THE TRANSITION TO PRODUCT-SERVICE SYSTEMS
— A BUSINESS DEVELOPMENT METHOD
FOR
SMALL AND MEDIUM-SIZED MANUFACTURING ENTERPRISES

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Abstract

The increasing competition on today’s globalized markets creates drivers for new business models in order to create competitive advantage. By integrating services with the physical product, unique offers that aim at fulfilling customer needs rather than just providing physical goods can be created. This type of offers, in the literature often referred to as Product-Service Systems (PSS), are more difficult to imitate than pure products. Furthermore, the focus on fulfilling customer needs rather than just providing physical goods can reduce the use of resources, decreasing both costs and the environmental impact of the offer. From the customers’ point of view, PSS offers can bring increased flexibility and reduced risk.

The development of successful PSS offers requires structured methods. Much of the research within the area, and consequently models and guidelines, has focused on large companies. However, since small and medium-sized enterprises (SMEs) constitute the foundation of economic growth in all developed countries, there is an important gap in the existing research within this area. One research initiative to fill this gap is the ongoing IPSE project (Integrated Product and Service Engineering), which aims at developing a methodology for efficient development of PSS offers in manufacturing SMEs. The methodology developed in the IPSE project is however at a conceptual level that is not applicable for the management in smaller companies. This thesis hence aims at developing a concrete and useful business development method applicable for the management in manufacturing SMEs, with the focus on generation of PSS offer concepts.

Based on earlier research within the PSS area, with the emphasis on the IPSE methodology, a concrete business development method for the generation of PSS concepts was created, which was then tested on three SMEs in order to verify and improve the method. The method consists of the three steps internal analysis, external analysis and planning of the new PSS offer. Each step contains a number of tools to be used in order to analyze different aspects of the business context. After analyzing the studies of the three case studies a revised method was developed, which was then summarized in managerial guidelines to be used by managers in manufacturing SMEs. The revision of the method mainly regarded simplifications of some of the tools in order to ease the use and increase the applicability.

The method proved to be useful and concepts could be generated for all the case companies. The method thoroughly examined the possibilities of creating PSS offers, even though it was found that it was also useful for the development of conventional business offers. Since the drivers for the case companies were specific threats or opportunities that would require changes in the offer, rather than a purpose in itself to integrate more services in the offer, this implies that the method can be useful as general business development method for manufacturing SMEs.

An important learning from our studies is that the day-to-day business is strongly focused by the managers in manufacturing SMEs, leaving little time for long-term business development. As stated by a manager in the case companies:

“It is like running beside the bicycle, but we do not have the time to get on it.”

The developed method can work as a tool for structuring the information needed in the business development process and hence reducing the time needed. However, if the reduction in time needed for long-term business development is enough to get the managers on their bikes is a question assigned to further studies.
Acknowledgements

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We also have to thank the persons within the case companies (MJP, Assalub and Polyamp) that have helped us understand their businesses. The discussions of ideas regarding the future development of the companies have been very interesting and rewarding.

Last but not least, we would like to thank our opponents Sofia Lingegård and Emma Sandström for always being helpful and supportive. Their rigorous and constructive feedback has without doubt enhanced the readability of this thesis; all remaining shortcomings are solely to be blamed on ourselves.

Tobias Calminder

Linköping, November 7th 2008

Martin Carlshamre
Abbreviations

The fundamental abbreviations used in this thesis are listed below.

ACRA  Anticipative Customer Requirement Analysis
CAM  Center for Applied Management for small and medium-sized enterprises
FS  Functional Sales
IPSE  Integrated Product Service Engineering
IPSO  Integrated Product Service Offer
LCA  Life Cycle Assessment
PSS  Product-Service System
SME  Small and Medium-sized Enterprise
SE  Service Engineering
# TABLE OF CONTENTS

1 INTRODUCTION ................................................................................................................................................. 1

1.1 Problem Background ........................................................................................................................................... 1

1.2 Thesis Background ............................................................................................................................................... 2

1.3 Purpose of the Thesis .......................................................................................................................................... 3

1.4 Research Questions ............................................................................................................................................. 3

1.5 Focus and Delimitations .................................................................................................................................... 4

1.6 Outline of the Thesis ........................................................................................................................................... 4

2 Frame of Reference ................................................................................................................................................ 6

2.1 Definitions of Theoretical Concepts .................................................................................................................. 6

2.2 Differences between SMEs and Larger Firms ............................................................................................... 8

2.3 Methodologies for Business Development towards PSS Offers in SMEs ..................................................... 10

2.4 Step 1 – Internal Analysis .................................................................................................................................. 12

2.5 Step 2 – External Analysis ............................................................................................................................... 18

2.6 Step 3 – Planning the New Offer .................................................................................................................... 26

3 Theoretical Synthetization .................................................................................................................................. 33

3.1 Summary of Theories ......................................................................................................................................... 33

3.2 PSS Offer Generation Method ....................................................................................................................... 34

4 Methodology .......................................................................................................................................................... 37

4.1 Type of Purpose .................................................................................................................................................. 37

4.2 Research Process ............................................................................................................................................... 37

4.3 Research Philosophy ....................................................................................................................................... 38

4.4 Research Approach ........................................................................................................................................... 39

4.5 Research Strategy ............................................................................................................................................... 39

4.6 Research Method ............................................................................................................................................... 42

4.7 Quality of the Study ........................................................................................................................................... 45

5 Case Study – MJP ..................................................................................................................................................... 48

5.1 About MJP .......................................................................................................................................................... 48

5.2 Step 1 – Internal Analysis .................................................................................................................................. 50

5.3 Step 2 – External Analysis ................................................................................................................................ 54

5.4 Step 3 – Planning the New Offer ....................................................................................................................... 60

5.5 Lessons Learned from the Case Study of MJP .............................................................................................. 65

6 Case Study – Assalub ............................................................................................................................................. 66

6.1 About Assalub ..................................................................................................................................................... 66

6.2 Step 1 – Internal Analysis .................................................................................................................................. 67

6.3 Step 2 – External Analysis ................................................................................................................................ 70

6.4 Step 3 – Planning the New Offer ....................................................................................................................... 74

6.5 Lessons Learned from the Case Study of Assalub ........................................................................................ 78

7 Case Study – Polyamp ........................................................................................................................................... 79

7.1 About Polyamp ..................................................................................................................................................... 79
TABLE OF FIGURES

Figure 2-1. The workshops in the IPSE methodology compared with the pattern found by Tukker & Tischner (2004) as well as the scope of this thesis ................................................................. 12
Figure 2-2. Value chain of the firm ................................................................................................................................. 13
Figure 2-3. Categories along the product-service continuum ............................................................................................. 15
Figure 2-4. The phases, processes and dimensions of the product life cycle ........................................................................ 17
Figure 2-5. System sales in networks .................................................................................................................................. 21
Figure 2-6. Determinants of when constellations arise and how they compete ......................................................................... 22
Figure 2-7. Porter’s five forces model .................................................................................................................................. 23
Figure 2-8. An example of how a profit pool can be visualized; the U.S. auto industry’s profit pool ........................................... 25
Figure 2-9. Gaps in communication and value with input from the analyses ............................................................................. 27
Figure 2-10. Fits between capabilities and processes that may lead to new business opportunities ........................................... 28
Figure 2-11. Example of diagram of the ratings from assessments of the four dimensions ..................................................... 30
Figure 3-1. Step one in our method ...................................................................................................................................... 33
Figure 3-2. Step two in our method ...................................................................................................................................... 34
Figure 3-3. Graphical illustration of the PSS Offer Generation Method ....................................................................................... 35
Figure 4-1. The different layers of a research process ............................................................................................................ 38
Figure 5-1. The placing of a set consisting of two waterjet units on a ship ................................................................................ 49
Figure 5-2. Typical boats for each segment. From left to right: Navy/CG, Commercial and Yacht ..................................................... 49
Figure 5-3. Number of waterjet sets delivered to each market segment since the start in 1987 ..................................................... 49
Figure 5-4. Mapping of MJP’s offer ........................................................................................................................................ 51
Figure 5-5. Conceptual distribution of the environmental impact of MJP’s offer at a product level and the distribution of the environmental impact at system level ................................................................. 53
Figure 5-6. Map over the network involved in the providing of MJP’s offer .................................................................................. 57
Figure 5-7. Profit pool of the waterjet-related industry ........................................................................................................... 59
Figure 5-8. Profit pool of the waterjet industry ....................................................................................................................... 59
Figure 5-9. Identified gaps regarding MJP’s offer ..................................................................................................................... 61
Figure 5-10. Identified fits regarding MJP’s offer .................................................................................................................... 62
Figure 5-11. Evaluation of concept 3; selling upgrades of the waterjets and give an increased warranty in return ......................... 64
Figure 6-1. Visualization of the LubeRight system ................................................................................................................ 67
Figure 6-2. Mapping of LubeRight ........................................................................................................................................ 69
Figure 6-3. Conceptual distribution of the environmental impact of the LubeRight offer at a product level and the distribution of the environmental impact at system level ...................................................... 70
Figure 6-4. Map over the network involved in the providing of LubeRight .................................................................................. 72
Figure 6-5. Profit pool of the bearing maintenance industry ....................................................................................................... 74
Figure 6-6. Identified gaps regarding the LubeRight ................................................................................................................ 75
Figure 6-7. Identified fits regarding LubeRight ....................................................................................................................... 76
Figure 6-8. Evaluation of concept 2; selling LubeRight via a specific distributor ........................................................................ 78
Figure 6-9. Three out of six DC/DC converter series built by Polyamp ...................................................................................... 79
Figure 6-10. Mapping of Polyamp’s DC/DC offer towards the customers .................................................................................. 81
Figure 7-1. Conceptual distribution of the environmental impact during the product life cycle of a DC/DC converter ................. 82
Figure 7-2. Map over the network involved in the providing of Polyamp’s DC/DC converters ..................................................... 85
Figure 7-3. Profit pool of the DC/DC converter industry .......................................................................................................... 87
Figure 7-6. The identified gaps regarding DC/DC converters .................................................................................................. 88
Figure 7-7. Identified fits regarding DC/DC converters ........................................................................................................... 89
Figure 7-8. Evaluation of concept 1; selling the function of conversion ..................................................................................... 90
Figure 9-1. Graphical illustration of the revised PSS Offer Generation Method ............................................................................ 105
TABLE OF TABLES

TABLE 4-1. ORIENTATION OF OUR THESIS

TABLE 4-2. OVERVIEW OF THE THREE CHOSEN CASE COMPANIES.

TABLE 4-3. CHRONOLOGICAL OVERVIEW OF THE EMPIRICAL STUDY.

TABLE 5-1. THE OUTPUT FROM THE FIVE FORCES MODEL FOR MJP’S WATERJETS.

TABLE 6-1. THE OUTPUT FROM THE FIVE FORCES MODEL FOR LUBERIGHT.

TABLE 7-1. THE OUTPUT FROM THE FIVE FORCES MODEL FOR DC/DC CONVERTERS.
1 Introduction

In order to introduce the reader to the subject of this thesis, this chapter will start with a description of the problem background and the background of the thesis. This will lead to the purpose of the thesis, which will be followed by a description of the chosen focus and delimitations. At the end of this chapter a reader’s guide will present an overview of the content of this report.

1.1 Problem Background

The increasing competition on today’s globalized industrial markets affect the way business is done. Mature markets with a high degree of product imitability, especially from low wage countries, make it harder to compete with mere products (e.g. Meier & Völker 2008, Hatfield 2008). Furthermore, rising disposal, material, energy and transportation costs create a need for an enhanced utilization of resources (Mont 2002). Also, EU environmental legislation is significantly increasing businesses' environmental liabilities. As stated by Crowhurst (2006, p.92):

“The growth of EU environmental legislation provides forward looking, responsible industry members with solid opportunities for growth and should help foster environmentally sound trade.”

Together the increasing maturity of markets and the environmental aspects are drivers for new ways of doing business. Hence, being competitive requires other means than just selling products. One way to create uniqueness and reduce environmental impact over the product life cycle is to integrate services with the core product in order to create new business models. Offerings consisting of products and services, in this report referred to as PSS (Product-Service System), are becoming more common (e.g. Mathieu 2001, Oliva & Kallenberg 2003). Examples of companies providing PSS are Fuji Xerox that provides the service of photocopying instead of photocopiers, and Volvo Aero that sells airplane propulsion instead of aircraft engines. The cost for the customers of these services is based on the numbers of photocopies and the number of flight hours, respectively. (Sundin, et al. 2008) Reasons for the customers to choose PSS instead of buying products include increased flexibility and reduced risk (Ritzén & Ölundh 2002).

The abovementioned drivers for PSS – maturity of markets and environmental aspects – can be considered as defensive motives, since they can largely be viewed as responses to external threats. There are however also several offensive motives or drivers for PSS, i.e. drivers that are important regardless the changing external environment. Focusing on understanding the customer’s problems and interacting with the customers to create complex business systems can give competitive advantage (Normann & Ramirez 1993, Vargo & Lusch 2004). According to Porter (1996, p. 62), competitive strategy is about “performing different activities from rivals’ or performing similar activities in different ways.” Both these aspects of strategy will be affected by integrating services into the core product, since the offer will be more difficult to imitate and thus creates competitive advantage (Oliva & Kallenberg 2003). PSS can, as well as creating competitive advantage on existing markets, also create new markets due to the added perceived value (Goedkoop, et al. 1999). Finally, services can have great impact on profits for the company (e.g. Anderson & Narus 1995, Oliva & Kallenberg 2003).
In order to be successful in the development of PSS offers, methods are required. Much of the research within the area, and consequently models and guidelines, has focused on large companies. However, there is a large potential also for small and medium-sized enterprises\(^1\) (SMEs) to increase their value creation by developing their business models towards PSS. (Lindahl, et al. 2008) Hence, there is a gap between existing methodologies for developing PSS and methods needed by SMEs.

In all developed economies SMEs provide a high proportion of national employment and output, even though the productivity is lower than for large enterprises (Foreman-Peck, et al. 2006). Furthermore, SMEs constitute the foundation of economic growth (Lee, et al. 1999). In Sweden, both the number of companies and people employed increased with more than five percent between the years 2003-2006 in companies with 20-250 employees\(^2\). Meanwhile, the figures for companies employing more than 250 people remained virtually unchanged. Firms with 20-250 employees contributed with nearly one-third of the job opportunities in the Swedish private sector 2006, almost as much as the larger firms’ contribution to employment (the rest of the employment is consequently made up by firms with less than 20 employees). (SCB 2008) To help SMEs develop their businesses is therefore vital for economic growth and employment.

Compared to larger firms, SMEs generally have disadvantages concerning resources. SMEs have limited resources when it comes to capital, human resources, economies of scale and production technology (e.g. Tanabe & Watanabe 2005, Alpakan et al. 2007). The limited resources and capabilities restrict the strategic options applicable for SMEs. In general SMEs can neither pursue cost leadership nor apply a differentiation strategy (due to limited market scope). The only remaining option, among Porter’s (1980) generic strategies, is the focus strategy which implies that only a narrow market segment is addressed by the company’s offer\(^3\). (Lee, et al. 1999) However, using this strategy, SMEs generally can also have some advantages over larger companies. By using the flexibility of a smaller organization, SMEs can create superior market orientation and service management to overcome the abovementioned disadvantages (Tanabe & Watanabe 2005, Alpakan et al. 2007). In summary, with the focus shifted from competing on products to competing with PSS, SMEs may have a great potential to increase their competitiveness.

1.2 Thesis Background

This thesis is initiated by and conducted for Center of Applied Management for small and medium-sized enterprises (CAM). CAM is a research center founded in collaboration between Linköping University and the regional business development supporting actors in Östergötland. The goal of CAM is to contribute to the business development of SMEs by combining theoretical competence and practical knowledge. To reach the goal, CAM supports both student courses and research projects with a high degree of interaction with local businesses in order to develop useful tools and methods. (CAM 2008)

\(^1\) We chose to use EU’s definition of SMEs in this thesis, which in essence define enterprises with 10-250 employees and an annual turnover of 2-50 million Euros as SMEs (European Commission 2005).

\(^2\) Companies in the manufacturing industry, construction and service sector according to SNI (Swedish Industry Classification) 2002. The reason for using enterprises with 20-250 employees – instead of 10-250 as is the EU definition – is that the data collected from SCB were only available for this interval.

\(^3\) For more information about Porter’s generic strategies, we refer to (Porter 1980).
One of the research projects that CAM has been involved in since 2006, is the ongoing 2 year long IPSE project (Integrated Product Service Engineering), which aims at developing a methodology for efficient development of PSS offers\(^4\) in SMEs (Lindahl, et al. 2008). The IPSE research group consists of researchers within the areas of Industrial Economics and Management, Product Development, Environmental Technology and Production Systems from Linköping University and Royal Institute of Technology (Stockholm) (IPSE 2008). This mix of competencies reflects the cross-functional nature of the PSS area.

The method used in the IPSE project is based on a workshop series with a number of participating companies. Five different workshops were developed, based on relevant theories from various areas. Workshop 1-3 are about evaluating and rethinking the current business situation, as well as planning for a PSS offer. Workshop 4 is about executing the business offer development, while the final workshop is about following-up and refining the offer. (Lindahl, et al. 2008) This thesis focus on the methodology developed through workshop 1-3, with the aim to further develop this methodology to a concrete and useful method applicable for management in manufacturing SMEs.

The method for this thesis is designed as a multiple case study of three manufacturing SMEs participating in the IPSE project. The criteria for a case company are that it should be a manufacturing SME participating in the IPSE project and operating within a different industry than the other case companies. Together with our supervisor three companies that met the outlined criteria were chosen; MJP, Assalub, and Polyamp. The companies are supplying waterjets, lubrication systems and DC/DC converters, respectively (a detailed description of each company is found in appendix V-VII).

The case companies were used to test and refine the method that we have developed from a theoretical framework based on earlier research within the PSS area. The thesis has a qualitative research strategy with interviews both with the case companies and their customers. In addition to the interviews, we have attended two workshops within the IPSE project as well as several meetings with the IPSE research group in order to enhance the validity of our study.

### 1.3 Purpose of the thesis

The purpose of this thesis is to develop a concrete and useful business development method applicable for the management in manufacturing SMEs, with the focus on generation of PSS offer concepts.

### 1.4 Research Questions

The research questions that this thesis will seek to answer are the following:

- Based on earlier research, how should a concrete and useful method for the business development towards PSS offers – applicable for the management in manufacturing SMEs – be designed?
- How applicable is this method for manufacturing SMEs?
- How can the method be improved?

\(^4\) The concept IPSO (Integrated Product Service Offer) is used in the IPSE project, but as will be discussed in section 2.1.3, we will use the term PSS in this thesis.
1.5 Focus and Delimitations
This thesis focuses on the development of concepts of PSS offers, which corresponds to workshop 1-3 in the IPSE methodology. The realization and follow-up of concepts (steps 4 and 5) are not covered by this thesis, since these phases can and need to span over a long period of time.

The objects of study in this thesis are the offers that each of the participating companies seek to develop. An offer is the connection between a company and its customers, meaning that to understand the offer, its context has to be understood as well. The starting point for the study is however the offers.

Furthermore, only three out of the 20 companies participating in the IPSE project are used as case studies. The reason for including more case studies is limits in time, but as argued in the methodology chapter, the validity of the study can still be considered to be satisfying.

The last step in our proposed method contained a feasibility analysis. This analysis could not be tested on the case companies due to the limited time available. However, the feasibility analysis will be kept in the theoretical parts of this thesis, since we argue that this analysis still is important to carry out for companies wanting to execute our method.

1.6 Outline of the Thesis
The content of each chapter in this thesis is briefly summarized in this section.

Chapter 1 – Introduction
In this opening chapter we have introduced the problem background as well as the background of this thesis, which ended in the purpose of the thesis. The purpose was then broken down into three research questions, and finally the focus and delimitations that we have chosen were presented.

Chapter 2 – Frame of Reference
The chapter is initiated with a discussion about the definitions of the most central theoretical concepts used in the thesis. Thereafter the relevant theories used to create our business development method are discussed.

Chapter 3 – Theoretical Synthetization
In this chapter the theories discussed in the frame of reference will be summarized and synthesized into our business development method for generation of PSS offer concepts. This result will be the answer to the first research question.

Chapter 4 – Methodology
This chapter presents the methodology of the thesis. The components of the research process are discussed, as well as the validity and reliability of the study.

Chapter 5-7 – Case Studies
In these chapters the empirical results from the case studies of MJP, Assalub and Polyamp will be presented. Each chapter is initiated with a short company description that will give the reader a basic understanding of the company’s situation; for a more detailed description we refer to Appendix V-VII,
respectively. Thereafter a description of how the execution of our method worked and what output was received in each step will follow.

Chapter 8 – Analysis
In this chapter the empirical results from our research will be analyzed and put in relation to our frame of reference. The drivers for development towards PSS offers as well as each step of our method will be analyzed.

Chapter 9 – Conclusions
The conclusions from our study will be presented in this chapter. The conclusions seek to answer the two remaining research questions – how applicable the method is and how it can be improved. The improved method and instructions on how to use it is presented in our managerial guidelines in Appendix VIII. Furthermore, a section in this chapter will be dedicated to reflections about the method and its generalization, as well as interesting further research.
2 Frame of Reference

In the frame of reference theories relevant for our thesis will be discussed. First, in order to avoid ambiguity, the definitions of the most central theoretical concepts will be introduced. Thereafter differences between small and larger firms will be discussed, followed by a briefing of the existing methodologies for business development towards PSS offers in small enterprises. The remaining part of this chapter will present and discuss the theories used to create our own method, which will be synthesized in next chapter.

2.1 Definitions of Theoretical Concepts

There are several definitions of the most essential concepts in this thesis. To avoid uncertainty about the concepts of product, service and the combination of the two, a discussion will follow which results in our own definitions. It is important to bear in mind that, traditionally, there is a clear distinction in the design process between a product and a service, which also affect the definitions of the terms (Arai, et al. 2008). However, when developing an offer combining services and products, the products and services have to be designed in an integrative process (Aurich et al. 2008, Lindahl, Sundin & Öhrwall Rönnbäck, et al. 2006). In order to avoid ambiguity we will make a clear distinction between a product and a service, even though they should be designed in an integrated process in order to create a successful offer.

2.1.1 Product

According to Goedkoop et al. (1999, p. 17) the definition of a product is “a tangible commodity manufactured to be sold”. Jobber & Fahy (2003) on the other hand include the concept of service in a product, as they suggest that a customer is in practice always buying a service. They divide a product into three levels, where the first and second level consist of a core product with features, styling and quality put on the market to fulfill a need. The third level, called the augmented product, is however made up by service aspects like delivery, installation and repair. Likewise, Kotler (2003) also includes the concept of service in the term product. He states that a product is anything that is offered to a market to satisfy a need, and that it includes not only physical goods in the term product but also services, information and experiences. The International Organization for Standardization (ISO) also includes the term service in a product meaning that a product is the output of process and that a can be tangible or intangible (ISO 9001:2005 2008).

Jobber & Fahy’s (2003), Kotler’s (2003) as well as ISO’s definition implies that a product can include elements of services, while Goedkoop et al. (1999) strictly constraint the definition of a product to something tangible. The difference in the design process, as Arai et al. (2008) point out, between a service and a product makes a definition in line with the one of Goedkoop et al. (1999) suitable for our thesis. However, Goedkoop et al.’s definition does not include the value the product creates for its user. We regard this as a shortcoming since, according to Jobber & Fahy (2003), the main purpose of a product is to create value through fulfilling of the customer needs. Therefore the definition that will be used in this thesis is that products are tangible goods that can be used to fulfill a customer need.

**Products:** tangible goods that can be used to fulfill a customer need
2.1.2 Service
Goedkoop et al. ’s (1999, p. 17) definition of a service is “an activity (work) done for others with an economic value and often done on a commercial basis”. Jobber & Fahy (2003) incorporates the service concept in a product, as discussed above, meaning that service is delivered to fulfill a need. Kotler (2003) defines a service in a similar way as Goedkoop et al. (1999) meaning that a service is an act that is offered to the customer which does not include a transfer of ownership. ISO defines a service as a type of product, which is a customer-oriented result based on activities performed to fulfill customer needs (ISO 9001:2005 2008). Lindahl et al. (2005) also define a service as an activity, but propose that it causes the receiver to change its state to a desired state. The service content and service channel are means for the service provider to realize this change in the receiver’s state. Vargo & Lusch (2004, p.2) has a different view on the definition of a service and defines it as being “an application of specialized competences through deeds, processes, and performances for the benefit of another entity or the entity itself”. They argue that all physical goods are produced by applying competence on raw material and hence that all products can be viewed as transmitters of service.

Due to the clear distinction in the design process between a product and a service, we do not agree with Jobber & Fahy (2003) and Kotler (2003) that a service is a subgroup of a product, although we do agree that a service is an activity performed and delivered to fulfill a need. On the other hand, Vargo & Lusch’s (2004) concept of service is too broad as it includes the product in a service. Nevertheless, we do concur that a service is produced for the benefit of some entity. Lindahl et al.’s (2005) definition suggests that the service causes the receiver to change a state. We reckon that this definition is suitable for the design of a service and hence important to bear in mind for that purpose, even though we do not regard it as a fulfilling definition of a service. ISO’s definition suits our purpose, as it defines service as a customer-oriented result based on activities performed to fulfill customer needs.

Service: an activity performed for another entity to fulfill a customer need

2.1.3 Product-Service System
Goedkoop et al. (1999) define a combination of a product and service put together to fulfill a customer need as a Product-Service System (PSS). Tukker & Tischner (2004) call such a combination a Product-Service (PS). Instead they argue that a PSS includes the network and infrastructure needed to provide a PS. Mont (2001) is using a broader definition than Tukker & Tischner (2004), stating that a PSS in addition to being competitive and satisfying a customer need also must have a lower environmental impact than traditional business models.

Another term frequently used to describe a product-service offer is Functional Sales (FS), which often is used interchangeably with PSS. Lindahl et al. (2006) define FS as a functional solution offered to a customer to fulfill a need using a life-cycle perspective. Such FS can be made up by combinations of products, services and systems (Lindahl, Sundin & Sakao, et al. 2006). Lagerholm & Öhrwall Rönnbäck

5 This term can be viewed as a further development of the term Functional Products used by Alonso-Rasgado et al. (2004), which is defined as a product (offer with our terminology) consisting of hardware combined with a service support system that together can perform a function for the customer (Alonso-Rasgado, Thompson and Bergström 2004).
(2004) define, in line with Lindahl, Sundin & Sakao et al. (2006), that FS is made by combinations of hardware, software and services. However, they ignore the life cycle perspective and suggest that FS generate higher value for both the customer and the supplier compared with a traditional product offer. We argue that while the FS must generate higher value for the supplier this must not necessarily be the case for the customer, as long as the offer does not decrease the customer value.

Lately, the term IPS² (Industrial Product-Service System) has become more frequently used (e.g. Meier & Völker 2008, Welp et al. 2008 and Seliger et al. 2008), even though little have been published yet. Obviously, the only difference between PSS and IPS² is that the latter is limited to industrial applications, why we consider it as a sub-term of PSS. Integrated Product-Service Offerings (IPSO) is the term used in the IPSE project (Lindahl, et al. 2008). We consider the IPSO concept as virtually interchangeable with PSS, since the only difference is the word integrated included in the former concept (we argue that the words offer and system do not affect the meanings of the definitions). However, the word integrated originate from the IPSE concept (Integrated Product and Service Engineering), which refers to the engineering process of the offer. Since we do not want to exclude product-service offers based on existing products, with added services, we will use the term PSS in this thesis. Additionally, PSS seems to be the most well-recognized concept in the so far published literature.

We do consider the network and infrastructure as important aspects in the PSS offer, as stated by Tukker & Tischner (2004). However, we argue that the network and infrastructure should be considered as enablers for the offer rather than as a part of it. Hence, we state that a PSS offer consists merely of a combination of products and services, according to Goedkoop et al.’s (1999) definition. Moreover, we believe that the environmental aspects of a PSS offer should not be included in the definition, as opposed to Mont’s (2001) definition. In conclusion, the definition of PSS used in this thesis will be:

| **Product-Service System (PSS):** a combination of products and services put together to fulfill a customer need |

Our argument for omitting the environmental aspects is that we believe that there are situations where PSS offers are developed without regarding the environmental impact. Companies will only do what provides profit for them now and in the future. These profits are coming from high revenues, generated by high customer value⁶ and from low costs. We therefore view environmental consciousness as a result of what the customers require and the fact that it can result in lower internal costs. In a case study including several Swedish companies, environmental aspects such as green marketing and ethical considerations in general actually turned out to be of low priority among the business drivers for offering PSS (Östlin 2008). Environmental legislation can however play a vital role in some situations (Östlin 2008, Crowhurst 2006).

2.2 Differences between SMEs and Larger Firms
There are some general differences between SMEs and larger firms that must be considered in the business development process. These differences give SMEs both comparative advantages and

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⁶ This could in many cases be triggered by selling offers with low environmental impact.
disadvantages, and it is of importance to be aware of the strengths and weaknesses that are related to size.

Findings by Weinrauch et al. (1991) state that limited financial resources are the biggest obstacle for smaller companies in the competition against large companies. As a consequence, the key for smaller companies to compete against large companies is to find a niche where the company has a competitive advantage. This is supported by Lee et al. (1999), who argue that among Porter’s (1980) generic strategies, only the focus strategy is applicable for SMEs. This means that, in general, SMEs can neither pursue cost leadership nor apply a differentiation strategy (due to limited market scope). Thus, in order to be competitive, smaller firms in general should focus on developing offers that satisfy a niche market in the market place. This is in line with Lee et al.’s (1999) arguments that there is a rational logic for larger firms to deliberately ignore the niches filled by small companies and instead accommodate their entries into the market. The logic behind this statement is – in addition to obvious reasons such as insufficient market potential – that direct competition with the niche players depresses the prices in the whole market, not just the niche segments. A similar logic is argued by Moore (1998), who furthermore states that companies with a large market share will ignore niche segments due to the cost of accommodating offers to each market segment. On the other hand, it has become easier to accommodate an offer to cover niche segments with modern production technology.

