, also referred to as the principal, which ignores the best interest of the principal. From another perspective, an agent can also be a manager who is appointed by a firm, which is the principal within the transaction. The main reasons for principal-agent problems to occur is based on the conflict of goals and the asymmetry of information. A goal conflict leads to the agent pursuing maximization of its own reward at the expense of that of the principal. Information asymmetry refers to the inequality of information whereby one the parties has superior information compared to the other. Due to information asymmetry existing between the principal and agent, failure can occur based on advert selection or moral hazard. Advert selection refers to the misrepresentation of the ability of the agent before the transaction occurs (Eisenhardt, 1989). The agent may argue that it has knowledge and skills to complete an undertaking, but the principal does not have the ability or resources to verify the claims beforehand. An example of adverse selection can directly be linked to the provisioning of a service. The agent may offer the principal a service which is not adequate designed for the needs and expectations of the principal. Since the principal does not have the ability to verify the stated claims or know if the service processes will satisfy their needs, the principal acquires the service anyway. A moral hazard is considered to be immoral behavior which occurs after a transaction. It refers to actions or risks taken by the agent, out of self-interest, without having to bear the consequences. For instance, in the banking sector, managers can influence the interbank offered interest rates, without informing the upper echelons, in order to obtain a better financial perspective and to gain an additional bonus. In this case, the agent is taking the risk of a fine, while the bank will bear the consequences of paying for it.

The effect of principal-agent problems can be reduced by creating incentive or additional responsibilities in order for both parties to become the problem owner (Shapiro, 2005). The agent can for instance, improve the relationship with the principal by effort of restoring equilibrium of information between principal and agent. From the perspective of the manager and a firm, the firm can mandate that a manager acquires a certain amount of stock of the firm in order to be more responsible for the consequences of the actions of the agent.

3.5 Performance measurement systems

Since the first publication of the balanced scorecard by Kaplan and Norton (1992) and its diffusion into the business world in the ‘90s, benchmarking performance systems have become important assessment tools. The need for such tools rose from firms who had pressing questions such as: “How are we performing? Are we investing in the right projects? What do our customers think of us?” (Sharif, 2002 p. 62). The important notion, which was captured in the balanced scorecard, was to “define a number of perspectives which can be measured in some way, so as to provide both means for historic analysis as well as forecasting, based upon the realization of key factors which embody the organization’s business strategy” (Sharif, 2002 p. 63). The tool deemed effective in visualizing different goals and objectives from all different layers of the organization whereby strategy and vision could guide the effectiveness and efficiency of the firm to a desired state. Performance measurement systems could be used for operational control, strategic planning, management reporting or for change management. Key Performance Indicators (KPI) are an important aspect in managing and measuring the performance of a firm.
KPI is defined by Vukomanović, Radujković, and Nahod (2010 p. 104) as “the measure of performance of an activity that is critical to the success of an organization”. They additionally argue that there are three different classifications of KPI. First there are the leading indicative measures which assess unfinished processes. They are not project outcomes but are factors which lead to a certain outcome. For instance the container terminal operator can have indicators such as crane movements per hour, yard occupancy ratio or truck turnaround times. These measures can anticipate future performance and aid decision makers in optimizing possible bottlenecks or other problematic areas. Lagging outcome measures are measures which are executed at the end of the process and specify accomplished performance and final outcomes, which means that only past performances can be signaled. A possible example is the usage of the “iron triangle” of project management, process time, - cost and - quality. These signals lack information on why certain phenomena occur, for instance why certain cost overruns take place or why it took more time to complete a process. Leading measures are intended to manage business processes while lagging measures indicate how well they have been managed, see Figure 18 (R. Smith & Mobley, 2008). Finally there are perceptive measures which report the perception of a stakeholder in the project. Typical perceptive measures are for instance client or employee satisfaction rates. KPI should ideally conform to the following range of ten attributes; name, purpose, goal, formula, frequency of measurement, source of data, who is responsible for KPI, what is their role, alignment with the strategy and other processes and the impact on other KPI.

From a perspective of the firm who defines a KPI, they are seen as indicators which state the current status or performance of a process or action. KPI can also be useful information when conducting business with other firms. If a firm stated as the principal, conducts business by hiring a contractor firm stated as the agent, it would be in the best interest of the agent to know what the KPI’s are of the principal in order to assess which product - or service proposition would ideally fit the principal. Knowing the KPI’s of the principal can therefore be seen as information of strategic value and will increase the competitive character for the agent firm.

3.6 Business Models

The correct definition of the term “business model” has been debated by many different researchers. Till this day there is still no general accepted definition of the term, while the meaning in itself is the subject of frequent misuse and confusion with other terms such as business strategy, business concept, revenue model (El Sawy & Pereira, 2012). Business models first appeared during the 1980’s, but practitioners first started adopting it during the dot-com revolution of the 1990’s. Many different definitions have surfaced which have been broadly formulated or more narrowly stating the main components of a business model. For instance, a more broad definition has been given by Casadesus-Masaneell and Ricart (2010 p. 196) who defined a business model as “the logic of the firm, the way it operates and how it created value for its stakeholders”. A narrow definition was given by Johnson et al. who state that a “business model consists of four interlocking elements that, taken together create, and deliver value… customer value proposition… profit formula… key resources… key processes” (El Sawy & Pereira, 2012 p. 14). In general five different phases can be defined which articulate the progress of the concept of business models, see Figure 19 (Gordijn, Osterwalder, & Pigneur, 2005). First a set of general definitions and classifications were articulated by researchers after which, during the second phase, the
authors coupled different business model components to the definitions, narrowing the research field. The amount of different components ranged from 3 to 9 per author (El Sawy & Pereira, 2012). The components were economic-, operational- and strategic themed. Economic components reflect the way the firm creates revenue through value. Operational components focus on operational processes which create actual value while strategic components focus solely on the direction of the firm. The third phase translated different components into detailed business elements. In the proceeding phase the elements were modeled, tested and evaluated forming the ontological knowledge of business models. The fifth phase is categorized by increased usage of reference models with a high increase of awareness by the management layers of firms. The last phase consists of extensive theory building for dynamic business modeling. In a sense, a business model can be seen as “a representation of the strategic choices that characterizes the business venture” (El Sawy & Pereira, 2012 p. 15) it can therefore be seen as an instrument on behalf of communication and planning, reassessing the business in order to guide the vision towards business execution. However many business models share a few common flaws (Shafer, Smith, & Linder, 2005):

- Flawed or untested assumptions about the future conditions and creating illogical causality relationships between business model components.
- Limitations in the strategic choices by only developing one business model component and neglecting others.
- Misunderstanding value creation and value capturing thus resulting in a mistranslation of value creation towards realistic revenue flow.
- Flawed assumptions about the value network resulting in a static view of the value network.
4 The Case of Siemens Cranes

In the following chapter the case of Siemens Cranes is discussed. The case will be elaborated through different hierarchical levels. First Siemens AG and its strategy is discussed which allows for better understanding of what the vision and outlook is for the department of Siemens Cranes. After the corporate premise is known, the department of Siemens Cranes is explained with regards to market channels, direct competitors and how Siemens Cranes is refocusing towards providing services. Afterwards, emphasis is given towards the product - and service portfolio of Siemens Cranes. The chapter concludes by stating a general scope of the case study.

4.1 Siemens AG

Siemens AG is a German conglomerate with their corporate headquarters in Munich, Germany which governs a total of 410.000 employees. The company specializes in solutions related to electronics and electrical engineering. Their product portfolio includes solutions for different product groups such as Healthcare, Automation, Energy and various other industries. Next to the business to business transactions, Siemens also has consumer products in their portfolio. The consumer products are however manufactured in cooperation with Bosch. Siemens has incorporated a new strategy which focuses on three different pillars, namely innovation, customer intimacy and employee empowerment, see Figure 20 (Siemens, 2011). With these pillars, Siemens aims at achieving revenue growth, capital efficiency & profitability and a solid capital structure. Revenue growth is considered to be one of the most important drivers for long-term value creation. The benchmark KPI for revenue growth is the revenue comparison between Siemens and its main competitors. Capital efficiency & profitability reflects the way Siemens uses its capital provided by shareholders and lenders as efficiently as possible. The aim is to obtain capital efficiency of 15% to 20% throughout Siemens. This can lead to an increase in profitability which Siemens aims at achieving in order to maintain and expand its market position and obtain higher profit margins. Aiming at a solid capital structure is also a key goal in order to provide a sustainable profit and healthy revenue streams. Siemens is intended to further optimize business elements in order to achieve this. In order to obtain customer intimacy and get closer to the customer, Siemens has incorporated a new division within their corporate structure which focuses primarily on customer satisfaction by offering customer support for their products. The “Customer Support” division is a comprehensive division with several different departments, one of which provides customer support and services for Siemens Cranes.
4.2 Siemens Cranes

Siemens Cranes is an international operated division which distributes its core functionalities between different countries. Siemens Netherlands is flagged as being the “Project House” for the entire cranes division and is responsible for various tasks such as worldwide project management and engineering. As a project house, the decisions which the Dutch Siemens Cranes division takes on matters of strategy and policy will be adopted internationally by all Siemens Cranes branches. The division has an installed base of more than 4,000 cranes which are all operated and maintained worldwide. Their products include different crane technology for terminals, industry and shipyards. Extensive expertise is present in the development of container cranes such as Ship-to-shore container cranes, Grab ship unloaders, Rubber Tired Gantries and Rail Mounted Gantries. Figure 22 depicts the market share of container terminal cranes. Siemens (19%) holds a slight lead on their biggest and main competitor Asea Brown Boveri (ABB 16%). Both firms deliver high-end products to the cranes market. Yaskawa (10%) focusses more on the low end market and has a strong presence in the Chinese market. The delivered crane solutions are engineered for various business to business (B2B) orientated crane manufacturers such as Shanghai Zhenhua Heavy Industries Company Limited (ZPMC), Cargotec, Konecranes and other specialized crane manufacturers who also maintain a close relationship with the end users specializing in transshipment terminals, industry and shipyards, see Figure 21 for depiction of the market channels used by Siemens Cranes. Although Siemens is the direct supplier to different crane manufacturers, they also prefer a close relationship with the end user. The conducted strategies have realized a push & pull marketing strategy by which promotional activities are focused both on the end user, as well as crane manufacturer. In a pull configuration, promotional activities are geared towards the end user who, in turn, confronts the crane manufacturer for specific Siemens solutions. On the other hand, Siemens also focusses on crane manufacturers in order for them to trigger the end user in buying Siemens solution, which is part of the push strategy. Due to the global presence and experience of Siemens Cranes in the market of container terminal cranes, the expertise and contacts the department maintains, this case is focused towards container terminal cranes in particular.

4.2.1 The current and future service strategy

Siemens Cranes focusses on technological product development in many different fields that relate to crane operations. However, additional services have had a low priority in the past. The current focus is represented in Figure 23. In the current situation, Siemens Cranes focuses solely on selling products, systems and projects for crane solution. During the warranty period, additional services such as spare parts can be delivered when functions are impaired. The future focus adds additional services to the product portfolio. Next to the products, systems and projects, Siemens Cranes will offer additional services to increase customer satisfaction. The rational which is used by Siemens Cranes to expand in
the direction of services, is based on the ratio of installed-base-to-new-units. For 2011 Siemens Cranes provided 43 full solutions for different types of cranes, while the installed base is approximately 4000. This implies that the installed-base-to-new-units ratio is approximately 100:1. Due to this ratio it can be argued that by providing additional services to the installed base would generate high amount of additional revenue in service sales. The same argument and rational is used by Wise and Baumgartner (1999) who argue that with such high ratios, it would be in the interest of the firms to look more downstream towards the customer and offer additional services.

4.2.2 The product portfolio of Siemens Cranes

As stated earlier, in this specific case the main focus will be on solutions for container terminal cranes. Figure 24 depicts the different cranes which belong to the specific category where Siemens Cranes provides their products and services for.

**Quay Side Gantry Cranes**

Quay Side Gantry cranes are dockside gantry crane which are located directly on the quay side of the harbor which can load or unload different goods and materials from a moored vessel. In general, there are two distinctive types of QSG cranes. A Ship-to-Shore container crane (STS) is used to load and unload intermodal containers from cargo vessels to the quay and vice versa. The crane is positioned along the width of a cargo ship and uses a spreader to lock and hoist containers. The crane uses rails to maneuver to the correct location. Grab Ship Unloaders (GSU) on the other hand are used to unload bulk materials such as scrap, coal and ore up to 5,500 tons per hour (tph). The crane is used for vessels that are able to handle bulk goods such as barges and bulk carriers. As with STS cranes, the ship positions along the width of the crane after which the grabber grabs the bulk goods out of the hull of the ship and deposits the goods at the quay area.

**Rubber Tired Gantries & Rail Mounted Gantry**

Rubber Tired Gantries (RTG) & Rail Mounted Gantry (RMG) are mobile cranes which are used to stack different intermodal containers at a container terminal. The cranes are used to stack the container to achieve the maximum storage density. A RTG moves via tires while a RMG moves along rails which has different advantages such that it has the capability of being driven by electric power, it has larger lifting capacity and a higher traveling speeds.
4.2.3 The service portfolio of Siemens Cranes

Siemens currently does not pursue the end-goal of Industrial Product Service Systems philosophy. This is mainly due to the inherent complexity of the cranes business environment on the one hand, and the technological complexity of cranes on the other. From a business perspective, Siemens does not deliver their crane solutions directly to the customer but through a crane producer. This makes it difficult to fully integrate product and service capabilities. Looking at a technological perspective, the produced cranes are complex and require specialized specifications per client. Rather than IPSS, Siemens would like to see the product service relationship as an extended product or as product capsulation whereby the service is seen as an add-on to the product.

However due to the specific properties of services, different strategies and methods are needed to successfully develop, position and sell services (Blankson & Kalafatis, 1999; Jaw et al., 2010; Vargo & Lusch, 2004).

The services in Figure 25 represent the service portfolio which Siemens Cranes is aiming to actively introduce into the cranes market through proactively addressing its installed base users and also new clientele. The services are geared towards the entire vertical market such as OEM and end users. The services are in place to increase product life cycle, reduce life cycle associated costs and to reduce managerial burden. For this case however, only the “spare parts services” and “maintenance services” will be used as case material. These two cases have been specifically chosen due to the following reasons:

- Service experience, Siemens cranes and other departments within Siemens have extensive experience when dealing with both services, making information collection possible;
- The services are complimentary, meaning that spare parts services and maintenance services are usually provided in combination.
- High volume and EBIT value, both services currently have a high impact on both the sales volume for services as well as earnings before interests and taxes (EBIT).

The reason for choosing two service instead of focusing on one specific service, relates to the inherent risk of obtaining insufficient research results. When choosing two design candidates, the risk of obtaining insufficient data for one of the services is reduced. For more on this subject, see chapter 5: Research Methodology.

4.2.4 The services of maintenance and spare parts

Siemens defines two different business units who manage the service portfolio for the entire industry sector. “Product Lifecycle Service” is responsible for the traditional portfolio and houses services which are directly linked to activities which increase the total lifecycle of a technical solution. Typical services entail online -, technical support and on-site -, repair and logistics services. The business unit of “Value Services” aims at integrating different services which provide added value to the processes of the customer. The provided services are more linked with the general business of the customer and are considered to be customer-oriented solutions such as consulting, training or more extensive services such as plant - and energy management. The goal of both business units is to minimize downtime, optimize personnel deployment and reduce the usage of assets. The maintenance and spare parts
services which have been selected to be analyze are part of the service portfolio of Product Lifecycle Services.

As stated in the previous paragraph, the spare parts services and maintenance services are complimentary. In many different industries, production - and service firms employ capital assets to provide products, services and ultimately value to their customers. To support the primary flow of production, a firm needs to establish a way in which their capital assets can be maintained in order to minimize downtime. Not only is it a vital reason for securing public safety, maintaining customer satisfaction and reducing lost revenues, but frequently, a necessity when Service Level Agreements (SLA) with the end-customer only allow high availability quota. For these reasons, firms have a Maintenance Organization (MO) which is responsible for a specific level of maintenance service for capital assets. In order to maintain capital assets, different tools and spare parts are needed. In a firm this can be managed by the Maintenance Logistics Organization (MLO). The MLO manages the logistical backbone of the MO in order to provide spare parts for maintenance services. It can be said that the maintenance service is therefore performed by the MO while the spare parts service is managed by the MLO. With maintenance and spare parts services Siemens aims at partially assuming the role of external MO and -MLO for container terminal operators with regards to crane specific electrical components.

**Spare parts service**
Siemens has an active presence in over 190 countries. Therefore, Siemens Cranes is capable of offering spare parts throughout the world when crane availability and uptime is at stake. Siemens guarantees parts availability for 10-15 years and has the ability to quickly ship and install spare parts to the required location. Siemens can also manage the logistics of spare parts. The OEM, dealers and customers are assured of crane reliability and benefit from reduced transaction costs and quick delivery times. In addition, less investment cost is required with regards to additional personnel.

**Maintenance service**
Maintenance service focuses on maintaining electrical crane systems. The installed base will profit from the service by increasing the entire life cycle due to preventive maintenance programs. Through service/maintenance contracts, professional support can be given which can prevent malfunctions therefore increasing crane availability, reducing risks and sustaining an optimum crane performance.

### 4.3 The scope of the case

In the previous paragraphs a delineation was made to introduce the case of Siemens Cranes and its willingness to design, redesign and provide services to the end users. Figure 26 provides an overview of the resulted scope for the research, the light blue elements indicate that what is left out of the scope while the dark blue colors are elements which represent the scope of the research.

The current operations concerning strategic, tactical and operational activities of Siemens AG and Siemens Netherlands will be used as policy principals for the redesign efforts. However, more emphasis is given to
business operations of Siemens Cranes Project House and Siemens Cranes Branches. The strategic, tactical and operational choices have been transposed from Siemens AG & Siemens Netherlands towards Siemens Cranes Project House and their branches. Possible considerations concerning changes in their policy can be brought up for recommendation which relate to service design. Although Siemens Cranes has eight different services, the services which will be redesigned are the services of spare parts and maintenance. The efforts will be focused towards the end user market of container terminal operators.
5 Research Methodology

This research can be divided into three different sections represented by the specific sub question. Section one represents the current business model of the services of spare parts and that of maintenance. Section two covers the redesign efforts of the stated services and focusses on KPI and needs gathering while section three represents the validation of the redesigned services. In this paragraph different research methods and data gathering methods per section will be evaluated.

5.1 Phase 2: User centric design

In order to redesign current services, a user centered design approach was chosen, see Figure 27. The approach is geared towards the identification and analysis of needs and requirements and conforms to the specifications of the ISO 9241-210:2010 standard for human-centered design for interactive systems (2010). User Centric Design (UCD) approaches are deemed to be successful for the collection and translation of user needs & requirements into fully functional services due to their attention to the end user during all phases of the process (Maguire, 2002). The reason for choosing the design framework in contrast to other design approaches such as NSD or PD is based on the following reasoning:

- Service dominant logic is based on a nondiscriminatory paradigm which does not give preference towards a good or a service, therefore a methodology should be chosen which unit of output can be a good as well as a service;
- UCD is focused on designing services based on customer input, whereby user needs play a central role in the design process;
- For service creation, many design processes in New Service Development are constructed based on the same principles, processes and components;
- UCD incorporates a high level of flexibility therefore increasing the applicability for different methods and tools which can be used in conjunction with the approach;
- PD requires active participation of the user during the design process which is not incorporated within the scope of the research.

Currently, many different UCD approaches exist. However, the process described in the ISO 9241-210:2010 standard or a derivatives used by the Usability Processionals’ Association (UPA), rely on a limited set of methods which hinder the applicability of the approach for this research. For instance, both the approaches prescribe the adaptation of a context of use analysis, while in many circumstances, such approaches are not realizable. For this research, the UCD process described by Maguire (2002) was chosen which is more descriptive in nature and discloses additional research methods. The process for gathering end user needs is centered on three different iterative steps with their specific research methods. The goal of the first step is to gather information relevant to the design process. The second step is geared towards the identification of user needs. The third and final step which is included in this thesis, is that of envisioning and validation, whereby a service is designed and validated. Although it is required to provide detailed specifications in order to design a functional service, the step of “requirement specification” will not be incorporated into this thesis. The goal of this step is to dispense detailed specifications which are approved by the end users and to further...
benchmark the performance of the service. Due to the scope of the research and the goal of the thesis, this step will not be undertaken.

Different methods for analysis can be performed during all different phases, making the approach applicable for different purposes of utilization. The chosen methods have been assessed based on the limited scope of time available for the research, the limited amount of skill and expertise of the researcher concerning the technical context of the case and the limited accessibility to the end users due to geographical distances between researcher and end users. This has impacted the amount of possible research methods. For instance, ethnographic research and contextual interviews would have been ideally to use as methods in gaining detailed insights into the needs and issues of the users, but due to the specified limitations, not the preferred methods of choice.