Yet, even though mass customization has become more common in recent years and therefore could be seen as a threat for small companies using niche strategies, there are limits in the mass customization strategy. In addition to the requirement of expensive production technology and operational capabilities, far from all markets are suited for mass customization since a “mass market” requires a large number of customers that are willing to pay for unique features. However, the development continues and it is difficult to predict what markets will use mass customization in the future. (Zipkin 2001) When it comes to production technology, SMEs have a clear disadvantage compared to larger companies. This disadvantage is not explained only by limited financial resources, but also by the lack of technical and manufacturing infrastructure to support new technology. (Thomas 2007) We therefore believe that it is important for small enterprises to be aware of and adapt to the superior production technology of larger firms. This strengthens the earlier mentioned statement that SMEs should focus on developing offers that satisfy a niche market, either by providing a superior product or service, or a combination of the two. The latter makes it easier to create a unique offer.

Another aspect that is related to size and should be considered by SMEs intending to compete with larger companies is alliances. Gomes-Casseres (1997) argues that the smaller a company is relative its rivals, the more likely it is to form alliances with other companies. The aim of these alliances is to strengthen the relative competitiveness and can take the form of e.g. joint ventures, joint R&D efforts or joint marketing efforts. Gomes-Casseres (1997) define a new unit of competition that he refers to as constellations, which is described as a set of companies linked together through alliances. The concept of constellations is interesting, since we believe that alliances can be of great importance for SMEs

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7 Based on a survey with 99 responding small business owners.
8 Mass Customization refers to a mass production process where each customer provides unique information in order to get a product tailored for specific needs (Zipkin 2001).
intending to develop PSS offers. It is probable that small firms cannot produce all parts in some offers without supplementing capabilities from other organizations.

SMEs, in addition to limited financial and technology resources, also have comparative disadvantages in human resources and information (Tanabe & Watanabe 2005) as well as market power, economies of scale and product lines (Alpakan, et al. 2007). However, there are also a number of comparative advantages that are related with smaller firms. Using the flexibility of a smaller organization, small companies can create superior market orientation and services management to overcome the abovementioned disadvantages (e.g. Alpakan, et al. 2007, Tanabe & Watanabe 2005). A high degree of entrepreneurship also helps smaller companies to develop their business and create innovations (Birley & Norburn 1985). Small groups’ ability to be innovative, compared to large R&D units, is something that got widely recognized during the eighties when Tom Peters and Robert Waterman released their bestseller9 In Search of Excellence – Lessons from Americas Best-Run Companies 1982. The authors also stress the inefficient management in large companies as a reason to copy the structures from smaller companies. (Peters & Waterman 1982)

To conclude the implications of the differences between SMEs and larger firms, it seems like small firms can actually have comparative advantages in niche markets where service is an important competitive factor. SMEs may thus have a great potential to increase their competitiveness through shifting their focus to compete with PSS offers rather than mere products.

2.3 Methodologies for Business Development towards PSS Offers in SMEs

Tukker & Tischner (2004) have collocated thirteen different methodologies for the development of PSS offers in SMEs. The conclusion that the authors reach in the collocation is that the methodologies follow a three step pattern:

- **Step 1: Analyzing**
  The current situation is analyzed through an internal and external assessment of the firm and its context.

- **Step 2: Creating and Detailing New Ideas**
  Based on the findings from the analysis, concepts for new PSS offers are created. The offers that are considered most feasible are examined more in detail, and an evaluation of feasibility is conducted.

- **Step 3: Realization of the Detailed Concept**
  The last step consists of development of the offer, preparation of the launch, launching and evaluating the success of the offer.

An examination of more recently presented methodologies shows that this pattern still seems to be valid. The methodologies of Schmitt & Hatfield (2008) and Brady et al. (2005) can be divided into these three steps, while the methodologies of Aurich et al. (2008) and Morelli (2006) are focused on only one of the steps. We therefore argue that a consensus has been reached among researchers within the PSS area regarding which basic steps a methodology should consist of.

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9 According to a Wikipedia article, which refers to WorldCat data, In Search of Excellence – Lessons from Americas Best-Run Companies was the most widely held book in libraries in the United States from 1989 to 2006.
2.3.1 The IPSE Methodology

In line with the aforementioned methodologies, the IPSE methodology also aims at helping SMEs developing PSS offers (as mentioned in chapter 1.2). The concept of IPSE originate from the term *Service Engineering* (SE), which is a concept that can refer to either the design process of a pure service offer (i.e. without including physical goods) (e.g. Bullinger, et al. 2003) or the design process of a PSS offer (e.g. Sakao & Shimomura (2007). In order to clarify the concept, the IPSE research team chose to add the words *integrated* and *product*. The purpose was to make clear that a physical product is involved in the engineering process and the resulting offer, while stressing that the design process of the product and service parts of the offer should be designed integrated in order to create a successful offer. (Lindahl, Sundin, Öhrwall Rönnbäck, et al. 2006)

The IPSE methodology is based on a mutual learning principle, where all participating companies have been divided into three so called learning groups. The workshop series, consisting of five workshops, have then been held with each learning group. At each workshop, the research team participates to discuss with and guide the companies in how they can develop PSS offers. This also gives the possibility to the research team to implement improvements to the IPSE methodology between workshop sessions. (Lindahl, et al. 2008)

The workshop series have the purpose of getting the companies to evaluate their current business situation, as well as increasing the understanding of a potential new business logic and how it affects the design of sales offers. The first two workshops are evaluating the current business context from both internal and external points of view. During workshop 3 the development and planning of a new business logic and sales offer are discussed. The two last workshops deal with the execution and follow-up of the new business offer. (Lindahl, et al. 2008) We argue that the IPSE methodology follows the pattern found by Tukker & Tischner (2004). The first two workshops can be regarded as the analyzing step in Tukker & Tischner’s (2004) pattern, while the third workshop is analogue with the creation step. The two final workshops treat the realization and following-up of the offer, which is line with the last step in the pattern identified by Tukker & Tischner (2004).

It is clear that the IPSE methodology has theoretical support in its structure. We therefore regard it as a valid base for the method we will develop in this thesis. As described in the delimitations section (see 1.5), this thesis will focus on the three first workshop topics, i.e. we will not focus on the realization of the detailed concept. Figure 2-1 illustrates the workshops and the scope of our thesis as well as the comparison to the pattern found by Tukker & Tischner (2004).
In more detail, the content of workshop 1-3 is described in Appendix I. The purpose of the workshops is to get the participants to change their mindset, while our method has the role of providing guidelines for firms that want to change their strategies. It should be noted that as the purpose of the study is to develop a method for manufacturing SMEs to use in their development towards PSS offers, it is the topics of each workshop that are important and not the workshops per se. Therefore, the steps will be altered and extended to some extent. The steps will build on relevant theories to cover the content in each workshop, as well as additional aspects that we find important. The theories will then be concretized into a useful tool for each step. We chose to name step 1 in our method internal analysis, since this analysis is performed from a company and offer perspective. Similarly, step 2 is named external analysis since the sale and customer requirements have an external focus. Step 3 consists of planning the new business logic and offerings, which we refer to as planning the new offer.

2.4 Step 1 – Internal Analysis
The IPSE methodology suggests that the first step is an analysis of the current business model. In order to analyze the business model, the customer offer should be categorized according to how much service it includes and what the key selling points are. Lindahl et al. (2008) also propose that the environmental impact of the offer should be examined through a life cycle perspective. The output for the firm from this step should be an understanding of its current business model.

In order to understand the current business model, we suggest that the starting-point should be an analysis of the internal activities. We suggest that the firm should focus on one offer that it seeks to develop when the internal activities are being analyzed (the method will be designed to handle one offer at the time). What offer to chose can be based on the business drivers discussed in section 1.1. This enables a deeper understanding of why the offer is designed the way it is, as well as how it can be further developed by exploiting the internal capabilities of the firm.
2.4.1 The Internal Business Processes

According to Porter (1985) a systematic and useful way of analyzing the internal activities of the firm is through the Value Chain of the firm. We will refer to this value chain as the *internal value chain*, in order to avoid ambiguity with the value chain of the offer in the external context (i.e. including suppliers and customers). Stabell & Fjeldstad (1998) argue that the value chain is a central framework for analyzing the firm’s strengths and weaknesses. Band (1991) describes the value chain as a method to identify untapped value creation in each of the value chain’s step. Hence, we argue that a value chain analysis combined with the assessment of the offer allows the firm to identify the activities that are crucial for them in order to provide the offer to the customer.

The internal value chain (illustrated in Figure 2-2) categorizes the activities performed in a firm as primary or supporting activities. The primary activities follow the main value creation process that exists in a firm. The firm will receive input from the inbound logistics that it will transform in operations, before shipping it in the outbound logistics. The product will be marketed and sold, after which the service unit provides support and maintenance etc. A margin will be put on all activities in order to create a profit for the company. The supporting activities act throughout the primary activities, defining and supporting the actions made in the primary activities. The goal of the internal value chain analysis is to identify if the costs in each activity correspond to an equal increase in value, i.e. to analyze if the customers are willing to pay for the efforts the company puts into each activity. The cost structure of the value chain can also be used for comparison with competitors in order to identify differences that can determine competitive advantage. (Porter 1985) This framework for internal value chain analysis is created as a general tool, which may need modifications for specific situations.

![Figure 2-2. Value chain of the firm (Porter 1985, 37).](image)

Stabell & Fjeldstad (1998) present two new value creation logics, as they argue that Porter’s value chain analysis is an insufficient tool for elucidating how and where value is created in some industries. The authors introduce the *value shop*, suitable for service industry analysis and the *value network*, suitable for companies creating value by providing access to network. Some of the elements included in the value shop and value network might be applicable on PSS offering firms as well. However, as this thesis is
focused on manufacturing companies delivering PSS offers\textsuperscript{10}, the activities in these companies will follow the structure in Porter’s value chain. We therefore consider this framework as a satisfying tool for analyzing the activities performed by the firm. The involvement of further theories would probably complicate the tool, while we stress that it is important to keep the tools simple in order for small companies to be able to use them.

According to Porter (1996, p.62), as mentioned in the problem background, competitive strategy is about “performing different activities from rivals’ or performing similar activities in different ways.” In addition, he argues that the fit between activities drives both competitive advantage and makes the business model difficult to imitate. Porter (1996) also states that it is important to choose what market segments to compete in, which in turn will determine what activities should be focused on. When using the internal value chain analysis, it is important trying to map both the differences in activities compared to competitors as well as the fit between the activities, in order to get an understanding of where the company’s competitive advantage is created.

We argue that the activities analyzed in the internal value chain analysis also can be viewed as business processes. Stalk et al. (1992, p.62) state that a company should compete on capabilities, which they define as “a set of business processes strategically understood”. They emphasize the importance of turning the company’s key processes into strategic capabilities by strategic investments in infrastructure that links functions together. In a similar way, Prahalad & Hamel (1990) argue that a company must identify and develop the core competencies of the company in order to create competitive advantage. They define a core competence as a competence that provides potential access to a wide variety of markets, makes a significant contribution to the perceived customer benefits and is difficult to imitate. It should be noted that both the works of Stalk et al. (1992) and Prahalad & Hamel (1990) are adapted to large corporations with several business units. Further, their works have a clear inside-out perspective (i.e. the starting-point is the company it-self, not the market). Prahalad & Hamel (1990) are also focused on developing competitive advantage through physical products (core products). We believe that their theories supplement those of Porter (1985, 1996) through a wider perspective on competitive advantage.

When the internal activities have been analyzed, the firm should evaluate its current offer. How this can be done will be discussed in the following parts.

2.4.2 Assessment of the Offer

Tukker & Tischner (2004) introduce a categorization of sales offers along a product-service continuum from a pure product offer to a pure service offer, which is illustrated in Figure 2-3. In between the two extremes are three categories of different PSS offers, as described below.

- **Product-oriented**: the product is the main part of the offer with the service as add-ons. Examples of offers are products with product-related services such as maintenance or financial services (see also Mathieu 2001, Oliva & Kallenberg 2003).

\textsuperscript{10} It is possible for service companies to provide PSS offers as well, as the product included in the offer can be purchased from external companies.
Use-oriented: the product still plays an important part of the offer, but the focus is shifted towards the use of the product and the ownership of products is not transferred. Examples of offers in this category are leasing, rental or pay-per-use (see also Mont 2002).

Result-oriented: the offer is based on achieving a certain result, which means the product itself is not a concern of the customer. Examples of offers in this category are activity management and functional results.

Kotler (2003) introduce a similar five-step-categorization as Tukker & Tischner (2004), with pure tangible goods at one end and pure services at the other. However, Kotler’s categorization is based on consumer goods and is focused on the distribution between products and services included in the offer, not on the actual proposition to the customer. Tukker & Tischner’s (2004) categorization is consequently more accurate for our thesis as it covers both the value proposition and the offer to the customer.

Oliva & Kallenberg (2003) argue that the transition from a product manufacturer to a service provider requires that the business model changes from being transaction- to relationship-based, where an increase of product-oriented services for the installed based is a first step. They state that companies are often developing services in order to support the sales of the core product, but argue that the incentives for integrating more services into the core product also should be increased profit and that services are difficult to imitate and hence create competitive advantage.

It is also important to analyze the market communication and what parts in the offer that are being charged for (Lindahl, et al. 2008). The external parts of these aspects, i.e. the analysis of customer requirements and input, will be conducted in step 2 of our method. However, when analyzing the current offer, it is important to have a clear view of what the strengths and weaknesses of the offer are and what market communication the company has today (i.e. what key selling points are used). This is a prerequisite for identifying gaps between what the customers value and what the company provides and communicates. We argue that the way the offer is charged the customers today also will affect the market communication. If the customers are being charged for the product, with services included in the price, they will probably perceive the company as product-focused. If the customers instead are charged a monthly fee for a function, the providing company is more likely to be perceived as a solution provider.
2.4.3 Life Cycle Perspective of the Offer

Goedkoop et al. (1999) suggest that the life cycle perspective of a PSS offer should be analyzed from an environmental perspective, since a low environmental impact can give cost reductions as well as create possibilities for green marketing. Even though the case study conducted by Östlin (2008) showed that green marketing and ethical considerations turned out not to be important business drivers (as mentioned in section 2.1.3), an analysis of the environmental impact can identify waste of resources that could lower the costs for the supplier as well as the customer. We therefore argue that it is still interesting to analyze the environmental impact of the offer. Goedkoop et al. (1999) state that one way to do this is to use the methods based on the traditional LCA (Life Cycle Assessment). The LCA can be used to evaluate and decrease the environmental impact from resources used over a product’s life cycle (Swedish Standards Institution 1998). However, in this step the focus should be a mapping of the environmental impact associated with the current offer. This mapping will be helpful for identifying potential resource savings in the design of a new offer.

Goedkoop et al. (1999) point out that there are flaws with existing tools and methods in LCA, but state that LCA is still valuable in most cases and that there exist no better methodology to assess the environmental impact of the offer in a systematic way. According to Sutherland et al. (2008), the biggest improvements to be made in LCA methods regard uncertainties and risks due to lack of process-specific information. However, in this step it is important to understand the basis of the environmental impact and costs associated with a process at a more conceptual level, rather than having exact figures on the dimensions. For companies in general and for SMEs in particular, it is important that LCA is flexible, practical and cost-effective at the same time as it preserves its technical credibility (Piper, et al. 2003). It is clear that this will give a trade-off between the feasibility (e.g. flexibility, practicality and cost-effectiveness) and the technical credibility. In our method, we argue that emphasis should be on feasibility.

The product life cycle is the basis of LCA, as it covers all the processes needed for the product to pass from “the cradle to the grave” (Westkämper, et al. 2001, p. 609). According to the Swedish Standards Institution (1998), LCA studies should address all aspects of a product system, ranging from raw material acquisition to final disposal. Westkämper et al. (2001) refer to Friedel (1999)11 who describes the phases in the life cycle as material production, manufacturing, transport, use and product-recycling, and finally material-recycling or disposal. Friedel (1999) further connects the phases with four dimensions; safety, efficiency (or cost), environmental soundness and future requirements (i.e. holistic optimization) (Westkämper, et al. 2001). Even though the safety dimension is important, we consider it out of scope for this thesis and will not further discuss this aspect. Figure 2-4 displays the phases, processes and dimensions of the product life cycle. This figure will aid in the conceptualization of the current offer.

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11 Friedel, A. Einfluss der Produktgestalt auf den Energieaufwand beim Recycling mechanischer Baugruppen und Bauteile, 1999 (Springer-Verlag, Berlin)
Once the life cycle of the offer is conceptualized, the second step of LCA only takes account to the environmental dimensions and implies a calculation of the emissions and resources used in each phase. According to ISO 14000 certified companies “...shall establish and maintain (a) procedure(s) to identify the environmental aspects of its activities, products or services that it control and over which it can be expected to have an influence, in order to determine those which have or can have significant impact on the environment” (Piper, et al. 2003, p. 46). Hence, the second step of the LCA should already have been finished to some extent in all ISO 14000-certified companies. However, the analysis required by ISO 14000 only concerns aspects that the company has a direct influence over, which typically do not include e.g. the use phase of the product.

According to Goedkoop et al. (1999) the calculation of the emissions and resources used in each phase is difficult to implement. They therefore suggest a simpler method, where the different phases of the product life cycle are grouped after environmental impact and resource usage. This method makes it easier to focus on the most important phases. In accordance with the previous mentioned emphasis on feasibility, we concur with Goedkoop et al.'s (1999) simplified second step. The problem with this approach is according to Goedkoop, et al. (1999) that it is difficult to judge how to weigh the different environmental effects. As the output from the first step, described in the IPSE methodology, is an understanding of the environmental impact of the offer, it is only important to get a holistic view on the environmental impact and resources used in each phase. Exact figures and numbers in the phases will therefore be somewhat superfluous.

The result from what can be referred to as a conceptual LCA will be a life cycle perspective of the offer that can be used for several purposes. The most important purpose for our method is however to identify waste of resources. If this waste is identified in the material production or manufacturing processes, the measures to be taken are out of scope for this thesis (even though this waste obviously should be minimized as soon as possible). Waste found in later phases, especially in the use phase, are
however of great interest, since it has the potential of being reduced by a changed offer towards the customer.

2.5 Step 2 – External Analysis

After the internal aspects of the company’s processes and offers have been analyzed, an analysis of external aspects should be conducted. The purpose of the analysis is to get a deeper understanding of the business context that surrounds the company. This will make it possible to create a fit between the internal activities and the customer requirements, as well as identify gaps between the current offer and the customer needs. Also, the network of actors involved in providing the current offer should be mapped and analyzed, in order to understand how the network is controlled and how it affects the company. Furthermore, this analysis will identify what capabilities the network possesses. Finally, the business context should be analyzed through the five forces industry analysis, as well as a mapping of the value chains’ revenues and profits in a profit pool analysis. Together these analyses will indicate what activities that are attractive to undertake.

2.5.1 Customer Requirements

When analyzing customer requirements, we believe that the view should be based on the statement made by Ford et al. (2003, p. 3) that “customers are not looking for a product from a manufacturer. Instead they seek a solution to their problem from a supplier: Business purchases are problem-driven.”

In order to in depth understand the customer needs, it is not sufficient just to ask the customers about their current needs, but also potential needs should be analyzed (Lindahl et al. 2008). According to Schmitt & Hatfield (2008), implicit needs can be anticipated in the design process of new PSS offers, e.g. through a framework called Anticipative Customer Requirement Analysis12 (ACRA) consisting of three steps:

1. The first step is to assess the customer’s13 processes in which the providing firm’s product is used. A flow chart should be created. Critical incidents and problems regarding the use of the product should be identified. In addition, phases before and after use should be analyzed. The result from this step is an understanding of the customer’s problems and how new solutions can be provided.
2. In the second step an analysis concerning customer values is conducted in order to examine if a suggested solution will really fit the customer’s need.
3. In the third and last step of the ACRA, the customer processes are mirrored with customer values. The goal here is to identify gaps where the process steps are not met or where values could be addressed in certain process steps through new service offers.

12 From Lorenzi, P. Service Scout – Dienstleistungsbedarfe antizipativ erkennen und in Netzwerken systematisch erfüllen, 2004 (Cuvillier, Göttingen)
13 If the providing company’s customer is not the end customer, i.e. the end user of the product, we suggest that also the customer’s customer is analyzed.
It is obvious that getting all the information required to assess the customer’s processes as described in the first step might be difficult. Seliger et al. (2008) state that it is important to capture missing life cycle information of the offer in order to understand the customer needs. They argue that a close provider-customer interaction is required in the design phase (as well as the use phase) of a PSS offer in order to fully understand the customer needs. One concrete example of how information about how a product is used by the customer can be collected is through maintenance personnel and technicians. Another way of collecting data about the use of a product is through built-in “self-awareness” (i.e. the products record different aspects of usage through electronics), an area where large companies such as General Electric are highly developed (Almendinger & Lombreglia 2005). For SMEs the latter method is probably, in general, too expensive relative the number of customers. However, it might be good to keep this way of thinking in mind, since more structured methods of collecting data can be helpful for the ongoing analysis of customer needs. This can for example be done by structuring the information gathered by the maintenance personnel, or by just calling the customers on a regular basis.

Another aspect of understanding the customer requirements is who, in the buying organization, has the real power over the buying decision. This will affect what criterion will be important when designing the offer. For example, if the user of the offer has a significant influence over the buying decision, user-friendliness can be more important than price. The opposite can be true if the purchasing department has substantial power over the buying decision. (Weele 2005) If the customers buying process works then the buying criteria and the customer needs should be the same.

2.5.2 Customer Perception
Understanding the customer requirements is not enough; it is also important to analyze how the company’s offers are perceived by the customers. In step 1 of our method we suggested that the key selling points should be analyzed from an internal point of view. Knowing what the company communicates and what the customers need, the only part missing for identifying gaps is how the customers perceive our offer’s performance on the important criteria.

Gale (1994) suggests a method for developing a market-perceived quality profile. This profile shows how a company’s product is perceived by the customers, also relative competitors’ products. The latter may not be relevant for all SMEs, since competitors with comparable products do not always exist. However, the reason for comparing with competitors’ products can be explained by Gale’s (1994) definition of quality, which emphasizes not only the ability to create customer satisfaction, but also the quality relative competitors. The market-perceived quality profile shows how well a company’s offer performs on measures used in the customer’s purchasing decision. This will complete the information needed for analyzing gaps between the three central aspects of meeting the customer requirements; the key selling points, the customer needs and how the offer is perceived.

The method developed by Gale (1994) for creating a market-perceived quality profile is built on a three-step process, which is described below:

1. Ask customers in the market to list the factors that are important in their purchasing decisions. Both customers and, if applicable, competitors’ customers should be regarded.
2. Ask the interviewed customers to describe how the different quality attributes are weighted in their purchasing process. The easiest way to do this is by letting the interviewees distribute 100 points over the selected factors.

3. Ask the customers to rate the performance of each competing company’s offer on each competing factor (e.g. on a scale of 1 to 10). Each company’s score is then multiplied with the weight of the factors, which add up to an overall customer satisfaction score.

The process is, as noted by the author, relatively simple. It is however time consuming to do this process well, since customers have to be interviewed. (Gale 1994) To decrease the amount of time required to gather the data, we suggest that this process is carried out at the same time as Schmitt & Hatfield’s (2008) ACRA described in the previous part.

The customer needs and perceptions discussed so far in this chapter are concerning existing customers. The understanding of existing customer’s requirements can be improved by a wider analysis, where the other actors involved in supplying the offer are included. Also, just as important, new potential customers might be found in this analysis, using the contacts in the network.

2.5.3 Supplier Networks
According to Cox (1996) a company should only perform activities that are of high asset specificity, i.e. activities connected to the core competence of the company. We argue that for manufacturing SMEs aiming at delivering PSS offers, this implies that a number of companies will be involved in delivering an offer to a customer. In addition to the actors identified in the analysis of the value chain, there will certainly be a number of other actors involved in the provided offer in one way or another. Cox (1996) suggests that the closer related to the core competence an activity is, the closer partnership relationships should be formed with the external suppliers. He argues that the activities most closely related to the core competencies, but that are not carried out in-house, should be managed in strategic alliances. For smaller companies however, especially seeking to provide a PSS offer, we argue that strategic alliances can also be used as a means to obtain capabilities that are not closely related to the core competence of the company. Strategic alliances are, according to Gulati et al. (2000), a sub-group of strategic networks. Strategic networks can create a number of advantages. As stated by Gulati et al. (2000, p. 203):

“...strategic networks potentially provide a firm with access to information, resources, markets, and technologies; with advantages from learning, scale, and scope economies; and allow firms to achieve strategic objectives, such as sharing risks and outsourcing value-chain stages and organizational functions”

As mentioned in section 2.2, Gomes-Casseres (1997) states that the smaller a company is relative the market leader, the more likely it is to form strategic alliances with other companies. We note that the potential benefits from strategic networks mentioned by Gulati et al. (2000), combined with the relative disadvantages of smaller companies discussed in section 2.2, especially limited resources, emphasize the attractiveness of strategic alliances for SMEs.
An important aspect of supplying an offer through network cooperation, is how the risks are to be shared. The most influential aspect is probably how the offer is provided to the customer, i.e. what company establishes the contract with the customer. Hammarkvist et al. (1982) distinguish two possibilities for system sales provided by a network of companies; the consortium case and the leader case. These are illustrated in Figure 2-5.

![Diagram: The Consortium Case and The Leader Case](image)

The Consortium Case
Supplying Consortium

The Leader Case

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
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<td>SK</td>
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Subcontractors

System Supplier

Buyer

A...E = Components
SK = System Knowledge

Figure 2-5. System sales in networks (modified from Hammarkvist, et al. 1982, p. 91).

In both cases in Figure 2-5, the buyer purchases a complete system instead of purchasing components that have to be assembled. The formal supplier, be it a consortium of companies or a single firm, is responsible for the whole system and the management of the relations between the actors in the supplying network. This means that being a system supplier requires resources and implies commercial risk taking. Meanwhile, being the system supplier brings benefits in the form of e.g. customer intimacy and positioning within the network. (Hammarkvist, et al. 1982)

Hence, if a company has the required resources and is willing to take the higher risk, it might try to position itself as a system supplier on its own, using the other actors in the network as subcontractors (note that strategic alliances within the network are still possible). If the company has not got the required resources or seeks to reduce the risk, it can form a supplying consortium in order to provide a system solution. The latter can be compared to the concept of constellations introduced by Gomes-Casseres (1997).

In an attempt to explain when constellations are created and how they compete, Gomes-Casseres (1997) suggest the framework illustrated in Figure 2-6.

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14 This can be done either through the creation of a new legal entity or just by contractual arrangements that regulate e.g. profit and risk sharing.
The context of a company (competition, customer requirements etc) determines what capabilities are needed to provide an offer. If the company does not have the needed capabilities internally, it must seek them through an alliance (arrow 1). The set of capabilities needed will affect the structure of control in the network, which is defined as the authority of a decision maker to use and deploy the set of capabilities (arrow 2). The structure of control will in turn influence how the capabilities are managed and developed (arrow 3). As the capabilities are developed, the network might be able to offer new products and services, which in turn will affect the business context of the company (arrow 4). The benefits of the network for a small firm will increase with the sum of the capabilities assembled in the constellation, since a more complex offer is enabled. Furthermore, the amount (or importance) of capabilities possessed by a firm relative its partners in the constellation, will affect the bargaining power of the firm within the network. (Gomes-Casseres 1997) Hence, the more capabilities that are held within a network, the more competitive the network can be. Meanwhile, if a company does not develop its own capabilities in at least the same extent as the other actors in the constellation, its position within the network will be weakened. This must be regarded e.g. when new members are selected to a network.

Furthermore, Gulati (1999) introduces the concept of firm network resources, which refers to the informational advantages a firm can obtain from participating in interfirm networks. Put in other words: the more information exchanges a company has with other actors in the network, the more network resources it will gain. Gulati (1999) further argues that the actors in a network create accumulated network resources, which can expand the strategic opportunity set available to them. This is supported by Zaheer & Bell (2005), who state that firms with superior network resources are better positioned to exploit their internal capabilities. The conclusion of Gulati’s (1999) and Zaheer & Bell’s (2005) findings discussed here is that a company’s cooperation and interaction in a network can provide better information about its external business context. This information can subsequently create new strategic alternatives, due to arising potential business opportunities, that would not have been acknowledged by the company without being a part of a network.

The purpose of the theories discussed in this part is to emphasize the importance of networks, especially for SMEs. It has been concluded that networks are crucial for obtaining capabilities not possessed internally by the company, as well as for getting information about the external business context. We

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15 Zaheer & Bell (2005) use the term network structures, but we interpret this concept as interchangeable with the concept of network resources.
therefore suggest that the company should map the network of actors involved in providing the current sales offer. In addition to mapping the contributing companies, and what each actor’s part of the offer is, we also suggest that the network of previous frequent cooperation partners is reviewed. The latter may reveal capabilities that may be useful in a future PSS offer. The mapping of capabilities will also give an understanding of the power distribution within the network, which is an important aspect to bear in mind when forming strategies. Cooperating with actors that the company has had a network connection with, should according to Gulati (1998) imply lower transaction costs and risk in future collaborations. Hence, when searching for capabilities needed to provide a PSS offer, the starting-point should be the existing networks.

The business network is a part of the external business context, which will be further discussed in the following section.

2.5.4 Understanding the Business Context
By understanding the external business context of the company, new business opportunities can be identified and threats can be eliminated. A well-recognized approach for industry analysis is Porter’s (1980) five forces model, which consists of the five competitive forces suppliers, buyers, industry competitors, substitutes and potential entrants. Another framework for analyzing an industry is the profit pool analysis introduced by Gadiesh & Gilbert (1998), which illustrates the distribution of profit and turnover among the activities within an industry. Together the five forces model and profit pool analysis will help to evaluate what activities are attractive for the company to undertake. Activities can be attractive either due to high profit margins or for strategic reasons. The two frameworks will be discussed in the following part.

*Porter’s Five Forces Model*
Porter’s five forces model is illustrated in Figure 2-7.

![Figure 2-7. Porter’s five forces model (Porter 1980, 4).](image)
By analyzing the forces in the model, an understanding of the competitive situation within an industry can be gained. The analysis can emphasize the power distribution among the players involved, as well as trends and potential threats. All five competitive forces collectively determine the intensity of the competition within an industry as well as the profitability. The strongest forces will be crucial aspects in strategy formulation (Porter 1980). The five forces are briefly described below.