5.1.1 Section 1: Information gathering

The first phase of the process is the ‘information gathering’ phase which consists of gathering vital background information concerning the current business models of the services and which stakeholders are affected by the shift towards service provisioning, see Figure 28. The following paragraph will depict the different methods used to analyze the business models and the stakeholders within the scope of the research.

Business model analysis

To be able to redesign services in a coherent and integrated manner, a closer look was given to the current business model logic behind both services. The business model analysis framework chosen for the analysis of the services was that of VISOR, see Figure 28. El Sawy and Pereira (2012) identified five different components and adapted them into their framework, entitled the VISOR framework. The VISOR components are considered to be the generalized elements of what different business models are comprised of. The VISOR framework aims at integrating different business modeling approaches, from previous research into business modeling, subsequently addressing the most overlooked subjects, such as interfacing factors. While interfaces are usually not included in business model development, they are deemed to be an important factor in theories which concern service innovation (El Sawy & Pereira, 2012). A different reason for choosing the VISOR framework and corresponding research as the primary focus for analysis, is its foreword looking perspective, focusing on future believes, views and scenarios which correspond to future societal and technological possibilities. The framework incorporates different features which can be game changing elements for firms for the future period. The ‘value proposition’ entails what and how value is created based on the technology that the firm possesses. The ‘service platform’ describes the entity which supports and enables the business processes from which current and possibly new services and products can be developed. The ‘organizing model’ describes how different actors, from the supply chain, work together in order to supply the value to the customer. The ‘revenue model’ depicts how revenue is created and distributed along partners. The last component is the ‘interface’, which clarifies the interaction and the interface experience between service and the customer. Data concerning the different business model components shall be gathered through desk research and interviewing case related interviewees on a face to face basis.
Stakeholder analysis

In order to gather the need of the end user, it is important to understand the environment and the networks in which it operates. A stakeholder analysis will disclose this information by obtaining different characteristics of the stakeholders which are operating within the supply chain. The method used for stakeholder analysis was based on the methodology proposed by Enserink et al. (2010). Although different types of stakeholder analyses currently exist which focus specifically on subjects such as, game theory or cognitive mapping, a general approach which is proposed by the previously stated researchers will yield a general understanding of the interests, objectives and problems of the stakeholders. The methodology consists of six consecutive steps. First a problem formulation was created in order to focus on specific issues after which an inventarization of all involved stakeholders was conducted. The stakeholders were then analyzed and their interests, objectives and possible issues relating spare parts and maintenance services were clarified. Different interdependencies between stakeholders were explained after which the results of the findings were concluded. Data concerning the stakeholders was gathered with the use of desk research and by interviewing case related interviewees on a face to face basis.

5.1.2 Section 2: User need identification

After the user data was collected, the needs of the users as well as the KPI’s were identified. The needs of the end users was gathered by identifying and collecting their need statements, see Figure 29. Through direct face to face interviews and indirect communication through telephone or digital alternatives, such as Skype, a five step approach was used in order to collect the need of the end users and their most important KPI for the service department.

User need analysis

In current business marketing and sales force management, a need assessment is frequently used within a sales process in order to determine what the true needs and expectations of the end users are (Spiro, Stanton, & Rich, 2008). In general, five sequential steps have been followed in order to obtain the need of the end users. First the current situation of the end user was discussed by assessing current service provision with respect to spare parts and maintenance services in relation to the installed subsystems. After the current situation was analyzed, the discovery of issues proceeded. Different potential problems with current services were discovered and discussed. Afterwards, the impact of the issues on the general business processes of the end users were analyzed after which the possible value of a solution to the stated issue was assessed and discussed.
**KPI analysis**

Another important element of this phase was to determine how the end user observes the performance indicators of their service & maintenance organization. This was analyzed by determining the main key performance indicators. By gathering the KPI’s and embedding them into the design space, the service could be redesigned in such a way as to facilitate in the improvement of end user KPI’s. The identification of different types of KPI was based on the subdivision noted as the leading, lagging and perceptive measures (Vukomanović et al., 2010).

**5.1.3 Section 3: Envisioning and evaluation**

The last section was incorporated in order to accumulate knowledge from the previous steps and to conceptualize the redesigned services. Based on desk research and interviews a service blueprint was constructed which connects the processes of the end user, with the service processes of Siemens Cranes. As stated in the previous chapter, due to the inherent risk of obtaining insufficient research results in order to redesign a service, the first two sections were related to the analysis of both service. For section three, one service was chosen which would benefit most for a redesign. For more information on the chosen service, see Chapter 7.2 Need statement of the container terminal operators.

**Service blueprint**

The envisioning process in the primary activity in which the conclusions of the user need analysis and KPI analysis are converted into a redesign. Taking account of the specific service characteristics, in order to model a service, a dedicated service modeling technique was chosen which allows a certain level of co-creational aspects to be imprinted into the design. Service blueprinting is in general a method which can be used for participatory design since it allows the users to interface with the designer by redesigning a service in close collaboration. Due to the scope of this research it was not possible to include the end users within the process of blueprint creation. However through the chosen user centric approach, the needs were gathered from the end user in order to design a service blueprint. In essence the service blueprint was therefore used solely as a tool to graphically represent the redesigned service. The method for constructing a service blueprint consists out of five different components, see Figure 30 (Bitner, Ostrom, & Morgan, 2008). First the “customer actions” were identified which include the processes which the end user undertakes as part of the service delivery process. When the processes of the end user were known, “onstage actions” of Siemens Cranes were added to the blueprint. These processes are conducted by frontline employees who interact with the end users. “Backstage actions” represent the way Siemens Cranes prepares for dealing with an end user who requires a service. The “support processes” are added which depicts processes and systems that are needed in order to support all of the primary processes. As a last component the “physical system” were clarified which represents the tangible systems which the end user is exposed to that influence the perception of service quality.
Service blueprint validation
The goal of the last section was to validate the redesigned services by confronting the service blueprint with the internal customer of Siemens Cranes, see Figure 30. Validation is defined as “the assurance that a product, service or system meets the needs of the customer and other identified stakeholders” (IEEE Standards Association, 2011 p. 452). Although validation frequently involves the external customer, the scope of the research excluded service testing in order to validate whether the service meets the actual needs of the users. Therefore an internal expert validation was conducted in order to validate if the service blueprint is suitable for conducting business with the end user. Verification was excluded from this research due to scope issues. Verification is defined as “the evaluation of whether or not a product, service, or system complies with a regulation, requirement, specification, or imposes condition (IEEE Standards Association, 2011 p. 452). Verification was not possible since the requirements and specifications step of the user centric design methodology was not pursued. Furthermore, the service blueprint is not a modeling method which can be verified since it does not concern an algorithmic model.

5.2 Redesign philosophy
The approach and the corresponding phases of UCD are geared towards design or redesign. From a designer’s perspective, different characteristics have been proven to encourage innovative thinking and improve the design process. Design thinking is a mindset which focuses on five specific characteristics (Brown, 2008). In this research focus was given towards empathy, taking multiple perspectives from different stakeholders into consideration. Integrative thinking was used in order to gain a holistic systems perspective of the entire design process, therefore creating an environment where multiple problems and contradicting views could co-evolve towards innovative solutions. Optimism was observed by the designer in order to envision and redesign new services which are better than the current alternatives. Room was given for experimentalism in order to experiment with constraints and theories. Finally collaboration between different disciplines was essential in order to compose complex and multidisciplinary designs.

5.3 Data collection methods
Figure 31 represents the data collection methods used per section of the research. As depicted, the data collection methods of desk research and interviews were used. It also depicts, per research approach or tool, which research method was used accordingly. This paragraph will further elaborate on the different methods used, their appropriateness for this research and the practicalities during the execution of the research.
5.3.1 Desk research

Desk research is a technique for collecting data from stored sources such as literature, internet, databases or any other media. It is a relatively quick and cheap method for gathering data and is considered to be useful as an initial analysis for when an overall view of problem area is required or when background information is essential (UsabilityNet, 2006). In general, two distinctive desk research techniques are available. Internal desk research specifically targets data sources present within the firm. Possible sources include intranet, internal databases, corporate presentations and reports. External desk research targets data available from outside the firm, such as internet, libraries or databases from statistical institutes.

For this research, desk research was used as a secondary research method. For section 1 and 3, relevant desk research was gathered from internal Siemens sources, as well as external sources from other locations. Siemens sources include data which was made available through intranet systems and databases which were deemed suitable and accessible through confidentiality agreements. External sources included data collection through literature studies obtained through various scientific databases of Scopus, Web of Knowledge, JSTOR, CSA, OvidSP or any other database that were accessible for analysis in the Library of TU Delft. In addition to scientific sources, commercial information was obtained through digital and non-digital archives such as, industry -, trade - and sector associations, legislation, legal articles and trade journals. Search terms that were used in the process of obtaining data were based on the following keywords, abbreviations or combinations thereof: Service Engineering, New Service Development, Goods Dominant Logic, Service Dominant Logic, Service Innovation, Open Service Innovation, User Centered Design, Customer Need Analysis, Requirements Engineering, Service Business Models and Participatory design. Additionally sources from online search engines and social media such as Google and Linkedin were used when deemed appropriate.

5.3.2 Interviewing

Interviewing techniques were used as the primary source for data gathering for all sections of the research. Interviewing is a method which is used to “discover facts and opinions held by potential users of the system being designed” (UsabilityNet, 2006). The basic form of interviewing is carried out between an interviewer who verbally interacts with a subject, after which beliefs, opinions, views and convictions of the subject can be analyzed and used accordingly. The benefit of such an approach is that direct interaction between interviewer and subject is undertaken which makes it possible for the interviewer to reformulate questions, observe subject attitudes and purge possible misunderstandings.

A generic interview typically consists of four different phases (UsabilityNet, 2006). In the “nurturing” phase, the interviewer and subject introduce themselves. In the “energizing” phase the subject of the research and interview is discussed between the interviewer and subject in order to establish a baseline for knowledge gathering and to clarify possible issues. The phase categorized as the “body”, consists of stating substantive questions concerning the main research subject. The format of the questions can be either structured, with typically close-ended questions allowing statistical analysis, unstructured where nearly all questions are open-ended with a high level of flexibility in interview questions, or semi-structured which is a combination of both. The last phase is the “closing” phase where the involved actors evaluate the interview and the discussions. Based on the previously stated phases, three questionnaires have been developed which were used to engage in an interview with the interview subjects, see annex 11.1.
Interviews for section 1: Information gathering

For this research three different groups were interviewed in order to gather the required data. In order to collect data for section one, Siemens employees were interviewed in order to assess current business models of spare parts - and maintenance services. Candidates which were part of this group shared the business function of “service manager” of the Siemens Cranes department, “product manager” of the Siemens Customer Service department and “division manager” also from the Siemens Customer Service department. Contacting the employees in order to issue an invitation for an interview, was done through internal Siemens systems. Table 2 depicts the interview subjects who participated and contributed to section one of the research.

Interviews for section 2: User need identification

Section two entails the identification of the user need and requires the participation of three interview groups. Siemens Cranes employees were asked for information concerning stakeholders. For the gathering of needs statements and KPI’s, “supervisors”, “maintenance managers” or other similar suitable corporate titles within container terminal operators were approached and interviewed. Key contact information for obtaining interview subjects was made available by Siemens Cranes. Table 3 depicts the sample interviewees which were provided by Siemens Cranes. Indicated in blue were actual respondents, while others did not participate in the research. Attention was given to the order in which the subjects were interviewed. First, an interview with a native Dutch speaker from a terminal located in the Netherlands was conducted. This would allow the interviewer to gain basic knowledge of terminal function, substantiate possible future question and answers, and familiarize with specialist jargon without the presence of a significant cultural - or language gap between interviewer and subject. With the gained knowledge, the focus shifted towards neighboring countries and terminals thereby increasing the amount of data accumulated. Finally, terminals from outside the European Union were approached. Due to the accumulated knowledge concerning the subject, interference in the form of cultural or language gaps were more manageable. For more information concerning the results, see Chapter 10.3 Research response. For more information concerning the interviewed global terminal operators, see annex 11.2.

Table 2: Interview subjects for section one, Siemens NL

<table>
<thead>
<tr>
<th>Electrical Components Manufacturer</th>
<th>Country</th>
<th>Interviewee</th>
<th>Business Unit</th>
<th>Corporate title</th>
<th>Means of interview</th>
</tr>
</thead>
<tbody>
<tr>
<td>Siemens NL</td>
<td>Netherlands</td>
<td>Abdessalam al Azzouzi</td>
<td>Cranes Project House</td>
<td>Service Manager</td>
<td>Face-to-face</td>
</tr>
<tr>
<td>Siemens NL</td>
<td>Netherlands</td>
<td>Gijs de Wildt</td>
<td>Customer Service</td>
<td>Division Manager</td>
<td>Face-to-face</td>
</tr>
<tr>
<td>Siemens NL</td>
<td>Netherlands</td>
<td>Ruud Welschen</td>
<td>Customer Service</td>
<td>Product Manager</td>
<td>Face-to-face</td>
</tr>
</tbody>
</table>

Table 3: Interview subjects for section two, Global Terminal Operators

<table>
<thead>
<tr>
<th>Global Terminal Operator</th>
<th>Country</th>
<th>Terminal</th>
<th>Interviewee</th>
<th>Corporate title</th>
<th>Means of interview</th>
</tr>
</thead>
<tbody>
<tr>
<td>APMT</td>
<td>Morocco</td>
<td>Tangier</td>
<td>K. Abdellah</td>
<td>Control Manager</td>
<td>Questionnaire</td>
</tr>
<tr>
<td>DP World</td>
<td>Belgium</td>
<td>Antwerp</td>
<td>K. Palmer</td>
<td>Supervisor Crane Department ASC</td>
<td>Telephone</td>
</tr>
<tr>
<td>DP World</td>
<td>UAE</td>
<td>Jebel Ali</td>
<td>T. Johnson</td>
<td>Sr. Supervisor Electrical</td>
<td>Telephone</td>
</tr>
<tr>
<td>HPM</td>
<td>Netherlands</td>
<td>Rotterdam</td>
<td>H. van Mullem</td>
<td>Technical Specialist</td>
<td>Face-to-face</td>
</tr>
<tr>
<td>MSC</td>
<td>Spain</td>
<td>Valencia</td>
<td>J. Andries</td>
<td>Maintenance Manager</td>
<td>Questionnaire</td>
</tr>
<tr>
<td>AMPT</td>
<td>Netherlands</td>
<td>AMPT HQ</td>
<td></td>
<td>Manager cranes services</td>
<td></td>
</tr>
<tr>
<td>DP World</td>
<td>Belgium</td>
<td>Antwerp</td>
<td></td>
<td>Supervisor Crane Department STS</td>
<td></td>
</tr>
<tr>
<td>DP World</td>
<td>Djibouti</td>
<td>Doraleh</td>
<td></td>
<td>Manager Cranes</td>
<td></td>
</tr>
<tr>
<td>DP World</td>
<td>Djibouti</td>
<td>Doraleh</td>
<td></td>
<td>Technical Support Manager</td>
<td></td>
</tr>
<tr>
<td>DP World</td>
<td>Senegal</td>
<td>Dakar</td>
<td></td>
<td>Consultant Cranes</td>
<td></td>
</tr>
<tr>
<td>DP World</td>
<td>UAE</td>
<td>Jebel Ali</td>
<td></td>
<td>Manager Cranes</td>
<td></td>
</tr>
<tr>
<td>HPM</td>
<td>Netherlands</td>
<td>Rotterdam</td>
<td></td>
<td>Maintenance Manager</td>
<td></td>
</tr>
<tr>
<td>HPM</td>
<td>UK</td>
<td>Felixstowe</td>
<td></td>
<td>Manager Operational Engineering</td>
<td></td>
</tr>
<tr>
<td>HPM</td>
<td>UK</td>
<td>Felixstowe</td>
<td></td>
<td>Contact for service section</td>
<td></td>
</tr>
<tr>
<td>MSC</td>
<td>Belgium</td>
<td>Antwerp</td>
<td></td>
<td>Manager Cranes Services</td>
<td></td>
</tr>
</tbody>
</table>
In addition to container terminal operators, other external experts were engaged in order to provide an overall view of the possibilities for future needs and KPI’s based on scientific research. Subjects from this group belonged to Delft University of Technology, department of Maritime & Transport Technology, section of Transport and Logistic Technology and the section of Transport Engineering and Logistics. To further increase knowledge about the subject, partners of Siemens Cranes were approached during the Siemens Cranes Partner Event held in Rotterdam on June 24th 2013. Furthermore data was gathered from various participants of the TOC Container Supply Chain Europe event. This event is the largest transshipment terminal event in Europe and was held on June 25th till 27th 2013.

**Interviews for section 3: Envisioning and evaluation**

Section three entails the envisioning of the redesign and the validation. In order to validate alternative service processes of the services for maintenance and spare parts, the business function of “service manager” of the Siemens Cranes was interviewed in order to obtain an expert validation.
PHASE 2: User Centric Design

Chapter 6 - Section 1: Information Gathering
Chapter 7 - Section 2: User Need Identification
Chapter 8 - Section 3: Envisioning and Evaluation
6 Section 1: Information Gathering

The following section represents the first step of the user centric design methodology through which analysis of the business models and the key stakeholders occurs. The section begins with presenting the results of the business model analysis which was conducted through the VISOR framework. Afterwards, the results of the stakeholder analysis are presented.

6.1 Analysis of the business models through the VISOR Framework

In the following paragraph, the services will be analyzed based on the components of the VISOR framework. Due to the manner in which the two services are arranged and managed within Siemens, first the value proposition, organizing model and revenue model of the services will be discussed per service, after which general interfaces and service platform will be discussed.

6.1.1 Maintenance Service

The goal of maintenance services is to maximize the availability of the system by reducing breakdown and emergency shutdowns or any other downtime related issues, by maintaining its subsystems thereby increasing the total lifecycle of the system. However, conducting maintenance has had a different meaning throughout the course of history. In the pre-World War II era, maintenance was purely seen as added costs to the system. The proper course of action was to minimize the costs by only maintaining the system whenever a subsystem would break down or was in the process thereof. In the modern view of maintenance services, this strategy conforms to the paradigm of reactive control and is seen as corrective maintenance, also known as “fire-fighting” (Swanson, 2001). An example of corrective maintenance is for instance the lubrication of a motor when noise - and vibration hinder are already occurring. During and after the Second World War, advancements in production, engineering and the development of complex sociotechnical systems, characterized by complex interfaces, developed the need for a proactive control paradigm thus preventive and predictive maintenance strategies were introduced (Swanson, 2001).

Preventive maintenance focuses on maintaining the system before the occurrence of subsystem failure by conducting maintenance during industry expected regular intervals. An example of preventive maintenance is for instance the lubrication of a motor every 3000 operating hours. Predictive maintenance goes beyond expected intervals and focusses on conducting maintenance only when it is deemed necessary through the use of continues monitoring. An example of predictive maintenance is for instance using a host of sensors to observe a temperature increase within the motor thus applying lubrication in order for the temperature to stabilize. Figure 32 represents an overview of advantages and disadvantages for different maintenance strategies. It should be noted that following a more proactive strategy such as preventive - or predictive maintenance, requires additional and more skilled maintenance staff while the expenditures for maintenance activities are lower compared to corrective maintenance.