**Industry Competitors**
The intensity of rivalry among existing competitors within an industry is important since in most industries the companies are mutually dependent, i.e. the moves of one firm affect the other companies. The intensity of competition will be affected by a number of aspects, such as the number of equal competitors, slow industry growth, standardized offers and high exit barriers. Some types of competition, such as price competition, can lower the profitability in a whole industry.

**Suppliers**
The bargaining power of suppliers can have significant effects on the profitability in an industry. The bargaining power will be affected by aspects such as number and size of suppliers, degree of differentiation, dependency on customers and availability of substitutes. Also the threat of forward integration should be considered.

Not only other firms should be regarded as suppliers, but also labor should be recognized as a supplier. If highly skilled labor is needed to produce an offer and this is a scarce resource, the bargaining power of the labor is enhanced and the salary demands will increase.

**Buyers**
Obviously, also the bargaining power of buyers will have significant effects on profitability. The bargaining power of the customers will be affected by the same aspects as the bargaining power of the customers, but mirrored from the customer’s point of view. The buyers might see reasons for backward integration, which is an aspect that should be regarded.

**Potential Entrants**
New entrants to an industry will increase competition, which in general is a bad thing for established firms. The threat of entry depends on the barriers to entry that are present within an industry, where low barriers increase the threat of new entrants. Examples of barriers can be capital requirements, economies of scale and requirement of access to distribution channels.

Porter (1980) argues that not only start-ups within an industry should be viewed as new entrants, but that also established companies that make acquisitions with the intent to build a market position within an industry should be viewed as new entrants. Acquisitions are often used in industries with high entry barriers in order to avoid the cost related to overcome the barriers.

**Substitutes**
Substitutes as a competitive force is powerful if the function of the industry’s products easily can be fulfilled by other products based on another technology.
Profit Pools

Gadiesh & Gilbert (1998) argue that there exists no market, no matter how homogeneous or narrowly defined, that has an even distribution of the profits among the actors. The profit structure will vary along the value chain and there are always activities that will generate a disproportional amount of the total profits. The authors introduce the concept profit pool which they define as “the total profits earned in an industry at all points along the industry’s value chain” (Gadiesh & Gilbert 1998 A, p. 140). Further, they introduce a framework for mapping the profit pool of an industry. An example the authors use and that is easy to understand is a mapping of the U.S. automotive industry, shown in Figure 2-8.

Mapping the profit pool is useful in several ways. The most obvious use is if a company can modify its business model to exploit the “deepest” parts of the profit (i.e. the most profitable activities along the defined value chain). Even if a company cannot expand beyond the boundaries of its current business model, which might be the case for many smaller companies, it deepens the understanding of the industry it acts in. In addition to visualizing the current state of an industry, a mapping of the profit pools may give clear hints about how the industry will change in the future. An example of the latter can be illustrated in the mapping of the U.S. automotive industry; the high profit margin in leasing will probably lead to an expansion of this business, attracting new entrants in this segment, which in turn (in a couple of years) will lead to an abundance of used cars and hence further lowered margins in this part of the profit pool. (Gadiesh & Gilbert 1998 A)
As can be seen in Figure 2-8, it is not the activities that generate the biggest revenues that are the most profitable; actually, quite the opposite appears to be true. This means that there might be parts of the profit pool with high margins but with relatively small revenues. These activities can be seen as niche markets, which according to the discussion in section 2.2 might be very prosperous for SMEs, since these markets may be ignored by larger companies. Another aspect of the profit pool mapping is that the power, in terms of revenues, within the value chain can be visualized.

It should be noted that the value chain concept in Figure 2-8 is somewhat differing from the definition we have chosen in this thesis. However, this is due to the first step in the four-step process that Gadiesh & Gilbert (1998 B) have created for profit pool mapping, which is defining the value chain one wants to analyze. The four steps are briefly described below (for a more detailed description, see Appendix II):

1. **Define the pool.** Determine which activities to include in the definition of the value chain. Look beyond the traditional industry definitions when doing this definition; take a broad view.

2. **Determine the size of the pool.** Estimate the cumulative profits generated by all activities in the chosen value chain (profit-pool activities). This can be done in many different ways, e.g. by company-level or product-level. The important thing is to be consistent in all calculations.

3. **Determine the distribution of profits.** Estimate the profits generated by each activity. Once again, this can be done in a number of ways. Think creatively when data are unavailable.

4. **Reconcile the estimates.** Compare the outputs from step 2 and 3. If they do not sum up, the numbers must be reconciled. It might be necessary to collect additional data.

   (Gadiesh & Gilbert 1998 B)

The four-step process described above may look simple, and the goal certainly is, but realizing it can be complicated due to the lack of data needed to estimate the size and distribution of profits (Gadiesh & Gilbert 1998 B). In spite of this, we argue that a profit-pool approach can be very useful for SMEs in the search of new business models. Although it may be complicated to estimate the profits with accurate figures, even rough estimates can work as eye-openers. Also, we believe that experienced directors of SMEs in niche markets often have a good idea of how profitable different activities are in their value chain. Thus, we argue that the profit-pool framework can be a useful tool for structuring this tacit knowledge.

When the internal and external analysis has been conducted, the next step is to plan a new offer based on the output from the analyses.

### 2.6 Step 3 – Planning the New Offer

Tukker & Tischner (2004) suggest that new ideas for PSS should be generated based on the findings from the internal and the external analysis. The most promising of these ideas should then be selected for further, more detailed evaluations. Based on this framework, we suggest that this process should be divided into three phases. The first phase is the generation of concepts. From the concept generation, a handful of concepts are selected for advancement to phase 2, in which a qualitative evaluation of the PSS concepts should be carried out. We suggest that one or two of the most promising concepts are taken into the final phase, which is a more quantitative and deeper evaluation.
2.6.1 Concept generation

In order to generate concepts for PSS, the findings from the internal and external analysis will work as input. In this phase it is important to generate different PSS concepts without too much emphasis on the feasibility of the offer, so that creativity is not restricted (Johannesson, et al. 2004). As a support for the creation of PSS concepts, we suggest three different approaches derived from the findings in both the internal and external analysis of the company. These approaches take on different perspectives, originating from the identified gaps, the identified fits and the categorization of value.

Identify the Gaps

One way to generate offers is to identify gaps that exist between the firm and customer, and then think of how those gaps can be filled. Especially two gaps in the company-customer relationship can be identified, which is illustrated in Figure 2-9.

![Figure 2-9. Gaps in communication and value with input from the analyses.](image)

First, there can exist some gaps in communication between the customer’s perception of the firm’s offer and what the firm communicates to the market (e.g. that the key selling points are not perceived to be matched by the actual offer). From the external analysis, the market-perceived quality profile will serve as input to what the customer perceives, while the assessment of the offer in the internal analysis will be the input for what the firm communicates. If there is a gap identified, not only the market communication but also the offer itself can be modified to close this gap.

Second, there can be some gaps in value between the customers’ need and what the company provides. Apart from obvious needs that can be rendered from customer interviews, potential customer needs can be identified by the ACRA tool. Through the analysis of the current offer, described in the internal analysis, it will be made clear what the firm actually provides the customer. If a gap is identified between the customer needs and the company’s offer, it will give inspiration for a concept of a new offer.
**Identify the Fits**

Another way of finding inspiration for new PSS offers is to focus on identifying fits between internal and external factors that match the company’s capabilities and processes with the customers’ needs and processes. We argue that the most relevant fits are those illustrated in Figure 2-10.

![Diagram](Image)

**Figure 2-10. Fits between capabilities and processes that may lead to new business opportunities.**

By analyzing the external business context – using the five forces model and the profit pool analysis – attractive activities can be identified. Activities can be attractive either due to high profit margins or for strategic reasons. The result from the business context analysis can be used in two ways.

First, the activities identified as interesting for the firm to undertake should be mapped to find fits between desired activities and the capabilities possessed by the company or its network (as discussed in section 2.5.3). This fit between the attractive activities and existing capabilities is the most desired match to search for. However, highly profitable activities that require new capabilities should not be ruled out in this stage, since new capabilities can be obtained from a network (or even be developed within the organization).

The second approach the company can use is an inside-out perspective by taking the starting-point in the analysis of the existing capabilities within the organization and its network. By doing so, unexploited capabilities can be found to be useful in activities not carried out by the company today. This may work as inspiration for new business models. Inputs to both abovementioned approaches are the analysis of the external business context and the analysis of the firm’s capabilities and the capabilities of the network.

Fits can also be found between the result from the conceptual LCA and the result from the customer requirement analysis. The understanding of the environmental impact of the offer should be matched with the understanding of the customer’s needs and processes in order to find ways to reduce waste. The environmental impact of the product during its whole life cycle should be matched with the customer processes in order to get inspiration for how the offer can be changed in order to reduce waste.
without decreasing the customer value. The result can be lower economical costs as well as lower environmental impact.

**Categorize the Value**
According to Normann & Ramirez (1993) companies should provide their customers denser value offers. This means that offers should be embedded with more knowledge and amount of information, so that the customer can enhance its own value creation. The authors further suggest that in order to provide offers with higher value, a reconfiguration of the value system has to be done. Instead of a regular value chain approach, firms should interact in forms of a *value constellation*, where value is co-produced by the actors providing the offer and the customer. The value constellation can be compared with the different offers categorized in Tukker & Tischner’s (2004) product-service continuum (presented in section 2.4.2), as each offer requires different capabilities to be provided. Each categorized offer represents a specific type of value constellation. With the goal of finding an offer with higher value, a suitable starting-point would be looking at different value constellations defined through the offer categorization. By analyzing how the change in composition of the offer would be affected by movement along the product-service continuum, different scenarios can be drawn that will act as inspiration for new PSS offers.

The output from the three approaches described in this section (identifying the gaps, identifying the fits and categorizing the value) will be ideas about how new PSS offers can be designed. Some of the ideas will surely be overlapping, which is a good sign. If, for example, a need for a concept founds support in the identification of gaps as well as in the identification of fits, the concept should be considered as validated to some extent. Some concepts will not be overlapping, but this does not necessarily mean that the concepts are not attractive. Of all the concepts generated, a handful should be chosen for further evaluation. We argue that the choice of what concepts to be advanced to the next level should be based on intuition and experience of the people involved in the decision. A more structured concept scoring method is suggested in the next step, which will provide a more detailed evaluation.

**2.6.2 Evaluation of PSS offers**
Goedkoop et al. (1999) present a qualitative assessment for evaluation of a PSS offer. This assessment is based on four dimensions in which the PSS concept is compared to the current offer, to see if the new concept has better potential to be successful than the current offer. The four dimensions are:

- Environmental impact
- Economical impact
- Identity and Strategy match
- Customer acceptance

They further suggest that a multidisciplinary expert panel rates the offers in the four dimensions from a qualitative point of view. In the case of SMEs, the expert panel can consist of the management, which should have enough insight in these dimensions. Each dimension is rated on a -3 to 3 scale, where -3 means that the current offer is much better, 0 that the offers are equal and 3 that the new offer is much
better than the current offer. These ratings can then be mapped in a diagram to create an overview of the attractiveness of the concept, as illustrated in Figure 2-11.

![Diagram of ratings from assessments of the four dimensions](modified from Goedkoop et al. 1999, p. 29)

**Environmental impact**

The environmental impact of the offer can, according to Goedkoop et al. (1999), be judged from the life-cycle assessment. To assess the environmental impact of the new offer the starting point is the life cycle of the current offer, which is a part of the internal analysis. The shifting to the PSS offer implies changes in the life cycle as activities are excluded, enhanced, added, etc. These changes will increase or decrease the total environmental impact of the offer, hopefully decreasing the impact.

**Economical impact**

Goedkoop et al. (1999) suggest that the economical impact should be examined on two levels: company perspective, by a logical analysis of revenues versus costs, and a business sector analysis, to identify if the concept can generate future strategic possibilities. The company perspective is important, since an offer needs to be profitable to be interesting. The business sector analysis implies looking at the potential for the concept of gaining access to new markets in the future. The company perspective can be viewed as the short run economical impact and the business sector analysis as the long run economical impact.

**Identity and Strategy match**

Goedkoop et al. (1999) identify three aspects of the match between the PSS concept and the firm. The first aspect is how the offer matches the company’s strategy. As concluded earlier, SMEs have a higher strategic flexibility than larger companies, meaning that the impact of a strategic mismatch is not as threatening as for larger companies. However, the willingness of the firm to deliver the PSS concept can be regarded as a strategic match. The second aspect is the capabilities of the firm and network, i.e. if the firm and/or its network are capable of delivering the PSS concept (Goedkoop, et al. 1999). Important issues to deal with under this aspect are the difficulties for the firm to get the capabilities needed to provide the PSS concept, if the firm does not have them itself. The capabilities of the firm have been covered by the internal analysis, while the capabilities of the network have been mapped in the external
analysis. The third aspect is whether important third parties accept the PSS concept. Third parties can be threatened by the PSS offer, such as suppliers losing business, and seek to reduce the firm’s chances to put the PSS offer to the market. Goedkoop et al. (1999) suggest that the firm should think on the changes that the PSS offer would impose the actors and the reaction they will have. The power and influence that these actors have will also play an important role.

Another aspect that is connected to the identity and strategy of the company, and that might work as a barrier for the development of PSS offers, is that a reorientation towards PSS offers can require a fundamental shift in corporate culture (Mont 2001). This aspect should absolutely be regarded, but we believe that a change of culture will be easier in smaller companies due to the closeness to the top management and closer connection between the different functions within the company.

Customer acceptance
Goedkoop et al. (1999) present a simplified four-step process for the assessment of customer acceptance:

1. Rank the most important features of both the new and the current offer.
2. Rate the PSS offer and the reference system according to these features.
3. Check whether the proposed communication and marketing strategy of the PSS is expected to be effective.
4. Determine the relative strength of the PSS offer.

Inputs for step 1 are the results from the market-perceived quality profile, the ACRA framework, the analysis of the current offer and the key selling points.

The customer acceptance is estimated by the company itself. The PSS offers that are beneficial over the current offer are interesting to develop further. We argue that the next step is to choose one or two of the most promising concepts to test their feasibility more in-depth. However, if the company cannot come up with a concept of a PSS offer that is considered superior to the current offer, it should stop further progress in the development process. If an iteration back to the concept generation step also fails to create superior concepts, then the company should keep to its current offer. However, the work done at this stage will not have been wasted, since a deeper understanding of the company’s business situation will have been gained. The lack of possible improvements on the current offer will also confirm that the current business model is successful and that there is no need for changing it in the near future.

2.6.3 Feasibility of the Offer
In this step, a more in-depth analysis will be conducted. This analysis will take a more quantitative approach with more accurate figures about the economical and environmental aspects of the offer, as well as a more detailed evaluation of how to manage the network required to obtain the capabilities needed to provide the offer. Finally, the customer acceptance must be judged by the customer themselves, in order to confirm that no vital aspects that might prevent customers from purchasing the PSS offer have been overlooked. Obviously, if the customers are not interested in purchasing the PSS offer, there is no point in trying to provide it.
According to Goedkoop et al. (1999) the methods for quantitatively assessment of the economic and ecological impact are investment analysis (revenue and cost streams), profit pools and life cycle assessment. Although these methods have already been used in the previous step, it was at a more basic level. In this stage more accurate data is required, since the decisions made can have great impact – financially as well as strategically – on the company’s future development. The analysis has to be more in-depth in order to really test the feasibility in a reliable way.

Finally, the firm should test the customer acceptance by asking the customers whether they are interested in purchasing the suggested PSS offer (as opposed to just using already collected data as done in the evaluation phase). A dialogue and constructive discussion with the customers can increase the competitiveness of the offer, since opinions from the customers can be used to further improve the design of the offer.

Hopefully this will render a detailed concept of a PSS offer that is competitive, creating value for both the customer and the firm while decreasing the environmental pressure. Just like in the previous evaluation, if no concepts are found to be feasible, the process should be aborted and the company should stay to its current offer. The realization of feasible concepts, which is the next step in the development of a PSS offer, is out of scope for this thesis. Instead, a synthetization of the subjects discussed in this frame of reference will follow in the next chapter.
3 Theoretical Synthetization

In this chapter the theories discussed in the frame of reference will be summarized and synthesized into our business development method for generation of PSS offer concepts. This method will be the answer to our first research question, which regard the design of such a method.

3.1 Summary of Theories

The frame of references introduced a three step method consisting of an internal analysis, followed by an external analysis before planning the new offer.

In the first step, three topics are covered. First, the internal business processes are assessed through an internal value chain analysis. The internal value chain analysis gives an understanding of the company’s activities and the relation between them. Fits between activities can create a competitive strategy for the firm. The activities form business processes that are of strategic importance for the firm, which can be seen as the capabilities of the firm. The outcome from analyzing the internal business processes is therefore the capabilities of the firm.

The second topic is the assessment of the offer, where the company’s current offer is categorized using the product-service continuum. A PSS offer could be either product-oriented (product with services as add-ons), use-oriented (leasing, rental or pay-per use) or result-oriented (activity management or functional results). Closely connected to the categorization is the communication of the offer, i.e. which key selling points the offer has. Together this will give an understanding of the current offer and key selling points.

The last step of the internal analysis is the life cycle assessment of the offer. By following the product from the cradle to the grave the environmental impact of each phase can be identified. The phases are material production, manufacturing, transport, use & product recycling and material recycling & disposal. The outcome of the life cycle assessment is an understanding of the offer’s environmental impact.

Figure 3-1 shows the topics of the first step and the outcomes of each topic.

As mentioned earlier, the second step consists of the external analysis. Here four topics are covered.

First, the customer requirements are gathered and analyzed through the Anticipative Customer Requirement Analysis (ACRA). This framework helps to identify potential needs that the customer might
have. By analyzing at the customer’s processes and comparing those with the customer’s values, potential customer needs can be identified. Furthermore, when analyzing the customer requirements it is important to get an understanding of who has the real power over the purchasing decision.

Second, how the company and its offer are perceived by customers is analyzed. To do so a market-perceived quality profile is conducted, which is a method that lets the customer evaluate the company and the offer on important purchase criteria. The outcome will be an understanding of the customer perceptions.

The third topic analyzes the network involved in providing the offer. By doing a network analysis the capabilities of the network can be identified, which will be the base for what offers can be provided.

Finally, the business context is analyzed using the five forces model and the profit pool analysis. This will show what activities that are attractive for the company to undertake, e.g. due to high profit margins or in order to gain market power by blocking competitors.

The topics and outcomes in step 2 are illustrated in Figure 3-2.

**3.2 PSS Offer Generation Method**

By synthesizing the previously discussed topics and theories, we have created a method for business development towards PSS offers, which aim at being applicable for the management in manufacturing SMEs. We chose to call this method the *PSS Offer Generation Method*, in the remaining part of this thesis simply referred to as *the method* and *our method* (used interchangeably), and it is graphically illustrated in Figure 3-3.
The output from step 1 and 2 in the method will be the base for development of new PSS offers. Step 3 starts with the use of the three approaches on how to use this output in order to support the concept generation process. These approaches were discussed in section 2.6; identifying the fits, identifying the gaps and categorizing the value. The two former approaches have been illustrated with arrows in Figure 3-3 and the connections will be briefly summarized below.

Figure 3-3. Graphical illustration of the PSS Offer Generation Method.
a) A gap between the current offer and the customer needs will work as inspiration for ideas of new PSS offers. This is probably the most obvious connection between the internal and external analysis.

b) An understanding of the environmental impact of the current offer, combined with an understanding of the customer’s needs and processes gives the possibility to create matches that reduce waste. The inspiration here should be changes in the business model that reduce waste at the same time as the customer’s value is increased.

c) A gap between the company’s key selling points and the customer perceptions about the offer might indicate how the company can change not only the market communication but also its offer to match the customer’s perception. The latter should of course only be done if desirable, i.e. if it is in line with the firms intended strategy.

d) The company should seek to identify a fit between the capabilities that it controls (internally or through its network) and attractive activities that have been identified in the analysis of the business context, where the five forces model and profit pool analysis is used. Both an inside-out perspective and an outside-in perspective should be used. The former will help the company exploiting its unused capabilities while the latter will help the company to undertake new attractive activities (which might require that new capabilities are obtained from the network or developed in house).

When the gaps and fits have been identified, the product-service continuum (presented in section 2.4.2) can be used to create different scenarios for the offer. By trying to create different scenarios along the product-service continuum (i.e. depending on the product/service ratio) new ideas can emerge concerning how the offer can be developed.

Using all the ideas that emerged from the three abovementioned approaches, new PSS offer concepts can be created in the concept generation phase. A handful of the most promising concepts should be advanced to the next level, based on the intuition and experience of the people involved. The evaluation of concepts is then made by the qualitative assessment discussed in section 2.6, with the focus on environmental impact, economical impact, identity and strategy match, and customer acceptance. One or two concepts should be advanced to the last phase, the feasibility analysis. If no concepts are judged to be superior the current offer, a new concept generation phase should be conducted. If this iteration still does not result in a concept superior to the current offer, the company should keep to its current offer.

In the feasibility analysis phase, a more in-depth analysis of the concepts will be conducted. This analysis will take a more quantitative approach in order to verify the feasibility of the concept, as described in chapter 2.6.3. This also means that the concepts have to be described more in detail. If a concept is found to be attractive and feasible, it should be advanced to the realization phase. The latter is out of scope for this thesis and corresponds to step 4 in the IPSE methodology. Hence, the result from our PSS Offer Generation Method should be a detailed concept to be used as input for the realization phase. If no concept is found to be feasible, the company should keep to its current offer.
4 Methodology

This chapter outlines the methodology of this thesis. First, the purpose of the thesis is categorized, since this gives some frames for the research process. The research process is further divided into four layers and treated in the following sequence: research philosophy, research approach, research strategy and the research method. The chapter is completed with a discussion regarding the quality of the study.

4.1 Type of Purpose

The purpose of the study is to answer the question why the study is conducted. According to Blumberg et al. (2003) there are four different types of studies:

- A **reporting study** is the simplest study and has the goal of producing some data or generating some statistics.
- A **descriptive study** is used when some basic knowledge exists and the researcher wants to describe a subject or group of subjects.
- An **explanative study** occurs when deeper knowledge is sought and the researcher wants to both describe and explain the reasons for the subject.
- A **predictive study** is, similar to the explanatory studies, based on deeper knowledge and used when the researcher wants to predict an event or outcome.

Lekvall & Wahlbin (2001) describe similar types of studies, but include an explorative study instead of a reporting study, that is used when no knowledge exits about the phenomena and the researcher wants to form a basic knowledge.

Björklund & Paulsson (2003) suggest another type of purpose which is called a normative study. This type is to be used when certain amount of knowledge exists and the researcher has the aim of give guidance and propose a motion.

The purpose of our thesis was to develop a method for the management in SMEs to use in their transition towards PSS offers. This can be seen as providing guidelines for SMEs, which is corresponding to a normative study. It also requires that a certain amount of knowledge about the area already exists. This was the case for our study, which is underlined by our frame of reference. Hence, this thesis had a normative purpose.

4.2 Research Process

According to Saunders et al. (2003) different layers of a research exist. The choices made in one layer will affect the choices in the subsequent layers. Other authors name these layers with differing terms, but have a similar meaning. Therefore the layers presented in Figure 4-1 are based on Saunders et al. (2003) but with some alterations. The first layer, which is the foundation of the research, is the philosophy on which knowledge is created. The second layer, the research approach represents how knowledge is used and created in the study. The third layer represents what strategy is used to answer the purpose of the study. The final layer, the research method, is the technique(s) used for collecting the required data.
4.3 Research Philosophy

Saunders et al. (2003) argue that the research philosophy is the development of knowledge which affects the way the research is being done. They present three different philosophies: positivism, realism and interpretivism.

Positivism is governed by three basic principles. First, the social world is external and objective. Second, the researcher acts as an independent objective observant and third, the research is free from values. (Blumberg, et al. 2005) Bryman & Bell (2007) state that positivism proposes the use of methods derived from natural science to study the reality and puts an emphasis on explaining human behavior. Hypotheses are generated from theory which then can be tested in reality in an objective way. In order for others to replicate these tests there is a need for highly structured methodology (Saunders, et al. 2003).

Realism has its starting point in the belief that there is a reality that is independent of the human being. This implies that there are underlying forces affecting people’s behaviors and actions without them being aware of it. Therefore realism acknowledges the importance of understanding a subjective reality where the people are not the real object of study. (Saunders, et al. 2003)

Interpretivism is contradicting the positivistic view stating that reality is too complex for testing of theoretically generated hypotheses (Saunders, et al. 2003). The interpretivism is based on three principles, opposing those of positivism. First, the social world is subjective and is given meaning by people. Second, the researcher is part of what is observed and third, the research is driven by his/her own interests. (Blumberg, et al. 2005) In contrast to the positivistic view, understanding of the human behavior and the subjective meaning of social actions are important. (Bryman & Bell 2007)

As our study had the purpose of developing a method for others to use, the research philosophy used was to a high degree positivistic. In line with the positivistic view we derived a hypothetical model to be tested from existing theory. However, as much of the information used as input were gathered from individuals, we must acknowledge the subjective meaning of their actions which means that the study had some influences of a interpretative philosophy.

Another way of looking on how knowledge is created is through the methodological approach of the study. Arbnor & Bjerke (1997) state three methodological approaches on how knowledge is created:
• The analytical approach provides a mathematical view on reality where the different parts form the whole picture. By piecing together different parts the researcher can get the whole picture. The knowledge is created through the logic and results that can be verified or falsified.

• The systems approach has a more complex view on reality and in contrast to the analytical approach, piecing together the different parts does not get the whole. The systems approach can be viewed as a number of components and their internal relations. Hence, the knowledge will be depending on the system structure and therefore the knowledge creation is system-dependent. To study one component at a time is not sufficient; one has to put it into a context.

• The actors approach has the same complex view on reality, but takes a starting point from the actors, claiming that the system only exists through the actors. In the actors approach the whole picture can be understood by examining the characteristics of the actors. The knowledge created is therefore dependent on the actors.

Our object of study, the offer, can be viewed as part of a system with relations to the company and its network in one corner, and to the customers in the other. This suggested the use of a systems approach for the thesis. Arbnor & Bjerke (1997) suggest that explanatory knowledge is suitable with the analytical approach while the actors approach is suitable for understanding knowledge. The systems approach is suitable for both knowledge philosophies. In other words the systems approach is appropriate for a positivistic philosophy with interpretative elements, which made it suitable with our knowledge philosophy.

4.4 Research Approach
Saunders et al. (2003) present two research approaches: deduction and induction. A deductive approach implies testing a theory in practice. From theory a hypothesis is formed to be tested through the findings of an empirical study (Bryman & Bell 2007). A correct deduction must be true and valid, which means that a conclusion must be valid if the reasons leading to the conclusion are true (Blumberg, et al. 2005).

Induction is the opposite of deduction and implies that theory is built from empirical data. Induction emphasizes an understanding of the research context as well as flexibility regarding research change. (Saunders, et al. 2003) Induction forms conclusions from the local facts and not from a general law or rule (Blumberg, et al. 2005).

As one can see, deduction is suitable for a positivistic view as both involve testing of a hypothesis to draw conclusions. We derived a model to be tested empirically which was a deductive approach. However, during the testing of the model we wanted to alter it and improve it from the empirical findings. Hence, the thesis had signs of an inductive approach as well. In conclusion, our thesis was mainly deductive with elements of induction. This is in line with Bryman & Bell (2007) who claim that a deduction cannot exist in its raw form and that it always contains elements of induction (and vice versa).

4.5 Research Strategy
The research strategy is about how the study is to be conducted in order to answer the purpose of the study. The type of purpose will to some extent dictate what strategy that is suitable and a distinction between whether the study is quantitative or qualitative is often made. (Bryman & Bell 2007)
A quantitative study relies on information based on quantitative data such as numbers and figures where results and conclusions can be confirmed or rejected. On the other hand, a qualitative study uses information based on qualitative data such as words, sentences and narratives. (Blumberg, et al. 2005)

Bryman & Bell (2007) suggest that a quantitative study is suitable when the study shows signs of a positivistic philosophy combined with a deductive approach. Further, they advocate that the traits of a qualitative study are congruent with an interpretative philosophy in combination with an inductive approach. Using these arguments, our study should have been considered as a quantitative study. However, as most of the input to our developed method came from the words and sentences of individuals involved in the system, our study had mainly a qualitative strategy. Some of the data gathered was of quantitative type, but this did not affect the primary strategy.

Saunders et al. (2003) suggest that a research can be performed for example through experiments, surveys and case studies. Bryman & Bell (2007) state that a case study involving more than one case is called a multiple-case study, which they mean enables the researcher to find similarities between cases and therefore gaining generalization. As discussed in the thesis background, the empirical research was performed through a multiple case study.

The orientation of this thesis is summarized in Table 4-1.

<table>
<thead>
<tr>
<th>Research philosophy</th>
<th>Positivist with elements of interpretativism</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research approach</td>
<td>Deduction with elements of induction</td>
</tr>
<tr>
<td>Research strategy</td>
<td>Qualitative study using multiple cases</td>
</tr>
</tbody>
</table>

The multiple case study was chosen in order to test and validate the method developed in the frame of reference. Three cases were selected and the selection criteria were that they should be manufacturing SMEs participating in the IPSE project, with various sizes and operating in differing industries. Together with our supervisor three companies that followed the outlined criteria were chosen. According to Eisenhardt & Graebner (2007) this type of sampling is appropriate for a multiple case study, since they argue that the cases selected should be chosen based on the possibility to find interesting phenomena, rather than being chosen randomly. The insight of our supervisor in these companies assured us that they were suitable for the study, i.e. they were in different interesting business situations. The number of employees, turnover and type of business for each company is shown in Table 4-2.
According to EU’s definitions only MJP is classified as medium-sized\textsuperscript{16}, while the two remaining companies are classified as small. None of the case companies has more than 50 employees (although MJP is a part of Österby Marine, which has around 150 employees). This implies that their organizations will not be fully comparable with the organizations of companies with closer to 250 employees, which is the upper limit of medium-sized companies. However, the chosen companies are representative for the SMEs participating in the IPSE project, since almost all of the participating firms have less than 50 employees.