<table>
<thead>
<tr>
<th>Advantage</th>
<th>Disadvantage</th>
<th>Cost per hour</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lower short-term cost of maintaining a system</td>
<td>Increase of long-term costs due to unscheduled equipment downtime</td>
<td>€ 2.403.50/h</td>
</tr>
<tr>
<td>Requires less internal staff since less work is being planned</td>
<td>If failure occurs, additional equipment or process may be damaged</td>
<td>€ 1.542.60/h</td>
</tr>
<tr>
<td>Increased sub-system lifecycle</td>
<td>The sub-systems may be prone to neglect</td>
<td>€ 1.318.60/h</td>
</tr>
<tr>
<td>Reduces the chance of sub-system failure</td>
<td>It can be more labor intensive and would require additional staff</td>
<td></td>
</tr>
<tr>
<td>Cost saving over corrective maintenance</td>
<td>Failures can occur despite preventive maintenance being carried out</td>
<td></td>
</tr>
<tr>
<td>Increased sub-system lifecycle</td>
<td>Can include unnecessary maintenance due to maintenance schedule</td>
<td></td>
</tr>
<tr>
<td>Decrease in equipment downtime</td>
<td>Initial investment needed due to the need for monitoring &amp; diagnostic equipment</td>
<td></td>
</tr>
<tr>
<td>Cost savings over Preventive Maintenance</td>
<td>Increased investment in staff training</td>
<td></td>
</tr>
</tbody>
</table>

Figure 32: Pro’s and con’s of maintenance strategies. Source: adapted from CHOA (2002)
**Value proposition**

Maintenance service is a form of a service contract which is defined by Siemens Cranes as a service which is carried out to preserve the e-package of cranes in order to enable its continues use and function, above the minimum acceptable level of performance, over its designed service life, without major modifications to the specifications (partially adapted from CHOA, 2002). In case of Siemens Cranes, an e-package is considered to be the electrical components of a crane, e.g. switchgear, transformers or motors. Currently Siemens Cranes observes that container terminal operators are struggling with their implementation of maintenance services. The result of an inefficient maintenance service, due to for instance the lack of skills, results in subsystems which operate in conditions which are not according the required specifications. Due to these impaired conditions, firefighting strategies are performed in order to maintain crane operations. This type of corrective maintenance is not desired due to the high costs of additional maintenance and the impending downtime as a result of subsystem failure. For instance, due to the usage of subsystems with high electric current, failure can result in dangerous explosions which can damage additional subsystems. Furthermore, due to the complexity of the subsystems, internal maintenance staff, as well as third party maintenance providers, lack the skills which are required to implement preventive and predictive maintenance strategies in order to reduce overall crane downtime. Even corrective maintenance can be difficult when certain knowledge about a subsystem is not fully present. It is observed that container terminal operators in low wage regions such as the Middle East, Asia and South-America have the tendency to only make use of internal maintenance staff, while western countries source out high skilled maintenance to third party maintenance providers. Another important advantage is observed when dealing with situations when service escalations occurs. When container terminal operators or first service responders are unable to provide a adequate service to a subsystem, Siemens Cranes can use their service escalation hierarchy to successfully solve service related issues faster than third party responders.

Siemens Cranes is offering container terminal operator maintenance service in order to reduce the chance of downtime while at the same time decreasing the need for attracting additional service staff or hiring third party maintenance providers. Additionally, Siemens Cranes offers container terminal operators a variety of maintenance strategies ranging from corrective - towards preventive - and predicted maintenance.

**Organizing model**

Figure 33 represents a simplified organizing model for maintenance services. Siemens Cranes has the ability to initiate three different ways in which maintenance can occur. Within the typical Siemens systems installed in cranes, approximately 80 to 90% will be engineered and produced by a specific Siemens departments. For such subsystems, Siemens Cranes employs Siemens Branches from the specific region to deliver maintenance for the container terminal operator. Service maintenance staff from the Customer Services department within the specific Siemens Branch will carry out the maintenance job. For the remaining 10% to 20% Siemens Cranes employs various third party manufacturers who originally developed the specific subsystems. For these third party manufacturers, arrangements are made on how maintenance will be committed, e.g., maintenance process, onsite or offsite repair. Another way to deliver maintenance services is directly through Siemens Cranes. However this is considered to be an exception for when regular methods of maintenance have not been successful.
Figure 34 constitutes a simplified service blueprint representation of the current process for maintenance services. The service blueprint is divided into three different phases. Phase 1 represents the service components which allow the end user and Siemens to develop a maintenance strategy in order to provide planned maintenance services for the electrical subsystems. Phase 2 represents the service components which aim at rendering actual maintenance activities for the end user. Due to the nature of the service, phase 2 is subdivided into two distinct variations. Phase 2A concerns scheduled maintenance, as suggested by the maintenance strategy, while phase 2B specifically targets the service rendered to the end user when unscheduled maintenance, during a breakdown of a subsystem, is provided. The components in phase 3 are post maintenance service components geared towards invoicing and improving the overall service.

- **Phase 1: Preliminary maintenance definition**
  After the customer requests a certain maintenance strategy, Siemens engages in collaboration with the customer to analyze, define and evaluate the provided objectives. Based on the technical specifications, the requirements specified by the end user and the environment in which the system functions, it is determined which maintenance strategy is appropriate for the electrical equipment. Subsequently the maintenance strategy is translated into different scheduling activities, provisions and allocations such as the assignment of staff, maintenance facilities and possible service parts. The maintenance plan is then adjusted based on the input of the end user and accepted as such.

- **Phase 2: Scheduled & unscheduled maintenance objectives**
  During a scheduled maintenance event, a ticket is created which initiates and prioritizes further processes and additional actions such as determining which resources to use. In order for maintenance to take place, the system needs to be prepared before the actual maintenance can take place. This is coordinated between the end user and Siemens. The maintenance service will be mutually coordinated while different maintenance engineers (internal or third party) and spare parts can be dispatched depending on the maintenance plan and the associated activities. Based on the maintenance objective, the engineer has the ability to inspect and/or repair the system through off-site means with the use of remote access, or by conducting the activities on-site. After the repair is completed, the customer can provide feedback on the delivered services or initiate further processes.

---

**Figure 34: Current (IST) service blueprint for maintenance services.**

<table>
<thead>
<tr>
<th>Physical Evidence</th>
<th>Customers' actions</th>
<th>Life of Interaction</th>
<th>Support Processes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Web-site</td>
<td>Request maintenance strategy</td>
<td>Analysis &amp; evidence gathering</td>
<td>Communication software</td>
</tr>
<tr>
<td>Maintenance log</td>
<td>Accept maintenance schedule</td>
<td>Adjust maintenance schedule</td>
<td>Insurance validation software</td>
</tr>
<tr>
<td>Service report</td>
<td>Prepare system for scheduled maintenance</td>
<td>Process maintenance plan</td>
<td>Database management software</td>
</tr>
<tr>
<td>Service report</td>
<td>Feedback of repair and/or further procedures</td>
<td>Identify next maintenance strategy</td>
<td>EDP system</td>
</tr>
<tr>
<td>Service report</td>
<td>Identify next maintenance strategy</td>
<td>Feedback of repair and/or further procedures</td>
<td>Maintenance coordination software</td>
</tr>
</tbody>
</table>

**Phase 1: Preliminary maintenance definition**
Customer actions: Physical Evidence

**Phase 2A: Scheduled maintenance objective**

- Create ticket
- Adjust priority
- Dispatch field engineer, part or third party

**Phase 2B: Unscheduled maintenance objective**
Customer actions: Physical Evidence

- Create ticket
- Adjust priority
- Dispatch field engineer, part or third party

**Phase 3: Post Maintenance activities**
Customer actions: Physical Evidence

- Close the maintenance ticket and update system
- Create and send invoice
The unscheduled maintenance event is almost identical to that of the scheduled event. After determining that the system is not performing according to the specifications, the end user contacts Siemens for maintenance purposes. A ticket is created and an off-site inspection and possibly a repair of the system is performed. If repairing the system through off-site means is not possible, coordination between the end user and Siemens will allow the dispatch of maintenance engineers to the location, while feedback follows.

- **Phase 3: Post maintenance activities**
  After maintenance to the system is provided, the maintenance ticket is closed and the invoice is send to the customer. Afterwards, the service is evaluated in order to improve overall maintenance services. In this phase different systems such as the Customer Relationship Management (CRM), Supply Chain Management (SCM) and Product Lifecycle Management (PLM) are updated with the knowledge obtained by the service occurrence.

**Revenue model**
From the perspective of the revenue model, Siemens Branches are seen as separate entities in relation to Siemens Cranes or the Headquarter. Due to this, they enjoy an independence when setting price schemes for maintenance services. Siemens sets specific goals and targets for the branches after which they themselves decide which revenue scheme would be best to apply. However, Siemens Cranes does provide the branches with models and concepts that can aid them in determining alternative revenue models. Between Siemens departments and Siemens Branches, a fixed margin is decided upon. The same is true when dealing with third party manufacturers. However, when maintenance is dealt by a Siemens Branch, the tariff and margins can be decided upon by the specific branch, which can be formalized for a specific service contract with a container terminal operator. The only limitation for such revenue agreements is that they should be conform market - and industry conditions.

6.1.2 **Spare parts service**
Different sources employ almost identical definitions for a “spare part”. The Oxford Dictionaries (2013) for instance defines a spare part as “a duplicate part to replace a lost or damaged part of a machine”. Likewise, The Cambridge Dictionaries Online (2013) defines it as “a part that can be used to replace another similar part in ... machinery or piece of equipment”. In general two different types of spare parts can be distinguished (Driessen, Arts, van Houtum, Rustenburg, & Huisman, 2010). Repairable parts are parts which are repaired rather than procured, while non-repairable parts, also known as consumables, are parts which can be scrapped after replacement. In general, repairable parts are more expensive compared to consumables. The spare parts service is classified as a product related service which offers the end user the required spare parts. The main service includes secondary services such as procurement, transport, customs clearing, storage, order management, logistics planning and delivery.

**Value proposition**
Ship to shore cranes, rubber tired gantries and rail mounted gantries are essential for loading and unloading of container carrying vessels and the management of container storage yards. Malfunctioning electric parts can decrease the efficiency of cranes or even result in a total breakdown, which can hamper operations by increasing ships’ turnaround time, - congestion, - overall waiting time, decreasing container throughput and ultimately, in lost turnover. Having the ability to quickly respond to failures is thus important. Spare parts services is a 24/7 service which is fully geared towards the delivery of spare parts to the container terminal operators by processing their requests and managing the logistical processes. Siemens uses its international global logistics network to make shipment to up to 200
Due to optimized logistical processes, the terminals can acquire spare parts and are ensured of a faster recovery of operations.

Acquiring spare parts services from Siemens has a few advantages compared to the provisioning of the same service through other channels such as a system integrator or distributors. Depending on the type of spare parts ordered, acquiring spare parts directly from Siemens can be more economically lucrative since Siemens is located more upstream in the supply chain, resulting in less accumulated margins. This is mainly the case for large, complex and relatively critical items previously referred to as repairable spare parts. Obtaining small, elementary and non-critical items, previously referred to as consumables, e.g., bolts and screws, which have a relatively small ordering price, is less lucrative since large distributors usually have a price advantage due to high amount of stored quantities. Another important advantage for Siemens spare parts service is that more knowledge and expertise can be provided when ordering complex items. Terminal operators sometimes order complex spare parts at other sources which do not provide additional information. This can result in spare parts not being compatible with the crane or with the environment they operate in.

**Organizing model**

Figure 35 represents a simplified process overview of the organizing model of spare parts for direct selling. Spare parts services deals with a few organizing entities. If the container terminal operator would require spare parts, the order will reach for instance Siemens Cranes Project House/Headquarters or any other regional Siemens Branch. An order is issued to either a Siemens logistical center, a specific Siemens fabrication department or to a third party. When it concerns a stocked item, one of the three logistical centers, located in USA, Europe and Asia, will be addressed to supply the container terminal operator with the needed spare parts. When customized parts are required, Siemens fabrication departments or a third party will be approached to produce the needed spare parts. For indirect spare parts selling, different parties which could be categorized as wholesalers, system integrators or crane manufacturers purchase spare parts from Siemens in order to provide container terminals with spare parts.

Figure 36 constitutes a simplified service blueprint representation of the current process for spare parts services. The blueprint consists of 3 subsequent phases. The user first requests a spare part after which Siemens receives the requests and sends the end user a confirmation that the requests was received successfully. Different supporting systems are engaged in order to issue the quotation after which it is send to the end user. When the end user decides to order the spare part, the order is received by Siemens and confirmation is send back to the end user. Siemens internally issues the order to the appropriate manufacturing department after which order management and logistical processes will enable Siemens to organize logistical performances in order for the spare parts to be delivered to the terminal. In most cases, logistical activities are performed by third party providers. When transport is completed, an invoice is send to the end user.
While observing the service blueprint it is noticeable that the service for spare parts only has a limited amount of physical evidence in the form of a website with contact details. Although the service is basic in nature and relies mainly on physical products as output, the lack of physical evidence in the service can have an influence in the way the end user ranks the quality perception of the service (Bitner et al., 2008). Furthermore there are no true onstage actions, which means that no direct contact occurs during the span of service provisioning. This is the direct result of cost optimization, reduction of prior obligatory face to face communication and the strive to increase the efficiency of providing the services, while no computerized ordering systems is implemented. Another element which can reduce overall quality perception is that there is no service component which is geared towards end user feedback in order to improvement overall service.

Revenue model
The pricing of spare parts depends on the product order amount which is ordered by the customer. A high ordering amount will result in a lower margin for Siemens while the opposite is true for a modest ordering amount. The usual margins range between 15 – 35% and are based on a price list which is updated several times a year. Framework agreements are made with large customers therefore ensuring a static low margin.

6.1.3 Interfaces for maintenance and spare parts services
Both services use the same external and internal interfaces. Next to the regular telephone, fax and e-mail capabilities to interface Siemens with the customer, Siemens has two specialized systems in place which manage the flow of information between Siemens and the customer, see Figure 37 for an overall view of all internal and external interfaces.

Siemens Industry Mall
The Siemens Industry Mall is an IT/WEB based ordering system which is accessible through the internet by high value, large volume buying customers, e.g., large distributors or wholesalers. The web portal provides the customer with the ability to find products, and obtain product information, e.g., features, technical data and accessories. The Mall also provides ordering information for a specific product. Registered customers have to ability to acquire real time priceings of products, but also advanced options which specify product related specifications in more detail. This ability is committed through the use of
different product specific configurators. When the product is configured, registered users can order the product through the mall. Additional information is also provided through manuals, training courses or by contacting the appropriate department. By registering, the customer can obtain fixed discounts rates automatically through the system. Furthermore, monitoring of the ordering status as well as track and trace capabilities are provided accordingly (Siemens Industry Mall, 2013).

**Siemens Industry Online Support**

Siemens Industry Online Support is an IT/WEB based product support tool which is accessible through the internet by different customers. It is also available as an application for Apple iOS and Google Android mobile operating systems. The tool allows customers to acquire product support documentation in order to solve pending issues with a product solutions. Also different applications & tools are provided for automatic system interaction and connectivity problems. A technical forum is accessible which allows the customer to share views, expectations and possible solutions with other users. In addition, information is provided on other services, e.g., energy & environment services, modernization & optimization and water related services. When desired, direct support can be provided by Siemens expert via a support request (Siemens Industry Online Support, 2013).

Next to these interfaces, there are also internal supporting interfaces which are only accessible for Siemens service employees that perform interfacing capabilities between Siemens and the customer. One of such tools is SIROT which is used to transfer service related information, e.g., service orders from Siemens Cranes towards the different Siemens Branches. Another of such tools is ASSIST which is a web based service coordination system which coordinates e-mail, fax and telephone traffic. Questions from the end user can be bundled and forwarded to the appropriate staff within Siemens in order to provide suitable assistance or to answer a specific question of the end user. Other internal systems such as the previously explained online support tools can interface with ASSIST. A different tool is the End User Notification Administration system (EUNA) which Siemens staff can use to assess which subsystems the specific end user has installed on an installation. For customers, a similar tool is developed which allows the customer to acquire an accurate database of all levels of subsystems present in the system (EUNA-WEB). The information of EUNA can be directly fed into PridaNet which is an analysis tool that can give recommendations concerning the required spare parts.

**6.1.4 Service Platform for maintenance and spare parts services**

The VISOR framework is designed to be used for modern business models which make use of digital attributes in order to develop and distribute services to the customer. The Service Platform element defines the architecture of the service such as the hardware and software required to enable the service. It also defines the agnosticity of the system and whether or not the service platform can be supported by multiple operating systems. It can address acquisition related questions such as if existing technology will suffice or if new technology is needed. Furthermore it defines how access to the service is provided. However due to the elementary and the traditional nature of the maintenance - and spare parts services, no service platform currently exists at Siemens Cranes which focusses on either service.
6.1.5 Conclusions of business model analysis

Throughout the analysis it is noted that maintenance service is more user orientated compared to spare parts services. For instance, compared to maintenance services, no user feedback is actively gathered in order to improve the spare parts service. This can be explained by the user input which is required to successfully be able to provision maintenance service. Also during service provisioning, more interaction with the customer is needed. In addition, as is made visible by the service blueprint, spare parts services has a limited amount of physical evidence which can reduce the level of perceived service quality. Another point of attention are the implemented interfaces between Siemens Cranes and the end users. Although the processes have been designed to work efficiently, interfaces such as Siemens Industry Mall are only made available to users who acquire high amounts of electrical components. Container terminal operators do not have that ability and do not have the ability to make use of a computerized ordering system.

6.2 Assessment of the stakeholders through the stakeholder analysis

The following paragraph represents the results of the stakeholder analysis conducted in order to gather information about current stakeholders within the process of service provisioning for the container terminal operators. First the dependencies between the different stakeholders are analyzed, followed by an in-depth analysis of interests, objectives and possible issues of the key stakeholders with regards to the maintenance and spare parts services.

In total, five different stakeholders can be distinguished who appropriate a role within the process of service provisioning, see Figure 38. With the exception of the electrical components manufacturer which has been previously analyzed in chapter 4, the following stakeholders have been identified:

- **Crane manufacturer**
  The Crane manufacturer can deliver both spare parts as well as maintenance services to the container terminal operator. For instance, the crane manufacturer ZPMC, the largest harbor crane manufacturer, is gradually changing its strategy in order to assume a service-oriented profile. Currently they employ 1000 employees who focus on providing customer service (ZPMC, 2013). ZPMC also collaborates with different partners such as EPMC Europe, a maintenance organization which offers a wide variety of services such as, spare parts, maintenance and consultancy (EPMC, 2013). Spare parts can be obtained by ordering them directly from the electrical components supplier, or indirectly through the electrical wholesaler.

- **System Integrator**
  System Integrators are represented in many different fields such as information technology, the defense industry and automation. They are primarily seen as service providers for a range of industries who rely on systems engineering to provide them with services which can aid in the design, construction and operation of a specific system. Due to the increasing interest for service provisioning by the producer of
electrical components, system integrators are observing more competition for design and installation services (Doren, 2012).

- **Electrical Wholesaler**
  The electrical wholesalers have major warehousing capabilities at their disposal which are stocked with products that are used by different users in order to build or assemble systems. A wholesaler uses its ability to purchase and stock high quantities of products in order to obtain a bulk discount therefore selling the products at a lower price than other business entities. This allows the wholesaler to be a possible competitor when it concerns spare parts services.

- **Container Terminal Operator**
  Container terminal operators acquire maintenance and spare parts services from various sources in order to attend to their terminal suprastructures. Some container terminal operators have even expended their own service capabilities. For instance APM Terminals (APMT) have created APMT Crane & Engineering Services, a subsidiary which is tasked with providing services as a system integrator for other container terminal operators and port authorities. Their services range from systems engineering, project management and inspection towards commissioning, maintenance and repair (APM Terminals, 2013a). This suggests that the industry for container handling exhibits a form of vertical integration whereby the container terminal operator assumes the role of a system integrator.

### 6.2.1 Container terminal operators

A Container terminal operator is a firm which is the owning entity of a container terminal that is primary engaged with the transshipment of containers between different sea- and land modalities. During the period in which the container transport gained ground (1960) (Zijverden & Negenborn, 2012), terminal operators were mainly localized actors contributing to hinterland transport for a certain geographical area. However, due to globalization, privatization, liberalization and fierce competition, container terminal operators began to internationalize their operations and diversify their global portfolio (Rodrique & Notteboom, 2011). The period between 2001 and 2007 was categorized by a series of economic up-scaling, whereby different container terminal operators focused on consolidation through merger or (hostile) takeovers. The originated large international container terminal operators were also entitled as being global terminal operators. To compare, the top 10 of the largest global terminal operator were responsible for a cumulative container throughput of approximately 42% for 2001, while this figure increased to approximately 65% by 2009, see Table 4. The table depicts different global terminal operators based on the amount of throughput of Twenty-foot Equivalent Units (TEU), a standard measure used for container transport. It however does not suggest that measuring and allocating the TEU amount is a simple process, on the contrary, the market in which the container terminal firm operates is considered to be complex. For instance many container terminals have a web of multiple global terminal operators as shareholders. Granting control to one of the operators is only based upon who ever holds the largest equity stake (Notteboom & Rodrigue, 2011). It is believed that major acquisitions due to consolidation has reached its limit since many terminal assets are already in control of global terminal operators (Rodrigue & Notteboom, 2011).