From the theoretical synthetization we knew what information would be needed in order to test our method. To structure what information would be needed we created a question guide, so that no information to a topic was overlooked. The question guide can be found in appendix III (English version) and appendix IV (Swedish version).

The research strategy for testing our method was to execute it ourselves, rather than letting the managers in the companies try to carry out the steps in our method. According to Eisenhardt & Graebner (2007) the strength of a multiple case study is its ability to find comparisons between the cases that indicate that an emergent finding is correct. They also suggest that using multiple cases as research strategy enables the researcher to use an iterative process where findings in one case can be regarded when looking at the other cases. This implied that we as researchers wanted to lead the testing of the method towards the emergent findings that we saw in the process of testing the method. For instance, when finding an improvement of one tool, we used this improvement on the other case companies to see if the improvement was valid here as well. This means that we had to carry out the method in order to not miss these aspects.

There are other arguments for executing the testing by ourselves. The method was created by a deductive approach, which means that there might have been parts that were difficult to carry out in real life. It would be easier for us to see the reason why the parts were difficult to execute than for the case companies. Also, we did not want to waste the time of the managements of the case companies on a non-empirically tested method. However, in order to further verify that step 3 works, we chose to let the management of Assalub execute it together with us.

\textsuperscript{16} EU’s definition of small companies is enterprises with less than 50 employees and an annual turnover not exceeding 10 million Euros (European Commission 2005). MJP had a turnover of around 13 million Euros in 2007.
Yin (1994) suggests that when conducting a multiple-case study, the research should be divided into two phases. First each case study should be performed individually, both in terms of data collection and analysis. He argues that an individual case report should be written for each case, before a cross-case analysis can be conducted. From the cross-case analysis conclusions can be drawn that relate to the theories developed in the design phase of the study. We will follow this strategy by first analyzing how our method worked for each case (chapter 5-7) and then making a cross-case analysis in chapter 8.

In order to test the method we visited the case companies and used our question guide to find out as much information about the companies and their business context as possible. This question guide was designed so that we got the input needed to perform the analysis of each topic. The analysis made was based on identifying which steps were difficult to carry through, either through lack of information or difficulties of using an intended tool. The idea was that this would answer how applicable the method is for manufacturing SMEs and how to improve the method. The information that could not be gained from the companies was collected from interviews with customers. The data collection method used is described in the following chapter.

4.6 Research Method
The last part of the research process is the research method, which consists of the actual techniques used in the data collection. Our purpose implied that we formed a hypothesis derived from theory to be tested in reality. This means that first a theoretical study was performed, followed by an empirical study.

4.6.1 Theoretical study
Our normative purpose implied that we started with the theoretical study. According to Lekvall & Wahlbin (2001) the pre-study is conducted through secondary data such as relevant literature and articles. This is an important part of defining the problem. As our study is a part of the IPSE project, a relevant start was reading the articles published by the IPSE research team, to get a deeper understanding of the problem. By using references in these articles we found more relevant articles to read, which is a method that is promoted by Ejvegård (2003). During meetings with our supervisor and the IPSE research team we received further guidance to relevant articles and literature. We also searched for articles in the business articles database Business Source Premier, which is accessible from the Linköping University Library’s website. To complement the articles we also used books that are relevant to the subjects examined. The theories used are described in the frame of reference and are the base of our method. Before we tested the method with the case companies, it was reviewed by both our supervisor and opponents.

Ejvegård (2003) states that when conducting theoretical studies, the primary sources should be used in order to avoid reference or interpretation errors. In order to avoid such errors, we have mainly used primary sources. In the few cases where it was not possible to get access to the primary sources, this has been noted in the text in the frame of reference.
4.6.2 Empirical study
The empirical study consisted of three parts; IPSE workshops, case studies and a workshop with the management of Assalub. A chronological overview of the different parts in the empirical study is displayed in Table 4-3.

Table 4-3. Chronological overview of the empirical study.

<table>
<thead>
<tr>
<th>Week</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>IPSE workshop with Österby Marine</td>
</tr>
<tr>
<td>1</td>
<td>IPSE workshop with Roslagens industriigrupp</td>
</tr>
<tr>
<td>2-3</td>
<td>Case study: MJP</td>
</tr>
<tr>
<td>4</td>
<td>IPSE workshop with Åtvidaberg companies</td>
</tr>
<tr>
<td>4</td>
<td>Case study: Assalub</td>
</tr>
<tr>
<td>5</td>
<td>Case study: Polyamp</td>
</tr>
<tr>
<td>6</td>
<td>Workshop with Assalub</td>
</tr>
</tbody>
</table>

IPSE Workshops
Before starting the empirical study of the case companies, we participated in two workshops with the IPSE research team. By doing so we gained a better understanding of the companies’ situations before conducting the case studies, which made it possible to refine the questions that we planned to ask. According to Yin (1994) this is the purpose of a pilot study, in which a case is chosen to refine the data collection plans. Even though we did not conduct a complete pilot study, the IPSE workshops can to some extent be viewed as a substitute of a pilot study since we could refine our questions in the question guide.

The first workshop was held with Österby Marine – mainly with representatives from MJP – which gave us a head start for the empirical study of MJP. During this workshop we got the input that when doing the profit pool analysis it might be helpful just to estimate the size and profitability of each activity on a three-step grade; low, medium and high. The second workshop was held with Roslagens Industriigrupp with representatives from six companies. During this IPSE workshop we realized that tools and methods designed to be used by the management in small manufacturing companies must be kept as simple as possible – otherwise they will not be used due to lack of time. We also found out that regarding the profit pool analysis, it can in some cases be valuable to mark revenue trends for each activity, in order to forecast what activities that will be attractive to undertake in the future.

Four companies attended the IPSE workshop in Åtvidaberg, which was held the same week as we started the empirical studies of Assalub. During this workshop both the use of getting away from the daily work tasks and the use of working with the process itself in the IPSE methodology were highlighted by the attending managers.

Case Studies
The case studies were used to test and verify the method that we have developed in the frame of reference and the questions that needed to be answered are collocated in our question guide in
Appendix III. The first two steps in the method required information gathering from both the companies and their customers. The data collection at the companies was made mainly through personal interviews and some complementary information was gathered over telephone. Since there were three case companies and each having customers located in different parts of Sweden and worldwide, it was not possible for us to interview the customers in person and therefore all the customers have been interviewed via telephone. When data had been collected we performed step 3 back in the office, using the output from step 1 and 2. The concepts generated were presented to MJP and Polyamp who got a chance to reflect on our findings. In the case of Assalub, we did the third step during a four hour long workshop with them at Linköping University.

**Data collection at the company**

The personal interviews were made at the offices of each case company. The first person interviewed at each company was the person we had been in contact with prior to our visit. In doing so we got the basic knowledge about the firm before interviewing the other employees. This also served as an investigation of who in the organization had more specific information about each topic. At this stage we also chose what offer to analyze in concurrence with the company, based on question 5 and 6 in Appendix III. When searching for information within the organization we used a so called snowball technique (Saunders, et al. 2003), letting respondents tell us who to contact in order to gain more information about a certain topic. The first interview was at a more general level dealing with all the topics, while the following interviews were related to a more specific topic.

The interviews were conducted in an open way, with a more discussion-like tone. We asked both for the facts of matter and the respondents’ opinions, which Yin (1994) refers to as questions of *open-ended nature*. By using this type of questions, he argues that the respondent can become an “informant” and that key informants can be critical to the success of a case study. The interviews were held with one person at the time, since we wanted to avoid influence between the interviewees. We started with a topic from the question guide and then let the respondent speak freely, with us leading the discussion depending on the answers. However, the interviews filled two purposes; to give us an understanding of the companies’ situations and to collect the information required as input to our method. In the latter case the interviews had the characteristics of what Yin (1994) refers to as *focused* interviews, since we more strictly followed a certain set of questions.

Usually one of us was the main interviewer while the other one was taking notes and asking follow-up question when feeling something had to be clarified or filled in. This made sure we did not miss important aspects in each topic and enabled the discussion-like tone since both of us were not busy taking notes.

As some employees were travelling a lot, we made phone interviews with them. During these interviews we used a mobile phone connected to a headset with two earpieces. This was done to increase the sound quality in both directions. One of us was talking on the phone while the other one was taking notes. When we were back at the office we could make complementary interviews with the employees at each company, something all the case companies had accepted.
Data collection from the customers

The customers were an important input to step 2. We asked the case companies about which customers were acceptable and relevant to contact. The interviews with the customers were made after we had been at the case companies, so that we had an understanding of the business before talking to the customers. Due to time limit all the interviews with the customers were made over the phone, increasing the number of customers being contacted. For Assalub and Polyamp, all the interviewed customers were located in Sweden, which eliminated the language barrier. MJP’s customers were however dispersed over the world which was not a problem in general. However, the customers in Asia tended to have a very unclear pronunciation, which slightly aggravated the communication.

When calling the contact person at the customer we started by explaining that we were calling from Linköping University and asked if the respondent had time to answer some questions. If so we stated our reason for calling, the subject of our thesis and that we had received their contact information from the case companies. None of the interviewees were forced to answer questions he/she did not want to answer. After each interview we went through what had been noted from the interview, complementing each other’s view of the information.

The interviews with the customers had the same characteristics as the ones held with the case companies. We first used questions of what Yin (1994) calls open-ended nature to get a basic understanding of the customers’ businesses where after the interviews got more focused in order for us to receive answers to the relevant questions in our question guide (questions 27-30 in appendix).

4.7 Quality of the study

This section will discuss the quality of the study through the reliability and validity of the study. Throughout the study it was important to bear in mind the impact on the validity and reliability of the thesis. Validity refers to if the measurements used really measures what was intended. This can be viewed as aiming towards the right point. Reliability refers to the consistency of measure, i.e. if the thesis can be stated as reliable and repeatable (Bryman & Bell 2007). If validity is viewed as aiming in the right direction, then the reliability can be viewed as the accuracy of hitting the aimed point.

Lekvall & Wahlbin (2001) also point out some sources of errors that affect the quality of the study. In our case the sources of errors are two-folded; first there are some sources of errors derived from us as researchers and second there are sources of errors connected to design of the method. In this section we will discuss the sources of errors that could be affected by us as researchers while the sources of errors connected to the design of the method will be discussed in the subsequent chapters of the case studies and analysis.

4.7.1 Validity

The guidance from our supervisor and the IPSE research team led us to appropriate articles for this thesis. This increased the validity of the thesis as it helped us to better define the purpose and create the frame of reference. During the literature study we came across and used articles regarding SMEs. However the case studies were made on smaller companies leaving doubts on whether articles dealing with both small and medium-sized enterprises are relevant. We believe however that the constraints on
the SMEs that these articles present are enhanced for small companies, making the arguments outlined in the frame of reference even more valid. Before testing the method in reality our supervisor and opponents reviewed the method, and therefore gave it face validity, as defined by Lekvall & Wahlbin (2001).

Yin (1994) defines concept validity as the matching of theory with the findings of the study, i.e. if the theories from the frame of reference are congruent with our empirical findings. If so then this implies high concept validity. Our analysis was therefore not only focused on the pros and cons of our method, but also focusing in finding similarities between the theories building up the model and the empirical findings.

The outputs from the steps in the method were validated with the case companies by letting them read the appendix and being told the output. This was to make sure that the method gave output that the companies considered valid and generated concepts that were suitable and interesting for the companies. The workshop made with Assalub in step 3 was a good way of validating if a company could perform this step, which further tested the validity of the method.

4.7.2 Reliability
When doing the literature study we tried to find different authors within each area in order to increase the reliability of the theories and arguments used to create our method. For some of the tools introduced in the frame of reference – such as the ACRA and profit pool analysis – it was not possible to find similar frameworks. However, since these tools are only used in order to gain information needed as input for issues with a more established theoretical base, we argue that the lack of additional sources will not affect the reliability of the frame of reference.

While doing the empirical study at the case companies we asked the several staff members the same questions so to make sure the information gathered showed a congruent picture. As several staff members contribute to our picture of their company we believe that this increased the reliability of the study. The reliability was also increased by the fact that we could do complementary interviews over the telephone when having lack of information.

The customers interviewed were chosen by the case companies. As we were not part of the selection process, customers with a positive image of the case company might have been overrepresented. This could decrease the reliability of the customer analysis. However, we argue that this source of error does not have too much impact on our study since we were more interested in gathering input to method rather than getting a comprehensive view of the all the case companies’ customers.

Another source of error that has impact on the reliability of the study is the fact that we could not meet the customers in person. This decreased our understanding of their processes, something that we believe have an impact on the conclusions that can be drawn from the output that require an understanding of the processes.

Also the language barrier that we experienced with some customers, especially from Asia, could decrease the reliability of the information from these customers. However after being on the telephone
with these customers we checked the information gathered from them with the corresponding case company to identify irregularities in the information.

4.7.3 Secrecy
Since parts of the empirical case studies are confidential, some parts of this report have been censored. This has not affected the quality of the study, but it will slightly decrease the readability of the report. This concerns the empirical case studies of MJP of Assalub (chapter 5 and 6, respectively).

4.7.4 Generalization
Yin (1994) states that case studies rely on analytical generalization, rather than statistical generalization as is the case when using quantitative research methods. He argues that this implies that instead of just selecting a representative “sample” from the group of units that should be analyzed, which can be done for statistical generalization, a particular set of results should be generalized to some broader theory.

In this thesis we seek to develop a method that should be applicable for the management in the group manufacturing SMEs by studying three case companies. Using Yin’s (1994) reasoning, we argue that if the results from the studies of these companies are congruent to the theories regarding what distinguish SMEs, then our findings should to some extent be generalizable.
5 Case study – MJP

In this chapter the empirical results from the case study of MJP will be presented. First a short description of MJP will give the reader a basic understanding of the company’s situation; for a more detailed description we refer to Appendix V. Thereafter a description of how the execution of the method – which follows the order of the questions in the question guide – worked and what output was received in each step of the method will follow. All the information in this chapter is based on interviews with MJP and its customers.

5.1 About MJP

MJP Marine Jet Power (MJP) manufactures and markets waterjets that are used for propulsion of fast-going large boats. The company was founded in 1986 as a separate business unit within the foundry Österby Gjuteri and the first waterjets were delivered in 1987. Österby Gjuteri and MJP are today both part of the same company group and there is a policy decision forcing MJP to purchase all casting components from Österby Gjuteri, albeit with an intended professional buyer-seller relation. The sales volumes have increased substantially during the last years and the increased demand for MJP’s products has not been matched by a similar increase in production capacity in the foundry, resulting in an average delay in delivery of 4-6 months. At the time of writing this is a major problem for the company, since the delays limit the growth of MJP and result in increased costs for express deliveries, customer delay penalties and the like. However, a management initiative aiming at improved productivity in the foundry in combination with large investments in new production machinery will hopefully result in decreased delays for the time coming.

Although MJP is part of a larger company group – the parent company Capilon has 286 employees and an annual turnover of around 500 million SEK – MJP is operated as an independent company. MJP’s turnover for the fiscal year 2007 was around 120 million SEK. During the years, a number of sales and service agents have been engaged around the world.

Since MJP only have one offer – selling waterjets – there was never a choice of offer to be made. Waterjets are used for propulsion of various watercrafts where high speed is wanted. As a rule of thumb, waterjets are more efficient than traditional propellers from around 25 knots and upwards. There are also other benefits with waterjets compared to traditional propellers, such as low vibrations, protected propulsion, superior maneuverability and low waterborne noise. MJP’s waterjets are suitable for boats from 15 meters in length and with an engine power of 500-15 000 kW per waterjet unit. Waterjets are usually sold in sets consisting of 2-4 waterjet units and the placing of the waterjets on a ship is illustrated in Figure 5-1.
The components of the propulsion system marked with a broken line in Figure 5-1 are provided by MJP, while the gearboxes and engines are supplied by other suppliers (for a more detailed description of the function of a waterjet we refer to Appendix V). In a typical boat, the waterjets – including the control system of the boat – contribute to less than five percent of the total cost while the engines usually contribute to around 35 percent of the total costs.

The customers can be divided into the three segments Navy/Coast Guard (CG), Commercial and Yacht. Typical boats for each segment are shown in Figure 5-2.

As can be seen in Figure 5-3, the sales to the Navy/CG segment has increased significantly during the last years, while the Commercial segment has declined.

The main driver for MJP to develop the current offer is to sell more spare parts, which have higher margins than the core product.
5.2 Step 1 – Internal Analysis
In this step the internal aspects of the company are analyzed. For each topic the execution of the method will be described and the feasibility will be discussed, followed by the output from each topic.

5.2.1 Internal Business Processes

Execution of Method
In order to analyze the internal value chain we first tried to follow the question 7-13 in our question guide (the question guide is found in Appendix III and IV). To calculate the total cost for each activity we first made a cost breakdown of a cost calculation for a typical offer. The result from this cost breakdown – which is not illustrated in this report due to company secrecy – showed that most of the costs are related to purchasing, while the internal costs are “hidden” in the contribution margin. However, we found out that it would not be meaningful to try to break down the internal costs, neither for primary nor support activities, since the employees of MJP are often performing more than one activity.

Consequently the trends for the cost structure could not be analyzed either. When asked about what differentiates MJP’s providing of the offer compared to its competitors (i.e. what activities are performed differently), the answer was that there are no major differences; the activities are performed in a similar way. Since there are only four major competitors and the industry is relatively small, it is easy for the players to “keep an eye” on each other. Hence the question could be answered in a satisfying way, even if no interesting differences were identified.

By asking different persons within the organization we got a good picture of the strengths and weaknesses of MJP. By doing so we felt that we got an understanding of MJP’s capabilities.

Output
The identified strengths of MJP are the following:

- Technical competency
- Long experience of waterjets
- Flexible organization
- High product quality
- Well-renowned due to successful reference projects

The identified weaknesses of MJP are the following:

- Dependency of Österby Gjuteri
- Delivery delay problems of waterjets
- Long lead time of some spare parts
- Small marketing unit
- Little focus on the after sales business
- Small service organization

17 The major players in the waterjet industry are, in order of size, Rolls-Royce, MJP, Hamilton and Wärtsilä.
5.2.2 Assessment of the Offer

Execution of Method

In order to make it easier to categorize the offer along the product-service continuum, we chose to map the different components of the offer. A distinction was made between components that are always included and optional parts of the offer. This worked well and made it easy to categorize the offer along the product-service continuum, with a reduced risk of neglecting aspects of the offer.

The strengths and weaknesses of the offer were obtained from interviews with the members of the management. This created a complete picture of the offer since the interviewees had somewhat different focus depending on their role in the organization. As an example the sales manager was focused on the aspects that are important for new deliveries, while the after sales manager naturally had good input about the after sales parts of the offer. There was an obvious risk that the answers would be biased, but this would be discovered during the interviews with the customers. If a gap between how MJP and its customers perceive the strengths and weaknesses of the offer, this would be useful inspiration for changes of the offer.

What key selling points are used by MJP was obtained from the sales manager, since he is the only person in the organization that is working with sales of new projects. In addition to interviewing the sales manager, information was also gathered from sales brochures and the company’s website.

Output

The mapping of MJP’s offer is illustrated in Figure 5-4. The components with broken lines are optional.
Since the offer always includes services such as calculation for configuration\(^\text{18}\) and training of service personnel, MJP’s offer cannot be considered to be a pure product offer. On the other hand product has the central role off the offer and the ownership is always transferred to the customer. It is therefore clear that MJP’s offer is a *product-oriented offer*.

The strengths of the offer were considered to be:

- High efficiency resulting in high performance and low fuel consumption (up to 7 % better than the competitor’s waterjets)
- Durability
- Serviceability
- Wear parts design enable high profit margin on spare parts due to a lock-in effect
- The new control system will make it possible to log how every set of waterjets is used

The weaknesses of the offer were considered to be:

- Insecure supply of spare parts to the current control systems
- Delivery delay problems of waterjets
- Long lead time of some spare parts
- Wear parts design using customized components increases lead time and costs of purchased spare parts

The key selling points used by MJP alternate somewhat depending on type of customer, but in general the following aspects are promoted:

- Performance
- Fuel economy
- Durability
- Serviceability

### 5.2.3 Life Cycle Assessment

*Execution of Method*

Since MJP is not certified according to ISO 14000, no calculations of the environmental impact of the offer have been conducted. It was therefore not possible for us to receive any figures concerning how the environmental impact is distributed along the different phases in the life cycle of the offer. However, by discussing the subject with the quality manager, who is also responsible for environmental issues, we got a holistic overview of the environmental impact through the product life cycle.

As the waterjets are used as a component in a system with the main part of its environmental impact in the use phase, we decided to make a holistic life cycle assessment on a system level in addition to the

\(^{18}\) In the tender stage of the sales process MJP uses a partner specialized in hydrodynamics for calculations of what configurations of waterjets to use in order to reach the requested performance for the specific ship hull.
one carried out on product level. This highlighted where the real potential of environmental savings can be made.

The question about the product’s lifetime could not be answered in a satisfying way, since there is no statistics over how long time an MJP waterjet is used in average. What should be remembered here though is that the company is only roughly 20 years old and the first waterjet set produced by MJP is still in use. However, we did get some input from the customers about the expected lifetime of MJP’s waterjets.

Since MJP has no commitments when the customer is using the product, this question did not fill any purpose. Neither did we get any input whether it would be possible to save resources if the customer would use the product in a new way.

**Output**

The output from the conceptual life cycle analysis is illustrated in Figure 5-5.

![Graph showing conceptual distribution of environmental impact at product level and system level.](image)

It should be observed that Figure 5-5 does not display the absolute level of environmental impact, and comparisons between the levels are not to be made based on Figure 5-5. The figure shows the distribution between the different phases at the product level and the system level; obviously the environmental impact at system level (i.e. including the engine and gearbox) is much higher than at product level where only the waterjet is regarded. The highest environmental saving potential is therefore found in the use phase of the system, since it is the phase with the highest environmental impact at the system level. MJP’s waterjets can contribute to this environmental saving by developing waterjets with as high efficiency as possible (and consequently lower fuel consumption).

What also can be done by MJP to reduce environmental impact – that does not regard the design of the physical product – is to help the customers chose the optimal set of engine and waterjet size for a desired performance with specific boat with. By using a smaller engine size substantial environmental
savings can be achieved during the use phase of a propulsion system. This service is already included in MJP’s offer.

The lifetime of the waterjets is not known yet, since the company is only roughly 20 years old and the first delivered waterjets are still in use on the Cinderella boats that are still operating in the Swedish archipelago. The Swedish Coast Guard expects the waterjets to last the whole lifetime of their boats, which is at least 25-30 years.

5.3 Step 2 – External analysis
In this step the business context is analyzed, including actors such as customers and suppliers. Just like in step 1 the execution of the method will be described for each topic and the feasibility will be discussed, followed by the output from each topic.

5.3.1 Customer requirements analysis

Execution of Method
Due to the distances to the customers that are spread over the world and the fact that there are three different customer segments, we were forced to do telephone interviews rather than visiting the customers. This gave some constraints in interview time and in communication ability. The reason for this is that the poor communication with some customers made it difficult to get the required interaction to perform such a structured task as the ACRA. The main reason for not performing the ACRA was however that it is difficult to map out customers’ processes by just asking them; the processes must be observed in order to get a deep understanding. Furthermore, the answers from the customers might be biased by what they perceive as important in their processes. This is also the case for their values. However, questions about their needs could be answered in a satisfying way. The needs that the customers stated were in line with what the sales staff at MJP had stated.

MJP had some knowledge about how the customers make their purchasing decisions, but this was clarified through the telephone interviews. The picture that MJP had about customer needs and purchasing decisions corresponded well with the customers’ answers.

Output
The buying process of the Navy/CG segment is characterized by public announcements of investments in new boats, especially for coast guards. The Navy/CG customers have a high technical competence and have detailed specifications on the equipment they buy and often the whole propulsion system is purchased as a package. The equipment is thoroughly evaluated with reference projects being of high importance. The cheapest equipment fulfilling the specifications is chosen and the customer needs identified in the Navy/CG segment are:

- Performance
- Durability
- Reliability
- Life cycle costs
- Service
In the commercial segment there are two actors having influence over the purchasing decision. The influence that the end customer (i.e. the shipowner) over what type of waterjets to use is depending on the level of knowledge it has about propulsion. If the shipowner has little knowledge or no strong preferences regarding the waterjet system is to be used on the boat being orders – which is often the case – the shipyard alone decides what waterjets to be used. This makes the buying process and purchasing criteria different depending on who has the power over the purchasing decision. The customer requirements in the commercial segment were therefore divided in to two groups, depending on who has power over the purchasing decision:

**Shipyards**
- Price
- Performance
- Delivery accuracy of the waterjet systems

**Shipowners**
- Fuel efficiency
- Performance
- Serviceability
- Availability on wear parts and service
- Durability
- Reliability

The yacht segment is characterized by a number of yacht builders designing their own models, which the end user can purchase. This means that the yacht builder chooses the equipment used in the yacht, usually without involvement of the end user. The buying criteria or customer needs for the yacht segment are:
- Performance
- Price
- Reliability
- Brand

It should be observed that the relative importance between performance and brand vary, depending on the purpose of the yacht. When performance is the most important aspect, the brand is less important and vice versa (in some yachts waterjets are not mainly used for performance, but rather for comfort).

### 5.3.2 Customer perception

**Execution of method**
As mentioned in the previous section, the customer interviews were made over telephone, which affected the communication ability. Just like the ACRA, the process for creating the market-perceived quality profile could not be conducted. The poor communication with some customers making it difficult to get the required interaction to perform such a structured task was however only the case for some
customers. Other customers, where the communication worked well, did not have the required experience from competitors’ products to evaluate the quality attributes. Despite not performing the market-perceived quality profile, we did however ask the customers what they thought of MJP’s offer compared to other waterjet suppliers in a qualitative way. By doing so we experienced that we got a good picture about the customers’ perceptions of the offer, without getting a specific quantitative relation on buying criteria as is the goal of the market-perceived quality profile framework.

**Output**
The Navy/CG customers considered that MJP’s waterjets fulfilled all their buying criteria (i.e. the customer needs that were described in the previous section). In the commercial segment, one shipyard perceived MJP to have low delivery accuracy and an uneven performance, but preferred MJP because of the long relationship they have had. Shipowners considered that the MJP’s waterjets were solid and had good product quality, but that the spare parts were expensive (although this was the case even for the competitors) and have a long delivery time. Where tested, the yacht builders often consider MJP to have the best performance, but that the brand is not as premium as MJP’s main competitor Rolls-Royce.

### 5.3.3 Network analysis

**Execution of method**
When asked to map the network, MJP could describe it well. The staff members at MJP also knew the strengths and weaknesses of each actor, since the company has had long relationships with most of its strategic partners. This also enabled us to understand the capabilities that exist in the network.

**Output**
MJP’s network is mapped in Figure 5-6. MJP has the role as system supplier as it has the system knowledge. The most distinctive capabilities that exist in the network are the following:

- MTU is a German engine supplier that has a much larger global presence with access to better distribution channels than MJP. There is a collaboration between MTU and MJP today, as MTU recommend MJP’s waterjets in some of its marketing brochures and MJP often recommends MTU’s engines to be used with MJP waterjets. MTU also offers package deals containing the whole propulsion package (engine, gearbox, propellers, control system etc) for smaller boats, but these packages are so far only available for propeller propulsion.
- CPAC Systems has been engaged to design a new control system for MJP. This will hopefully increase the quality of the control system, easing the serviceability of the control systems.
- The agents and service agents around the world provide a global presence and are a useful source of information about the customers.
5.3.4 Business context

Execution of method

The first part of the business context was the five forces model as presented in the frame of reference. To conduct the five forces we needed the information about the industry. After having talked to MJP and its customers, and gathering information from the websites of competitors and suppliers, we felt that we could conduct the five forces model in a good way.

The first IPSE workshop we attended was at MJP, where we performed a profit pool analysis for MJP. As mentioned in section 4.6.2, it was during this workshop that the idea of grading the revenues and profits of each activity in scale of 1 to 3. When returning to the profit pool that had been compiled at that meeting, we found some of the activities falling out of scope or that they should be incorporated in other activities. With information from MJP and the Internet, we estimated the levels of revenues for each activity (explained in Appendix V). We kept the profit margins that MJP had set during the workshop, if no other source stated differently (e.g. customers with more insight in certain activities). Obviously MJP had good knowledge about the profits connected to its own offer but when it came to the other activities in the profit pool, the estimates were more roughly based. The conclusions that could be drawn from our modified profit pool were the same that could be drawn from the original profit pool made at the IPSE workshop.

We also found that since the waterjet market was so small in comparison to the other activities, we had to divide the market into a micro and macro level. This enabled us to see the small opportunity that MJP had of successfully going into the other activities closely related to waterjets.
By combining the five force model with the profit pool we got an overview of which activities that can be considered attractive for MJP to carry out.

**Output**

The output from the five forces model is displayed in Table 5-1. The conclusions that can be drawn are that the suppliers have low bargaining power and that there is relatively low industry rivalry. There are however some other interesting aspects that have to be reckoned. The market consolidation has made Rolls Royce and Wärtsilä being able to offer complete propulsion packages, something that seems to be demanded by customers in the Navy/CG segment. This also illuminates the risk of potential entrants in the form of larger companies (e.g. marine engine suppliers) acquiring waterjet suppliers, although the threat from new start-ups is low due to high entry barriers. The commercial segment has a large installed base, demanding an increased amount of services and spare parts.

Table 5-1. The output from the five forces model for MJP’s waterjets.

<table>
<thead>
<tr>
<th>Suppliers</th>
<th>Industry Rivalry</th>
<th>Potential entrants</th>
<th>Substitutes</th>
<th>Customers</th>
</tr>
</thead>
<tbody>
<tr>
<td>A large number of suppliers of tailormade components.</td>
<td>Low rivalry; only four major competitors, where Rolls-Royce has the largest market share</td>
<td>High entry barriers due to high R&amp;D costs and large investments in production</td>
<td>Other propulsion types such as propellers or Volvo Penta’s new IPS</td>
<td>Navy/CG: Slow growing segment, demand package deals, purchases larger quantities at one time</td>
</tr>
<tr>
<td>All suppliers are exchangeable in the long run; there are no suppliers with exclusive technology.</td>
<td>Market has been characterized by consolidation where Rolls-Royce and Wärtsilä have been active in buying smaller waterjet manufacturers</td>
<td>Risk of new entrants in the form of e.g. engine suppliers acquiring competitors to MJP.</td>
<td>High fuel prices drive especially the commercial segment to swap to low speed propulsion such as propellers</td>
<td>Yacht: Fastest growing segment, Rolls Royce has 90 percent of the market</td>
</tr>
<tr>
<td>Rolls Royce and Wärtsilä can offer complete propulsion package deals</td>
<td></td>
<td></td>
<td></td>
<td>Commercial: Large installed base but has declined in new ships ordered</td>
</tr>
</tbody>
</table>

The output from the profit pool at the macro level, i.e. the waterjet-related industry, is presented in Figure 5-7. Clearly, the waterjet segment is very small compared to the rest of the industry, diminishing the ability of MJP moving into waterjet-related activities not closely connected to the waterjets themselves.
We had to look deeper into the waterjet industry, which we named the micro level. The micro level consists only of the components of the waterjet offer as were presented earlier. This profit pool is displayed in Figure 5-8. The profitable activities are connected to after sales, where spare parts, service and control system upgrades are present. MJPs earn an even smaller share of its revenues from these activities compared to the industry average, which implies that MJPs after sales activities can be expanded.

Figure 5-7. Profit pool of the waterjet-related industry.

Figure 5-8. Profit pool of the waterjet industry.
By looking at the output from the five force model and the profit pool analysis, the following activities that are attractive due to strategic reasons or high profit margin could be identified:

- Sales of complete propulsion packages are attractive since large competitors to MJP are already offering such deals today, and this is something that is demanded by some customers in the Navy/CG segment. It is in this segment that MJP has had most of its sales during recent years and there is a risk of losing this market if other players are having offers better suited for the segment.
- The waterjet market is a relatively small market, but MJP has the potential to increase its market share. If MJP could use market channels of other activities in the macro profit pool the market share could be increased.
- After sales activities such as service, spare parts and control system upgrades have high profit margins.

5.4 Step 3 – Planning the New Offer
In this step the output from step 1 and 2 will be put together in different approaches in order to generate new concepts. These approaches regard the identification of gaps and fits as well as a categorization of the value. The approaches will be treated one by one and the concepts they generated will be discussed

5.4.1 Identify the gaps

*Execution of method*
The idea is to identify gaps in communication and value between the company and its customers. MJP had three different customer segments – each with their own needs and perceptions of MJP. Therefore we had to look at each customer segment separately. We could identify gaps in both communication and value, especially in the Commercial segment.

*Output*
In general, MJP uses the same key selling points regardless customer segment. Starting with the Navy/CG segment, we found no gaps between MJP’s key selling points and the customers’ perception of the offer. In the Commercial segment there were however a potential gap, since MJP ensures top performance while a shipyard that has purchased many waterjets from MJP stated that the performance was uneven between different units. In the Yacht segment, we found no gaps in communication.

In all the customer segments there was a gap in value, where customers are demanding high reliability while the control systems decrease the reliability (it is most often the control system that causes breakdowns, since sensors and the like are sensitive compared to the pump unit; this is the case for all waterjet suppliers). Also the current wear part design causes long delivery times to the customers, which creates a gap since the customers demand availability on spare parts. In the Commercial segment, we found an additional gap in delivery problems on the water jets that are not in line with customer needs as shipbuilders demand delivery accuracy.

In summary, the identified gaps are shown in Figure 5-9.
5.4.2 Identify the fits

Execution of method
The first fits to identify are between capabilities and attractive activities, and we were able to find several fits. However, we only found one fit between the environmental impact of the offer and the customer needs and processes.

Output
The first fit that we identified is between the capabilities that the service agents have and the attractiveness of selling spare parts. MJP has service agents around the world providing global presence and closeness to the customers. There is a high margin on selling spare parts, and if the service agents are doing more maintenance and repairs MJP can sell more spare parts.

MJP is a highly skilled technical company with a good knowledge in building waterjets. The construction department could improve the wear part design using components that are standardized so that the delivery time on spare parts is shortened. This means that MJP could sell more spare parts. Thus there is a fit here between wear part design and the high margins of the spare parts.

The cooperation with MTU will give MJP access to new market channels. This will hopefully increase the number of sold waterjets and enlarge MJP’s market share. Hence, there is a fit between cooperation of MTU and MJP small market share. The cooperation could also enable offerings of complete propulsion packages, which will help both MJP and MTU meet up the competition of Rolls-Royce and Wärtsilä in this field.
On a system level (i.e. the ship), the use phase has the highest environmental impact. As MJP’s waterjets have high efficiency it implies not only that fuel consumption will be lower, but also that a smaller engine could be used for the same performance. Usually the customers specify to the shipyards the desired top speed and using MJP’s waterjets the shipyard could save money by the use of smaller engines, and the end customers will save money as smaller engines require less fuel. Hence there is a fit between the customer needs and the low environmental impact of the waterjets.

The identified fits are displayed in Figure 5-10.

![Figure 5-10. Identified fits regarding MJP's offer.](image)

5.4.3 Categorize the value

Execution of method

The idea was that see how the offer would look like in the different offer categories in the product-service continuum. We had a difficult time doing this with the waterjet in mind; the offers were too impracticable or non-attractive for MJP to realize. However, when looking at complete propulsion packages, ideas got more realistic and we could get concepts that could provide value for both the customers and MJP.

Result

The initial offer is product-oriented. If presented as complete package, it would only mean that MJP will deliver the waterjets and contingently the control system, while some other partner provides the engines, gearboxes and intermediate shaft arrangement. This could be done either in a joint venture or
in a less structured type of cooperation. It should also be noted that this has already occurred on the initiative of a sales agent that composed a package consisting of components from various providers.

A use-oriented offer states that the ownership of the product is not transferred to the customer. The suppliers will therefore own the product which probably means that MJP will have to enter a joint venture with a partner in order to clarify ownership issues. The maintenance costs of the system will then be internalized, meaning that the joint venture must stand for the maintenance costs. This implies that incentives for easier service and cheaper spare parts would be created (which is not in line with the current aftermarket strategy). We see a solution where the joint venture performs an annual control of the propulsion function, with help of logs from the control system. The cost for the customers could be based on number of running-hours.

In the result-oriented category, the joint venture can provide the function of propulsion. The customers would then just specify a certain speed and number of hours they want their vessel transported. This requires cooperation with engine manufacturers etc, and in addition the crew needed to operate the boat must be hired. This concept seems a bit farfetched and impracticable, but it is good for stretching your mind in order to think outside the box.

5.4.4 Concepts generated
From the different approaches we got useful input to brainstorming of concepts. We found three concepts that we considered to be interesting to develop:

1. Redesign the wear parts so that standard components can be used in order to avoid unnecessary customizations. This should be combined with imprinting the spare parts as original and offer an extended warranty of new waterjets sold (obviously the spare parts cannot be modified for the existing waterjets), provided that they get serviced according to recommended service intervals and using only original spare parts. Hopefully this extended warranty will create a lock-in effect, making the customers buy original spare parts.

2. Offer a thorough inspection and overhaul of existing waterjets with an increased functional warranty. An upgrade means that MJP thoroughly inspects the waterjet and the control system and changes wear parts and control system. This way the after sales would increase substantially for the installed base.

3. Offer complete propulsion packages to customers, mainly to the Navy/CG segment where customers are demanding this kind of offers. This can be done in collaboration with partners such as MTU.

5.4.5 Evaluation of the concepts
In this stage we fully performed the evaluation for only one of the concepts, since we regarded this to be sufficient for testing the method. We believe that the second concept will serve as good example for the evaluation, i.e. overhauls of existing waterjets resulting in extended warranty.

Execution of method
We took the role as the expert panel and evaluated the concepts. This was difficult in some situations, especially since we had a tendency to drift away from the reference offer when grading the aspects. For
us, much of the evaluation was based on very rough estimations, especially the economical aspect was difficult since it has some “it depends on”-elements. The short run aspect of revenues and cost were dominating our view over the long run, since the concepts generated had focus on short run actions. The customer acceptance was in some cases difficult to estimate as well, but we felt that we could find arguments for our grading based on our understanding of MJP.

**Result**
Figure 5-11 shows the evaluation of the concept based on the four aspects, environmental impact, economical impact, identity and strategy match, and customer acceptance.

![Evaluation of concept 3](image)

Figure 5-11. Evaluation of concept 3; selling upgrades of the waterjets and give an increased warranty in return.

The environmental impact of the concept will have no difference from the reference offer, i.e. from how service is sold today. Small positive effects can be gained by assuring the efficiency of the waterjets, but on the other hand more spare parts will be used by the increased preventive maintenance.

The economical aspect will be positive since MJP have a large installed base of existing customers and selling them additional service and spare parts will increase the revenues. Probably the margins can be held on the same level as for the service and spare parts sold today, which is substantially higher than on sales of new waterjets. An increased share of after sales of the total turnover, combined with an increased turnover, will increase the total profit of MJP. The risk of increased warranty costs due to the extended warranty must be considered, but judging by the durability of MJP’s waterjets this should not be a major issue. The long run economical impact implies that MJP will reach a position where it has a good overview of the condition of their installed base, knowing when to contact the customers for further upgrades (when the warranty period has run out).

The match between the offer and the strategy/identity of MJP is considered high since the company wants to increase their after sales revenues. Furthermore, an extended warranty is something that illuminates MJP’s durability and ability to provide service to the customers, which should enhance the MJP brand.
The customer acceptance is graded as moderately positive. MJP has its largest installed base in the commercial segment, where the size of the shipowner will determine the customer’s willingness to purchase the upgrade. Since MJP will give an extended warranty when performing the upgrades, shipowners with smaller fleets will be more interested of the offer since they are dependent on fewer boats and the increased warranty will decrease their risk.

5.4.6 Feasibility analysis

Execution of method
Due to time limitations we did not perform this stage. It requires deeper analyses in a number of areas such as operational capabilities, economical aspects and customer acceptance, something that was not possible with our short time frame of the thesis.

5.5 Lessons Learned from the Case Study of MJP
Since the case study of MJP was the first we conducted, it was expected that this study would teach us several lessons on how to improve the method for the following case studies. These lessons have been described during the description of the execution of each topic and are summarized below:

- Beginning with the internal analysis, there were problems associated with analyzing the internal business processes through the internal value chain framework; it was easier just asking the company about their strengths and weaknesses.
- In the assessment of the offer we learnt that it was helpful to map the different components of the offer in order to illustrate what the offer really includes. This made it easier to map the offer along the product-service continuum.
- In order to illustrate the potential environmental savings that the offer can contribute to, we found that it was not sufficient to assess the environmental impact at a product level. It was also relevant to regard the system that the product is used in.
- It was difficult to perform the ACRA without visiting the customers, since we were not able to in depth understand the customers’ processes.
- When trying to create a customer-perceived quality profile it was found important that the customers have relevant experience of the competitors’ products, which is not always the case.
- When making the profit pool analysis, we discovered that the profit pool will be of little use if the activities that the company performs make up only a negligible part of the total industry revenues. In this case we found it helpful to make a second profit pool that included only activities that were more closely connected to the activities currently undertaken by the company.
6 Case Study – Assalub

In this chapter the empirical results from the case study of Assalub will be presented. First a short description of Assalub will give the reader a basic understanding of the company’s situation; for a more detailed description we refer to Appendix VI. Thereafter a description of how the execution of the method – which follows the order of the questions in the question guide – worked and what output was received in each step of the method will follow. All the information in this chapter is based on interviews with Assalub and its customers.

6.1 About Assalub

Assalub is an Åtvidaberg-based company that has manufactured lubricators since the 1920’s. The company has two product groups, which are equipment for lubrication handling and industrial lubrication systems. Every industry using machinery is in need of lubrication, since the bearings in the machines need to be greased at regular intervals in order to prevent wear. Especially in the process industry (e.g. paper mills and steel plants), where one machine often contains several thousand bearings, lubrication is a crucial activity.

The expected turnover for 2008 is around 45 million SEK, of which 30 percent is sold on direct exports and another 20 percent is exported through Sweden-based distributors. Assalub has 36 employees with a large part of them working in production. The company has always been driven by technological development and its products are known for their high quality. As an example, Assalub was the first company in the world to introduce a grease meter, and the innovative spirit is something the company continues to strive for. The latest result of this innovative spirit is LubeRight, a patented system making greasing foolproof. We decided to use this offer as reference offer, since it has a small turnover today but has a big potential to expand. Therefore the main driver for changing this offer is to increase the number of sold LubeRight systems.

The LubeRight system is one of a kind; since it is a manual lubrication system as opposed to the other industrial lubrication systems that are automated (examples of such systems are centralized lubrication and one-point lubricators). LubeRight is designed to help the maintenance department keep track on when, where and how much a lubrication point (through a nipple) should be lubricated. The components of the LubeRight are shown in Figure 6-1.
The PC software keeps track on which lubrication points that should be greased on every grease round. Every lubrication point is usually greased a couple of times a year, which means that several hundred lubrication points can be included in a greasing round. The system then uses RFID transponders for identification of lubrication points, where each nipple is equipped with a transponder. When the grease meter coupler is connected to a nipple it recognizes the lubrication point and the grease meter is set to the amount of grease needed for that lubrication point. As the greaser greases the lubrication point the grease meter counts down, making sure that the right amount of grease is injected. When all the lubrication points in the round have been greased, the grease gun is connected to the computer and information about the round is transferred to the computer. The software can now easily identify if all the lubrication points in the round have been greased or not.

6.2 Step 1 – Internal analysis
In this step the internal aspects of the company are analyzed. For each topic the execution of the method will be described and the feasibility will be discussed, followed by the output from each topic.

6.2.1 Internal Business Processes

Execution of Method
As stated by the method and questions 7-12 in our question guide we tried to analyze the internal value chain of Assalub. In similarity with the case of MJP we found it difficult to break down the costs of the activities in the internal value chain, since employees are often performing more than one activity. Wise from the experience from MJP, we did not do the cost breakdown and consequently we could not analyze the trends of the cost structure either.
Since the LubeRight system is patented, we could not do a comparison with competitors’ value chains, but we could nevertheless assess the strengths and weaknesses of Assalub by interviews with different sources within the management. We believe that we got a good understanding of Assalub’s capabilities.

**Output**

The identified strengths of Assalub are the following:

+ Competent and experienced
+ Innovative
+ Flexible organization
+ Strong brand
+ High product quality

The identified weaknesses of Assalub are the following:

- Scant international presence
- Small sales force
- Small financial resources

### 6.2.2 Assessment of the Offer

**Execution of Method**

As we learned from the MJP case, we started the assessment of the offer by dividing the offer into components, which made it easier for us to categorize the offer along the product-service continuum. The components were labeled if they are always included or optional parts of the offer. By dividing the offer into components we reduced the risk of missing important parts of the offer.

The assessment of information about the offer was gathered from different people in the organization. The different roles the interviewees have in the organization made them put emphasis on different aspects, so by having more people contributing to our picture of the offer resulted in a more accurate picture. This is also the case about the strengths and weaknesses of LubeRight.

The key selling points were obtained from the sales force of Assalub as well as from its website.

**Output**

This mapping of the offer is illustrated in Figure 6-2.
Since the offer always includes services such as education and support, the LubeRight offer is not a pure product offer. However, the product still has the central role of the offer and the ownership is always transferred to the customer. It is therefore clear that LubeRight is a *product-oriented offer*.

The strengths of the offer were considered to be:

+ Foolproof
+ Increased machinery availability (up-time)
+ Lowered maintenance costs
+ Cleaner working environment
+ Enables longer greasing intervals
+ Status-enhancing for the greasers

The weaknesses of the offer were considered to be:

- Incompatible with business systems
- Investment of LubeRight is decided at a low level in the customers’ organization

The key selling points used by Assalub are the same as the strengths of the offer.

### 6.2.3 Life Cycle Assessment

**Execution of Method**

Assalub is not ISO 14000 certified, which meant that we could not calculate the environmental impact of the offer. The same conceptual approach as used in the case of MJP was therefore used, which was done with the help of the management of Assalub. The LubeRight system itself has an insignificant environmental impact compared to the process machinery it serves. The environmental impact on the
system level was hence relevant to get an overview of, since it is at this level the real potential of environmental savings is.

**Output**

At a product level the production has the largest impact on the environment. However, the number of units used is low, meaning that the product has no large environmental impact in itself. The lifetime of the LubeRight system is virtually unlimited, even though grease guns and grease meters may be worn out if handled carelessly.

It is at the system level – the process machinery - that LubeRight has its greatest environmental benefits. In the use phase of a machine the main environmental impact is caused by the use of energy, which cannot be more than fractionally affected by the use of LubeRight. The customers can however save both grease and bearings when using the LubeRight system, which will give substantial environmental savings in the long run. The product life cycles at a product level and system level is displayed in Figure 6-3.

![Figure 6-3. Conceptual distribution of the environmental impact of the LubeRight offer at a product level and the distribution of the environmental impact at system level.](image)

**6.3 Step 2 – External Analysis**

In this step the business context is analyzed, including actors such as customers and suppliers. Just like in step 1 the execution of the method will be described for each topic and the feasibility will be discussed, followed by the output from each topic.

**6.3.1 Customer requirements analysis**

**Execution of Method**

Assalub has sold LubeRight to a number of different companies and businesses. However, in Sweden these sales have been dominated by the paper industry, where some paper mills have purchased
LubeRight. We decided to focus on this industry and we talked to two mills who have implemented LubeRight and two mills that so far have decided not to. The mills that had not purchased LubeRight had made a deeper evaluation of it, and therefore had good knowledge about the product. What can be said about the paper mills in Sweden is that they are very advanced in terms of machine maintenance, to a high extent using centralized lubrication and advanced technology to determine the conditions of the bearings.

The paper mills were very good input to our understanding of customer requirements. Like in the case of MJP, the interviews were made over the telephone which restricted the time and questions that could be asked. The problem with mapping the processes was also noticeable in this case. After our initial interviews with Assalub it became clear that the customer buying process has large impact on purchases of LubeRight. Therefore, much of the interviews with the customers were dedicated for establishing information about the customer buying process.

**Output**

In general the managers of the preventive maintenance unit evaluate the LubeRight system and this evaluation is then used by the head of maintenance, that in turn either has the whole power over the purchasing decision or discusses the investment with the management of the plant. Also the greasers can have substantial influence in the evaluation phase. For more detailed information about the purchasing process we refer to Appendix VI.

The customer needs that were assessed were the following:

- Accurate greasing with control and traceability
- Compatibility with business system
- Lowered maintenance and standstill costs
- Cleaner working environment
- Maintenance department needs calculations that quantify the savings obtained from LubeRight

### 6.3.2 Customer perception

**Execution of Method**

Learning from our experience with MJP, the market-perceived quality profile was not prioritized as we tried to assess as much information as possible. Besides, as LubeRight is a patented system and there is no competition, which means that some parts of the market-perceived quality profile was not applicable. Despite this we got satisfying answers about the customers’ perceptions.

**Output**

The customers’ positive perceptions of LubeRight are:

+ Foolproof system
+ Greasers can show that they have greased (the mills that have bought LubeRight)
+ Lowered maintenance costs
+ Less pollution from redundant grease, resulting in cleaner working environment
The customers’ negative perceptions of LubeRight are:

- Price is too high compared to saving
- Greasers feel supervised (the mills that have not bought LubeRight)
- LubeRight is incompatible with the mills’ business system.

6.3.3 Network analysis

**Execution of Method**

The mapping of the network was done with the help from Assalub and the questions in the question guide covered the interesting aspects of the network. Some parts of the network, such as the roles of some specific customers, were clarified in the workshop that was held with the management of Assalub.

**Output**

Figure 6-4 shows Assalub’s network.

As can be seen in the figure, Assalub does not have many strategic partners, and the existing ones are connected to marketing and sales of the LubeRight system. The distributors are acting on a few export markets, providing Assalub with knowledge about these markets. However, there are many potential markets that Assalub cannot reach due to limited market channels which reduce the sales of LubeRight. Assalub also has help from Gurami, a maintenance software supplier that includes LubeRight in its advertising and offer, since its software is compatible with the LubeRight system.
The exclusive suppliers are exchangeable since Assalub owns the drawings and hence can change suppliers if needed. Customer A and B buy other products from Assalub as parts of larger systems which are then sold to the end customers, but not yet the LubeRight system. Therefore there is an indirect way from Assalub to end customers via these customers. As both customer A and B have worldwide presence, this can be potential market channels for LubeRight as well.

The capabilities that exist in the network are:

- Distributors’ knowledge about other markets.
- Marketing help from Gurami.
- Market channels from customer A and B.

### 6.3.4 Business context

**Execution of Method**

Input to the five forces model was mainly gathered through information from Assalub and the customer, and none of the competitive forces were particularly difficult to analyze.

The profit pool was conducted during the IPSE workshop 5 in Åtvidaberg. Assalub identified the activities in the pool as well as the size for revenues and profit margin, judged after the suggested three-grade scale. The identified activities were very specific and in larger firms these activities are only a small fraction of their total turnover. This made it difficult for us to find the data needed to get more quantitative figures for the activities, even if the larger firms were public. Therefore we could not confirm the estimations made by Assalub at the IPSE workshop.

**Output**

The output from Porter’s five forces model is displayed in Table 6-1. Interesting remarks from the five forces model is that there is a low competitive force from industry rivalry and potential entrants due to the patent that protects LubeRight. The strongest competitive forces are coming from substitutes, where automated lubrication methods have a strong support in the industry, and large customers that are present worldwide.

<table>
<thead>
<tr>
<th>Suppliers</th>
<th>Industry Rivalry</th>
<th>Potential entrants</th>
<th>Substitutes</th>
<th>Customers</th>
</tr>
</thead>
<tbody>
<tr>
<td>All suppliers are exchangeable in the long run; there are no suppliers with exclusive technology</td>
<td>No rivalry; LubeRight is protected by a patent</td>
<td>No potential entrants in the short run</td>
<td>Automated lubrication methods are substituting manual greasing; one-point lubricators are becoming more frequent</td>
<td>Assalub have large customers, whereof several act worldwide</td>
</tr>
<tr>
<td></td>
<td></td>
<td>When the patent period has expired, some competitors might launch similar systems</td>
<td></td>
<td>The customers in Sweden, mainly paper mills, are frontrunners in machinery maintenance</td>
</tr>
</tbody>
</table>
The profit pool is shown in Figure 6-5, and what can be seen is that the LubeRight system is the only lubrication method that has high profit margin, whereas Assalub’s other offers have only average profits. The other activities in the profit pool with high profit margin—vibration analysis equipment and lubricants—are not reasonable for Assalub to undertake due to high entry barriers in the form of high development costs.

![Figure 6-5. Profit pool of the bearing maintenance industry.](image)

The output from the five forces analysis and the profit pool analysis indicates that the most attractive activity for Assalub is to sell more LubeRight, which can be done by selling through customers’ market channels that reaches a global market.

6.4 Step 3 – Planning the New Offer

In this step the output from step 1 and 2 will be put together in different approaches in order to generate new concepts. These approaches regard the identification of gaps and fits as well as a categorization of the value. The approaches will be treated one by one and the concepts they generated will be discussed.

6.4.1 Identify the gaps

Execution of Method

We could in this case identify gaps, both in communication and value, but in contrast to MJP we found just as many gaps in communication as in value. The gaps were connected to the weaknesses of the offer rather than the strengths being totally wrong. During the workshop that we had with the management of Assalub it became clear that they were aware of the identified gaps.

Output

There were two gaps found in the communication, which mostly were concerned the mills that had not implemented the LubeRight system. These mills thought that contrary to what Assalub said about
LubeRight increasing the status of the greasers, it decreased the integrity of the greasers since they felt supervised and controlled. The second gap is where the mills that opted against purchasing LubeRight felt that the cost reduction they would get with LubeRight was lower than the price.

We found two gaps in value, where one of them was connected to mills that had not implemented LubeRight. The first gap is regarding the incompatibility of LubeRight to other business systems, and mills prefer to have one system (mainly blaming company policy). The second gap, valid for all mills, is that they needed pay-back analysis in order to justify the purchase of LubeRight to higher levels in their organization, and Assalub has problems quantifying economic savings that can be made from using LubeRight. The gaps are shown in Figure 6-6.

**Key selling points**

LubeRight increases the status of the greasers

Use of LubeRight decreases maintenance costs

**Customer perceptions**

Decreased integrity for greasers as they feel they are supervised and controlled with LubeRight

The price of LubeRight does not justify the decrease in maintenance costs

**Assalub provides**

LubeRight incompatible with business system

Difficulties quantifying savings in maintenance costs

**Customer needs**

Paper mills demand compatibility with business system

Customers want investment material that can justify investment in LubeRight

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**Figure 6-6. Identified gaps regarding the LubeRight.**

### 6.4.2 Identify the fits

**Execution of Method**

We could identify fits for LubeRight in both regards, i.e. matching attractive activities to capabilities as well as matching customer process to the environmental impact of the offer. The latter was true for the customers who have not yet implemented, since they have waste of resources in their processes.

**Output**

The attractive activity we found in the business context was the LubeRight system. Thus, increasing the sales of the LubeRight system is an obvious ambition. The available capabilities in the network for doing so are the external market channels possessed by some specific customers.
The fits between the offer and the processes were mainly regarding reducing waste. For mills that have not yet implemented the LubeRight system, the waste of resources can be reduced since LubeRight enables savings not only in terms of grease but also bearings used.

The fits that we found are displayed in Figure 6-7.

![Available capabilities vs Attractive activities](image)

<table>
<thead>
<tr>
<th>Available capabilities</th>
<th>Attractive activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Market channels via specific customers</td>
<td>Fit</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Environmental impact of the offer</th>
<th>Customer needs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enables reduced waste of resources</td>
<td>Fit</td>
</tr>
</tbody>
</table>

*Figure 6-7. Identified fits regarding LubeRight.*

### 6.4.3 Categorize the value

#### Execution of method

The reference offer was defined as a product-oriented offer, so we envisioned how LubeRight could be sold in the other two PSS offer categories. Concepts in each category were realizable, and when doing the workshop with Assalub it appeared that they had already thought of the concepts.

#### Output

A use-oriented offer, could in the case of LubeRight mean that the customer leases the LubeRight system and at the end of the lease period decides if it wants the pay the residual value. This is a good concept in terms of diffusing the product, since there are customers that have opted against purchasing the LubeRight system due to the high initial cost. By leasing the system to the customers, the high initial investment cost is avoided and a monthly fee may do that no investment decision has to be made by the top management; the preventive maintenance department can take the cost on its running budget.

The result-oriented offer implies that Assalub relieves the customer of the greasing activity. By implementing LubeRight at the customers, Assalub can easily perform the greasing by itself (by contracting another firm or hiring its own personnel) and then show the result to the customers. This is a way to diffuse the LubeRight system and increase Assalub’s share of activities in the industry. Even though the assumed profit margin for conducting the greasing is low, it can be viewed as a way of selling more LubeRight systems with high margin.

### 6.4.4 Generated concepts

The concepts that Assalub and we found to be the most interesting were:
1. Sell LubeRight via external OEM customers. By doing so, the LubeRight system gets installed already at the manufacturing phase of the machinery. This means that when the machine arrives at the end customer, the nipples and transponders are already in place diminishing the extra effort required from the customer implementing the system on old machines. For the OEM customer LubeRight enables a guarantee that the machine is lubricated in the right way by the customers, which can be useful in warranty discussions.

2. Give exclusive rights to sell LubeRight on all markets but Sweden to some global lubrication or bearing enterprise. By doing so, Assalub can increase its customer base reaching to customers that otherwise would be unreachable. For the distributing company the LubeRight system can complements its current product portfolio. By letting the distributor making the marketing effort and “teaching” the market about the benefits of the system, the LubeRight system can become a generally accepted system within process industry. Also the LubeRight brand should be used together with the other company’s brand in order to spread the name, and when the patent is expiring in around 10 years, Assalub can take back the exclusive rights for the use of the LubeRight brand. At this point, Assalub will hopefully have gained the power to sell the LubeRight system via its own market channels.

3. Take over the greasing activity from the customers, as explained as the result-oriented offer in the previous section. By doing so the sales of LubeRight systems can be increased, since the customers avoid large initial investments and can cut their costs for greasers.

6.4.5 Evaluation of the concepts
In similarity to the case study of MJP, we fully performed the evaluation for only one of the concepts, since we regarded this to be sufficient for testing the method. We believe that the second concept will serve as good example of evaluation, i.e. to sell LubeRight via a specific customer who will act as distributor.

Execution of Method
In contrast to MJP, we did not have to take the role as the expert panel since this step was performed with the management of Assalub. This made the evaluation of concepts real, and we found that the management of Assalub had different thoughts than us in grading some aspects; especially the identity and strategy match aspect. The output shown is the result of their thoughts, not ours, even though we had discussion about each aspect.

Output
Figure 6-8 shows how this concept was graded on the four aspects environmental impact, economical impact, identity and strategy match as well as customer acceptance.
The environmental impact at a system level would be decreased by letting a large distributor selling the LubeRight system, since markets that currently do not put too much emphasis on the lubrication methods can be reached. As LubeRight can lower the environmental impact by reducing waste of resources in form of grease and bearings, any customer implementing the system will encounter environmental savings.

The economical aspect in the short run will be influenced by a big rise in revenues since the customer base is increased. However, selling through a distributor in large quantities means that they probably want the price on LubeRight to be cut, but since Assalub has high margins on LubeRight this could be a favorable trade-off. In the long run, the number of LubeRight systems in the world will increase which will spread the LubeRight brand. When the patent expires Assalub is hopefully in a good position to use this brand on its own on the markets that has previously been exclusive to the distributor. The conclusion is that this offer is highly favorable in terms of economical aspects.

The strategy and identity match is considered to be slightly negative. The reason for this is the management’s negative personal feelings towards cooperation with a distributor, since most of them are also competitors to Assalub. It should however be noted that the concept has a sound strategic business logic that we argue would be beneficial for Assalub, as explained in the previous section when the concept was described.

The customer acceptance is judged to be high since to be high, but the reasons for this cannot be explained due to secrecy reasons.