<table>
<thead>
<tr>
<th>Global Terminal Operator</th>
<th>TEU (m)</th>
<th>Share</th>
</tr>
</thead>
<tbody>
<tr>
<td>HPH</td>
<td>64.2</td>
<td>13.6%</td>
</tr>
<tr>
<td>APMT</td>
<td>56.9</td>
<td>12.0%</td>
</tr>
<tr>
<td>PSA</td>
<td>55.3</td>
<td>11.7%</td>
</tr>
<tr>
<td>DP World</td>
<td>45.2</td>
<td>9.5%</td>
</tr>
<tr>
<td>Cosco Pacific</td>
<td>32.5</td>
<td>6.9%</td>
</tr>
<tr>
<td>MSC</td>
<td>16.4</td>
<td>3.5%</td>
</tr>
<tr>
<td>Eurogate</td>
<td>11.7</td>
<td>2.5%</td>
</tr>
<tr>
<td>Evergreen</td>
<td>8.6</td>
<td>1.8%</td>
</tr>
<tr>
<td>SSA Marine</td>
<td>7.7</td>
<td>1.6%</td>
</tr>
<tr>
<td>CMA-CGM</td>
<td>7</td>
<td>1.5%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>305.5</td>
<td>64.6%</td>
</tr>
</tbody>
</table>
The impact of economic decline
Other reason for the halt in investment in the previous years have been caused by the economic decline. Due to several financially fueled crises, beginning in 2008, many container terminals have witnessed business decline. For instance, the throughput in container transport contracted in 2009 by 12% (Notteboom & Rodrigue, 2011). The global terminal operators adapted to the situation by assuming rationalization strategies therefore reorganizing the firm in order to increase efficiency by changing the size of the firm, its policies and/or service portfolio. The strategies have resulted in several cancellations or postponements in the construction and development of new terminals. While old economic incumbents are suffering from financial decline, new and upcoming economies like South America, Africa, India and Southeast Asia are becoming hotspots for terminal investors due to growth in trade and their future potential (Notteboom & Rodrigue, 2011). However, from 2011 and onwards it is believed that the market will gradually recovering from the previously stated decline of trade.

Three different types of global container terminal operators
The process of internationalization has realized a distinction between three different container terminal operators, see Table 5 (Mori, 2006; Rodrigue & Notteboom, 2011). The first group consists of stevedoring firms who see the terminals as a pure profit centers. The second group consists of integrated carriers who own shipping lines and view their own terminals as cost centers. The difference between both types of container terminal operators is apparent. Unlike global operators who focus on stevedoring, a shipping line who sees the container terminal as a cost center will more likely try to drive down the terminal charges and not optimize them (Port Strategy, 2012). The third is a hybrid variant consisting of shipping lines who are also involved in container stevedoring which handle their own throughput as well as third party traffic in order to obtain profit.

Although different characteristics can be assigned to different container terminal operators, the main attribute for growth of business is to repetitiously duplicate the business model and to assure and assign capital for suprastructural improvement (Rodrigue & Notteboom, 2011). In order to sustain this type of business growth, the investment strategy is geared towards profitability by rearranging assets in order to acquire operational efficiency and growth potential. In order to maintain operational efficiency, the terminals rely on a series of general KPI’s and control objectives in order to measure their performance and to set possible targets. Based on literature reviews, Zijverden and Negenborn (2012) gathered different control and KPI measures for a container terminal, see Table 6. The # symbol indicates the amount of times the KPI was found in their literature research. Most literature indicated that the turnaround time of a ship is a high rated/high level indicator. The indicator for congestion is important.
when it concerns a terminal where throughput is increasing therefore resulting in more traffic related management. Other sets of indicators such as quay crane rates, container throughput and empty yard crane movements indicate lower level indicators, they can for instance influence the impact of the turnaround time. Other type of indicators such as yard occupancy, waiting time of quay cranes and waiting time of trucks indicate the rate of equipment - or modality use.

6.2.2 System Integrators

Just as many other system related trends and inventions, such as system thinking and systems engineering, system integration and the firms who implement such activities, stem from the military. Due to the increasing complexification of systems during the cold war, the United States contracted system integrating firms to design and manage the development process of complex systems (Prencipe, Davies, & Hobday, 2005). The general logic behind a system integrator (SI) has not changed since. A SI incorporates different subsystems into a working system by combining different Original Equipment Manufactured (OEM) products. In many cases, the resulting system is complex in nature, whereby the managing firm relies on interface management in order to understand the behavior of the holistic system, such is also the case with cranes. In order to do so and to be able to design new and more efficient systems, the SI should not only have an understanding of the primary system, but also be aware of newly researched state-of-the-art technologies in order to be able to integrate them into a system. It is important for the SI to monitor and reflect on many technological trends, changes and developments in order to deliver a system which closely approaches the needs of the customer and to sustain their own long-term organizational continuity (Davis, 2011). To deliver the required skills to a project, a SI uses in-house business functions, or organizes subcontractors to carry out system specific work. For the electrical industry such contracts are usually carried out by electrical contractors and panel builders. Electrical contractors can perform different jobs on high and medium voltage installations, while panel builders can be contracted to provide assistance to design and construct high voltage panels.

Next to design of complex systems, large international system integrators such as Imtech and Cofely GDF-Suez focus on various services through the entire system life cycle, starting from engineering and development, consultation as well as advanced maintenance engineering and implementation of 24/7 maintenance and repair capabilities (Cofely, 2013a; Imtech, 2013). Furthermore some SI such as Cofely actively promote their service activities for the cranes market (Cofely, 2013b).

The size of the system integrator can be an indicator of what type of services they provide. In the North American countries, a system integrator uses the same basic technical toolset such as automation engineering, programmable logic controllers and human-machine interfaces, however the larger firms concentrate more on high level automation (Doren, 2012). Focusing on high level automation changes the way services are implemented and the ability to engage in more value adding services. For instance, large system integrators (51%) additionally concentrate more on data collection and reporting systems when compared to the overall system integrator community (33%). More emphasis is given to Supervisory Control And Data Acquisition (SCADA) systems by large firms (60%) compared to the general population (44%). Large system integrators offer additional project management services (52% - 36%) and they are also more involved in the installation and start-up of the system (57% - 41%). Looking at the different industries which large system integrators serve, oil and gas represents the largest share (11%) followed by food and beverages (9%) and automotive (6%). Another property of system integrators in general, is that they prefer to work with a selected few electrical components manufacturers. For the North American market, products of Rockwell Automation are on most preferred list of both large as well as smaller system integrators. However the products of Siemens, General Electric, Schneider Electric and Honeywell increase in popularity when it concerns a larger system
integrator. The biggest challenge which system integrators face concerns the economic impact on the automation market (29%). Although previous years have been difficult for system integrators to acquire projects due to economic downturn, the forecasts for future growth are rated positive (Control System Integrators Association, 2012). Another notable challenge is that of the competition which system integrators face from product suppliers such as electrical components manufacturers (ranked fourth by 13%). The previously stated challenge is the direct result of the product suppliers increased focus on service provision.

6.2.3 Electrical wholesalers

An electrical wholesaler is defined as a distributor of electrical products who acts as a conduit for the upstream market consisting of manufacturers of electrical components, and the downstream market existing out of a variety of different firms such as end users, installers, system integrators, smaller electrical distributors, or any other firm in the electrical business (partially adapted from European Union, 2008). The product portfolio consists of mainly 5 product categories ranging from, cables, lighting and installation materials towards Heating Ventilation & Air Conditioning (HVAC) and communication & security products. However, the downstream market can also obtain spare parts from other sources such as smaller electrical distributors, or directly from the manufacturers. The difference between electrical wholesalers and smaller distributors or Do-It-Yourself (DIY) stores is the previously mentioned only sell a narrow collection of components, while a wholesaler usually sells a wide range of products from many different manufacturers. Furthermore, a wholesaler provides additional equipment for accompanying different installation - or construction phases. It has been noted that the professional downstream market only purchases from smaller distributors during emergency situations (European Union, 2008). The difference between buying directly from a manufacturer differs with regards to a limited product portfolio, prices and financial conditions. With regards to a limited product portfolio, the downstream market can choose out of a limited amount of products. The downstream market indicates that only customized or complex items get ordered through the manufacturer. The price for standardized items are more favorable, while it is indicated that purchasing directly from the manufacturer only occurs when it concerns custom or complex product. However, highly dispersed pricings between different electrical wholesalers are noted due to individual price negotiations. It is standard practice to request three different quotation from different wholesalers without disclosing the actual prices offered by different wholesalers (European Union, 2008).

The largest electrical wholesaler groups are Rexel Group and Sonepar Group. Both firms have a leading presence in their active geographic markets. In European, North American and Asian countries, one of the firms usually assumes a role as the largest electrical wholesaler, a monopoly or in some cases shares a symmetrical duopoly with another wholesaler. As groups, both firms have many different subsidiaries under their supervision. Sonepar Group has approximately 160 subsidiaries active in 35 countries while Rexel Group focusses on 40 different subsidiaries in 37 countries (Rexel, 2013; Sonepar, 2012). In the Netherlands, Sonepar Group is the parent organization of Technische Unie while Rexel Group is the owner of Hagemeyer. In general, different business models are used which adopt a specific customer focus such as a distinct downstream market. For instance, Hagemeyer concentrates on large industrial customers while other Rexel entities concentrate on small electrical installers. Hagemeyer and various other wholesalers also sell their own brand of products while some include HVAC products into their portfolio.
6.2.4 Crane Manufacturers

Although different crane manufacturers produce, transport and commission different cargo handling cranes for container terminal operators, compared to Liebherr, Cargotec, Gottwald, Konecranes and Paceco, Shanghai Zhenhua Heavy Industries Company Limited (ZPMC) holds by far the highest market share on container cranes. With a share of approximately 75%, ZPMC can be defined as a monopolist within the cranes market (Wignall, 2011; World Cargo News, 2011, 2012; World Port Development, 2012). As a state owned Chinese company, ZPMC has ascended to become the preferred manufacturer for the majority of terminals. It now has cranes operational at 200 terminals, spread over 80 different countries. During its institutionalization in the beginning of the 90’s the firm had difficulty in convincing non-Chinese container terminals that the quality and reliability of their crane solutions were competitive with the incumbent manufacturers. These market issues were however quickly nullified by competitive prices which were at least 20% below that of the main competitors (Wignall, 2011). In order to sustain a low price, the firm relied on low cost labor while at the same time investing in production capabilities and cost effective delivery. High investments were made specifically on acquiring new factories, equipment and transport ships which results in elevated fixed costs (Wignall, 2011). In order to remain competitive while enduring high fixed costs, ZPMC is increasingly dependent on a growing need for container handling cranes. Due to global economic downturn and the effect that it has on container terminal construction, the total amount of crane orders declined which made price negotiations a difficult matter. Furthermore, labor costs in Shanghai have risen which in turn has lowered margins for ZPMC. The firm has therefore changed its strategy towards marked and product diversification, focusing on different civil engineering sectors such as bridge building, offshore marine, high capacity floating cranes, mining machinery and bulk handling equipment. These sectors have been proven to be more lucrative compared to the container sector (World Cargo News, 2011). ZPMC also believes that their current market share of 75% will most likely not increase in the future (World Cargo News, 2012). On the contrary, it is believed that other crane manufacturers will regain market share.

6.2.5 Conclusions of stakeholder analysis

Figure 39 represents the interests, objectives and issues of the key stakeholders. The market for container terminals is a complex environment inhabited by different container terminal operators who require and acquire machinery and services in order to constantly spread out and duplicate their business model to various regions. To optimize their operations and achieve higher operational efficiency, they are required to assure and assign capital and improve their high - and low level KPI’s. Due to the sensitive character of terminal operators towards economic fluctuations, the entire container crane construction as well as container handing market has had a decrease in orders. Container terminal operators react by applying rationalization strategies towards their own business practices, which affects different echelons of crane suppliers. For instance, project – and especially price negotiations are more problematic whereby the crane manufacturer has to drastically lower its margins in order to win the crane project. The decrease in
margin echoes through the supply chain towards various product - and service providers, electrical component manufacturers, system integrators and electrical wholesalers.

The combination of rationalization strategy, aim for efficiency and the preservation of the business model make decisions to invest in maintenance and spare parts services seem like a rational choice. Indeed, prolonging the operational status by providing maintenance and spare parts services does fall within this philosophy. However, the consequences for an increase in the focus on services, is that there are different capable partners who are able to provide these services without the immediate intervention of the electrical component manufacturer like Siemens. For instance, the competition between the system integrator and the components manufacturer has risen due to the increase in service perspectives. Both stakeholders observe the same economic drawbacks and both focus on providing services for container terminals. The same can be said for crane manufacturers, they too share the willingness to adapt their portfolio in order to provide and enhance their services. Competition for spare parts services with electrical wholesalers is at a different level. Although they have the ability to deliver spare parts services to the container terminal operator, the focus lies primarily on standardized electrical components, seen as a profit center, while electrical components manufacturers primarily focus on customized and complex components. For the previous mentioned firms, delivering simple products is seen as a cost center due to high overhead costs associated with the transaction.
7 Section 2: User Need Identification

The following paragraph represents the analysis of the need statement data which was obtained through interviews and questionnaires gathered from container terminal operators, see Table 7.

Table 7: The results of the data gathering phase for Need Statement and KPI

<table>
<thead>
<tr>
<th>Interviews/questionnaires</th>
<th>Key Performance Indicators for maintenance organization</th>
<th>Discovered issue</th>
<th>Issue impact</th>
<th>Issue solution</th>
<th>Collaboration for service development</th>
</tr>
</thead>
<tbody>
<tr>
<td>Face-to-face interview:</td>
<td>Mean time to repair = 30 min.</td>
<td>Long waiting period for tender</td>
<td>Decrease in KPI of MTTR</td>
<td>Increase speed for tender request</td>
<td>Collaboration is definitely needed in order to increase service value. Although meetings are not always the right option, there should be a better way</td>
</tr>
<tr>
<td>HPH Rotterdam (EC) Mr. H. van Muffum</td>
<td>Mean time between failure = 1200 cont.</td>
<td>Overall customer feeling</td>
<td>Lost sales/orders</td>
<td>Increase organizational flexibility</td>
<td></td>
</tr>
<tr>
<td>Telephone interview:</td>
<td>Availability, uptime</td>
<td>Hypothetically speaking, due to size of Siemens inflexibility in service provisioning</td>
<td>Longer waiting period for tender</td>
<td>Develop database with adv. parts info</td>
<td>Collaboration would most likely be a big improvement with regards to maintenance services. Arranging meetings to develop services</td>
</tr>
<tr>
<td>DPW Antwerp Mr. R. Palmer</td>
<td>Reliability, Mean time to repair</td>
<td>Total number of failures</td>
<td>Lost sales/orders</td>
<td>Develop database with adv. parts info</td>
<td>More collaboration is definitely needed in order to create a service and redefine a service</td>
</tr>
<tr>
<td>DPW Jebel Ali Mr. J. Johnson</td>
<td>Total cost of maintenance</td>
<td>Lack of information installed parts</td>
<td>Inability to properly manage “end of life”</td>
<td>Develop database with adv. Parts info</td>
<td></td>
</tr>
<tr>
<td>Telephone interview:</td>
<td>Total number of failures</td>
<td>Lack of information installed parts</td>
<td>Inability to properly manage “end of life” &amp; longer waiting period for quotation</td>
<td>Develop database with adv. parts info</td>
<td>More advice on how to manage the local warehouse especially on warehousing conditions and live of each spare part</td>
</tr>
<tr>
<td>APM Terminals Tangier Mr. A. Khalid</td>
<td>Total cost of maintenance</td>
<td>Price list of parts with negotiated rebate</td>
<td>Inability to properly manage “end of life” &amp; longer waiting period for quotation</td>
<td>More advice on how to manage the local warehouse especially on warehousing conditions and live of each spare part</td>
<td></td>
</tr>
<tr>
<td>Telephone interview:</td>
<td>None existent for maintenance organization, but should be the following: availability of equipment &amp; cost analyzing KPI</td>
<td>Inability of local Siemens branch to implement major technical changes</td>
<td>If control of the process is lost this can lead to uncertainties and ultimately to unexpected breakdowns thus in economic losses.</td>
<td>To maintain more constant &amp; regular assistance and to collect and evaluate data to improve overall performance</td>
<td>It’s difficult to gather everything what the customer needs in the contract. Collaboration on service development is needed for increase in satisfaction</td>
</tr>
<tr>
<td>E-mail questionnaire:</td>
<td>Reduce delivery time, increase warranty</td>
<td>No overview about maintenance jobs &amp; pending hours of work</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>APM Terminals Tangier Mr. J. Andrés</td>
<td>Lack of information installed parts</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

First the different KPI’s that were deemed important by the contacted container terminal operators will be analyzed after which the discovered issues, the impact the issues have on terminal operation and the different solutions that the operators envision in solving the stated issues will be discussed. The section ends with the opinions of the operators concerning collaborative service design.

7.1 Key performance indicators of the container terminal operators

The first column of Table 7 represents the Key Performance Indicators of the maintenance organization for the specific container terminal operator. Although most of the participated container terminal operators are actively using KPI to manage and analyze the performance of their maintenance organization, there are still improvements to be realized. For instance, in the case of MSC Valencia, the management tools such as IBM - Maximo analyze important data relating to asset -, work -, service -, contract -, inventory and procurement management. However, although the data is available, they are currently not being translated towards usable maintenance related KPI’s.

Looking at the different KPI’s provided by the container terminal operators, all can be classified as lagging indicators. Lagging indicators are intended to measure how well a process has been managed but not how to manage the process, such is only the case with leading indicators. Within the lagging indicators a distinction is made between cost - and time related KPI’s. The KPI of cost is directly associated with the cost of conducting actual maintenance while time related indicators are more diverse. All contacted container terminal operators value KPI’s which are related to reliability, availability and maintainability as highly important. In systems engineering these system characteristics are commonly referred to as the Reliability, Availability and Maintainability (RAM) attributes. These
attributes are frequently the subject of different studies which focus on enhancing the RAM attributes in order to increase efficiency. By successfully improving the RAM attributes, different benefits can be gained, such as, an increase in profitability, productivity, customer satisfaction and public relationship, while reducing investment costs, maintenance costs, inventories and capital costs (Sutton, 2010). Furthermore, an improvement in safety and environmental performance can be realized, especially when dealing with hazardous operations and potential unsafe processing conditions, which can be present at container terminals. The KPI’s of reliability, availability and maintainability in the context of the maintenance organization will be elaborated in more detail.

**Reliability**

In the case of a container terminal operator, the term reliability is seen as the probability that the crane or subsystem thereof will function during a specific period of time, under the stated specifications without succumbing to failure. In essence, reliability provides the container terminal operator with a way of indication if the crane or subsystem is successfully providing its designated function (adapted from Pham, 2007). In the case of DPW Antwerp, reliability was mentioned as a global term, while ETC Rotterdam more specifically, mentioned the term Mean Time Between Failure (MTBF) which is frequently perceived as the quantification of reliability. It should be noted that the measure is seen as an indication for a crane or subsystem to be successfully performing its function without registering failures or needing maintenance.

**Availability**

Availability is the time that the crane or subsystem thereof is able to perform its stated function during a specific period of time, under the prescribed specifications (Sutton, 2010). This measurement, although related to reliability, deems failures as repairable and accumulates it within the measure. For systems which are not repairable, such as non-repairable parts, reliability and availability are identical (Pham, 2007). The difference between availability and reliability is depicted in Figure 40. Although a system can successfully operate at 90% of its stated capacity during a period of time, when time increases, the individual subsystems of the crane will show signs of functional deterioration making the crane therefore more prone to failure and less reliable for future operations.

**Maintainability**

It has been stated by multiple container terminal operators that the KPI of Mean Time To Repair (MTTR) is deemed important. This indicator is a critical measure to assess and predict the maintainability of a crane. Maintainability is defined as the probability that a crane or subsystem thereof is restored to its functioning order, within a certain amount of time, when maintenance is performed according to the prescribed procedures and with adequate resources (Pham, 2007; Sutton, 2010). In essence, the

---

**Figure 40: Difference between availability and reliability. Source: adapted from Sutton 2010**

**Figure 41: Difference between MTTR & MTBF**
activities associated with the measure are for instance fault detection, fault isolation, the replacement or repair of the subsystem and the validation that functionality is restored. Figure 41 depicts an example which states the differences between the (sub)system attributes of Mean Time Between Failure (MTBF) and Mean Time To Repair (MTTR) in reference to the availability of the crane over a period of time. In the example, when dealing with non-critical subsystems, the MTTR represents the red line of activities associated with bringing the subsystem in operational mode by conducting maintenance, while the MTBF, represented by the green line, indicates the period when the subsystem is “in between” failures. The system behavior is different when malfunctioning occurs in either critical or non-critical subsystems. If non-critical subsystem 1 & 2 are malfunctioning, the availability of the crane will not be significantly impacted. However, if critical subsystem 3 & 4 are affected, the availability of the crane will deteriorate since critical systems are vital to ensure the primary function of the crane.