### 6.5 Lessons Learned from the Case Study of Assalub

The experiences we gained from the case study of Assalub are mainly a confirmation of the lessons learned from the case study of MJP. The only “new” lesson is regarding the network analysis, where the importance of actors that are not directly involved in providing the current offer was stressed (some specific customers turned out to be important actors in this case).
Case Study – Polyamp

In this chapter the empirical results from the case study of Polyamp will be presented. First a short description of Polyamp will give the reader a basic understanding of the company’s situation; for a more detailed description we refer to Appendix VII. Thereafter a description of how the execution of the method – which follows the order of the questions in the question guide – worked and what output was received in each step of the method will follow. All the information in this chapter is based on interviews with Polyamp and its customers.

7.1 About Polyamp

Polyamp is a world-class supplier of DC/DC converters, used in a wide variety of applications within the industry. The company is divided into three business segment, whereof one is a system supplier and two are pure product suppliers. Polyamp AB was founded in 1966 in Sollentuna and in the 1970’s production plants were set up in Åtvidaberg and in Switzerland. For many years the product development was conducted in Sollentuna, but today the product development is located in Åtvidaberg as well.

In 1982 Polyamp started the military division Polyamp Systems, which supply total solutions mainly for degaussing systems for naval ships and submarines (in order to avoid mines). Polyamp Systems has accounted for around half of Polyamp’s total turnover the last years and the sales and marketing of this business unit is located in Sollentuna. However, since Polyamp Systems already supplies a PSS offer, we found it more interesting to focus on the DC/DC converters produced in Åtvidaberg in this study. The converters are basically sold as pure off-the-shelf products, even though some customization can be done if requested by the customer. This business segment has historically sold a majority of its products to large Swedish companies such as ABB (former Asea), SJ and Telia. Today the exportation share is around 60 percent and the product range has also been complemented with a distribution assortment of AC/DC converters, DC/AC converters, battery chargers and insulators. In 2007, the whole company had a turnover of 44 million SEK and 49 employees, whereof 30 is located in Åtvidaberg.

DC/DC converters convert one direct current voltage level to another, e.g. from 110 volts to 48 volts. The product range is built up by six different series, mainly based on the power that needs to be handled (Polyamp’s power range span from 30-2 000 watts while the price range is approximately 2 000-14 000 SEK per unit). Three of the product series are shown in Figure 7-1.

Figure 7-1. Three out of six DC/DC converter series built by Polyamp.

Polyamp’s DC/DC converters are used in applications with tough physical or electrical environment and where the demands are high on accuracy and reliability. Polyamp is a well-renowned brand in this
The main driver for Polyamp to develop the current offer is to meet the threat from competitors’ low cost products that are produced in highly automated processes in low-wage countries.

### 7.2 Step 1 – Internal Analysis

In this step the internal aspects of the company are analyzed. For each topic the execution of the method will be described and the feasibility will be discussed, followed by the output from each topic.

#### 7.2.1 Internal Business Processes

**Execution of Method**

Also in the case of Polyamp it was difficult to do a cost breakdown for each activity in the internal value chain, and wise from the studies of MJP and Assalub we did not put too much effort in doing so. Consequently the trends for the cost structure could not be analyzed in this case either.

Since Polyamp has many competitors and only a vague insight in their businesses, the activities of the internal value chain could not be compared to the competitors’. However, the managers were aware that the company has a different structure of the production than most competitors since a large part of the costs are related to the manual work (whereas most competitors use highly automated production lines in low-wage countries). This is an important aspect that could be highlighted without any exact figures about the competitors’ cost structure.

In general we believe that we did get a satisfying picture of the strengths and weaknesses of Polyamp by just discussing with the managers; the company seems to be aware of its position compared to the competitors.

**Output**

The identified strengths of Polyamp are the following:

+ Technical competency
+ High product quality
+ Flexible for product customization
+ Brand well-renowned for high quality
+ Detailed sales statistics

The identified weaknesses of Polyamp are the following:

- Expensive production due to high share of manual work (and hence weak on large-scale production)
- Insufficient marketing organization

#### 7.2.2 Assessment of the Offer

**Execution of Method**

The offer we chose to focus on was, as earlier mentioned, the DC/DC converters as this business unit is very product-oriented. Despite that the offer is mainly consisting of a physical product, it proved helpful
to map the different components of the offer. Several components that can be regarded as a part of the offer was not viewed as parts of the offer by the management, mainly because they are used only by a few customers and are not charged extra for.

The strengths and weaknesses of the offer were obtained by interviewing the managers and salesmen of Polyamp. Since the interviewees considered that the most significant strengths regard the world-class product quality and life expectancy of the converters, we reckoned that there would be an obvious risk that the answers would be biased. However, just like in previous case studies a gap between how Polyamp and its customer perceive the strengths and weaknesses of the offer would be discovered when interviewing the customers in step 2. The key selling points used by Polyamp were obtained from the salesmen as well as from sales brochures.

**Output**
The mapping of Polyamp’s DC/DC converter offer is illustrated in Figure 7-2, where the activities with broken lines are optional.

![Diagram](image)

Figure 7-2. Mapping of Polyamp’s DC/DC offer towards the customers.

The vast majority of the customers only use the physical product. The support is seldom used and only a few parts per thousand of the converters are returned in warranty matters. The consultation and customization are viewed as a part of the sales process where needed and the repair activity seems to be little known among the customers. In most cases the offer hence should be considered as a pure product offer, although it can be viewed as a product-oriented offer towards some specific customers.

The strengths of the offer were considered to be:

- Life expectancy
- Few wear parts
- Robustness (resistance against moisture and vibrations)
- Efficient cooling (mainly fan-less)
- Low electromagnetic emissions
- Accuracy
The weaknesses of the offer were considered to be:

- Expensive to produce
- The product development has been somewhat neglected during the last years
- Will not meet the requirements of an EU energy legislation that may take effect during 2009

The key selling points used by Polyamp are differing somewhat depending on what application the converter will be used in, but the following are the most common and as one can see similar to the strengths of the offer:

- Life expectancy
- Robustness (resistance against moisture and vibrations)
- Efficient cooling (mainly fan-less)
- Low electro-magnetic emissions
- On time delivery (proven record of 98% on-time delivery)

### 7.2.3 Life Cycle Assessment

#### Execution of Method

In similarity with the other case companies, Polyamp is not certified according to ISO 14000. The work with environmental issues mainly regards legislation within the electronic industry, which is focused primarily on the use phase of the converters. This means that no calculations of the environmental impact in the other phases of the product life cycle were available and only a conceptual picture of the product life cycle could be achieved. Furthermore, no single product life cycle could be done on system level, since there are a countless number of applications for DC/DC converters to be used in.

The question about the life expectancy of the product could be answered in a satisfying way, since this is a vital aspect of DC/DC converters. Except for the experience that the company has about the lifetime of the converters, independent tests have been conducted by the well-renowned German Technical Monitoring Association (TÜV) which validating the quality and safety aspects of technical products.

#### Output

The conceptual product life cycle of a Polyamp DC/DC converter is illustrated in Figure 7-3.

![Figure 7-3. Conceptual distribution of the environmental impact during the product life cycle of a DC/DC converter.](image-url)
A new Polyamp DC/DC converter has a life expectancy of at least 20-30 years (TÜV has certified the life expectancy of Polyamp’s DC/DC converters to 55 years). This means that the time for the product being used is long compared to the other phases of the life cycle, diminishing the effects of the environmental impact of these phases. The converters have an average efficiency of around 87 percent, meaning that much energy is lost as heat during the long use phase. An increase in efficiency hence means that less power is needed for input and thus saving energy, but this can only be done by improving the physical product, not by changing the business model. This may become a severe problem for Polyamp, since a new EU environmental legislation regarding the energy use of power converters (originally intended for consumer electronics) will be voted during the fall 2008. If the EU’s Environmental Committee votes for the legislation, it will come to effect one year after the vote. It is doubtful if Polyamp can handle the required product development and testing in one year.

However, the aluminum casings used for the DC/DC converters require a substantial amount of energy in the material production phase. If the casings could be reused when the electronics (usually the capacitor) are failing, instead of destructed or in best case recycled as is the case today, environmental savings would be achieved. This can be done by changing the business model rather than the product itself.

7.3 Step 2 – External analysis
In this step the business context is analyzed, including actors such as customers and suppliers. Just like in step 1, the execution of the method and the output will be described for each topic.

7.3.1 Customer requirements analysis

Execution of Method
Since DC/DC converters can be used in such a wide variety of applications, it was not feasible for us to study all customer segments. Even within each of the five segments that Polyamp has divided its most frequent customers into, there are many different applications for the DC/DC converters. However, we chose to focus on train refurbishing companies and power suppliers, since these are big customers to Polyamp. Unfortunately we could not visit the customers, so all the interviews were carried out via telephone. This made a proper ACRA impossible. However, by speaking with persons within the customers’ organization that have good insight in the processes that are conducted we believe that we received a good understanding of the customer needs and processes.

From the train refurbishers we got a good picture over how the converters are used and what the customer needs are, but we found no needs that were not met by the current offer. From the power suppliers we first only got input on the current needs, but we later also found new needs that currently are not met by Polyamp or any other DC/DC converter supplier.

Output
In general, both the studied customer segments have similar requirements on DC/DC converters. In both cases the life expectancy is the single most important aspect as the functionality of the converter is critical for the whole system. Other important aspects are accuracy, moisture resistance, EMC
classifications (Electro Magnetic Compatibility) and delivery times. In the case of train applications vibration resistance is another important feature.

It was found that, in general, the converters are used until they break down both within the power industry and in trains. However, when speaking to a projection manager at the medium-sized power producer and supplier Jämtkraft with several hundred installed DC/DC converters, a new approach was requested. Since failing DC/DC converters is one of the most common causes for power failures\(^\text{19}\) which causes substantial costs for repair and down-time, a need of “converter management” was found. By discussing with the projection manager, the following needs were generated:

- Inventory of current converters in order to clear away too old units on behalf of new ones. Also, when upgrading to new units, the projection manager wished to get advice on what models to choose as replacements.
- A secured functionality of purchased DC/DC converters in the range 15-30 years.
- To buy the function of converting rather than the physical converters.

7.3.2 Customer Perception

*Execution of Method*

The customer perceptions were gathered simultaneously with the customer requirements. We found it difficult to carry out the market-perceived quality profile in a satisfying way due to several reasons. First, the customers could not compare the different quality attributes for different brands on a detailed level; it was just concluded that Polyamp’s DC/DC converters have few equal competitors. This was also aggravated by the fact that the interviews were made via telephone, since it is hard to get the required interaction to perform such a structured task. Another aspect that complicates the market-perceived quality profile is that the long life time of the converters often means that the individuals that once purchased the converters have left the organization. Similarly, the individuals that purchase the converters today will probably not be able to evaluate the actual life time of the products. This means that the converters that were manufactured 15-20 years ago are the ones that can be evaluated by people in the current organization, which makes the “track record” very important for Polyamp.

Regardless the abovementioned problems, we got a fairly uniform picture of the customers’ perception of Polyamp’s offer. We also asked the salesmen at Polyamp about the customers’ perceptions in order to get a more complete view, since the salesmen are in contact with customers on a daily basis and get feedback from them.

*Output*

All the interviewed customers perceived Polyamp’s DC/DC converters as the best converters available. They have earned a reputation of high quality, good technical specifications and long lifetime. Also the organization of Polyamp was commended for its technical competency. The latter also turned out to be the downside of Polyamp; the company can be perceived as too focused on technology instead of

\(^{19}\) It is mainly competitor’s converters that fail, but since these are easier to purchase on a short notice they are often used instead of Polyamp’s (i.e. not due to the price difference).
customer oriented. The long lead times compared to some competitors makes Polyamp losing business in for example the case of Jämtkraft.

The high price of the products was highlighted as a comparative disadvantage by the salesmen at Polyamp, but this was not mentioned by the customers we interviewed. This is probably depending on what applications the converters are used in.

7.3.3 Network analysis

Execution of Method
Polyamp had not been thinking of their suppliers and customers in terms of network. Through discussions with the site manager we together mapped the network of actors that are involved in the providing of DC/DC converters. On the supplier side of the network no interesting aspects surfaced, but when talking about the distributors the perspective widened. The latter among other things lead to a discussion about the role of technology consultant firms in the sales process.

Output
The actors involved in the providing of Polyamp’s DC/DC converters are mapped in Figure 7-4.

![Diagram](image)

Figure 7-4. Map over the network involved in the providing of Polyamp’s DC/DC converters.

Even though the aluminum profiles used for the casings are provided by three exclusive suppliers and some of the electronic hardware components are customized, Polyamp is not dependent on any of the suppliers; they are all exchangeable and no close cooperation is undertaken with any of them.

The converters are sold by Polyamp or via distributors (in Sweden both channels are used, which can lead to competition), either directly to the end customer or to a systems integrator (such as e.g. ABB). Lately Polyamp has made efforts to create closer relationships with technology consultant firms in order to support them in the specifications for the DC/DC converters in a system. The hope is that when the technology consultants realize all the different aspects that should be required from a DC/DC converter,
Polyamp is the only supplier that will be able to meet the specifications. The only actors that can be viewed as strategic partners today is the distributors, whose capabilities mainly consist of access to customers. In the future some type of partnership may be formed with a technology consultant firm, perhaps in the form of deeper mutual information exchange. The capabilities of the technology consultant firms are system knowledge, influence over system design and access to potential customers.

7.3.4 Business Context

Execution of Method

Information about the different aspects in the five forces model was mainly gained by discussions with the management of Polyamp. The only problematic competitive force was the customers, since those are acting in such various industries and have so different structures. We therefore had to make a generalization about the character of a typical customer. The other competitive forces were uncomplicated to get an overview of.

The profit pool analysis did not work well for Polyamp's DC/DC converter offer. Since the business unit in Åtvidaberg mainly sells pure products that currently are not serviced by neither Polyamp nor any other actor, the only relevant activities we could come up with was the production and marketing of the converters. Activities upstream in the supply chain were not found relevant due to the high entry barriers for aluminum extrusion or electronic component manufacturing. Activities downstream in the supply chain were regarded for the same reason, since most customers are large systems integrators (such as ABB). Since the DC/DC converters are used in so many different applications it was not possible to make a meaningful profit on a global level, and we therefore choose to just divide the DC/DC converter market in the different segments. This conceptually showed what kind of converters that is most profitable, but it obviously did not lead to any new attractive activities. Combined with the result of the five forces model it was emphasized what kind of converters that are the most attractive for Polyamp to produce. It should be noted though that a more thorough assessment of the customer's use of the converters might lead to the discovery of new attractive activities to undertake.

Output

The results from the five forces model are concluded in Table 7-1, where the most significant aspects of each competitive force are emphasized. The most influential competitive force is the internal rivalry, since there are many competitors that are using automated production processes in low-wage countries and that lately have reached an increased level of quality and better specifications of their converters.
Table 7-1. The output from the five forces model for DC/DC converters.

<table>
<thead>
<tr>
<th>Suppliers</th>
<th>Industry Rivalry</th>
<th>Potential entrants</th>
<th>Substitutes</th>
<th>Customers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large but exchangeable suppliers of customized components</td>
<td>Several global competitors with automated production processes in low-wage countries and many local competitors</td>
<td>Low barriers for new entrants, but this is no large threat for Polyamp since it takes time to build a reputation of quality in the premium segment</td>
<td>There are no substitutes for DC/DC converters as such</td>
<td>Often large companies using the DC/DC converters in large systems</td>
</tr>
<tr>
<td>Standard components can be purchased from many suppliers</td>
<td>Few competitors in the premium segment, but cheaper competitors are increasing their quality</td>
<td>External converters are substituted by integrated converters for low-power applications</td>
<td>High quality is the most important purchasing criteria; some customers are not price sensitive</td>
<td></td>
</tr>
<tr>
<td></td>
<td>High rivalry in the segment of small DC/DC converters</td>
<td></td>
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</table>

The profit pool that was conceptually estimated with the help from Polyamp is illustrated in Figure 7-5. As the profit pool was made on a schematic basis, we have not displayed any figures on the share of industry revenue.

![Figure 7-5. Profit pool of the DC/DC converter industry.](image)

As can be seen in Figure 7-5, the market size is much smaller for large DC/DC converters, but at the same time the margins are higher (due to less price sensitive customers and fewer competitors). The attractiveness of producing high-power converters is also enhanced by the five forces model, where the threat of cheaper products from automated production processes as well as the risk of substitutes in the form of integrated converters seems to be more substantial for low-power converters.
7.4 Step 3 – Planning the New Offer

In this step the output from step 1 and 2 will be put together in different approaches in order to generate new concepts. These approaches regard the identification of gaps and fits as well as a categorization of the value. The approaches will be treated one by one and the concepts they generated will be discussed.

7.4.1 Identify the Gaps

Execution of Method

This part of the method was conducted in the same way as for the other case companies. However, we did only find a gap in terms of value.

Output

The gaps we found regarded the value. Some customers considered that the price for the product was too high compared to the requested quality of the product, i.e. the quality is not something these customers want to pay for. Furthermore, we found a need of the function of DC/DC conversion rather than converters (even though this was stated by one specific customer, we believe that this can be the case for other customers as well). The identified gaps are shown in Figure 7-6.

![Figure 7-6. The identified gaps regarding DC/DC converters.](image)

7.4.2 Identify the fits

Execution of Method

We were able to find fits between the attractive activities and available capabilities. In contrast to MJP and Assalub there were internal capabilities, both from the offer and from the company that could be matched with attractive activities. Regarding the fit between customer processes and environmental impact of the offer, we could not find any.

Output

The first fit that we found was between the technology consultants and the activity to sell more of the larger converters. Since the technology consultants have influential power over the system design, they can help Polyamp to sell more high-power converters by making specifications that the cheaper competitors cannot meet.

Polyamp also has access to detailed sales statistics enabling them to do inventories of the converters used in large systems (provided that the customers know the serial numbers), something that some customers want. Hence, there is fit.
The third fit is between the superior life expectancy of the Polyamp’s DC/DC converters and the demand from customers of precise and secured power converting during long periods of time.

The identified fits are displayed in Figure 7-7.

![Available capabilities vs Attractive activities](image)

**Figure 7-7.** Identified fits regarding DC/DC converters.

### 7.4.3 Categorize the value

**Execution of Method**

In this approach we could generate concepts for both the use-oriented and result-oriented offer without any problems.

**Output**

In the use-oriented offer we envisioned that Polyamp can sell rental contracts to customers. In this rental contract the customers send the converters to Polyamp after a certain interval (let say 15 years) for renovation, which in practice means changing the capacitor. Meanwhile a replacement converter is supplied to the customer.

The result-oriented offer implies that Polyamp sells the function of converting and charges the customer depending on the number of running hours the converter has. This requires the ability to log the usage of the converter, a technology that exists at Polyamp Systems, the other business unit of Polyamp. One customer that could be interested in such an offer is Jämtkraft.

### 7.4.4 Generated Concepts

The concepts that we found most interesting are the following:

1. Sell the function rather than the products, as suggested above. The customer signs a contract lasting between 15 to 30 years, during which Polyamp secures the function of conversion.
2. Increase of warranty of new converters, and sell renovated converters with half the warranty time to a lower price. This should be done primarily on high-power converters with the aim on customers that feels that the price on Polyamp’s new converters is too high, enabling Polyamp to compete with low cost alternatives while still keeping the quality in the brand.
3. Offer inventory of converters in existing systems in order to recommend the customer which converters that need to be changed in order to secure further functioning. The customers can either be advised on what new models to buy (the converters have certainly been developed since the old converter was installed probably 15-25 years ago) or renovated according to concept 1.

7.4.5 Evaluation of the Concept
In similarity to the two previous case studies, we made a thorough evaluation for only one of the concepts, since we regarded this to be sufficient for testing the method. We believe that the first concept will serve as good example of evaluation, i.e. to sell the function of power conversion.

Execution of Method
Now we had to act like the expert panel again as in the case of MJP. However, in this case we had discussions with the management of Polyamp regarding the feasibility of the concepts. The concept regarding the renovated converters was actually also presented by the CEO and site manager for the product development and production unit in order to “sell in” the concept and test the feasibility. It was easy to come to the conclusion that the environmental impact will decrease with the chosen offer, although it is difficult to estimate how much. This was the case also for the economical impact; it was difficult to calculate the costs for the concepts, since several assumptions needs to be made. The strategy match was no problem to evaluate as this subject was discussed with the management and the same goes for the customer acceptance, since input to the concept was gained directly from a customer.

It is however difficult to know how other customers will accept the offer without speaking to them, but in this case it would be enough to start with one customer as a pilot project, since no development costs are required.

Output
Figure 7-8 shows the evaluation of the concept based on the four aspects environmental impact, economical impact, identity and strategy match, and customer acceptance.

![Figure 7-8. Evaluation of concept 1; selling the function of conversion.](image)
The environmental impact for the offer is considered to be lower than the reference offer, since the most parts of the converters is reused (hopefully only the capacitor has to be changed).

Also the economical impact of the offer is considered to be better than the reference offer. The revenues would increase, since selling the function implies that Polyamp gets paid a monthly fee for securing the conversion, regardless of the condition of the converters. The sum of the monthly fees could generate more revenues than just selling a converter if the reduced risk is appreciated by the customer. The profit margin depends on how much the service of securing the running of the converters costs. However, as Polyamp has the technology to log the conditions of the converters, the surveillance of the converters can get somewhat automated. Combined with the well-proved reliability and durability this suggests that the profit margin can be quite high.

The identity and strategy match was considered to be high, at least from the management’s point of view. Polyamp also have detailed sales statistics meaning that it can take over the function on existing systems as well, knowing how long the Polyamp converters have been in that system. Polyamp clearly has excellent knowledge about converters and by realizing this concept the knowledge is further underlined, whereas the confidence that Polyamp shows in its products by guaranteeing the function differentiates the company from the competitors and enhances the brand.

The customer acceptance aspect is as high as it can get in the case of Jämtkraft, which was the customer that requested the function of power conversion. Jämtkraft is large enough to use as a pilot customer for the concept and we believe that there certainly can be other customers that are interested in this kind of offer as well. However, since we are not sure about how many other customers that would adopt the concept, we will not give the maximum rating for the customer acceptance.

7.5 Lessons Learned from the Case Study of Polyamp

From the case study of Polyamp we learned that having many types of customers that are using the product in several types of applications makes it more difficult to execute parts of our method. The lack of a “typical application” made it complicated to assess the environmental aspect of the offer at a system level and the profit pool analysis was difficult to perform, since we could not define a meaningful set of activities to include in the industry. Nevertheless, the profit pool analysis did fill a purpose by illustrating what kind of products that are most profitable, which was a good complement to the five forces analysis.
8 Analysis

In this chapter the empirical results from our research will be analyzed and put in relation to our frame of reference. As an introduction the drivers for development towards PSS offers will be analyzed, since this area was central for why a firm would want to develop PSS offers as discussed in the problem background of this study. Thereafter the structure of the analysis will follow the steps of our method.

8.1 Drivers for Change

In the problem background of this thesis (section 1.1) several drivers for the development towards PSS offers were discussed. The drivers were categorized into defensive and offensive motives. In the former category the maturity of markets with a high degree of imitability (Meier & Völker 2008, Hatfield 2008) and environmental aspects such as new legislation and increased costs for resources were the most important (Mont 2002, Crowhurst 2006). The offensive motives were regarded to be the possibility to create unique offers that are difficult to imitate as a way of gaining competitive advantage (e.g. Oliva & Kallenberg 2003), create new markets (Goedkoop, et al. 1999) or simply to increase the profitability (Oliva & Kallenberg 2003). Oliva & Kallenberg (2003) also states that it is common to integrate more services in the core product in order to support the sales of the core product.

The drivers for the case companies to change their offer were differing. The main driver for Assalub was to sell more core products (LubeRight systems), MJP sought to increase the profits of the offer while the main driver for Polyamp was to reduce the threat from low-cost competition. The latter can be viewed as an attempt to create a unique offer in order to gain competitive advantage. However, we found that it was no purpose in itself for any of the companies to include more services in the offer. Put in other words, the companies did not see any drivers for the development towards PSS offers, but rather saw specific threats or opportunities that would require a change in the business models. For example, in the case of MJP the goal of the change was to sell more spare parts in order to increase the profit margin.

The fact that the case companies did not see any drivers for the development towards PSS offers is important to bear in mind. When developing our method and started our field studies at the case companies, our approach was that it would be a purpose in itself to do a transition towards PSS offers. All studied literature indicated that it would bring benefits for companies to develop towards more service-oriented offers. However, the results from our method did not show that this is always the case (although it certainly can be). As an example, Assalub can have higher margins on their core product than on services, since there is no competition for the LubeRight system.

Furthermore our empirical studies show that it is often impracticable for the case companies to undertake certain activities due to limited resources or the fact that their products are often used as a component in a larger system, which means that the companies generally cannot offer services on system level. In our original method it is suggested that a company should keep to its current offer if no PSS concept can be generated that is superior the current offer. However, when using the method we
realized that it could be used as a general business development method in the case companies; even concepts of “conventional” offers or other changes were generated. We therefore consider it wise that the companies that will use the method do not only consider what are their drivers for transition towards PSS offers, but rather what drives them to change their offer in general – the inspiration for PSS offers will be gained by the method anyway, given that the situation makes it attractive.

8.2 Analyzing Step 1
In the following sections each step of the internal analysis in our method will be analyzed.

8.2.1 The Internal Business Processes
The objective of an internal value chain analysis, as suggested by Porter (1985), is to identify the costs related to each activity in order to analyze if these are corresponding to an increased value for the customers. This could not be done for any of the companies in our study. Since the companies are so small, the employees are often performing more than one activity, which means that it is not possible to estimate the cost for each activity. In larger companies predefined cost centers facilitate a value chain analysis as it is easy to collect the required economical data that proved to be difficult to access in the case companies. Besides, even if this could be done, it would take an unjustifiable amount of time to do – especially since the managers are already more than busy with the daily work. Also, after discussing the matter we arrived at the conclusion that the total costs for each activity would be of little use if they could not be easily related to and compared with competitor’s costs. We therefore chose to exclude the internal value chain analysis as described by Porter (1985) from our method, since it is not suitable for our purpose. It is simply too complicated in relation to the potential benefits.

However, the internal value chain structure – not the analysis of it as such – proved to be useful as a starting-point when comparing a company’s activities with its competitors’, in order to clarify what activities to compare. Even though it was not possible to get an estimation of the competitors’ cost structure, the managements in the case companies had a good feeling for what differentiated their own performing of the activities from their competitors’ (although this was not relevant for Assalub since there are no competitors to the LubeRight system). According to Porter (1996) this is important, since he argues that competitive strategy is about performing different activities than the competitors’ or performing similar activities in different ways. By comparing the activities of the company to the activities of the competitors, an understanding of what makes the company competitive will be achieved.

The efficient management and flexible organizations of SMEs as pointed out by Alpakan et al. (2007) and Tanabe & Watanabe (2005) was observed in the case companies. The ways of communication and decisions are short due to the small organizations, decreasing the need of structured business processes. Stalk et al. (1992) suggested that the capabilities of the company are a set of business processes strategically understood. Due to the small size of the case companies these business processes are less complex to understand, and therefore the capabilities are easier to grasp. As stated in the frame of

20 It can be argued that a business development method should regard the whole company and not just an offer. However, small companies often tend to be focused around one or a few offers, and each can be used in the method to cover the whole business.
reference, these capabilities can be viewed as the fit between activities that Porter (1996) argues for, and will thus be easier to understand. However, this less complexity in the business processes does not mean that the business models of SMEs are easier to imitate since the business processes should have a connection to the core competence of the firm, which according to Prahalad & Hamel (1990) per definition is hard to imitate. In conclusion, we therefore argue that the capabilities of manufacturing SMEs are easier and just as relevant to assess by asking about their strengths and weaknesses. We did find that the management in general was well aware about the strengths and weaknesses of the company.

8.2.2 Assessment of the Offer
The offer categorization along the product-service continuum as suggested by Tukker & Tischner (2004) was easy to perform for all three case companies. However, the companies all have product-oriented offers – or even a pure product offer in the case of Polyamp's DC/DC converters. This probably made the categorization simpler than it would be for more complex offers. For more complex offer we believe that breaking down the offer into its components, as we introduced in our method, will be helpful in order to get a structured procedure for the categorization. The categorization of the offers proved to be useful both for the understanding of the current business model and as inspiration for concepts in step 3 of our method.

The strengths and weaknesses of the offer were well known by the management in the case companies. The bias of the answers about strengths and weaknesses proved to be diminutive, as there were only small differences between the companies’ views of their products and the customers’ perceptions. Even though none of the companies have structured methods for gathering feedback from customers, the closeness to the customers, combined with the short ways of communication in the small organizations, seems to be sufficient for making the management well aware about the strengths and weaknesses of the offer. This can be related to the statements of Alpakan et al. (2007) and Tanabe & Watanabe (2005) that small companies can create superior market orientation compared to larger firms due to increased flexibility. A good example of this is Assalub, where the management meets customers on a regular basis and continuously gets feedback on how the offer can be improved. In contrast the ways of communication from the customers are substantially longer within the organization of a large competitor such as company A, where the sales and product development function are clearly separated.

The key selling points used by the companies were as expected based on the strengths of the offers. Not all the strengths of the offer were used as key selling points though, since some of the strengths are beneficial for the company rather than for the customer (as in the case of the high profit margins on spare parts in the case of MJP's waterjet offer). In the cases of MJP and Polyamp, the key selling points of the offers almost entirely regard the product itself, while the key selling points of the LubeRight system are focused on what the offer can do for the customer. All three companies are focused on selling products, so the difference cannot be explained by terms of how much service is included in the offer. One explanation could instead be that while the offers of MJP and Polyamp are competing against similar offers, the LubeRight system is competing against substitutes due to the lack of competitors.
8.2.3 Life Cycle Perspective of the Offer

In the frame of reference we stated that the life cycle perspective of the offer should be gained by a conceptual LCA in line with the suggestion by Goedkoop et al. (1999), since it could be expected to be difficult to gather the data required to make a more detailed analysis. This turned out to be true, and what aggravated the data collection even more was the fact that none of the case companies are certified according to ISO 14000. Hence there had never been any attempts to carry out a LCA in any of the companies. Neither did any of the companies have any dedicated appointment for environmental issues. This made the input to the conceptual LCA somewhat vague and uncertain, which in turn obviously decreases the credibility of the results. According to Piper et al. (2003) it is important that the LCA is flexible, practical and cost-effective at the same as the result preserves it credibility. The importance of feasibility was obvious in the studied cases, due to limited knowledge and time. It is however questionable if the credibility of the results was preserved; the feasibility got the upper hand.