None of the cases have mentioned the use of any leading - or perception related KPI’s. Leading KPI’s can either be not fully implemented within the maintenance organization, not properly hierarchically linked to lagging KPI’s, or the interviewees were not aware of the importance or the existence of these type of measurements. However, in the case of DPW Antwerp, it was reported that many subsystem related measurements are accessible through their asset management program which indicates that certain subsystem related leading measures are available. The lack of perceptive related KPI’s can be explained by the supporting nature of the maintenance organization. Since the maintenance department is solely focused on providing (internal) firm wide maintenance through work orders, less weight is given by the organization to measure the perception of other departments concerning the maintenance activities. Perception oriented KPI’s can be useful when the maintenance organization focusses on providing service to other firms. In such cases, friction between the firms can be made measurable by implementing perceptive KPI’s.

7.2 Need statement of the container terminal operators

The second, third and fourth column of Table 7 represent the need statement which was obtained through analysis of pending issues, the impact that the issues have on key business operations and the opinion of the container terminal operators on how to resolve the issues.

Although the interviews concerning the need statement with the container terminal operators were focused on both the spare parts - as well as maintenance services, four out of the five terminal operators primarily concentrated on the service of spare parts. The lack of service issues on the subject of maintenance services can either be explained by the actual lack of issues, the low degree of impact that the issues have on organizational performance, or simply because the container terminal operator does not have the extensive experience in dealing with maintenance services from Siemens or other third party providers. Container terminal operators rely heavily on their own maintenance organization to provide them with work order reduction through maintenance and, in most of the time, rely on manufacturers only when escalation is imminent.

The container terminal operators witness issues which can be categorized in three different categories, lead time related -, information related - and flexibility related issues. These categories will be elaborated in more detail in the continuation of the chapter. To elaborate more thoroughly on the issues, their impact on terminal operations and the way the issues influence the previously stated KPI, a causal diagram is constructed, see Figure 42. The causal diagram depicts the causation between different system events and the consequences of such events on other system elements. It therefore creates an overview of how certain events can increase or decrease the output of other system
elements. A positive influence, meaning if an increase in one element will ensure an increase in another element, is indicated with a plus (+) symbol, while a negative influence, meaning if an increase in one element will ensure a decrease in another element, is indicated with a minus (−) symbol. A connection between elements without a symbol indicates the presence of a logical sequence of steps without direct causality.

7.2.1 Lead time related issues

Issues related to the lead time have been noticed multiple times by the container terminal operators. More specifically, it is perceived that the lead time associated with setting up a quotation by the electric components manufacturer consumes too much time. Causality between long lead times of critical spare parts are apparent and have been discussed in the previous paragraph. If a critical subsystem fails during operation, the crane will not be able to function, reducing the overall availability of the crane. This makes it necessary for container terminal operators to store critical subsystems as inventory in warehouses. However, there is an indirect causality between non-critical subsystem and the availability...
of the crane on the one hand, and the KPI’s of reliability (MTBF) and maintainability (MTTR) which will be elaborated by the causality diagram, see Figure 42.

The causal diagram is divided into six segments. The first segment is that of Siemens spare parts service which depicts different service phases within spare parts services, for more information concerning these phases, see Chapter 6.1.2 Spare Parts Services. The second segment is that of the processes which manage the Maintenance Logistics Organization (MLO) of the container terminal whereby the interaction between Siemens and the container terminal operator results in the acquisition and ultimately the replenishment of the spare parts inventory. The third category is that of the main processes associated with the Maintenance Organization (MO) whereby maintenance is conducted on the crane. The fourth and fifth categories represent the critical and non-critical subsystem loops which house the KPI elements. The sixth segments is related to the higher goal of the container terminal operator, mainly crane availability.

Interaction between the processes of the MLO and Siemens spare parts services
The first and second segments represent the interaction and processing elements of the spare parts services. From the perspective of the container terminal operator, within the process of obtaining spare parts from Siemens, the container terminal operator distinguishes three different stages which all retain certain lead times. These lead times are the direct result of the processes used by the container terminal operator, the processes designed and provided as spare parts service of Siemens Cranes, see Chapter 6.1.2 and the interactions between the firms.

The pre-processing lead time is the time which is associated with the processes of gathering specifications from engineers and selecting possible suppliers which can provide spare parts with the specific requirements. This lead time can directly be linked to the phase of information provisioning for the service of spare parts where Siemens Cranes provides information through their website about different products and their specifications. After the creation of a short list, which is filled with possible supplier candidates, the purchasing department gathers quotations from different suppliers and creates a purchasing order for the selected supplier. The time required for these actions are added to the processing lead time. This lead time can directly be linked to the phase of information provisioning where Siemens Cranes provides quotations for spare parts, and also for the ordering phase where Siemens supervises the internal processing for ordering the spare parts. After the order has been placed, the purchasing department tracks the order until it is delivered and put into warehousing. The time associated with these actions are added to the post-processing lead time. This lead time can be directly linked to the delivering phase for the service of spare parts where Siemens Cranes ships and manages the transport of the spare part to the terminal. When all different lead times are based on the need of the container terminal operator, the responsiveness or throughput of spare parts is sufficiently arranged and availability of both critical and non-critical spare parts is adequately managed.

The processes of the MO and their interaction with the subsystem loops
The third, fourth and fifth segments represent the processes of the maintenance organization and the effect it has on critical and non-critical subsystems. If the needed spare part is available, the maintenance engineers perform maintenance by isolating the fault and accessing the malfunctioning subsystem by disassembling one of the major systems of a crane. Afterwards, actual maintenance is performed whereby a subsystem is repaired or fully replaced. After reassembling, a validation is committed in order to assess if maintenance was successful and if system performance is according to the specifications. The previously mentioned maintenance processes directly impact the KPI of MTBF and MTTR. In relation to the MTBF, assuming that the subsystem is not the subject of unprecedented or
unspecified working conditions, the quality of the conducted maintenance and the inherent properties of the subsystem are ruling variables which determine the reliability of the subsystem. With respect to MTTR, if the lead times of any of the process steps is delayed as a result of a disturbance, the MTTR will increase as a linear function. If the MTTR increases, a higher amount of malfunctioning subsystems on the crane can be noted due to the accumulation of pending work orders for non-critical subsystems. The amount of malfunctioning subsystems increases the pressure and need for the MLO to increase the responsiveness of the spare parts service.

The resulting effect of the amount of non-critical subsystem on the availability of the crane

The sixth segment represents the main processes which influence the availability. As depicted in the crane availability paragraph, the availability of the crane is determined by the amount of downtime sustained due to unplanned downtime as a result of a malfunctioning subsystem, or by planned downtime as result of various types of preventive maintenance schemes. Although planned downtime contributes to a lower availability, the organizational characteristics of planned maintenance does not drastically impact the organizational performance of the container terminal operator. On the other hand, unplanned maintenance due to critical subsystem failure directly impacts the availability as previously mentioned. Although theoretically more than one critical system failure can occur, one will be sufficient to impact the overall crane availability. However, the non-critical subsystem loop can also impact the amount of unplanned downtime. This can happen in situations when specific non-critical subsystems are awaiting maintenance and at the same time influence the ability for the MO to complete a successful maintenance process. In such situations an increase in MTTR and a decrease in MTBF occurs therefor creating consequential economic loss. In order to clarify this causality, the following example is presented, see Figure 43. The following scenario depicts the consequential economic loss for the container terminal operator due to the increase in time needed to conduct proper maintenance on a critical subsystem due to pending maintenance on non-critical subsystems, thereby reducing crane availability.

A non-critical subsystem which handles the pulley motor on the crane fails and a work order is issued for the specific subsystem on the crane. During the service lead times, a non-critical subsystem which controls the lighting system on the same crane also fails. A separate work order is created and added to the work order buffer list of that specific crane. In the same period, before the tenders are presented, a second motor of the lift malfunctions after which a third work order is created and put on the work order buffer list. In the meantime, during regular operations, the crane operator notices that the crane is not performing accordingly and is on the brink of failure. The operator notifies the maintenance department and a maintenance engineer is assigned to conduct maintenance. The engineer is required to isolate the problem through onsite inspection. For this, the engineer is required to proceed to the malfunctioning subsystem and assess the situation. In order to do so, the engineer needs to be able to use the elevator, but due to previous malfunctions the elevator is out of order, still waiting on spare parts. The time associated with traveling to the malfunctioning subsystem is increased. After assessing and disassembling the system, the engineer notices that a motor, which is vital for the availability of the crane, has failed. In order to repair the subsystem a new motor has to be hoisted to position. Although the hoisting of a motor is a routine activity, due to the malfunctioned pulley motor and the decreased hoisting power, the positioning of the spare part motor requires more time than anticipated. Overall, the total repair takes more time than anticipated due to the lack of proper lighting conditions on the crane which was also instigated by the pending work order on the lighting system. The lack of proper lighting also increased the time which was needed to reassemble the system. The KPI of MTTR was drastically increased resulting in consequential economic loss.

Figure 43: Example of non-critical subsystem reducing availability
Suggested improvements for resolving lead time related issues

The main problem for the previously mentioned consequential economic loss is to improve service lead times by focusing on redesigning the ordering phase of the spare parts service. By doing so, the lead time which is associated with tendering and obtaining an accurate quotation in a fast manner can be realized. An opted solution is to introduce an electronic ordering system which contains tendering data such as delivery time and quotations when dealing with non-customized spare parts with known article numbers. Other lead time issues such as the decrease in delivery time are more difficult to optimize since delivery is primarily outsourced to 3rd party logistic providers and outside the scope of the research.

7.2.2 Information related issues

Multiple issues related to the provision of spare part information have been noticed by the container terminal operators. More specifically, it is perceived that information concerning the “phase out period” of the spare part is not provided. It is believed that it is in the interest of the electrical components manufacturer to not actively communicate the phase out information due to the possibility of increased financial benefits. In economics, less optimal outcomes are endured when two parties such as a client, generally referred as the principal, and the contractor, generally referred as the agent have divergent goals and are not in the process of sharing vital information. The decision tree in Figure 44 depicts the previous mentioned situation. In this case, the container terminal operator is represented as the principal, while Siemens Cranes is represented as the agent. For instance, the principal has a crane which has a certain configuration of critical electrical subsystems. If a critical system fails, the maintenance organization repairs the subsystem and new spare parts are ordered to replenish the stock to the normal level. If a critical spare part is not available for ordering due to new technological advancements committed by the agent, such as a newly released but incompatible version of the subsystem or the introduction of a totally new product, the principal is required to order the spare parts or suitable alternatives from other sources such as wholesaler or other vendors. In the case of wholesalers, the old products can already be depleted, while the new product is awaiting its introduction. In the case of other vendors, such as second hand industrial vendors, the quality of the refurbished part can be questionable. In both cases the transaction cost and agency costs will increase. However, the container terminal operator can also choose to modify the crane in order for it to be adapted to the new technology. Modifications will require additional investments, therefor new contractual arrangements between the principal and agent have to be made. In the current situation, the agent is not actively informing the principal about the status of the phase out. This constitutes an asymmetry in information and represents a principal-agent problem. A possible solution is to offset the asymmetric characteristic of the flow of information in order to restore equilibrium between principal and agent.
Another information related issue which was often the topic of discussion is the lack of a general overview of suitable alternative products. When a spare part has been phased out, it is difficult for the container terminal operators to find a suitable alternative to replace the phased out spare part. Conveying this information would decrease the pre-processing lead time.

The decision tree of Figure 45 depicts a situation when more information symmetry between principal and agent exists. In this example, information concerning the phase out period of a specific spare part is known by the principal. If the needed spare part is not in a phase out period and will still be available for a long period of time, the principal can order the spare part for the regular stock. However, if the spare part is in its phase out period, the principal can order a higher amount of spare parts whereby a strategic stock can be accumulated. The benefit of having accumulated a strategic stock is that a transitional period is created which allows the principal more decision room to seek possible alternative choices. The principal can postpone immediate crane modification and schedule for a future modification or search for other alternative suppliers. The benefit for the agent lies in an increase in the order amount for spare parts when a phase out is due, and a higher service quality due to an increase in customer appreciation.

**Suggested improvements for resolving information related issues**

The solution to the main problem when dealing with information asymmetry is to improve the process for information transition by creating incentives for the agent to convey the information. A solution which container terminal operators suggest is a database with the bill of materials, delivery times, compatible alternative spare parts and the product life cycle status in order to assess which strategic and tactical choices are suitable. The incentive could be to frame this database as a new secondary service within spare parts services.

### 7.2.3 Flexibility related issues

A theme which was noted multiple times throughout the interviews was the lack of flexibility that typically large firms have when dealing with container terminal operators. In some cases, electrical components manufacturers were seen as inflexible and propagated an arrogant stance. The reason for this perception lies hidden in the power-relationship between the container terminal operator and the electrical components manufacturer. Table 8 depicts the purchasing portfolio matrix, a management tool which is frequently used to distinguish the power of the client (container terminal operator) also referred

<table>
<thead>
<tr>
<th>Strength of Principal</th>
<th>Exploit</th>
<th>Exploit</th>
<th>Balance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strength of Agent</td>
<td>Exploit</td>
<td>Balance</td>
<td>Diversify</td>
</tr>
<tr>
<td>Low</td>
<td>Balance</td>
<td>Diversify</td>
<td>Diversify</td>
</tr>
</tbody>
</table>

Table 8: Purchasing Portfolio Matrix. Source: adapted from Kraljic (1983)
to as the principal, in relation to the contractor (electrical components manufacturer), also referred to as the agent (Kraljic, 1983). Different indicators can reflect the power of the firm and scale them to be either low, medium or high.

**The strength indicators of the principal**
Looking through the perspective of the principal, the purchasing volume of electrical components is relatively low since container terminal operators are not considered to be bulk users for electrical crane components. Therefore the principle of economy of scale is less applicable for the principal. Many electrical components are considered to be critical subsystems which directly influence the availability of the crane. This indicates that they are considered to be of strategic importance. Additionally, the demand or growth in the need for additional components is directly linked to the acquisition of new cranes, which only rarely occurs depending on the drift towards expansion of the container terminal and the strategic goals set by the management. As previously mentioned, although the top 10 of the global terminal operators control 70% of the container terminals, each container terminal is an independent operating unit which is responsible for their own purchasing policy concerning the type of electrical installation. This means that the market shares of individual container terminals is relatively spread out between all geographical locations and therefore relatively low, depending on the amount of cargo traffic.

**The strength indicators of the agent**
With regards to the agents, there are relatively few manufacturers which are able to produce a high variety of electrical components for the purpose of operating a crane. Furthermore it has been noted that the quality of the products of electrical components manufacturers with high market share such as Siemens and ABB are superior compared to other producers. In addition, installing a crane with components of a specific producer, directly results in a technological path dependency. This means that additional orders or contracts will most likely be derived from the same manufacturer. Changing from core technology or manufacturer will lead to additional investments, switching costs and a temporary decline in crane availability.

Having regarded these indicators, it can be concluded that the strength of an individual principal is relatively low, while the strength of the agent is high. In such occasions less long term collaboration is evident between principal and agent, while at the same time the agent is less willing to invest in risk holding ventures with the principal. This discrepancy can lead to a lower quality perception by the principal towards the agent and less customer intimacy due to less prospect for future financial gain. The strategy for a container terminal operator in such occasion is geared towards supplier diversity, meaning that it is more in the interest of container terminal operator to search for, if possible, alternative suppliers, manufacturers or supply routes. For instance, the diversity argument has been used as a decision variable for ECT Rotterdam to choose for ABB instead of Siemens as the supplier of electrical components for the constructing of the new EUROMAX terminal. In other cases, contracts can be made with less powerful agents in order to tip the balance of power, making the agent more willing to invest in a long term relationship.

### 7.2.4 Collaboration for co-creation of services between container terminal operator and electrical components manufacturers
Currently no efforts are undertaken to co-create services with the contacted container terminal operators. All container terminal operators have acknowledged that more collaboration is needed to improve current services. In some cases efforts have been undertaken to redesign various services in the past, but not with any noticeable improvement. In the case of ETC Rotterdam, it is noted that almost
every three to four years an effort by Siemens or other producers is made to improve service related issues. In most cases this was in a form of a meeting through which they discussed various ongoing issues and complaints. In all cases the container terminal operators would welcome the opportunity to participate in co-creative service design if this would lead to a mutual benefit. The opportunity to co-create services in the near future are present. Multiple container terminal operators have acknowledged that certain business practices concerning outsourcing can change in the near future resulting in more need for services of providers such as Siemens. Services which container terminal operators find increasingly interesting relate to stock management, whereby a reduction in local warehouse inventory is realized or services where an efficiency increase in stock management can be realized in order to decrease inventory related costs. For instance, ECT Rotterdam currently has approximately €25 million worth of spare parts in their inventory which corresponds with approximately 12% of their total costs. This figure can be decreased with more efficient stock management.

However, from the perspective of the container terminal operator it is unknown what the best approach is to co-create services. Some argue that regular meetings would be in order while others argument that regular meetings are less efficient altogether. In the case of meetings, it is unlikely that an one-off meeting will gather suitable information or will provide appropriate moments for feedback and knowledge assimilation. It is more likely that recurring meetings or a series of meetings will be more adequate. Interactive meetings are also possible. For instance, in current engineering design processes, collaborative engineering is gaining ground. Collaborative engineering is the process where different stakeholders are collectively drafting a solution in order to realize a certain outcome which is beneficial to the collective. This could be in a form of a design or just to come to an agreement on a topic.

7.2.5 Conclusions of the user need identification step

Through various interactions with container terminal operators, a general indication is given about the most observed KPI’s and issues that container terminals have concerning spare parts and maintenance services. In general, the lagging KPI’s which are deemed the be most important are the RAM attributes. More specifically, the measures of MTTR and the MTBF are important notifications for assessing the ability of the maintenance organization in conducting proper maintenance. There is however a causality between the service of spare part and the previously stated KPI. In certain situations specific non-critical subsystems or the combination thereof, can influence the MTTR of critical subsystems thereby decreasing overall availability of the crane resulting in consequential economic loss. The container terminal operators deem it vital to decrease the lead times of the spare parts services in order to increase the responsiveness of their maintenance organization and decrease the sustained economic loss.

Throughout the analysis, a principal-agent problem was uncovered concerning the phase out of spare parts and the discrepancy between the balance of power of the principal and agent. The container terminal operators deem it important to resolve these issues in order to increase the quality of the service. It is suggested to introduce an electronic ordering system which contains tendering data such as delivery time and quotations when dealing with non-customized spare parts with known article numbers. Furthermore, to decrease information asymmetry, it is suggested to maintain a database with the bill of materials, delivery times, compatible alternative spare parts and the product life cycle status in order for the container terminal operator to assess which strategic and tactical choices are suitable.

With regards to the co-creation of services, all container terminals operators would welcome such a service design approach. The operators have rarely noticed a co-creative process which was initialized by a service provider. Such process should be beneficial for both the agent and the principal.
8 Section 3: Envisioning and Evaluation

The following chapter represents the last part of the redesign efforts and focusses on envisioning and the evaluation of the design. To define which changes will be made to the current service blueprint of spare parts, a comparison will be made of the proposed changes based on the analyses conducted in section 1 and section 2. Afterwards, two service blueprints will be presented and discussed.

8.1 Comparison between the issues of section 1 and section 2

Based on the conducted analysis of section 1, which used the VISOR framework and the stakeholders analysis to analyze current services, and section 2, which used end user input in order to obtain KPI’s, need statement and suggestions from the container terminal operators, a comprehensive overview of overall service issues was created, see Table 9.

Table 9: Findings of VISOR framework analysis, service blueprint analysis and actual service issues

<table>
<thead>
<tr>
<th>Service issue</th>
<th>Issue consequence</th>
<th>Issue resolution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internal analysis by means of VISOR analysis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. No automated ordering system for spare parts</td>
<td>More labor intensive indirect work</td>
<td>Decrease laborious work</td>
</tr>
<tr>
<td>2. Limited amount of physical evidence in service blueprint</td>
<td>Lower service quality perception</td>
<td>Increase physical evidence</td>
</tr>
<tr>
<td>3. No proactive user feedback possibilities</td>
<td>Lower service quality perception, future issues</td>
<td>Integrate user feedback</td>
</tr>
<tr>
<td>External analysis by means of KPI, need statement analysis and suggestions from container terminal operators</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Long service lead times</td>
<td>Slow spare parts responsiveness</td>
<td>Decrease in RAM KPI’s</td>
</tr>
<tr>
<td>5. Principle-agent problem</td>
<td>No life cycle visibility of spare parts</td>
<td>Less strategic decision making possible, high costs</td>
</tr>
<tr>
<td>6. Large power difference of actors</td>
<td>Inflexibility, less willingness of agent</td>
<td>Aptilated end user, lower service quality</td>
</tr>
</tbody>
</table>

The overview depicts the gathered service issues, their consequences and possible solutions in order to resolve the issues. When ordering the issues by similarities and causality, a model is formed which connects all the issues through linear connectivity. For the sake of clarity, an explanation of the mutual interaction between the issues will be shown by following the mutual interaction between issue 1 and 4 and continuing by the logic of the network topology. Doing so will confront the issues gathered from the analysis in order to create cohesion and discover possible overlap between issues which ultimately can shape the design space for the redesign effort.

8.1.1 Automated ordering system and longer service lead times

The 1st issue concerns the lack of a computerized environment which allows the realization for an automated ordering system. Due to this, additional work activities have to be conducted in order to process the spare parts order. This issue is directly linked to issue 4. Due to the lack of such an automated system, longer lead times are noted which gradually decreases the responsiveness of the spare parts management capabilities of the container terminal operator and subsequently reduces the RAM KPI’s. As a possible resolution to the issue, the container terminal operators opted for an automated alternative in order to reduce lead times.
8.1.2 Service lead times and limited physical evidence

Order automation can also resolve the lack of physical evidence which was noted by observing the service blueprint of spare parts services. By creating a viewable system which allows the end user to be able to collect order information and to have the ability to order spare parts in a direct manner, the end user interfaces with the spare parts service more evidently. This can ultimately improve the perception of service quality by the user. This logic of this argument links issue 4 to issue 2.

8.1.3 Limited physical evidence and principal-agent problem

By creating a system which allows the end user to interface with several information systems, such as order information or life cycle status, the principle-agent problem becomes less apparent and the end user is able to improve the decision-making process while at the same time incurring less costs altogether. The container terminal operators have also opted for more information transfer in order to create more information symmetry between principal and agent. Therefore it can be reasoned that issue 1 is linked with issue 5.

8.1.4 Principal-agent problem and customer feedback capabilities

As previously mentioned a principal-agent problem occurs when information asymmetry is at hand and when the goals of the principal and agent are divergent. The severeness of the issue can be increasingly problematic when problem solving interaction and feedback possibilities are not fully integrated in the service. The lack of an ability for the end user to be able to improve future service interaction will only increase the distance between the principal and agent, diverging the goal perceptions of both actors which can reduce the level of trust. This argument links issues 5 and 3.

8.1.5 Customer feedback capabilities and power position of actor

Another issue which is important to take into account is the relationship between the lack of proactive feedback and the large power difference between the principal and the agent. Due to the difference in power between the principal and agent, it can be difficult for the principal to engage in fruitful cooperation which is beneficial for both the principal and agent. The powerful agents will tend to invest less in principals which will ultimately reduce the service satisfaction. By integrating user feedback as a process within the service, the imbalance can be improved. This links issue 3 to issue 6.

8.1.6 Conclusion of the comparison between section 1 and section 2 issues

Section 1 resulted in the discovery of three service issues. The tools which were used were geared on solely internal analysis and interactions without any actual contact with the end user. On the other hand, by means of an external analysis conducted in section 2, in the form of a KPI - and need statement analysis, three specific end user issues were found. Based on the comparison between the logic of the service issues, it can be concluded that the overall issues share causality and are interlinked. It can be stated that both analyses share important value in redesigning services. With regards to issues gathered from section 1, it can be stated that the issues were less customer orientated, more technical in nature and rather systemic in character, meaning that the service issues could cause multiple events within service provisioning which could ultimately lead to several operational service issues. In contrast, the analysis conducted in section 2 resulted in issues which were more specific and more focused on an
operational level from the perspective of the end user, therefore with an evident customer orientation. It was observed that considerable overlap between issues was present. For instance, the issues resulting from the lack of feedback capabilities and an automatic ordering system was made evident by both sections. In many cases, the issues gathered from the section 1 were more causative while the analysis in section 2 reported the possible operational outcome of the internal issues.

Based on the conclusions, the following design opportunities will be included into the redesign effort:

- Introduction of an automated ordering system
- Integrated customer feedback capabilities
- Sharing of life cycle information

8.2 Service blueprint for the redesigned spare parts service

Figure 46 depicts the redesigned service blueprint of the spare parts service with an automated ordering system, customer feedback capabilities and life cycle information as service components for the primary service of spare parts provisioning.

Based on the hierarchical nature of the added service components, and the impact of the automated ordering system has on the service experience, a specific IT platform and modules were introduced in order to facilitate service provisioning. The overall Siemens Cranes Online Ordering System will be elaborated below.

**Siemens Cranes Online Ordering System (SCOOS)**

SCOOS is an online ordering system which facilitates the end user with the primary service of ordering spare parts by conveying appropriate information such as current price, rebate rates and delivery conditions through digital means. The system is of modular design to which different modules can be introduced to act as general service components which can be seen as part of the primary service or as secondary services which can complement the primary service offering. The choice to incorporate a
module design is based on the notion that changing needs of the end user can be an argument to modify the service composition when a change in customer needs is due, or when a customer need requires a new module to be introduced. The service is divided into three phases through which SCOOS provides a supporting platform for.

For phase 1, the SCOOS Public web provides the end user with a public environment which facilitates the registration process for spare parts services. For phase 2, the SCOOS system provides the user with a private dashboard where different modules can be accessed in order to facilitate information exchange through different additional services and to order spare parts. Furthermore, SCOOS facilitates the delivery and service feedback in phase 3 by integrating different handling functionalities into the system. The function, additional argumentation and alternatives of the SCOOS framework will be illustrated in more detail below.

**Phase 1: SCOOS Registration**

In order to make use of SCOOS, the user is required to first register online at a designated website. After receiving the registration request, the Siemens employee can either accept the request or request for additional information in order to complete the registration. When the registration is fully completed, the employee can accept the registration request and send the user login data and detailed instructions on the functions and possibilities of SCOOS. At the same time a corporate profile is created in order to facilitate the SCOOS system and record the preferences and the conditions under which the corporation has access to SCOOS. It is for instance important to incorporate an updated set of contracts between user and Siemens Cranes in order to adjust the quotation with the correct discount rates for spare parts acquisition.

Although the registration process is required in order for the system to accept new end users, it can also be argued that registration should only be possible as an unilateral decision and internal process, meaning the end user would only be able to register at the prerogative of Siemens. Such an approach may be needed as a temporary measure in order for the redesigned service of spare parts to be fully accepted by the end user and to manage the amount of simultaneous registrations. It may be required to use this registration method during the initial registration period in order to allow the redesigned service to diffuse uniformly into the end user community.

**Phase 2: Information gathering & ordering**

The second phase is the section where the user can orientate on the different type of spare parts and order the parts when needed. First the user is required to login onto the SCOOS dashboard. Afterwards the user can search or navigate through different spare parts systems and subsystem categories in order to find the suitable spare part. When a spare part is ordered, the system sends an order notification to a Siemens employee which then issues an order received confirmation. In some cases, the order can be erroneous, meaning that the ordered spare part is less suitable for the specific crane installation. In such cases, an Siemens employee can contact the user to suggest a different spare part which would be better adaptable. When the order is accepted, the user will receive a confirmation.

The SCOOS dashboard acts as the primary environment where the end user can access different SCOOS modules. The user can for instance access the administration module which allows the user to change preferences and edit user information, or access the ordering module which grants the end user with the capabilities to order spare parts. These modules can be seen as general service components which allow the user to use the primary functions of the service. Secondary services can also be introduces by means of a new service module. This was implemented with the life cycle module for the service
redesign. Although conveying life cycle status to the end user will increase service quality, it can also reduce turnover due to the need for less required crane modification. It can therefore be argued that a fee for using such a secondary service is permitted. It is however vital to find a break-even point for the remuneration of such secondary services versus the perceived service quality by the end user. For more information on the life cycle module and the service blueprint for the secondary service, see Chapter 8.3.

**Phase 3: Delivery & service feedback**
The concluding phase incorporates the delivery of the spare parts to the user, as well as user feedback. When the order confirmation is send to the user, the order tracking system becomes active whereby the status of the order can be tracked by the user. Siemens internally issues the order to the appropriate manufacturing or warehousing department after which order management and logistical processes will enable Siemens to organize logistical performances in order for the spare parts to be delivered to the terminal. After the spare parts have been delivered to the user and the invoicing has been send, feedback can be given in the SCOOS system in order to improve spare parts services.

The modules which are accessed in order to facilitate the service is the lead time module and the client feedback module. The feedback capabilities are only activated after the invoice has been send to the end user. This was done in order to acquire feedback after the majority the processes have been executed. It can be argued that feedback capabilities should be available during the entire service provisioning. Allowing this may however create a feedback culture which is not beneficial for improving the service due to a possible increase of “over replying”.

### 8.3 Service blueprint for the life cycle status service

Figure 47 represents the newly designed service blueprint of the secondary service for life cycle status services represented as the Life Cycle Status (LCS) module. The service for LCS consists of 3 different
phases through which the LCS module facilitates the user in obtaining life cycle status information. For phase 1, the SCOOS system provides registration capabilities in order for the end user to be able to register for the secondary service. For phase 2, the LCS module provides the user with navigational capabilities and a dashboard in order to obtain life cycle information from the spare parts database. In phase 3 the LCS module can facilitate life cycle notifications to the end user. The function, additional argumentation and alternatives of the SCOOS framework will be illustrated in more detail below. Furthermore various revenue streams which can result from the usage of the LCS module will be discussed. Beforehand it should be noted that the provided alternative revenue streams should only be viewed as suggested input for the revenue model. A single revenue stream can be used as a primary source for remuneration, acting as a standalone revenue stream, or several alternatives can be combined in order to define a more layered revenue model.

**Phase 1: Registration**
In order to make use of life cycle status services, the user is required to activate the life cycle status module. Activation commences when the user registers for the secondary service at the SCOOS dashboard. When the registration request is received and accepted by Siemens employees, instructions are sent to the user and the corporate profile is updated in order to allow the user to be able to use the module. In order for the module to be fully activated, an updated bill of material is coupled to the corporate profile which allows the LCS module to define which crane systems and subsystems are installed at the container terminal in order for the system to determine which subset of spare parts will be used by the system to gather life cycle status information.

Table 10 depicts different alternative revenue streams and subscription mechanisms based on the service components of the life cycle module service. The given numbers correspond to specific service components found in the provided service blueprint of Figure 47. For phase 1, two different revenue stream alternatives with corresponding subscription mechanisms are proposed. The first alternative is to base the revenue stream on the LCM registration, meaning that remuneration is provided by the user when registering for LCS services. The subscription mechanism can either be on the basis of an annuity, relying on a recurring revenue model, or a one-off transaction. Administering this revenue model would relative be a simple process, since less procedures and less interventions are required in order to incur remuneration. Another alternative is to incur revenue by the amount of parts available in the bill of material for a specific crane or the pool of cranes used by the end user. This would mean that if an end user uses more subsystems in order to sustain operations, and therefore has the need to obtain more life cycle information, additional revenue will be required. This alternative can be annuity based, requiring a contribution every year based on the updated amount of parts found in the bill of material.

**Phase 2: Obtaining life cycle information**
The user is required to have an active SCOOS dashboard session and access to the LCS module. When accessed, the user can navigate through different spare part systems and subsystems categories in order to select which spare parts the user would like to view the life cycle status of. After selecting the spare parts, an overview of the selected spare parts is created at the LCS dashboard making it possible to view the life cycle status of the spare parts. Additionally, the LCS dashboard allows the user to create custom spare parts categories, such as a segmentation of spare parts and their life cycle status per critical or
non-critical items thereby improving the overview capabilities of the LCS dashboard. In order for the system to be able to provide life cycle status, the databases of spare parts and there life cycle status need to be aligned with the LCS module. It may also be advisable to use a different set of life cycle terms. While life cycle notions, within Siemens, have a clear meaning for internal use, other concepts or a level of aggregation may be required when notifying the user.

For phase 2, four alternative revenue stream are elaborated. The user can be billed on the basis of the amount of logins that are registered by the system. Administering this revenue model would relative be a simple process since less procedures and less intervention would be required in order to incur remuneration. An alternative would be to base remuneration on the amount of spare parts selected for viewing in the LCM dashboard, meaning that more selected items would result in higher remuneration by the user. As previously stated, different life cycle aggregation levels can be introduced for the user. A higher level means that higher precision is given with regards to the life cycle status. The provided information can for instance be based by annual quarters, monthly or represented by a fixed date. The more precise the classification, the higher contribution would be required. From the perspective of the critical or non-critical items, a distinction can be made on the basis of characteristic of the spare part. For instance, a non-critical spare part, would require lower contribution compared to a critical item.

**Phase 3: Life cycle notification**

In order to proactively inform the user about the changing life cycle status of a spare part, the LCS dashboard allows the user the ability to configure an automated notification which will be presented through dashboard notifications and e-mail. After the user has registered and configured for LCS notifications, the user can customize the preferences of the notification. For instance, an option would be to allow the user to obtain weekly or monthly notifications of the selected spare parts, or a notification when the LC status of a single spare part changes. If a life cycle status changes, the notification system will issue a notification to the LCS dashboard, as well as to the e-mail address provided in the corporate profile. A possible alternative for the revenue stream is to acquire remuneration per received notification.

### 8.4 Validation of the service blueprint

This paragraph is dedicated to the validation of the service processes as designed in the service blueprints and focusses on the added value of the redesigned service. In general, three different value added components were identified and implemented into both service blueprints. The modular Siemens Cranes Online Ordering System (SCOOS) was introduced in order to integrate the automatic ordering system, its processing and customer feedback capabilities as a primary service. Using its modular design, the Life Cycle Status (LCS) module is designed to share life cycle information as a secondary service.

**Validation of the redesigned spare parts service blueprint**
The redesigned service of spare parts is designed based on existing processes of Siemens spare parts services. The difference between the processes of the original spare parts service are the internet components related to the SCOOP services and the added feedback capabilities. It has been stated that Siemens Cranes is currently working on a system which incorporates the changes advised by this report. The new system focusses on an online ordering system and improved customer feedback processes for a select few container terminal operators and crane manufacturers. Although the changes advised by this report have not directly contributed to these high level decisions to improve the current ordering system, it can be stated that the changes opted in this research confirm the actual need statement of the end users. Although full disclosure is not given concerning the newly designed spare parts system, in
contrast the redesigned service, it is observed that the new system is a closed system which does not except new users. Another issue which is disclosed is that in order to implement an online ordering system, a certain minimum amount of orders is required. This is due to the cost associated in designing a digital environment for a specific client.

Validation of the life cycle status service
Although life cycle status is currently not a standalone service, the ability exist to obtain life cycle information by one off means, free of charge. This is usually the case when a firm obtains the information through direct communication with service employee free of charge, it is however not a rendered service. The designed service is not a typical service which Siemens employs concerning life cycle information. Currently, Life cycle information can be obtained through a package which adds additional analysis on warehousing and other storage related attributes. In relations to the processes which are employed in the designed service of life cycle information, information concerning the life cycle status as well as the segmentation between critical and non-critical subsystem is already present, as well as a mail notification system.
PHASE 3:
Conclusions & Reflection

Chapter 9 - Conclusions and Recommendations
Chapter 10 - Reflection
9 Conclusions and Recommendations

The goal of this thesis is to increase the understanding of redesigning services by researching current business models and the needs of the end users in order to ultimately create a competitive service through the service dominant perspective. Based on the service dominant logic, which focusses on co-creation in order to design and manage services, a user centric design methodology is chosen, Figure 48. Through this methodology the services of spare parts and maintenance of Siemens Cranes have been redesigned by translating the six steps of the methodology in sub questions. This chapter is dedicated to the conclusions and recommendations of the thesis. First the sub questions which were analyzed throughout the previous chapters will be listed and answered in order to provide answer to the main research question. Additional conclusions are presented based on the chosen user centric methodology as a method to redesign services.

9.1 Business models of spare parts and maintenance services

The first step of the user centric design method was to analyze the business models of spare parts and maintenance services through the VISOR framework. The following sub question is answered:

“What business models are currently implemented for the services of spare parts and maintenance in the container handling cranes industry?”

As with many industries, competing electrical components manufacturers share similar ways in which they commit to services within the scope of their industries. Based on the organizing - and revenue model, both services are organized through different direct and indirect channels where independent Siemens branch offices decide on how to arrange their service organization and revenue stream for their geographical region. However, when analyzing the services of spare parts and maintenance of Siemens Cranes, other more specific differences and similarities between the services are noted. Maintenance services is seen as a more user orientated service compared to spare parts services. This can be explained by the essence in which the service is rendered. For instance, the primary goal of spare parts services is to eventually provide the end user with the appropriate goods. The goal is therefore seen along the paradigm of goods centered logic whereby the spare part is seen as a value which is exchanged. However, the goal of maintenance services is to provide skills, experience, knowledge or other operant resources in order to resolve the issues plaguing the end user which conforms to the paradigm of service dominant logic. Differences are also observed within the actual service processes of both services. For instance, for spare parts service, less attention is given to user feedback, while maintenance services employs user feedback in order to improve future service provisioning. Both services do not have any service platforms which enable any kind of digital distribution of service elements to the users. These issues can, with the limited level of physical systems for spare parts services, decrease the level of perceived service quality by the user. In reference to the common...
interfaces for both services, the interface of Siemens Industry Mall does provide high value customers who acquire high amounts of electrical components with an electronic ordering system through which spare parts can be ordered. However, container terminal operators do not have access to this system. Only the Siemens Industry Online Support system is accessible for information relating to customer support. The following additional conclusions have been drawn based on the VISOR business model analysis.

- VISOR framework is useful when analyzing service business models in order to obtain an overview of current service issues, possible process optimization, or act as an indicator for operational issues witnessed by the user.
- Less issues are witnessed during the business model analysis with services which have feedback capabilities and require more user engagement;
- VISOR framework is deterministically drawn towards IT solutions due to the adaptation of a service platform component and the focus on future service systems.
- VISOR framework possesses certain elements of a basic stakeholder analysis in order to analyze the supply chain or value chain of the service.

9.2 The interests, objectives and issues of key stakeholders

The second step of the user centric design method was to analyze the stakeholders which are active in the supply chain of spare parts and maintenance services, through the use of a general stakeholder analysis. The following sub question is answered:

“Which interests, objectives and issues do stakeholders in the supply chain of container handling cranes have with regards to the services of spare parts and maintenance?”

Within the research, five different stakeholders were analyzed in order to obtain their interests, objectives and issues. The electrical components manufacturers, crane manufacturer, system integrators, electrical wholesalers and container terminal operators are part of a complex supply chain network which objective is to supply value to the next supply chain echelon. Within the industry, different sings of vertical integration are noticed, such as global terminal operators’ ability to act as a system integrator for other container terminal operators. The industry can also be classified as a conservative industry were, due to servitization, service focus is slowly but surely gaining ground.

Looking at the interests, objectives and issues of the upstream supply chain, the electrical components manufacturers, crane manufacturers, system integrators and electrical wholesalers focus their interests on the selling of either products or services to the container terminal operators. The economic situation has, in effect, forced the global terminal operators to adapt by assuming rationalization strategies. The operators are reorganizing their firms in order to increase efficiency by changing size, policies and/or service portfolios. This strategy has resulted in several cancellations or postponements in the construction and development of new terminals. Although currently the economy, in some parts of the world, is improving, it remains to be seen how terminal operators will continue to drive their business in the upcoming economic recovery. The economic shift has had an effect on all other supply chain echelons. In the strive to increase profitability, electrical components manufacturers, crane manufacturers and system integrators are increasing their customer focus and are relying on service provisioning to improve their financial performance. The crane manufacturers are partnering with service organizations in order to be able to provide additional services on a global scale, while electrical components manufacturers are becoming a hinder for system integrators who in the past were
designated to render services, such as maintenance, to the container terminal operators. The firms are therefore becoming, in addition to supply chain partners, also each other's competitors. In relation to spare parts services, the electrical wholesalers rely on standardized goods which they sell to the supply chain. Although they have the ability to deliver spare parts services to the container terminal operator, their focus lies primarily on standardized electrical components, seen as a profit center, while electrical components manufacturers primarily focus on customized and complex components. For the previous mentioned firms, delivering simple products is seen as a cost center due to high overhead costs associated with the transaction. The following additional conclusions have been drawn based on the stakeholder analysis.

- Conducting a stakeholder analysis is more useful when an equilibrium exists between the strength of supply chain partners or value chain;
- In addition, the stakeholder analysis is more useful when the interaction of the value chain results in a complex sociotechnical service system where inherent risks to the stakeholders are based on value chain requirements in relations to the redesigned service processes;
- When the distribution of strength is disproportionately leaning towards the service owner, the stakeholder analysis becomes less informative, for redesign purposes, due to the indifference towards the interests, objectives and issues of other supply chain partners.

9.3 The key performance indicators of the maintenance organization

The third step of the user centric design method was to analyze the key performance indicators of spare parts and maintenance services. The following sub question is answered:

“Which key performance indicators do the end users of crane handling cranes employ to assess the services of spare parts and maintenance?”