In general, a large part of the products manufactured by the case companies are purchased from subcontractors and not in any case were environmental aspects important purchasing criteria. This probably leads to a weak overview of the environmental impact in the material production- and manufacturing phase, compared to if the products would have been manufactured in-house to a larger extent. The companies did however have a reasonably good picture about the environmental impact in the transport phase, but this phase did not constitute any major relative environmental impact in any of the case companies’ product life cycles. The environmental impact in the use and recycling phases of the product life cycles were difficult to estimate for all the companies. It was still found useful to get an estimation of the life expectancy for the products, since this gave a better understanding of the product life cycle.

A common denominator for the studied companies was that the environmental impact caused by the products are insignificant compared to the environmental impact caused by the systems that the products are used in. This insight was the reason for us to divide the environmental assessment into a product level and a system level. By doing so it could be illustrated – on a conceptual level – how significant the environmental impact is in the phase of the system life cycle where the product is used. If, for example, the product is used in the use phase on a system level and the biggest environmental impact for the system is caused in this phase, it is probable that a larger environmental saving can be achieved by focusing on a decrease of the environmental impact on a system level instead of on a product level. A conceptual LCA was feasible for MJP and Assalub, as both companies had good knowledge about how their products are used. In the case of Polyamp it was however difficult to carry out even a conceptual LCA on system level, since the DC/DC converters are used in a countless number of applications and by various types of customers.

In the frame of reference we stated that the result of the conceptual LCA would be a life cycle perspective that can be used for several purposes, but that the most important purpose would be to identify waste of resources. This could be achieved in the case of Polyamp, were the destruction of faulty converters was found to be a waste of resources since the only failing component usually is the capacitor. By changing the capacitor and reuse the remaining part of a converter, environmental as well as economical savings can be achieved – both for Polyamp and the customers. This is a good example of
the win-win-win (company-customer-environment) situation that PSS offers seek to create. For the other case companies the life cycle perspective mainly gave an understanding of in which phase the most substantial environmental savings can be made. If the savings primarily can be achieved at a system level, this can be used as an argument in the marketing towards the customers.

In summary we found that environmental issues are not of high priority neither in any of the case companies nor in the purchasing processes of their customers. In similarity with the findings of Östlin (2008), aspects such as green marketing and ethical considerations seem to have low priority. A life cycle perspective of the offer may however give inspiration for changes in the business model, as in the case of Polyamp. The statement made by Crowhurst (2006) that EU environmental legislation will create opportunities for growth was not confirmed in our studies, although this could be true in the case of Assalub if stricter legislation regarding grease handling would be introduced. Polyamp may on the contrary be severely negatively affected if the new EU environmental legislation regarding the energy use of power converters will come to effect during 2009. In that case a change of business model will not help; the core product itself must be redesigned to be allowed on the market. However, this emphasizes the power of environmental legislation.

8.3 Analyzing Step 2

In the following sections each step of the external analysis in our method will be analyzed.

8.3.1 Customer Requirement Analysis

The customer requirement analysis had its focus on the potential needs that customers have. In all three cases, the ACRA tool was difficult to carry out since all the interviews were made over telephone. We believe the reason for this is that customer processes have to be studied in real life in order to be understood, meaning that the customers have to be visited. As suggested in the frame of reference, SMEs in general have limited resources, which mean that it may be difficult to dedicate people to travelling around and visiting customers just in order to perform the ACRA. However, by combining the ACRA with other errands of personnel such as salesmen or service technicians, that will visit the customers anyway, little extra resources would be required. For instance, MJP has a service technician that travels worldwide visiting the customers and has excellent knowledge about customers’ processes and both Assalub and Polyamp have salesmen travelling around and meeting customers.

Another suggested way of collecting information about the customers’ process was products with “self-awareness” that could log the use of the products. In the frame of reference we argued that due to the limited financial resources that SMEs have, it would be too expensive for them to develop such technology. This assumption proved to be wrong. Assalub already has this function built into the system, MJP will have it when the new generation of control system is introduced and Polyamp uses data-logging for the DC/DC converters used for degaussing systems that could be built into the rest of the model range.

Obviously, the buying process of the customer was important for all case companies. It was particularly important for MJP and Assalub, where the end-user had different roles in the buying process, in line with
the reasoning of Weele (2005). Therefore the success of any offer will depend on how the part of the customer’s organization that has the real power over the purchasing decision perceives the offer.

Understanding of the customer requirements and buying process was important input to the concept generation step; often the generated concepts were derived from this understanding. However, we believe that even if that is not the case, this type of analysis provides important information for any company. The level of customer knowledge in the case companies varied from very good knowledge as in the case of Assalub to low knowledge in the case of Polyamp. This naturally affects how much new information that will be gained by performing the customer requirement analysis; the less knowledge a company has about its customers, the more it will benefit from speaking with them. Consequently, we received much more new information when speaking to customers of Polyamp than when speaking to the customers of Assalub. We also found that the types of customers a company has, the more difficult it is to get an overview of their needs since they may vary to a high extent.

**8.3.2 Market-Perceived Quality Profile**

In order to understand the customer perceptions, we proposed the usage of Gale’s (1994) method, the market-perceived quality profile. It was supposed to be carried out at the same time as the ACRA analysis, but in similarity with the ACRA there were difficulties connected to this. In the case of MJP, either communication problems or insufficient experience of competing products were barriers. The product of Assalub, LubeRight, has no competing products and therefore Gale’s method was irrelevant. The customers of Polyamp either had insufficient knowledge about the products or had not been involved in the purchasing of the converters. Despite these difficulties it was found that we could get an understanding of the customer perceptions by just talking to the customers. This implies that the market-perceived quality profile is not necessary for getting an overview of the customer perceptions, but we still believe that it will be useful in order to gain a deeper understanding of how the offer is perceived by the customers. It would probably more easily executed if the customers are met in person, rather than speaking with them over the telephone. We believe that in-real-life meetings would not only improve the execution of the method, but would also enable an enhanced relationship with the customers since they will feel that their opinions matter.

**8.3.3 Network Analysis**

For all three case companies, the mapping of the network could be conducted in a satisfying way. The case companies had information and understanding about their role in the network as well as the capabilities and power of the other actors.

As suggested by Gomes-Casseres (1997), strategic partnerships proved to have an important role in the case companies, both historically and at present. However, the type of strategic partnership that the case companies have is differing. MJP has strategic partnership with both subcontractors and agents, while Polyamp and Assalub only have strategic partnership with distributors. MJP is the system supplier and assembles the components, which can be seen as the leader case according to Hammarkvist et al.’s (1982) reasoning. MJP’s decision to add new capabilities (new control system designer) can be viewed as changing the constellation that Gomes-Casseres (1997) deals with. The context (i.e. customers) demands higher reliability on the control system, which cannot be provided by the existing network. MJP, as the
system supplier, has the control of the network and will seek to meet these demands by finding capabilities that enable MJP to provide such an offer. The inclusion of the new control system designer will thus change the constellation providing the offer and the bargaining power amongst the actors will be affected, just as Gomes-Casseres (1997) suggested.

In the other cases the strategic partnerships are established to enable the provisioning of the offer to a larger market. For manufacturing firms the sale of its products is a crucial activity and is closely connected the core competence of the firm, and is therefore important to have some control over as argued by Cox (1996). The strategic partnerships with agents are primarily due to limited financial resources, which Weinrauch et al. (1991) identified as the biggest obstacle for SMEs. Larger companies that own their sales channel are not forced to engage in partnership regarding distribution of the offer.

The network analysis proved to be important input since concepts generated for both MJP and Assalub require capabilities in the network. This is in line with Gulati’s (1999) and Zaheer & Bell’s (2005) arguments that accumulated network resources, i.e. existing capabilities in the network, will give strategic opportunities for the actors in the network. Not only MJP and Assalub will benefit from the new offers, but also the actors that have the capabilities needed to provide the new offer, increasing their sales and/or competitive advantage.

8.3.4 Business Context
The business context was analyzed through the five forces model and profit pool analysis. The five forces model was feasible for all companies, and provided understanding that were useful in the concept generation phase. Input to the five forces model was mainly gathered from the case companies themselves, but complementary information was gained through the interviews made with customers.

The profit pool analysis was more difficult to execute, due to two reasons. First, the case companies are small and acting in niche markets, which limit the availability of data. For instance, in Assalub’s profit pool some activities are also carried out by large companies, but this represent a marginal part of their whole business. This means that even if the large companies were public, financial data would be difficult to obtain since the revenues and profits from the activities is just a small fraction of the large companies’ total turnover or profit.

Second, companies can have a poor overview of industry profits or revenues, as was the case for Polyamp. The situation that Polyamp is in, with suppliers delivering to multiple segments and customers in various segments, may have contributed to this. If anything, this makes the profit pool difficult to define. The method introduced during the workshop held with Österby Marine, with a three-grade scaling of the profitability and revenue for each of the activities proved to be sufficient to be able to make some conclusions about the profit distribution of the industry. This was highlighted by the case of MJP where our quantitative estimates on the activities resulted in the same conclusions as the rougher estimate. However, even though the case companies (with the exception of Polyamp) had a good idea about the profits and revenues in their industries, a deeper analysis may be useful for verifying these rough guesses.
Furthermore, if the activities that the offer is a part of make up a negligible share of the total industry revenues, it may be useful to change scope for the analysis. By excluding activities that have a high share of the revenues in the industry and that are regarded as impracticable for the company to undertake, a better overview of the more relevant activities can be achieved. This was done in the case of MJP, since the activities that are directly regarding the waterjet turned out to be insignificant in relation to the whole industry. The analysis first conducted with the wider scope will however still be useful, since it illustrates the power distribution within the industry.

In general, larger firms have more apparent profit pools, which make it easier for them to identify activities in a profit pool. They are also a larger part of the system and therefore figures from public annual reports are more accommodated for their purpose. Furthermore, the larger firms have more analytical resources helping them perform the profit pool analysis. Nonetheless, we argue that the profit pool analysis is a powerful tool for SMEs since our experience from the case companies has shown that it can be performed without rigorous information gathering.

The five force model and profit pool analysis complemented each other in a good way. Aspects that were missed by the five force model were obtained by the profit pool and vice versa. We believe that the tools presented here are a good way of structuring information that managers already have, and we believe that a good understanding of the business context is important for all companies, even if it should not generate new concepts.

8.4 Analyzing Step 3

The findings from the case studies will be analyzed in the following section, in the subsequent order of phases; concept generation, concept evaluation and feasibility.

8.4.1 Concept generation

To generate concepts from the outputs in step 1 and 2, we had proposed three different approaches: identify the gaps, identify the fits and categorize the value. These three approaches complemented each other in a satisfying way, using different inputs and thus giving different perspectives to generate concepts. In a concept generation stage Johannesson et al. (2004) argue that it is important not to put too much emphasis on the feasibility of the offer so that the creativity is restricted. This cannot be stressed enough since we found that ideas at first seem impracticable, could contain elements that are suited for other concepts. Therefore restricting the creativity too much at this stage will have an impact on the quality of the generated concepts.

In the identify the gaps approach, we found gaps for all the case companies. However, the gaps that we found were mainly connected to gaps in value, as some customer needs were not matched by the offers provided by the case companies (i.e. the weaknesses of the offer). The lack of communication gaps indicates that the case companies all have good contact with their customer and have a good knowledge about their own offer.

The identify the fits approach also worked well, especially between the attractive activities and the capabilities of the network. Often the capabilities needed to provide an offer that takes advantage of the attractive activities were found to exist within the companies’ business network. The fit between the
customer processes and life cycle of the offer also turned out to be useful, since fits were identified both in the case of MJP and the case of Assalub. However, since we were not able to map the customer processes as intended, we obtained a reduced understanding of the customer processes. With a better understanding of the customer processes, chances are that more fits would have been found.

The categorize the value approach generated concepts for all case companies, but sometimes proved to be impracticable. In the case of MJP, the concepts generated when thinking of the product waterjet gave unrealistic concepts. However, when looking at a propulsion package deal we could generate more realistic and attractive offers. For Polyamp and Assalub this approach generated interesting concepts starting from the original offers.

MJP's package deal concept can be viewed as making a denser value offer that Normann & Ramirez (1993) suggest companies should provide their customers. As more ingredients (i.e. waterjets, engine and gearbox) are put into the offer the offering contains more knowledge, but this comes with a price of reconfiguring the value constellation that Normann & Ramirez (1993) discuss. The reconfiguration of the value constellation is also occurring in the case of Assalub's concept of delivering the function of greasing.

The three parts in the concept generation gave inspiration of new concepts, together and on their own. The first two approaches generated concepts that mainly were improvements of the current offers rather than changing business models towards new PSS offers. However, the categorize-the-value approach is based on the PSS offer categories and by looking at the offer through the different categories; the concepts generated from this approach are bound to be more service-filled PSS offer. In summary, the concepts generated were not only PSS offers, but also development of current offers, which can be seen as regular business development. We do not see this as a flaw of the method but rather a huge advantage, as it equips the SMEs not only with a method to develop PSS offer but also to develop their businesses.

8.4.2 Concept Evaluation
The concept evaluation consisted of grading how the new concept stands compared to the reference offer regarding the four aspects environmental impact, economical impact, identity and strategy match and customer acceptance. We experienced the last three aspects to be relevant and very important aspects to take in consideration when evaluation the offers.

The economical aspect takes into account the short run through the company perspective and the long run through the business sector analysis. The latter is looking for future profitable activities to undertake that are connected to the suggested concept. For SMEs with limited financial resources the economic aspects in the short run are crucial, since the SMEs do not have persistence of having an offer that has negative economical impact in the short run in order to reach to another strategic position where the firm finally can undertake profitable activities. Therefore the economic aspect, especially in the short run, is of high importance to consider when evaluating the concept.

Since the SMEs have a greater strategic flexibility than large enterprises, which should mean that a strategic mismatch may not have big consequences, the aspect regarding identity and strategy match
can be viewed as less relevant. However, a strategic match must also regard the firm’s willingness to embrace the new concept; otherwise the concept cannot be successful. This was highlighted by the Step 3 workshop held with Assalub, where a concept that strategically and economically perceived as sound was regarded as negative due to the management’s negative personal feelings towards it. Thus, the identity and strategy match is important to reflect on when evaluating a concept.

The aspect regarding the customer acceptance was judged using the four-step process suggested by Goedkoop et al. (1999), but in some cases even following this process proved to be hard. It can be difficult thinking about how the customer will accept the new concept, but nevertheless customer acceptance is an important aspect since the customers can decide whether the concept is a success or a failure. If a customer initiates the concept, such as in the case of Polyamp where Jämtkraft demanded a concept, the need for analyzing the customer acceptance obviously decreases.

The aspect that we felt was a bit irrelevant was the environmental impact, since we found that the customers to the case companies did not care too much about the environment. This means that whatever impact the new concept has on the environment it does not affect the customer acceptance of the offer. Any company looking to maximize their own profits will therefore sell a concept if the other aspects are favorable, regardless of the environmental impact. This might of course endorse the omitting of the environmental impact, which might be true looking in near future of the company. However, in the long run the awareness of the environmental impact of an offer is important since this can open future strategic opportunities. Also, if legislative decisions appear the company can be in good position.

The third workshop was conducted with the management of Assalub, which gave a good result and good feedback to the method. This validated the method since the management thought that the concepts generated were relevant and interesting for Assalub to pursue, showing that the concepts generated by the method were good.

8.4.3 Feasibility Analysis
The feasibility analysis could not be performed due to time limitations, which means that we do not know how this phase would work in practice. However, we argue that this part is an important step before realizing the concept, since it is important to understand if the concept really is feasible and useful. Our idea of the feasibility analysis is to analyze the concept on a more quantitative basis regarding the aspects presented in the concept evaluation. In some cases this can be difficult, especially regarding the customer acceptance, since this cannot always be tested before the launch of the concept. Despite this, we argue that the companies performing this method should try to evaluate the feasibility of the offer to the extent where they feel assured that the concept has a great chance of success. The need for feasibility analysis is diminished if small investments are required as in the case of Polyamp, where a customer is willing to test new offers – that do not imply any significant development costs – together with the company.
9 Conclusions

In this chapter the conclusions from our study will be presented. The conclusions seek to answer the research questions introduced in the first chapter of this thesis, which regard the development and refinement of a PSS offer generation method. Furthermore, a section in this chapter will be dedicated to reflections about the method and its generalization, as well as interesting further studies. In the next – and last – chapter of this thesis we will present some managerial guidelines.

9.1 The Method
The first research question, how a concrete and useful method for the business development towards PSS offers – applicable for the management in manufacturing SMEs – should be designed, was addressed in our theoretical synthetization in chapter 3. This method was tested in our empirical studies and analyzed in the previous chapter. The applicability of the method will be discussed in the following section.

9.2 Applicability of the Method
The second research question was how applicable the developed method is. From the analysis of the execution of our method, we can draw the conclusion that the method in general works satisfying; concepts of offers could be generated for all three case companies. The method proved to thoroughly examine the possibilities of creating PSS offers, even though we found that it was no purpose in itself for any of the case companies to integrate more services in the offer. The drivers for the case companies were rather specific threats or opportunities that would require changes in the offer. However, the method was applicable not only for the business development towards PSS offers as the purpose of this thesis suggests. The method proved to be useful as general business development method for manufacturing SMEs, since several of the concepts generated could not be regarded as PSS offers. The conclusion that can be drawn from these findings is that the method will be applicable not only for manufacturing SMEs where the management has decided to develop an offer towards a PSS offer, but also for companies that seek to enhance their business in general. The analyses conducted in the different phases of the method provide an understanding of the company’s situation and business context that is valuable regardless the output in form of new business concepts.

An important learning from our study, although it may not be groundbreaking news, is that business development requires much time and that managers in SMEs in general cannot devote the required time due to the amount of operatively work in their daily tasks. The implication of this is that the management loses the focus on strategic issues. In the studied companies it was obvious that most of the information needed to execute our method was available within the organization, but that a structured method was needed to put all the pieces together in order to create the whole picture. We therefore argue that our method would be useful for most manufacturing SME’s as a way of structure the strategic work. However, some of the tools used in our method proved to be too complex – especially regarding the aforementioned lack of time – or resulting in superfluous information. How the method can be improved is therefore discussed in the following section.
9.3 Improving the Method

Our third research question was how the method can be improved, which will be presented in this section. The improvements that we suggest mainly aim at making the method simpler, since we noticed an obvious lack of time for strategic work among the management in the case companies. The downside of this is the more basic the method is the less accurate the output will be, but we argue that in some phases of the method a conceptual view is sufficient for our purpose. A simpler method will more likely be used by SMEs. Besides, if a more accurate result is required then the frame of reference in this thesis discusses the tools needed for such an approach.

We argue that the method should be improved in the following ways:

- **Dismiss the internal value chain analysis.** Porter’s value chain analysis proved difficult to execute for SMEs, since the cost structure of a small organization cannot easily be broken down in the different activities of the internal value chain. It is simply too complicated in relation to the potential benefits. However, it should be noted that the internal value chain structure – not the analysis of it as such – proved to be useful as a starting-point when comparing a company’s activities with its competitors’, in order to clarify what activities to compare.

- **Focus on a simple assessment of the firm.** Instead of a focus on the internal business processes, as was suggested when using the internal value chain analysis, the focus should lie on the capabilities of the firm by a simple assessment of the strengths and weaknesses. We therefore suggest that the first topic in step 1 is called *assessment of the firm* instead of *internal business processes*.

- **Map the components of the offer.** By making a breakdown of the components of the offer, two benefits were gained. First, we found that a better understanding of what the company actually provides to its customers was achieved. Second, the mapping of the components made it easier to categorize the offer along the product-service continuum.

- **Get a life cycle perspective also on a system level.** If the product is used as a component in a larger system, we suggest that a conceptual life cycle assessment is conducted on a system level as well as on the product level. This will illustrate how significant the environmental impact is in the phase of the system life cycle where the product is used, which can lead to the insight that it is on a system level that the significant environmental savings can be achieved.

- **Replace the ACRA with interviews if customer visits are not feasible.** The ACRA tool was not able to be conducted without visiting the customers’ sites. We strongly recommend that the customers should be visited if possible (e.g. by salesmen), but if this is not found feasible we suggest that the customers are interviewed instead. This can preferably be done over telephone and the information wanted is the same as would have been the output from the ACRA, although the customers’ processes cannot be observed. Hence, the questions should seek to create an understanding of how the current offer is used and what the customer’s real needs are – both the ones they realize themselves and the anticipative needs that can emerge by thinking outside the box.

- **The profit pool analysis can be made on a conceptual level.** When performing the profit pools we found that it was difficult to find the required data for some activities. The method
introduced during the workshop held with Österby Marine, with a three-grade scaling of the profitability and revenue for each of the activities proved to be sufficient for the identification of profitable activities. However, in order to get a more detailed overview of the industry we still recommend that some effort is made to find at least rough estimates of the figures. This is mainly a matter of how much time that is available.

- **The profit pool analysis may need to be done with two different scopes.** If the activity that the offer is a part of makes up a negligible share of the industry revenues in a profit pool, it may be useful to change scope for the analysis. By excluding activities that have a high share of the total revenues in the industry and that are regarded as impracticable for the company to undertake, a better overview of the more relevant activities can be achieved (as done in the profit pool analysis for MJP). The analysis with the wider scope will however still be useful as well, since it illustrates the power distribution within the industry.

- **Also consider concepts that do not regard PSS offers.** During our empirical studies it became obvious that the method is useful not only for creating PSS concepts, but also conventional concepts or other changes of the business model. We therefore argue that this should be integrated in the method in order not to dismiss good ideas that do not regard PSS development.

The changes of the method are illustrated in Figure 9-1. This figure is however just a revision of the graphical illustration of the method; most of the changes regard the execution of the different tools used in the method and the questions asked in each step. These changes as well as guidelines on how to use the method in practice are summarized in what we chose to call **managerial guidelines**, which is found in Appendix VIII. These managerial guidelines include the revised question guide, as well as brief explanations of how to use the different tools. The purpose of the managerial guidelines is to work as a free-standing manual for managers in manufacturing SMEs on how to execute the method (i.e. the PSS Offer Generation Method, which is the intrinsic name introduced in chapter 3 of this thesis).
It should be observed that even though we did not have the time to test the feasibility analysis, we are convinced that some sort of feasibility study should be carried out before going into the realization phase of an offer. Despite not having verified the suggested way of conducting the feasibility analysis, we chose to keep this part in our method.
9.4 Reflections
During our studies, we have gotten new insights and questions have been raised that are not directly related to the purpose of this thesis. We would like to share those issues as well as suggest topics for further research within the area.

9.4.1 What Will Prevent the Method From Being Used?
When working with the managers in the case companies, we realized how much focus is put on the day-to-day business; little time is available for business development. According to the managers, our presence on the companies resulted in a well-needed pause from the daily work tasks. During discussions with the managers many new ideas emerged. The ideas did not emerge from new knowledge; it was just that new approaches to the current knowledge created new perspectives and a more comprehensive view on the business. The managers in general had vast experience of their products and the industry the company acts in. We therefore believe that our method can be important for managers in manufacturing SMEs as a way of getting new perspectives and structure to existing knowledge. The question is how the method can be spread to and used by management of SMEs?

First, the managers must be able to use some of their time for business development instead of day-to-day business. A prerequisite for this is that they must first see the use of shifting their focus to long-term business development. Many managers are certainly aware of this, but they simply cannot free time from the daily work tasks, even though they know that they would benefit from it in the long run. Or as stated by a manager in one of the case companies:

“It is like running beside the bicycle, but we do not have the time to get on it.”

How to help the managers in SMEs getting on their bikes is not an easy question, and unfortunately we do not know the answer.

Second, if the management in a company decides to reserve the time required for business development, how should they get the work started? We find it unlikely that a management group getting this thesis (or just the managerial guidelines) in its hands would just get on with the execution without any input from a facilitator or other supportive actors. During the IPSE workshops it was also stated by managers that the development towards PSS offers is a learning process that requires time, which is an important aspect to bear in mind.

Another aspect that should be regarded before conducting the method is if there are any risks associated with executing the method. The only risks that we can see regard the parts of the method that require contact with customers. Even though we believe that it is unusual, there might be companies that have situations where they for some reason do not wish get a closer relation with the customers. For example these companies can claim that it would be unfavorable for them if the customers would evaluate the offer, since they may discover that the price is too high or that there are shortcomings of the current offer. This could in turn potentially lead to a change of supplier or demands on lower prices. However, we argue that this reasoning is wrong, since it would be much more dangerous in the long term not to use this feedback in order to improve the offer.
9.4.2 Generalization
The method was tested on three case companies that turned out to have several characteristic similarities. All three case companies act on niche markets where quality and product features are more important aspects than price, the offers are all product-oriented. Further the case companies have flexible organizations, the marketing units are small and little time is spent on business development. Does this make these companies too particular for being representative for manufacturing SMEs in general? The theories regarding the differences between SMEs and larger firms, discussed in the frame of reference, would suggest that this is not the case. The mentioned features rather seem to be typical for SMEs.

The similarities mentioned in the previous paragraph indicate that the case companies are representative for manufacturing SMEs in general. There are however also differences between the case companies that make them representing different kinds of manufacturing SMEs. Examples of important aspects that vary between the studied companies are the degree of internal industry rivalry, the number and sizes of customers, turnover, number of employees, type of products and degree of specialization.

The conclusions that can be drawn from this reasoning are that the companies used in our study are both representative for the group manufacturing SMEs and that they make up a varied sample within this group. We therefore argue that the method we have developed and tested on the three case companies also should be applicable for other manufacturing SMEs. Furthermore, since the case companies all had different drivers for developing their offers – and none of them saw the transition to PSS as a purpose in itself – the method seems to be applicable as a general business development method for manufacturing SMEs seeking to avoid threats or exploit opportunities.

There are however two groups of companies that have not been included in our study; companies with use-oriented or result-oriented offers. Especially the latter group of companies is already providing typical PSS offers, which implies that it would have no use for a business development method aiming at developing PSS offers. However, as has been discussed the method can be used to develop the offer not only from PSS aspects. This means that the companies already providing result-oriented offers could still improve their offer by using the method. There might be parts of the method that do not work as well for this group of companies as for the case companies, but being aware of this we believe that the method without major problems can be executed by service-oriented companies as well; most of the tools used in the method are universal.

9.4.3 Further Research
An interesting area of future research is how the method can be implemented in manufacturing SMEs. This area regards both how the method can be spread to the management in appropriate companies and how much support is needed for the execution of the method. The latter can for example be studied by giving the managerial guidelines in Appendix VIII to a number of management groups and study their actions as a silent observer. By doing this, any aspects that decrease the feasibility of the method would be discovered. If such a study shows that the method works well, or that supporting actors are needed, the next research question would be how the method can be spread to managers in SMEs in order to be used in a proper way.
10 Bibliography


**Interviews**

The interviewees at the case companies have been interviewed several times, both in person and in complementary telephone interviews, if not stated otherwise.

**Case 1 – MJP**

**MJP**

**Patrik Modig**, CEO

**Nils Morén**, Sales Manager

**Hans Lindgren**, After Sales Manager

**Niklas Widemark**, Project Department Manager

**Michael Näsström**, Service Manager, Telephone interview 23rd September
Joachim Boqvist, Quality Manager, Telephone interview 6th October

Customers
The list of interviewed customers of MJP is confidential.