The maintenance organization of container terminal operators focuses on the lagging indicators of reliability, availability and maintainability. In systems engineering, these attributes are also referred to as the RAM attributes. Reliability is seen as the probability that the crane or subsystem thereof will function during a specific period of time, under the stated specifications without succumbing to failure. Reliability, in essence, is quantified by the Mean Time Between Failure (MTBF). Availability, while related to reliability, is the ability of the crane to perform its stated function during a specific period of time, under the prescribed specifications. This attribute deems failures as repairable. Maintainability, on the other hand, is seen as the probability that a crane or subsystem thereof is restored to its functioning order, within a certain amount of time, when maintenance is performed according to the prescribed procedures and with adequate resources. The attribute is quantified by the Mean Time To Repair (MTTR).

Although theory dictates that a firm which uses key performance indicators should acknowledge lagging, leading as well as perceptive indicators, the stated RAM attributes exclusively belong to the category of lagging indicators. Lagging indicators are intended to measure how well a process has been managed but not how to manage the process, such is only the case with leading indicators. None of the cases have mentioned the use of any leading - or perception related KPI’s. Leading KPI’s can either be not fully implemented within the maintenance organization, not properly hierarchically linked to lagging KPI’s, or the interviewees were not aware of the importance or the existence of these type of measurements. The lack of perceptive related KPI’s can be explained by the supporting nature of the maintenance organization. Since the maintenance department is solely focused on providing (internal) firm wide
maintenance through work orders, less weight is given by the organization to measure the perception of other departments concerning the maintenance activities. The following additional conclusions have been drawn based on the KPI analysis.

- KPI analysis can lead to a better understanding of operational issues, which can influence the scope and direction of the design space;
- Although leading measures are collected by specialized systems, a firm can disregard the importance of such systems and not pursue direct optimization;
- Redesigning services based only on lagging indicators without linking leading indicators is inappropriate due to validity issues which can arise when the redesign is based on wrong indicators;
- Collecting and analyzing leading indicators is a difficult undertaking without the accessibility to a hierarchical map or causality model which links leading measures to lagging indicators;
- Perceptive measures are less important to firms or departments who only focus on internal activities such as work order reduction through maintenance services.

9.4 The need statement of container terminal operators

The forth step of the user centric design method was to obtain and analyze the need statement maintenance organization. The following sub question is answered:

“What are the current and future needs and expectations of the end users with regards to the services of spare parts and maintenance?”

The container terminal operators witness issues which can be categorized in three different categories, lead time related, information related and flexibility related issues. Lead time related issues are primarily caused by the observed long lead times during the information provisioning phase of the spare parts service where Siemens Cranes provides information to the container terminal operator. More specifically, it is perceived that the lead time associated with setting up a quotation by the electric components manufacturer consumes too much time. Due to the interaction between lead times and the processes observed by the maintenance logistics organization, the responsiveness of the spare parts service is lagging behind. This leads to altercations whereby non-critical subsystems heavily influence the key performance indicator of availability and mean time to repair due to the inability to properly maintain a critical subsystem. Therefore, consequential economic loss is endured by the container terminal operator in the process. In order to resolve these issues, the container terminals opt for manufacturers to improve the lead times by incorporating an electronic ordering system which contains tendering data such as price and delivery time when dealing with standard spare parts with known item numbers.

Information related issues are primarily the effect of a lack in the ability to obtain information concerning the phase out period of a spare part. It is believed that it is in the interest of the electrical components manufacturer not to communicate phase out information due to the possibility of increased financial benefits for the electric components manufacturer. In the current situation, when a spare part is phased out, container terminal operators have to seek other less reliable sources or let the components manufacturer modify the crane in order to maintain functionality. The asymmetry in information is perceived as a principal-agent problem. A possible solution is to offset the asymmetric characteristic of the flow of information in order to restore equilibrium between principal and agent. The container terminal operators opt for a database with the bill of materials, delivery times, compatible
alternative spare parts and the product life cycle status in order to assess which strategic and tactical choices are suitable. The incentive could be to frame this database as a new secondary service within spare parts services.

Flexibility related issues relate to the sense of arrogance of the electric components manufacturers as perceived by the container terminal operators. This is mainly caused by the discrepancy between the power of the container terminal operator, referred to as the principal and the electric components manufacturer, referred to as the agent. While reflecting on several subjects such as the uniqueness of the offered products, market capacity, corporate risks, price structures, demand and strategic importance, it can be concluded that the strength of the principal is considered to be low, while the strength of the agent is relatively high. In such occasions less long term collaboration is evident between principal and agent, while at the same time the agent is less willing to invest in risk holding ventures with the principal. This discrepancy can lead to a lower quality perception by the principal towards the agent and less customer intimacy due to limited prospects for future financial gain. The strategy for a container terminal operator in such occasion is geared towards supplier diversity, meaning that it is more in the interest of container terminal operator to search for, if possible, alternative suppliers, manufacturers or supply routes. This is however difficult to realize such a strategy, since a technological path dependency is persistently presents which guides the acquisition behavior of the principal.

Container terminal operators would also welcome efforts to employ co-creation of services by participating in design initiatives. The operators have rarely noticed a co-creative process initialized by a service provider. Although not certain about how to implement such initiatives, container terminal operators would welcome different levels of co-creation based on simple meetings, towards more constructive processes such as participatory design. The following additional conclusions have been drawn based on the need statement analysis.

- The issues specified in the need statement analysis are operational issues and act as a confirmation for issues which have been gathered from the businesses model analysis;
- Issues related to principal-agent problems can be used to redesign service processes or create an opportunity to design additional primary or secondary services that resolve information asymmetry;
- Less issues are witnessed during the need statement analysis with services which have feedback capabilities and require more user engagement;
- Power balance within the supply chain can cause collaborative friction which hinders the effort for service redesign;
The fifth step of the user centric design method was to redesign the service on spare parts. The following sub question is answered:

“Which service processes should be redesigned in order to comply with the needs and expectations of the end users?”

Based on the information and data gathered from the internal analysis resulting from the business model analysis and stakeholder analysis and the external analysis gathered from the KPI analysis and the need statement of the container terminal operators, a set of 6 issues is observed. It can be stated that issues originating from the internal analysis were less customer orientated, more technical in nature and systemic in character, meaning that the service issues could cause multiple events within service provisioning which could ultimately lead to several operational service issues. The external analysis yielded issues which were more specific and more focused on an operational level from the perspective of the end user, therefore with an evident customer orientation. Since cohesion between the issues exists, overlap between different issues is present.

Based on the findings, the following service processes are included into the service redesign:

- Automated ordering system
- Customer feedback capabilities
- Life cycle information

Based on these processes, a primary service of spare parts is redesigned by implementing a modular service interface called Siemens Cranes Online Ordering System (SCOOS). Through SCOOS, the end user can acquire information concerning spare parts. Information such as ordering data, price, rebate - and delivery conditions, as well the ability to trace the package are included. When the spare parts package is received, additional feedback can be provided by the user in order to improve the overall service provisioning. These improvement are intended in order to introduce an automated ordering system and to allow customer feedback capabilities.

For life cycle information, a secondary service is designed. Due to the modular design of SCOOS, it is also possible to include secondary services as modules to the SCOOS framework. The Life Cycle Status (LCS) module enables the users to obtain phase out information based on a set of revenue streams and subscription mechanisms. The following additional conclusions have been drawn based on the redesign effort:

- Although the service blueprint was created based on singular input of the designer without the direct interaction with the user, the service blueprint as a graphical representation tool of the service design can be useful without following all the steps of a blueprinting session;
- All elements of the VISOR framework can be successfully transferred to a service blueprint;
- Increasing the level of process detail can hamper the effectiveness of the service blueprint.
9.6 Validation of the redesigned spare parts service

The sixth step of the user centric design method was to validate the design. The following sub question is answered:

“Which alterations to the design can be made in order to validate the redesigned services?”

Validation of the redesigned spare parts service blueprint
The redesigned service of spare parts is designed based on existing processes of spare parts services. The difference between the processes of the original spare parts service are the internet components related to the SCOOP services and the added feedback capabilities. It has been stated that Siemens Cranes is currently working on a system which incorporates the changes advised by this report. The new system focusses on an online ordering system and improved customer feedback processes for a select few container terminal operators and crane manufacturers. Although the changes advised by this report have not directly contributed to these high level decisions to improve the current ordering system, it can be stated that the changes opted in this research confirm the actual need statement of the end users. Although full disclosure is not given concerning the newly designed spare parts system, in contrast to the redesigned service, it is observed that the new system is a closed system which does not except new users. Another issue which is disclosed is that in order to implement an online ordering system, a certain minimum amount of orders is required. This is due to the cost associated in designing a digital environment for a specific client.

Validation of the life cycle status service
Although life cycle status is currently not a standalone service, the ability exist to obtain life cycle information by one off means. This is usually the case when a firm obtains the information through direct communication with service employee free of charge, it is however not a rendered service. The designed service is not a typical service which Siemens employs concerning life cycle information. Currently, life cycle information can be obtained through a package which adds additional analysis on warehousing and other storage related attributes. No real time observation of life cycle status is currently implemented. In relations to the processes which are employed in the designed service of life cycle information, information concerning the life cycle status as well as the segmentation between critical and non-critical subsystem is already present, as well as a mail notification system. The following additional conclusions have been drawn based on validation.

- Using a service blueprint within the business model analysis and comparing it with the redesigned service blueprint proofed to be working method to communicate and validate the design.
9.7 Answering the main research question

The final step of this thesis is to answer the stated main research question by incorporating the results of the previous sub questions. The following main research question is answered:

“How can a firm, which operates in a goods dominant environment, redesign their services in order to meet the needs and expectations of the end users?”

In this research the services of spare parts and maintenance were researched. While focusing on user need through the usage of a user centric methodology in order to redesign the service of spare parts, the evidence for the issues in the lack of an automatic ordering system and feedback capabilities were revealed in advanced. While analyzing the business models of spare parts, these issues were reported when analyzing the service processes through the service blueprint. Incorporating user needs during the design process, although required in order to understand operational issues of the end user, will be more useful when the service to be redesigned has matured through continues user feedback. The lack of proactive user feedback mechanisms hinder incremental innovation to gradually change the service in order to adapt to the changing need of the customer. The lack of gradual improvements can leave a wider competency gap which can only be traversed by radically changing the service which was also the case with the redesigned spare parts services. In the case of Siemens, the lack of feedback mechanisms resulted in a discrepancy between the service processes and the need of the end users. The issues caused consequential economic loss due to the influence of the processes on the key performance indicators of the end users.

The type of service rendered
The services of spare parts and maintenance have different processes, characteristics and require a different level of knowledge, participation and influence of the end user. The service of spare parts requires less influence and interaction with the end user while the service of maintenance, due to its goal, requires additional assistance, influence and interaction. During the gathering and analysis of the need statements and key performance indicators of the end users, it was observed that a larger amount of issues were gathered for the service of spare parts compared to maintenance services. Furthermore, the issues were more critical in nature. This could be explained by the design process which was initially geared on an unilateral process more in line with the goods dominant logic on the one hand, and the inability to gather end user feedback in order to redesign the service to match the needs of the end users. Maintenance service, on the other hand, forces the designers to develop and manage the service more in line with the service dominant logic. Therefore, it is important to take into account the difference in the type of services offered. Some services will have a strong bond with goods, such as spare parts services, while others are more pure services such as maintenance. During the gathering and analysis phases of the chosen user centric design methodology, it proved to be less successful for analyzing and designing maintenance services. Due to the feedback processes, the maintenance service evolved to be more user specific compared to spare parts services. This means that other design methods or methodologies are needed to improve the design of maintenance for future adaptation.

The difference in power between agent and principal
The power difference between the container terminal operator, referred to as the principal, and the electric components manufacturer, referred to as the agent, has had a repercussion on the way the container terminal operators view the electric components manufacturers. In essence, due to limited gain, the agent is less willing to invest in long term close collaboration for redesign efforts of services due to the overhead costs associated with these methodologies. In such occasions, user centric design
Methodologies can prove to be useful in gathering the user need and transferring it towards a service design. However, in other cases, when the principal has more power than the agent, additional investment in collaboration is pursued in order to satisfy the needs of the principal and to obtain customer intimacy. In such occasions, it would be in the best interest of the agent to invest in methods and methodologies which stimulate additional co-creation.

Although different methodologies can potentially lead to different service designs, the characteristics of the involved stakeholders and the type of service can influence the choice of methodology. Although from the perspective of service dominant logic, co-creation and networked collaboration should be imprinted in every service design, the type of service and the power difference between the designer and the user can determine the methods to be used. Figure 49 depicts the characteristics of the type of service, represented by the goods-service continuum and the balance between power of the principal compared to the agent. From the perspective of the goods-service continuum, based on service dominant logic, if a product is categorized as being a pure service, additional cooperation is needed in order to design a product which is in the service domain. Methodologies which are associated with participatory design allow the user to become a co-designer by contributing to the actual design process thereby increasing the co-creative character. In such cases, methodologies such as service blueprinting whereby the user and the designer design a service blueprint in collaboration, will proof to be beneficial. From the power perspective it can be concluded that if the agent has more power compared to the principal user centric design methodologies are suitable guidelines to redesign services due to the focus on the needs of the users. When the power balance shifts towards the principal, close collaboration is needed in order to pursue customer intimacy. It can therefore be stated that participatory design methods, such as service blueprinting are more appropriate.

Figure 49: Level of co-creation and the methodologies
9.8 Recommendation for user centric redesign

Figure 50 represents an adapted user centric methodology focusing on redesigning services which require less co-creation whereby the strength of the agent is dominant within the value chain. Although the methodology looks similar to the methodology used in this research, a few improvements have been introduced based on the conclusions.

Step 1: Information gathering
Information gathering by analyzing the business model through the use of the VISOR framework can be used to obtain an overview of current service issues, possible process optimization, or act as an indicator for operational issues witnessed by the user. Although a stakeholder analysis was originally conducted, the analysis is less useful when a service is not seen as a complex sociotechnical system and where the designing firm is dominant within the supply chain. In that case, sufficient stakeholder information is already incorporated within the organizing model of the VISOR framework.

Step 2: User need identification
The user need identification step consists out of the need statement analysis and, if possible, a KPI analysis. By combining current service issues, the problems they create for business operations of the user with possible repercussions for the key performance indicators, the redesign space can be reduced. If the user does not have valid indicators, it is advised to limit the impact of the stated indicators for the redesign. Designing service systems based on invalid measures will yield negative externalities resulting in service processes negatively impacting the business processes. Furthermore, if the service only focuses on an internal department and not for outsourcing activities of the user, perceptive measures can be left out.

Step 3: Envisioning and validation
The envisioning and validation step consists out of the design of the service processes by completing the levels of the service blueprint. The service organization has gained knowledge of the business model and the need that the end users. Combining both will yield a service blueprint which acknowledges the business model of the service organization while focusing on the needs and of the end user. Validation can be done by stating the differences between the original service blueprint and the redesigned service blueprint through the use of expert validation.

Although step 4 of the user centric design has not been pursued in this research, the last step should focus on translating the redesigned service blueprint into requirements in order to specify the processes in more detail.
Figure 51 represents an adapted service blueprinting methodology focusing on redesigning services which require additional co-creation whereby the strength of the principal is dominant within the value chain. Sessions of service blueprinting were initially discussed by Bitner et al. (2008) but adapted to incorporate the results of this research.

Preparatory step 1: Divining a goal
First, preparations need to be met in order to organize the internal or external service blueprint session. The organizer, has to set out a goal for the upcoming blueprint session. A possible goal can be to design a new type of primary, or secondary service, or to decrease lead times of an existing service. Stating the goal can be done through the analysis of the current business model.

Preparatory step 2: Arranging involvement
Another important preparatory step is to decide who will be involved in such sessions. Ideally for an internal session, internal actors should be invited who have observed the individual service processes, or are engaged with - or in charge of the process. For external sessions it depends on the goal. If the goal is set to redesign a service for a specific end user, it is more likely that a combination of key personal of the service provider as well as the end user are invited. If it concerns a complex sociotechnical system, a generic stakeholder analysis is advised. If it concerns a more simple service, a selection of stakeholders obtained from the business model analysis will suffice.

Execution step 1: Transferring fundamentals
When the preparatory steps are concluded, a service blueprint session can be scheduled. A general session consists of four steps. The first step is to convey to the importance of such a session and to stimulate the stakeholders to contribute to the effort. By gaining attention, interest, desire for the subject, action is stimulated in order to redesign a service. It is for instance important to stress that such sessions are vital in order to identify possible failures, areas for improvements and to possibly exchange knowledge of processes which are not fully visible.

9.9 Recommendation for redesign through service blueprinting
from a holistic systems perspective. In order to understand the fundamental layers of which a service blueprint consists of, it is important that the invitees fully understand the basic layers. This is the reason why an examination of an existent service blueprint, as an example, is advisable.

**Execution step 2: Create familiarization**
After the fundamentals are known, familiarization of the technique will allow the invitees to read and design service blueprints. This can be done by designing a simple service blueprint from everyday services, such as hotel-, garage- or a postal services. Developing such service blueprints can be done by multiple groups. Afterwards, the groups can exchange their designs and see which differences are present in the designs and why some groups chose different alternatives.

**Execution step 3: Service blueprinting**
When the invitees are confident that they understand the technique, the organizer can start to conduct actual service blueprinting with the aim of accomplishing the previously stated goal. Depending on the goal, it might be necessary to first design a blueprint got the current service and afterwards, depending on the feedback, redesign the blueprint with live feedback from the invitees. If the organizer has extensive knowledge about the service, a prefabricated service blueprint can be presented to the invitees in order to kick start the redesign process. The initial service blueprint would have been ideally designed based on the input of the business model analysis. In order to obtain a redesigned blueprint, the stakeholders will engage in the sharing of knowledge about the current service processes and how they can be improved. Obtaining the need of the user and their key performance indicators can improve the outcome of the redesign. Because service blueprinting requires interaction between organizer and invitees, it is important to blueprint on a digital canvas, which can be done through different closed - and open source software packages, relying on multiple computers, or by projecting the blueprint onto a surface. The latter can be accomplished by using a projector. When digital means are not present, it is also possible to work on a whiteboard.

**Execution step 4: Modify blueprinting process**
When the goal of the session has been accomplished, the service blueprint technique can be modified to better suit the service for future sessions. For instance, as previously stated, it might be possible to include in- and output, KPI variables for each process, or to completely remove certain layers within the blueprint technique altogether. When multiple sessions have been concluded, a definitive service blueprint can be presented after which the service processes can be assessed in more detail.
10 Reflection

The thesis concludes with the chapter for reflection. The chapters aims at clarifying why some choices in research methodology and conclusions were made. This is done by critically examining research literature, methodology and techniques which were presented throughout the thesis and examining them with the findings of the research. Doing so will reveal the limitations of the research and ultimately the actual value of the findings through which recommendations can be proposed for additional research initiatives.

10.1 Reflecting on the research literature

Throughout the theory of service, a great deal of attention is paid to the difference in characteristics of service compared to the classical characteristics of goods. For instance, researchers stress that a service is intangible, rendering storage of services impossible, or that a service exhibits heterogeneous properties, meaning that service standardization is difficult to implement and production & consumption are inseparable. These characteristics, in their entirety, provide a strong basis for the argument that co-creation should be infringed during the process of design and provisioning of service (Jaw et al., 2010; Meier et al., 2010; Vargo & Lusch, 2004; Zeithaml et al., 1985). However, insufficient emphasis is given to the argument of how co-creation should be executed by the managing practitioners. Although the concept of co-creation has been defined by researchers, it still remains inconclusive what level of co-creation is required in order to, on the one hand, satisfy customer needs while at the same time maintaining low costs in the design and provisioning of services. This is especially problematic when the balance of power between the principal and agent is asymmetrical, whereby the distribution of power is leaning unproportionatly towards the agent. In such cases, the agent is less willing to commit to co-creation due to the resulting high costs and relatively low benefits resulting from a confined project scope while incurring high overhead costs. It is therefore unlikely that full co-creation is feasible or can be made profitable for the service providing agent. It is more probable that a distinction should be made between certain levels of co-creation. Ironically, to further elaborate on this issue, an analogy is drawn based on concepts which were developed for use in the goods dominant dimension.

The analogy of the Customer Order Decoupling Point

Within the development and distribution of goods, different levels of customer interaction, co-creation and product distribution can be permitted to certain product ranges. In operations research, supply chain management and logistics, these levels are referred to as Order Penetration Points (OPP), or Customer Order Decoupling Points (CODP), see Figure 52 (Jodlbauer, Olhager, & Schonberger, 2012). The CODP model distinguishes four specific decoupling points which relate to different production and design phases. Based on product characteristics and the strategic capabilities of the production firm, the firm chooses a specific point in its design process through which collaboration with the customer is preferred for single or multiple product lines. It also states where the inventory is held. The drive to choose for a specific point in the design process relates to the ability of the production firm to forecast the demand of the customers. For instance, if the demand of a specific product is known in advance, a more forecast-driven CODP can be chosen, such as Make-to-Stock. In such cases, customers are unable to co-create the product, because
the production firm chooses to simply deliver a standardized good to stock, for instance, a commodity good. A production firm can also choose for a total customer order-driven solution, such as Engineer-to-Order. This time the production firm chooses to allow customer specific orders to penetrate downstream into the design process. Such firms usually produce exclusive custom designed goods.

**The level of co-creation within service design**

In the CODP analogy, different levels of co-creation, ranging from nonexistent co-creation with Make-to-Stock, towards high levels of co-creation between production firm and customer with Engineer-to-Order, exist. A production firm chooses a decoupling point based on different product characteristics such as, customizability, volume sizes and the predictability of demand or on firm based strategic considerations, such as lean or agile production, the overall design of the supply chain and other strategic priorities. Some classical services such as spare parts services and maintenance may require less co-creation than other services such as technical consulting or engineering support. This can be explained by the previously gained experience in the field of spare parts and maintenance services. For instance, spare parts and maintenance services are required in order to sustain a level of firm continuity and productivity. Therefore the variety of typical spare parts requests in relation to the different types of container terminals have been exhausted and can largely be predicted making forecasting of the demand of the services and its content realistic. Technical consulting and engineering support are more specific services, where more variety is observed and the need of the customer is required in order to provide assistance. This segmentation of levels of co-creation coupled to certain service properties and firm based strategies is currently unavailable. It therefore remains unclear at what level of co-creation should be permitted within service design and how far the end user should ideally penetrate the design process.

While a proper theoretical framework is still absent, the service provider can perform a costs-benefits analysis in order to ascertain which costs co-creation has compared to the benefit of customer experience. The service provider can also engage in a pareto efficiency analysis, see Figure 53. The analyst can research the benefits of the service provider, compared to the benefit of service for the customer and how co-creation and the corresponding costs relates to both actors. Current levels of co-creation of a specific service can for instance constitute a pareto inefficient solution. This would imply a solution which is not efficiently chosen with regards to the recourses used by the service provider or the customer. When pareto optimization occurs, different configuration of the service, or of other methods of co-creation can reveal a pareto efficient solution. A minimal condition for a pareto efficient solution, is to reconfigure the resources in order to obtain more benefit for a single actor, while the benefit for the other actor remains constant.

It is recommended for those interested to further research the variables which define which level of co-creation is suitable for different type of services. The focus of researchers can thus be geared towards uncovering these characteristics which determine the level of co-creation in order to aid practitioners in service design. However for practical considerations, a cost-benefit analysis or a pareto efficiency
analysis in order to gain additional benefit for either actors is recommended. Through this research the following indications of characteristics have been discovered:

- Complexity of the service and the rank within the goods – services continuum
- The strength of the service provider within the supply chain and value chain

10.2 Reflecting on the research technique

During the analysis of the business models of the spare parts and maintenance services, based on the analysis of the VISOR components, a different method was initially chosen to depict the organizing model. Figure 54 represents the original flow chart which depicted the organizing model of spare parts services. This depiction represents a model which was constructed by a combination of a standard and compact flow chart technique with a chart technique which is used by Siemens Cranes in order to visualize and improve the service of spare parts. The adapted flow chart depicts three different attributes. The input represents the input needed in order to initiate a process. The process is the service activity which adds value to service provisioning. The output is the result of the process and usually acts as an input for the adjacent process activity. During the initial analysis of the organizing model it became clear that drawing conclusions relating to service discrepancies or possible improvements on the basis of the depicted flow chart, was problematic. This was mainly due to the descriptive character of the flow chart technique which was used. Insufficient proper conclusions on behalf of spare parts service could be drawn since the methodology lacked analytical fundamentals to give a judgment over the current service processes. In order to be able to pass judgment over the current services, the organizing model was additionally modeled by means of a service blueprint. The service blueprint can be used as a descriptive model, but can also be used as an analytical modeling technique which combines multiple process levels of a service and also adds customer actions and interaction as variables. After reconstructing the processes into different service components and adding them to the service blueprint framework, more discrepancies, points of attention and peculiarities were made evident. The flow chart technique proved to be less efficient for analyzing and improving services and too much internally focused in order to incorporate customer orientation.

It is recommended for practitioners who use simple flow charts to model services and struggle with analytical consequences of using such an approach to switch the technique of service blueprinting. However, the technique of service blueprinting in its default form, can be improved by adding inputs and outputs - and KPI variables to the service processes. This will enrich the overview and possibly challenge service improvement contributors in improving their criteria, for more information concerning possible improvements of the service blueprinting technique, see Roudman (2013).

10.3 Reflecting on the research response

Based on the input and selection provided by Siemens Cranes, 16 individuals, originating from 5 different container terminals, ranging from 4 different global container terminal operators, with specific corporate titles and functions were contacted for this research. Ultimately only 5 external correspondents actively participated in the research. Although it is feasible to design a service based on the needs and expectations of a single end user, it was hoped to have the possibility of interviewing
more individuals and to have a greater research response. Having more contributors to the research can aid in the process of finding consensus for service issues and possibly a smoother transition towards the definitive design. The reason for a lower response than anticipated could be related to the strategic choices and policies made by different global container terminal operators. Since many different and hidden alliances between operators, producers and suppliers exist, it is difficult to obtain information from global terminal operators who hold a strong relationship with a competing supplier.

Furthermore, although face-to-face interviews, as well as interviews by telephone and other digital means were made available, only one face-to-face interview was conducted. The reason for the low amount of face-to-face interviews was either the direct result of the unavailability of an interviewee due to work related issues, such as projects being abroad. When face-to-face interviews were not possible, an interview by digital means was suggested to the interviewees. Using the call function of Skype was the preferred choice by the interviewer since voice recording is possible with such digital means. However, due to the lack of supporting IT infrastructure at all the offices of the container terminals, Skype was not an alternative for any interviewee. The use of a regular telephone was the only alternative. In some cases, telephone calls were not chosen by the interviewee to which questionnaires were mailed.

The face-to-face interview resulted in the most accurate and trustworthy results. Expressions of interviewees were noted and questions were rephrased or changed to better suit the situation. This created a lively discussion. In relations to the discussions through the telephone, no recording was possible, therefore answers were immediately noted in writing. This resulted in less discussion and debate with the interviewee. Also the interviewees had less time to participate while on the telephone. It was observed, that terminals outside Europe, in for instance Africa and Asia, were less well understood due to the difference in the skill of the English language. Due to the this and the lack of recording capabilities, the researcher summarized the answers of the interviewee, per topic section, in order to get an acknowledgement whether the interviewee was correctly understood. It is recommended that if such a research would be repeated on a more global scale, the interviews should be carried out by skilled interviewers situated in the home country of the terminal. In the case of Siemens this would ideally be performed by service specialists at branch offices situated in the same country as the targeted terminal.

### 10.4 Reflecting on the research results

Before data collection, it was surmised that since spare parts and maintenance services are classical services and have been provided numerous times in the past, that due to optimization, many service issues would already be solved. Although this was largely the case for maintenance services, it seemed that the service of spare parts did not fully cover the needs and expectations and therefore remained amendable in the view of the end user. If service issues would have already been resolved in previous rounds of service improvements, less coherence within the answers of the interviewees would have been present. On the contrary, more strategic behavior would have been noticed in the given answers. Some strategic answers were disclosed, such as the possibility to increase the standard warranty period. This suggestion was not included into the analysis because it lacked linkage with any primary or secondary services. Although it could be argued that an increase in the standard warranty period would be an unique selling point for a service offering, such service is already provided by the extended warranty service. By changing the standard business model to include a longer warranty period would not be in the interest of Siemens Cranes, nor would constitute a win-win situation.
The reason for a reduced customer satisfaction for the service of spare parts can partially be explained by the method used to analyze, design and improve the service. As previously stated, a flow chart technique is used to analyze and improve service processes. This approach is internally focused and does not fully incorporate the needs and expectations of the end user. In order to further improve the spare parts service, it is recommended to apply the service blueprint technique internally with the department, as well as externally with the client.
Bibliography


Case No COMP/M.4963 - Rexel / Hagemeyer (2008).


Ng, I., Vargo, S., & Smith, L. (2012). Reconceptualising Service through a Service-Dominated Logic (pp. 14): The University of Warwick.


Roudman, P. (2013). Defining an alteration to the service blueprinting model by incorporating performance measures and service I/O characteristics in order to improve the process of co-creation in service design (pp. 6). Delft: Delft University of Technology.


11 Annexes

11.1 Annex 1: Interview questionnaires

11.1.1 Questionnaire Siemens

<table>
<thead>
<tr>
<th>Questionnaire – Business Model Analysis of “spare parts services” and “maintenance services” through VISOR framework components: Siemens Netherlands N.V.</th>
<th>Date:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name:</td>
<td></td>
</tr>
<tr>
<td>Function:</td>
<td></td>
</tr>
<tr>
<td>Relevance:</td>
<td></td>
</tr>
</tbody>
</table>

**Nurturing:**
Vragen naar functie, bezigheden en academische voorgeschiedenis.
Aangeven over welke services het precies gaat.
Aangeven welke soorten vragen er gesteld gaan worden.

**Energizing:**
Aangeven dat het gaat over het verbeteren van de huidige services. Om beter aan te kunnen sluiten op de eindgebruiker. Daarbij moet er vermeld worden dat de “eindgebruiker” in dit geval een container terminal operator is.

**Body:**

**Co-creation:**
1. Hoe worden services bedacht binnen Siemens?
   a. Via welke methode, model, strategy?
2. Denkt u dat er meer interactie moet zijn tussen de klanten en Siemens bij het bedenken van de services?
3. Is de markt voor industriële services al verzadigd?

**Value proposition:**
1. Kunt u in uw eigen woorden vertellen wat de services precies inhouden?
2. Welke voordelen hebben de services voor de eindgebruiker?
3. Voor welke eindgebruikers zijn de services primaire gericht?
   a. Zijn er ook eindgebruikers die beslist de services niet nodig hebben?
4. Heeft Siemens Cranes een onderscheid gemaakt tussen verschillende eindgebruikers?
5. Waarom moet een eindgebruiker voor de services kiezen voor Siemens?
   a. Waarom kan de eindgebruiker het niet zelf?
   b. Waarom kan de eindgebruiker niet naar de concurrent voor de services?
6. Welke aanpassingen kan de eindgebruiker maken aan de services?

**Interface:**
7. *Welke interacties vinden er* plaats tussen de eindgebruiker en Siemens bij het volbrengen van de services?
   a. *Hoe vinden de interacties plaats?*
i. *Met welke tools*; traditionele formulieren, digitale formulieren, PDA’s, smart phones, etc

ii. *Verschilt de interactie per eindgebruiker of is dit een gestandaardiseerde proces?*

*Service Platform:*

8. *Welke platformen zijn er voor het realiseren van de services binnen Siemens?*
   a. Indien aanwezig, wat zijn de mogelijkheden van deze platform?
   b. Indien niet aanwezig, waarom niet?

*Organizing Model:*

9. *Welke partijen spelen een belangrijke rol voor het realiseren van de service?*
   a. Welke partijen binnen Siemens zijn van belang?
      i. Processen en taken
   b. Welke partijen buiten Siemens zijn van belang?
      i. Processen en taken
   c. Wat is hun onderlinge interactie op gebied van product/service flow en informatie flow?

*Revenue model:*

10. *Hoe word de financiële stroom binnen Siemens geregeld voor deze services?*
    a. Hoe wordt het geregeld tussen Siemens Cranes PH en de Siemens branches?

11. *Hoe wordt de financiële stroom buiten Siemens geregeld aan de overige partijen met betrekking tot de services?*
    a. Hoe wordt de prijs bepaald van de services?
    b. Vindt er prijsdiscriminatie plaats tussen verschillende eindgebruikers?

*Co-creation:*

12. Voorafgaand

13. Wanneer heeft de klant invloed op het uitoefenen tijdens de service?

14. Denk je dat de momenten wanneer de klant invloed uit kan oefenen voldoende zijn?
    a. Waarom wel/niet
    b. Ziet u specifieke momenten tijdens

*Closing:*
Aangeven dat er een samenvatting wordt gemaakt van het interview

**11.1.2 Questionnaire Container Terminal Operators**

**11.1.2.1 English Questionnaire need statement and KPI**

<table>
<thead>
<tr>
<th>Questionnaire – User Need Identification of spare parts services and maintenance services through need statement and KPI: Container Terminal Operators</th>
<th>Date:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Firm:</td>
<td>Name:</td>
</tr>
<tr>
<td>Function:</td>
<td>Relevance:</td>
</tr>
</tbody>
</table>

**Nurturing:** Questions concerning company, function, occupation and academic degree, explanation about the services and questionnaire.

**Energizing:** Improve services, to re-align the services to the needs of the customer, to let the customer participate in the creation of the services.
Body:

Current situation:
1. How is spare parts and maintenance services currently implemented?
   a. Which parties are involved with providing the services?
2. Who decides if these services will be used?
   a. Are services decided upon per terminal or on a higher level?
      i. Is the coordination of these services organized in a centralized or decentralized manner?
      ii. Are there specific management tools that aid you during the service process?
3. Does your service organization have specific key performance indicators?
   a. How do you use the KPI’s?
   b. Which KPI’s do you find most important and why?
4. How much influence did your organization have in the development of the service?
   a. Did you want more influence, why so?

Problem discovery:
5. How satisfied are you with the current service?
6. What issues are you currently having with the services?
   a. Have you previously addressed these issues?
   b. Do you see any reason in the future to re-arrange the services, change provider?

Problem impact:
7. How do these issues impact your business operations?
   c. How do they disturb your business?

Value solution:
8. Do you already have a possible solution in mind with regards to the services?
   a. Which solutions should come from the service providers in order to resolve the issues?
9. Do you think that more cooperation in the field of service-creation is useful?
   d. If so, how do you see it?

Confirmation:
10. Would the improved services be more worthwhile than the services currently provided?
11. How can cooperation with regards to services be improved?

Closing:
Summary will be made and submitted for review
11.1.2.2 Dutch Questionnaire need statement and KPI

<table>
<thead>
<tr>
<th>Questionnaire – User Need Identification of spare parts services and maintenance services through need statement and KPI: Container Terminal Operators</th>
<th>Date:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Firm:</td>
<td>Name:</td>
</tr>
<tr>
<td>Function:</td>
<td>Relevance:</td>
</tr>
</tbody>
</table>

**Nurturing:** Vragen naar functie, bezigheden en academische voorgeschiedenis, uitleg over de services, uitleg over de vragenlijst, vragen over het bedrijf.

**Energizing:** Verbeteren van de services. Beter aansluiten van de services op de eindgebruiker, meer de eindgebruiker laten betrekken bij de services.

**Body:**

**Current situation:**
1. Hoe wordt bij u spare parts - en maintenance services uitgevoerd?
   a. Welke partijen zijn betrokken bij de uitvoer van de services?
2. Wie beslist of er van deze services gebruik wordt gemaakt?
   a. Wordt er terminal breed gekeken naar services, of operator breed?
      i. Wordt er centraal of decentraal gecoördineerd?
      ii. Zijn er specifieke management tools die u hanteert daarvoor?
3. Heeft uw service organisatie specifieke Key Performance Indicators?
   a. Hoe worden de KPI’s gebruikt?
   b. Welke KPI’s vindt u het belangrijkst en waarom?
4. Hoeveel invloed heeft uw organisatie gehad bij de totstandkoming van de services?
   a. Had u meer invloed gewild?
      i. Zo ja, wanneer en waarom?

**Problem discovery:**
5. Hoe tevreden bent u met de huidige services?
6. Welke issues ondervindt u met de huidige services?
   a. Hebt u eerder deze issues aangekaart?
   b. Ziet u in de toekomst enige reden om de services anders te regelen?

**Problem impact:**
7. Hoe vertalen de issues zich naar problemen in bedrijfsprocessen van uw bedrijf?
   a. Welke hinder ondervindt u daarvan?

**Value solution:**
8. Hebt u reeds mogelijke oplossingen voor ogen met betrekking tot de issues?
   a. Welke oplossingen dienen er vanuit de markt te komen om uw issue op te lossen?
9. Denkt u dat meer samenwerken op het gebied van servicecreatie nuttig is?
   a. Zo ja, hoe ziet u het voor u?

**Confirmation:**
10. Zouden de verbeterde services beter overkomen dan de services geleverd door andere partijen?
11. Hoe kan samenwerking op gebied van services volgens u worden verbeterd?
Closing:
Samenvatting wordt gemaakt en opgestuurd ter controle

11.1.2.3 Questionnaire validation

<table>
<thead>
<tr>
<th>Questionnaire – Validation of Service Blueprint</th>
<th>Date:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name:</td>
<td></td>
</tr>
<tr>
<td>Function:</td>
<td></td>
</tr>
<tr>
<td>Relevance:</td>
<td></td>
</tr>
</tbody>
</table>

Wat vindt u van de opgeleverde service blueprint concepten?

Spare parts service blueprint
1. Wat vindt u van de modulaire karakter van de SCOOS concept?
2. Welke mogelijke problemen kunnen er optreden bij het introduceren van een dergelijke concept?
3. Denkt u dat een dergelijk concept in de toekomst mogelijkheden biedt voor Siemens?
4. Welke aanpassingen zou u het liefst door hebben gevoerd?
5. Heeft u alternatieve processen die wellicht nuttig zijn binnen de blueprint?
   a. Moet de registratie verlopen via Siemens of kunnen de klanten dat zelf doen?
   b. Wanneer kan het beste feedback worden gegeven, achteraf of altijd?
6. Worden de doelen van Siemens Cranes gedekt door de processen van de service blueprint?

Life cycle service blueprint
7. Wat vindt u van de life cycle module?
8. Welke mogelijke problemen kunnen er optreden bij het introduceren van een dergelijke concept?
9. Denkt u dat een dergelijk concept in de toekomst mogelijkheden biedt voor Siemens?
10. Welke aanpassingen zou u het liefst door hebben gevoerd?
11. Heeft u alternatieve processen die wellicht nuttig zijn binnen de blueprint?
12. Worden de doelen van Siemens Cranes gedekt door de processen van de service blueprint?
11.2 Annex 2: Overview of interviewed Global Container Terminal Operators

11.2.1 APMT

Currently headquartered in The Hague in The Netherlands, APM terminals had a total container throughput of 35.4 million TUE for 2012. The global container terminal operator is a subsidiary of A.P. Moller-Maersk Group, a Danish business conglomerate which bundles activities in the transportation sector focusing on container shipping. APMT operates a total of 69 ports spread out over 68 countries in all continents (APM Terminals, 2013b).

11.2.2 HPH

With a total container throughput of 76.8 million TUE for 2012, Hutchison Port Holding (HPH) is considered to be the largest global container terminal operator. HPH is for 80% subsidiary of the Chinese investment holding company Hutchison Whampoa (HWL) which is based in Hong Kong. The remaining 20% is owned by PSA International, a competing container terminal operator. HPH owns a total of 320 berths spread out over 52 ports, spanning 26 countries in Asia, the Middle East, Africa, Europa, America and Australia (HPH, 2013b). HPH focusses on seven core businesses: ports, airports, cargo security, cruise terminals, hotel resorts, logistics and ship repair (HPH, 2013a). The flagship ports of HPH are the Hong Kong International Terminals (HIT) in Asia and the European Container Terminals (ECT) located in The Netherlands and are among the largest container terminals in the world.

11.2.3 DP World

DP World had a total container throughput of 56 million TUE for 2012 and is considered to be the fourth largest global terminal operator. The container terminal operator is a relatively new player within the industry (Rossignol, 2007). It was founded in 2005 by means of a merger of Dubai Ports Authority and Dubai Ports International. Due to several major acquisitions such as the purchase of Peninsular and Oriental Steam Navigation Company (P&O) it has gained ground in different countries. Currently it operates around 65 ports in all continents (DP World, 2013a). DPW is owned by Dubai world and thus a state owned firm of Dubai. The operator focusses on four core businesses: ports, maritime services, cargo services and rail road services (DP World, 2013b). Container handling activities represent a total of 80% of the total revenue. The flagship ports of DP World are the Jebel Ali facilities and Port Rashid, both situated in Dubai.

11.2.4 Mediterranean Shipping Company

The Mediterranean Shipping Company (MSC) is a privately owned Swiss shipping line which was founded in 1970 (Mediterranean Shipping Company, 2013). The shipping line is active in all continents where it ships containers to approximately 215 different terminals. They currently have 434 container carrying vessels at their exposal. Due to the private status, information concerning the company is less publicly available (Port Strategy, 2012). However, the terminals are usually on a joint venture basis whereby MSC has an equal or minority share of ownership (Rossignol, 2007).