Case 2 – Assalub

Assalub
Kim Funck, CEO
Pär-Olof Funck, Exportation Manager
Niklas Rehn, Engineering Manager

Customers
Göran Strand, Technical Group Preventive Maintenance at Stora Enso Skutskär, Telephone interview 19th September
Karin Rodell, Maintenance Manager at Stora Enso Skutskär, Telephone interview 19th September
Bernt Pettersson, Preventive Maintenance Service Technician at Stora Enso Hylte, Telephone interview 22nd September
Anders Truedsson, Mechanical Maintenance at Södra Cell Mörrum, Telephone interview 23rd September
Lars Andersson, Preventive Maintenance Group Manager at Braviken Holmen Paper, Telephone interview 24th September

Case 3 – Polyamp

Polyamp
Eric Östlund, CEO
Bengt Hellerstedt, Plant Manager in Åtvidaberg
Anna-Lena Josefsson, Salesperson
Olle Persson, Salesperson

Customers
Ulf Malmros, Purchaser Locomotive Renovation at Bombardier, Telephone interview 1st October
Mikael Berzelius, Locomotive Designer at Banverket Örebro, Telephone interview 1st October
Sven-Olof Palm, Quality Manager for Electrical Components at Forsmark, Telephone interview 1st October
Ted Lundin, Maintenance Manager at Forsmark, Telephone interview 1st October
**Stefan Johansson**, System Designer at *Vattenfall Service Syd*, Telephone interview 1st October

**Jan-Erik Kruslock**, System Tester at *Vattenfall Service Syd*, Telephone interview 1st October

**Mikael Häggmark**, Projection Manager at *Jämtkraft*, Telephone interview 2nd October
## Appendix I – IPSE Workshop 1-3

<table>
<thead>
<tr>
<th>Workshop 1: State-of-the-art – The current business situation</th>
<th>Workshop 2: SWOT, service mapping, triggers, business logic, customer communication and value arguments</th>
<th>Workshop 3: Plan (IPS) development project</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Topic 1</strong> State-of-the-art analysis: Describe the current situation and position regarding combined hardware-, software- and service offerings in order to be the base for the further business development.</td>
<td><strong>Value chain:</strong> How is it for my company, in different business situations? What is the business logic? Who has the buying power, i.e. the real power over the buying decision? Who has the power in the value chain, how are sales and profit distributed over the actors (firms) in the value chain?</td>
<td><strong>Customer requirements:</strong> How do we collect user and customer and market requirements? Especially environmental requirements and wishes, how do we manage those? What methods could we use?</td>
</tr>
<tr>
<td><strong>Topic 2</strong> Lifecycle analysis: The environmental considerations taken today by the company is analyzed from a lifecycle perspective.</td>
<td><strong>Market communication and arguments:</strong> How can we think in terms of the customer’s customer and the user?</td>
<td><strong>Project method:</strong> How do we plan our development projects today? Is there project methodology available especially adapted for integrated product and service concepts? How can we integrate different competencies and maybe customers and suppliers in the development work (IPD, CPD)? What IT support do we use, what do we need?</td>
</tr>
</tbody>
</table>
| **Topic 3** Selling: How do we sell today, what could we do differently? What are we selling today – what are we paid for, and what are the key selling points? | **Contract:** How should we design our contracts, as a consequence of the business logic we want to achieve? How can we avoid traps and risks, what should be considered, what should we change? | **Homework** - Anayze and improve the selling process. | **Result** - Map over stakeholders in the offer – the customer and its customers, suppliers and other involved parts  
- Securing how customer requirements and other requirements (e.g. environmental) are captured and spread within the organization  
- New aspects to be recognized in the contract with the customer  
- Awareness that the company’s position in the value chain can change if the company move in a certain direction  
- Support for development of new offers, methodology, project support |

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116
## Appendix II – Mapping a Profit Pool

### Mapping a Profit Pool

<table>
<thead>
<tr>
<th>Step 1</th>
<th>Step 2</th>
<th>Step 3</th>
<th>Step 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Define the pool</td>
<td>Determine the size of the pool</td>
<td>Determine the distribution of profits</td>
<td>Reconcile the estimates</td>
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</tbody>
</table>

### TASK
- **Step 1**: Define the pool
  - Determine which value-chain activities influence your ability to generate profits now and in the future

- **Step 2**: Determine the size of the pool
  - Develop a baseline estimate of the cumulative profits generated by all profit-pool activities

- **Step 3**: Determine the distribution of profits
  - Develop estimates of the profits generated by each activity

- **Step 4**: Reconcile the estimates
  - Compare the outputs of steps 2 and 3 and, if necessary, reconcile the numbers

### GUIDELINES
- **Take a broad view of the value chain**: Look beyond traditional industry definitions
  - Seek a rough but accurate estimate

- **Examine your industry from three perspectives**: Your own company’s, other players’, and the customer’s
  - Take the easiest analytical routes available; go where the data are
  - Look at your own company’s economics first, then look at large pure players, then at large mixed players, then at a sample of smaller players

- **Talk to industry players and analysts to uncover new or emerging business models**
  - Try to take at least two different views of pool size – for example, company-level and product-level
  - If relevant company data are unavailable, use proxies such as product-level or channel-level sales

- **Don't disaggregate activities more than is necessary**
  - Focus on the largest components – for example, large companies, high-volume products; extrapolate smaller components from a sample
  - Think creatively

### OUTPUT
- **Step 1**: Define the pool
  - List of all value-chain activities in your profit pool (in sequential order)

- **Step 2**: Determine the size of the pool
  - Estimate of total pool profits, usually expressed as a range

- **Step 3**: Determine the distribution of profits
  - Point estimates of profits for each value-chain activity

- **Step 4**: Reconcile the estimates
  - Final estimates of activity and total pool profits

### Source
Appendix III – English Question Guide

Background

1. Basic facts
   a. Number of employees and change during the last years
   b. Turnover and change during the last years
2. General description of the company’s situation
   a. Profitability
   b. Market share
   c. Etc...
3. Shortly describe the existing business area(s)
   a. Who are the customers?
   b. What characteristics do the customers have (size, part of total turnover etc)?
4. Shortly describe the existing offers
5. What are the drivers towards PSS offers?
   a. Defensive
      i. Mature markets
      ii. Threats from low cost countries
      iii. Environmental aspects (legislation, customer requirements or rising resource costs)
      iv. Other
   b. Offensive
      i. Deeper understanding of the customer’s problem
      ii. Creating a complex business model that is difficult to imitate
      iii. Increased profitability
      iv. Create markets
      v. Other
6. Which offer(s) is regarded to have the greatest potential of making a successful PSS offer?

Internal Value Chain

7. Calculate the total costs for each activity using economical data
8. Identify the cost drivers in each activity
   a. What factors can change the cost structure in the activities of the internal value chain?
   b. What trends are there for the cost structure in the activities of the internal value chain?
9. Does the cost in each activity correspond to an equal increase in value (i.e. are the customers prepared to pay for the work done in each activity)?
10. Approximate the cost structure of the chosen offer.
11. What strengths and weaknesses does the company have?
    a. What strengths and weaknesses do the competitors have?
12. What differentiates the providing of the offer compared to the competitors? Take a starting-point in the activities in the internal value chain.
13. What works well and what needs to be improved in the providing of the offer?

Assessment of the Offer
14. What is included in the offer except for the physical product?
   a. Consultation (designing the offer)
   b. Finance
   c. Assembling
   d. Training of operators
   e. Operators during use
   f. Logistics
   g. Consumable goods (lubricants etc.)
   h. Energy
   i. Support (help with problems regarding use of the product)
   j. Maintenance and service
   k. Repair
   l. Take back responsibility after the end of the contract
   m. Other

15. How big proportion of the offer’s total value is made up of each abovementioned activity?

16. Who owns the physical products included in the offer?
   a. The company
   b. The customer/user
   c. Another company (e.g. a leasing firm)

17. To what extent is the physical product adopted to fit the offer?
   a. Not at all (standard product)
   b. Adopted to the offer (modified standard product)
   c. Specifically designed for the PSS offer
   d. Other

18. Categorize the offer along the product-service continuum

19. What strengths and weaknesses does the offer have?
   a. What strengths and weaknesses do the competitors’ offers have?

20. What key selling points does the company use?

**Life Cycle Analysis**

21. (If applicable) How large is the environmental impact of the offer according to the calculations made according to the requirements in ISO 14000?

22. How is the environmental impact of the offer distributed along the different phases of the life cycle?
   Distribute 100 points over the following phases:
   a. Material production (processes: production and recycling technologies) _______
   b. Manufacturing (processes: manufacturing and assembly) _______
   c. Transport (processes: transport and packaging) _______
   d. Use and product recycling (processes: function, maintenance and remanufacturing) _______
   e. Material recycling and disposal (processes: reprocessing, treatment, disposal) _______

23. Can any unnecessary waste that can be affected by the company be identified?
24. Would it be possible to save resources (at the customer or in the company’s own processes) if the customer would use the product in another way?
25. What are the company’s commitments when the customer is using the product?
26. In general, what is the life expectancy for the physical products included in the offer?

**Customer needs and perceptions**

27. Try to figure out who in the customer’s organization has the real power over the purchasing decision.
28. Ask what needs the customer currently has regarding the activities that the existing offer carry out.
29. Anticipative Customer Requirements Analysis (ACRA):
   a. Analyze the customer’s processes in which our offer is used, as well as the phases before and after.
      i. Create a flow chart
      ii. Identify critical problems in the customer’s processes
      iii. How is our product really used and what are the customers’ real needs?
   b. What are the customer’s values?
   c. Mirror the customer’s processes with its values; identify gaps.
      i. Are there process steps where the customer’s values are not met?
      ii. Are there any values that today are not addressed in the process, but that would be able to address by offering new services?
30. Market-Perceived Quality Profile:
   a. Ask customers in the market to list the factors that are important in their purchasing decisions. Both customers and, if applicable, competitors’ customers should be regarded.
   b. Ask the interviewed customers to describe how the different quality attributes are weighted in their purchasing process by letting the interviewees to distribute 100 points over the selected factors.
   c. Ask the customers to rate the performance of each competing company’s offer on each competing factor (e.g. on a scale of 1 to 10).
   d. Multiply each company’s score with the weight of the factors, which add up to an overall customer satisfaction score.

**Five forces**

31. Who are the competitors to the offer?
   a. How intense is the industry rivalry?
32. What are the substitutes to the offer?
   a. How big is the threat from the substitutes to the offer?
33. How big is the threat from the potential entrants to the offer?

**Profit Pool**

34. Define the pool
   a. Which value-chain activities influence the company’s ability to generate profits now and in the future?
35. Determine the size of the pool
a. What is the total combined revenue generated by the company and the other actors in the value chain?
b. What is the total combined profit generated by the company and the other actors in the value chain?

36. Determine the distribution of profits
   a. What revenue is generated by each activity in the value chain?
   b. What profit is generated by each activity in the value chain?

37. Reconcile the estimates
   a. Do step 2 and step 3 generate the same result?

**Network**

38. What actors are involved in providing the current offer?
   a. Map the network

39. How does each actor contribute to the offer?

40. What capabilities does each actor have?
   a. What is the strength and weaknesses of the each actor?

41. How is the power distributed within the network?

42. What is the role of the company?

43. Does our company have “latent” relations with other suitable actors?
   a. What capabilities do these actors have?

44. Has our company gained business contacts through actors in the network?
   a. In that case, is it a specific actor who has given us business opportunities?
Appendix IV – Swedish Question Guide

**Bakgrund**

1. Basfakta
   a. Antalet anställda (förändring under de senaste åren)
   b. Omsättning (förändring under de senaste åren)
2. Allmän beskrivning av företagets situation
   a. Lönsamhet (förändring under de senaste åren)
   b. Marknadsandel
   c. Etc...
3. Beskriv kortfattat de affärsområden som företaget har idag
   a. Vilka kunder finns det?
   b. Vad har kunderna för karaktäristik?
4. Beskriv kortfattat vilka erbjudanden företaget har idag
5. Motiv för förändring
   a. Defensiva
      i. Mogna marknader
      ii. Hot från lågkostnadsländer
      iii. Miljöaspekter (lagar, kundkrav eller ökade råvarukostnader )
      iv. Annat
   b. Offensiva
      i. Bättre förståelse för kundens problem
      ii. Skapa en komplex affärsmodell som är svårkopierad
      iii. Ökad lönsamhet
      iv. Skapa nya marknader
      v. Annat
6. Vilket/vilka erbjudanden anses ha störst potential att utgöra ett framgångsrikt PSS-erbjudande?

**Intern värdekedja**

7. Utifrån ekonomisk data, ta fram de totala kostnaderna för varje aktivitet.
8. Ta reda på kostnadsdrivarna i varje aktivitet.
    a. Vilka faktorer kan förändra kostnadsstrukturen i värdekedjans aktiviteter?
    b. Vilka trender finns det för kostnadsstrukturen i värdekedjans aktiviteter?
9. Motsvaras kostnaden i varje aktivitet av en motsvarande värdeökning (dvs är kunderna beredda att betala för det arbete som utförs i varje aktivitet)?
10. Uppskatta kostnadsstrukturen för det valda erbjudandet.
11. Vilka styrkor och svagheter har företaget?
    a. Vilka styrkor och svagheter har konkurrenterna?
12. Utgående från aktiviteterna i värdekedjan, vad skiljer företaget från konkurrenterna i tillhandahållandet av erbjudandet?
13. Vad fungerar bra och vad fungerar mindre bra i tillhandahållandet av erbjudandet?

**Utvärdering av erbjudandet**
14. Vad inkluderas i erbjudandet utöver den fysiska produkten?
   a. Konsultering (utformning av erbjudande)
   b. Finansiering
   c. Montering
   d. Träning av operatörer
   e. Operatörer under användning.
   f. Logistik
   g. Förbrukningsprodukter, t.ex. oljor, tonerpulver, tvättmedel.
   h. Energianvändning
   i. Support (hjälp vid problem med användande av produkten)
   j. Underhåll och service
   k. Reparationer
   l. Ansvar för produktomhändertagande efter kontraktets slut.
   m. Annat

15. Hur stor andel av erbjudandets totala värde utgör respektive ovan valda aktiviteter?
16. Vem äger de fysiska produktarna som är inkluderade i erbjudandet?
   a. Företag
   b. Kunden/Användaren
   c. Ett annat företag (exempelvis ett leasingföretag)

17. Till vilken grad är den fysiska produkten utformad för att passa erbjudandet?
   a. Inte alls (standardprodukt)
   b. Anpassad till erbjudandet (modifierad standardprodukt)
   c. Specifikt designad för PSS-erbjudandet
   d. Annat

18. Placera in erbjudandet på produkt-service-kontinuumet

19. Vilka styrkor och svagheter har erbjudandet?
    a. Vilka styrkor och svagheter har konkurrenternas erbjudande?

20. Vilka key selling points använder företaget?

Livscykelanalys

21. (Om tillämpbart) Hur stor miljöpåverkan har erbjudandet enligt de beräkningar som gjorts enligt kraven i ISO 14000?
22. Hur stor del av erbjudandets miljöpåverkan uppstår i de olika delarna av livscykeln? Fördela procentuellt över följande delar:
    a. Materialproduktion (processer: produktions- och materialteknologier)
       __________% 
    b. Tillverkning (processer: tillverkning och montering)
       __________% 
    c. Transport (processer: transport och emballering)
       __________%
d. Användning och produktåteranvändning (processer: funktion, underhåll och återtillverkning) 
   ________%

e. Materialåtervinning och avyttring (processer: återvinning, behandling, avyttring) 
   ________% 

23. Finns det steg med onödigt slöseri som företaget kan påverka?
24. Skulle resurser kunna sparas genom att kunden använder produkten på ett annat sätt (hos kund 
   eller hos företaget)?
25. Vad har företaget för åtaganden när kunden använder produkten?
26. Generellt, hur lång livslängd har de fysiska produkterna som är inkluderade i erbjudandet?

Kundkrav och kundens uppfattning

27. Försök reda ut vem i kundens organisation som har den verkliga makten över köpbeslutet.
28. Fråga vilka behov kunden har i dagsläget rörande de aktiviteter som den befintliga produkten ska 
   utföra.
29. Anticipative Customer Requirements Analysis (ACRA):
   a. Analysera kundens processer i vilka vårt erbjudande används, samt de processer som 
      föregår och efterträder dessa processer.
      i. Gör ett flödesschema.
      ii. Identifiera kritiska problem som kunden har.
      iii. Hur används vår produkt och vilka behov har kunden egentligen?
   b. Vilka värderingar har kunden?
   c. Spegla kundens processer med dess värderingar; identifiera gap.
      i. Finns processteg där kundens värderingar inte uppnås?
      ii. Finns värderingar som idag inte adresseras i processen som skulle kunna göra 
          det genom nya serviceerbjudanden?
30. Market-Perceived Quality Profile:
   a. Be kunder lista de faktorer som är viktiga i deras inköpsbeslut (både egna kunder och 
      konkurrenters kunder ska tillfrågas om möjligt)
   b. Be de intervjuade kunderna att beskriva hur de olika kvalitetsattributen är viktade i deras 
      inköpsprocess (låt dem fördela 100 poäng över de valda faktorerna).
   c. Be kunderna att klassa varje konkurrerande företags erbjudande på en skala från 1 till 10 för 
      respektive kvalitetsattribut.
   d. Multiplifiera ihop varje företags poäng från föregående steg med vikterna från steg b, vilket 
      ger en övergripande kundnöjdhetspoäng.

Five forces

31. Vilka är konkurrenterna?
   a. Hur intensiv är industriirivaliteten?
32. Vilka är substituten till erbjudandet?
   a. Hur stort hot utgör substituten på erbjudandet?
33. Hur stort är hotet för nya aktörer på marknaden?
**Profit Pool**

34. Definiera poolen
   a. Vilka aktiviteter i värdekedjan påverkar företagets möjlighet att generera vinst nu och i framtiden?

35. Uppskatta storleken på poolen
   a. Hur stor omsättning genererar företaget och de andra aktörerna i värdekedjan tillsammans?
   b. Hur mycket vinst genererar företaget och de andra aktörerna i värdekedjan tillsammans?

36. Uppskatta andelen av vinst i varje aktivitet
   a. Hur stor omsättning genererar varje aktivitet i värdekedjan?
   b. Hur stor vinst har varje aktivitet i värdekedjan?

37. Gå igenom resultatet
   a. Ger steg 2 och steg 3 liknande resultat?

**Nätverk**

38. Vilka aktörer är inblandade i att leverera det aktuella erbjudandet?
   a. Rita upp nätverket

39. Vad bidrar respektive aktör med till erbjudandet?

40. Vilka förmågor har respektive aktör?
   a. Vilka styrkor och svagheter har respektive aktör?

41. Hur ser maktfördelningen ut i närverket?

42. Vilken roll har företaget?

43. Har företaget tidigare ”vilande” kontakter med bra samarbetspartners?
   a. Vilka förmågor har i sådana fall dessa?

44. Har företaget fått affärsmöjligheter via kontakter i nätverket tidigare?
   a. Är det i sådana fall en specifik aktör som gett företaget affärsmöjligheter?
Appendix V – MJP

*MJP Marine Jet Power (MJP)* is located in Österbybruk (a small village around 100 km north of Stockholm) and designs, manufactures and markets waterjets that are used for propulsion of fast-going boats larger than 15 meters. This appendix will give a description of MJP and its offer, as well as the market and business context.

1.1 History

MJP was founded in 1986 when the two Swedish companies Marinteknik Shipyard in Öregrund and Österby Gjuteri decided to develop and produce waterjets in a joint venture. The first waterjets were delivered in 1987 to the Cinderella boats that are still operating in the Swedish archipelago. During the first years jets were primarily sold to the Marinteknik Shipyard, but in 1993 Marinteknik declared bankruptcy. MJP was then forced to look elsewhere for customers and succeeded to get a break-through order from the Swedish Coast Guard, which became very important as a reference project for future customers in this segment. In 2007 Österby Gjuteri was acquired by the investment company Termoregulator Holding, which owns TermoRegulator (a subcontractor company in the sheet metal industry). The takeover led to a name change to Österby Marine and a separation of Österby Gjuteri, MJP and Alcopropeller (a grinding company specializing mainly on propellers) into independent business units. At the same time Patrik Modig was hired as CEO for MJP. The important dates in the history of MJP are summarized in Table 1-1.

Table 1-1 Important dates in the History of MJP

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1986</td>
<td>MJP founded as joint venture between Österby Gjuteri and Marinteknik Öregrund</td>
</tr>
<tr>
<td>1987</td>
<td>First delivery to Cinderella, a commercial ship operating in the archipelago of Stockholm</td>
</tr>
<tr>
<td>1989</td>
<td>First delivery to a yacht</td>
</tr>
<tr>
<td>1991</td>
<td>First delivery to a navy boat</td>
</tr>
<tr>
<td>1993</td>
<td>Marinteknik Öregrund declared bankruptcy</td>
</tr>
<tr>
<td></td>
<td>The Swedish Coast Guard put orders on 10 waterjet sets for patrol boats</td>
</tr>
<tr>
<td>2007</td>
<td>Termoregulator Holding) acquired Österby Gjuteri</td>
</tr>
<tr>
<td></td>
<td>Österby Marine is founded, in which MJP becomes a business unit</td>
</tr>
<tr>
<td></td>
<td>Patrik Modig is hired as CEO for MJP</td>
</tr>
<tr>
<td>2008</td>
<td>Termoregulator Holding changes name to Capilon</td>
</tr>
</tbody>
</table>

The company structure is illustrated in Figure 1-1.

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21 The product and the offer are described more in detail in chapter 1.3.
Although MJP is part of a larger company group – Capilon has 286 employees and an annual turnover of around 500 million SEK – MJP is operated as an independent company. MJP’s turnover for the fiscal year 2007 was around 120 million SEK with an EBIT\(^{22}\) of 3 million SEK. The reason for the low profit margin is delivery problems mainly caused by shortage of castings delivered by Österby Gjuteri, which in turn not only limits the growth of MJP but also implies increased costs for express deliveries, customer delay penalties etc. Meanwhile MJP is not allowed by the parent company to purchase casting components from other suppliers than Österby Gjuteri and the two are supposed to have a strictly professional buyer-seller relation (it should be noted that the two business units are located in the same building). This situation has gotten even worse during 2008, since an increased demand for MJP’s products has not been matched by a similar increase in production capacity, resulting in an average delay in delivery of 4-6 months in general for the order stock. A management initiative aiming at improved productivity in the foundry in combination with large investments in new production machinery will hopefully result in decreased delays for the time coming.

During the years, a number of sales and service agents have been engaged around the world, while MJP has kept its entire organization in Österby. However, at the moment of writing MJP is planning to set up a sales office in Singapore in order to get a closer contact with the market. This office will later on, if desirable and feasible, include a service unit.

1.2 Organization

MJP has 14 employees. The low number of employees relative to the turnover is explained by the simple fact that the only production performed by the company is assembly of purchased components. The organization is divided into the four areas market, project, after sales and design, which is illustrated in the organization chart in Figure 1-2.

\(^{22}\) Earnings Before Interest and Taxes
The after-sales manager Hans Lindgren has until recently been the only person working with after sales, but has now got assistance from Hartmut Bergström that will take over some of the daily activities such as shipping and parts of the order administration. Hopefully this will disengage time for Hans Lindgren to work with development of the after-sales area on a more strategic level.

Another interesting aspect about the organization is the service manager Mikael Näsström, who has been working with service of MJP’s waterjets since the start 1987. In practice he is not working as a manager, but rather as a guru, even though that title did not seem appropriate for the organization chart. He is also known as a true guru among the customers and most of them call him as soon as problems arise. Mikael’s extensive knowledge about the products (both the hardware and control systems) means that many of the problems can be solved by telephone support, but he still spend a major part of his time traveling around the world to help customers. To be more precisely, Mikael has more than 200 travel days a year (a normal working year in Sweden contains less than 240 working days).

1.3 The Offer
Waterjets are used in various applications of watercrafts where high ship speed is wanted. As a rule of thumb, waterjets are more efficient than traditional propellers from around 25 knots and upwards. There are also other benefits with waterjets compared to traditional propellers, such as low vibrations, protected propulsion, superior maneuverability and low waterborne noise. MJP’s waterjets are suitable for boats from 15 meters in length and with an engine power of 500-15 000 kW per waterjet unit.
The offer can be divided into six primary components, whereof five are always included and one is included upon request. This is illustrated in Figure 1-3, where the optional components are marked with a dashed line around a white square.

1.3.1 Calculations for Configuration
In the tender stage of the sales process MJP uses a partner specialized in hydrodynamics for calculations of what configurations of waterjets to use in order to reach the requested performance for the specific ship hull. By doing this MJP can in some cases also recommend the customer to use another engine configuration than intended, if the calculations show that MJP’s waterjets due to higher efficiency than what the customer used in the calculation of engine configuration show that less power is needed. This service can save a lot of money for the customer, since the engine is by far the most expensive component on a ship (usually around 35 percent of the building cost, while the waterjets usually make up for less than 5 percent). At this stage the intake is also designed by the same partner in order to reach maximum efficiency from the waterjet. MJP has recently released a designer’s guide in order to support the customers in their choice of waterjet setup.

1.3.2 Waterjet
The waterjet always includes the pump and steering unit, as well as the hydraulic components, while the intermediate shaft arrangement and intake are optional features. All these components are displayed in Figure 1-4, as well as the impeller and the hub unit (these are subcomponents of the pump unit and distinguished with red lines).
The function of a waterjet unit is to create thrust by shooting a stream of water through a nozzle that can also change the direction of the stream in order to steer the boat (there are also waterjet units without a steering unit on the nozzle, called “boosters”). Water is sucked through the intake, propelled by the impeller and then let out through the nozzle. Figure 1-4 shows the waterjet in three different views. The first view shows a cross section that illustrates how the different components are related to each other, as well as the relation to the gearbox and engine. The second view is showing two waterjets mounted in a large boat, which illustrates the placement of the waterjets as well as their size (each waterjet weigh 1 couple of tons). The third view shows an intake and a pump unit that has been separated to reveal the inside of the pump unit (mainly the impeller is visible though). What is marked as “hydraulics” in Figure 1-4 is only the hydraulic cylinders, which is just a part of the hydraulic system that is supplied by MJP (consisting of a system of pumps, valves, pipes, hoses etc.).

The pump unit is the most expensive and complex component, since it consists of many parts that has to be manufactured with very tight tolerances and with extreme durability requirements. The pump unit is made of duplex stainless steel, as opposed to some competitors that uses aluminum. MJP has got two patents regarding the design of the pump unit, whereof one expired 2007. The expired patent allowed MJP’s waterjets to be manufactured with tighter tolerances\(^\text{23}\) resulting in higher efficiency (i.e. better performance and lower fuel economy) than competitors. This design will now be copied of the main competitor. The second patent, which will last for another 9 years, means that most parts\(^\text{24}\) of the waterjet is possible to change from the outlet side (from “behind” the boat). This makes MJP’s waterjets

\(^{23}\) Tighter tolerances between the impeller and the housing can be achieved due to a flexible coupling allowing some flex in the drive shaft alignment.

\(^{24}\) The hub unit containing the coupling and several bearings and seals are changeable from outside the boat.
easier to maintain than the competitors’ waterjets, and also makes it possible to change vital parts with the boat still in the water.

The intake is most often designed by a partner of MJP in order to get an optimal flow into the pump unit, but it is most commonly built by the shipyard. When the intake is supplied by MJP, it is manufactured by a subcontractor. Also the intermediate shaft arrangement is optional, since it can be provided by the gearbox or engine manufacturer.

1.3.3 Control system
The control system is optional, but it is practice in the marine industry that the waterjet supplier also delivers the control system for the entire boat, since the steering (which is handled by the waterjets) is the most complex part of the system. Waterjets offer the possibility of vector controlled steering, which is not possible with ordinary propellers (even though it should be noted that Volvo Penta’s new revolutionary IPS propeller system offers this feature). The control system consists of a number of sensors, electrical circuit boards, CPUs and the whole control panel (not including the steering wheels on luxury yachts for esthetical reasons). Both the hardware and software are supplied by an external supplier and delivered to the customer as a plug-and-play kit (the plugging may take some time though, since there is a lot of wiring to do).

A new control system is being designed that will contain a modem used for remote diagnosing of the system. An interesting aspect is that it is possible to develop this system to communicate with the logging system of the boat, meaning that running-hours etc. can be monitored on remote.

1.3.4 Documentation
Each waterjet set is supplied with an extensive documentation that is required for classification as well as for the customers to be able to service the system.

1.3.5 Training of Service Personnel
Before a waterjet set is delivered, the customer is invited to MJP’s plant for a free five-day education on how to operate and service the system. The education includes both the theoretical and practical parts and is addressed mainly to service personnel.

1.3.6 Support and Warranty
Free support is always included, which can be gained both from service agents and MJP. A one-year warranty (from the launch of the boat) is always included and if the customer requires it an extended warranty can be offered, usually two years. This is naturally done at an added price, around 3 percent of the total price for an extra year, even though this added price is not disclosed for the customer.

1.3.7 After Sales
The after sales activities include service and spare parts. The service does not differ from the one included in the warranty, other than that it is performed at a cost for the customer. The spare parts are only sold by orders from service agents or customers; there are no type of spare part supply contracts. After sales only make up for around 10 percent of MJP’s turnover, but contribute to half of the total profit. A growing installed base (a total of 565 units have been delivered up until 2008) gives

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25 Vector controlled steering means that the captain can operate the boat with a joystick, while a computer calculates how to (individually) control the jets to reach a desired movement. For example this means that the boat easily can be moved sideways in a harbor.
prerequisites for an expansion of the after sales business. For instance, Rolls-Royce Marine – that include MJP’s main competitor Kamewa Waterjets – has service revenues of 35 percent of its total turnover.\textsuperscript{26}

Except for pure standard components, the wear parts are usually based on standard components that have been modified to suit MJP’s needs. However, the reason for modifying the standard components (such as roller bearings available in a wide range of standard dimensions and shapes) is not mainly because the waterjet design would be difficult to adapt to standard products. The modifications are rather viewed as a way to force customers to buy “original” spare parts from MJP, resulting in a possibility to gain high profit margins on spare parts. The drawbacks of this strategy are more expensive components, longer lead times and a dependency of the chosen suppliers.

1.4 Product Life Cycle

Since MJP is not certified according to ISO 14000 and has no staff dedicated to environmental issues, no calculations of the environmental impact of the offer have been conducted. It was therefore not possible for us to receive any figures concerning how the environmental impact is distributed along the different phases of the product life cycle. However, by discussing the subject with the quality manager, who has insight in the environmental issues, we got a conceptual overview of the environmental impact through the product life cycle.

As the waterjets are used as a component in a system with the main part of its environmental impact in the use phase, we decided to make a holistic life cycle assessment on a system level in addition to the one carried out on product level. This highlighted where the real potential of real environmental savings can be made. The output from the conceptual life cycle analysis is illustrated in Figure 1-5.

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{figure1-5.png}
\caption{Conceptual distribution of the environmental impact of MJP’s offer at a product level and the distribution of the environmental impact at system level.}
\end{figure}

It should be observed that the absolute level of environmental impact is not displayed in Figure 5-5, just the distribution between the different phases; obviously the environmental impact at system level (i.e. including the engine and gearbox) is much higher than at product level where only the waterjet is regarded.

\textsuperscript{26} Rolls-Royce Group Ltd., Annual Report 2007
At the product level, the highest environmental impact is in the first two phases. The waterjets are made of stainless steel, which requires an energy demanding process to produce. When the stainless steel arrives at the foundry in the form of ingots and/or scrap it is melted in the casting process, which requires much energy. Also the painting of the waterjets requires much use of chemicals, resulting in a high environmental impact.

There is also a substantial part of transportation involved at the product level. All the components used in the waterjets are transported to MJP at Österbybruk, where the waterjet is assembled and then transported to a shipyard somewhere in the world. This environmental impact of transportation is however regarded to be lower than the first two phases.

The waterjet itself is a non-active product, and it is the engine that will consume energy. Therefore the use phase of the waterjet will not have a high environmental impact other than lubrication products and wear parts. Recycling the waterjet means re-melting to stainless steel, a process that requires some energy but not as much as the material production.

The highest environmental saving potential is found in the use phase of the system. MJP’s waterjets can contribute to this environmental saving by developing waterjets with as high efficiency as possible (and consequently lower fuel consumption).

What can be done by MJP to reduce environmental impact – that does not regard the design of the physical product – is to help the customers chose the optimal set of engine and waterjet size for a desired performance for the specific boat. By using a smaller engine size substantial environmental savings can be achieved during the use phase of a propulsion system. This service is already included in MJP’s offer.

The lifetime of the waterjets is not known yet, since the company is only 20 years old and the first delivered waterjets are still in use on the Cinderella boats that are still operating in the Swedish archipelago. The Swedish Coast Guard expects the waterjets to last the whole lifetime of their boats, which is at least 25-30 years.

1.5 Suppliers and Business Network
The actors involved in supplying MJP’s waterjets and spare parts are mapped in Figure 1-6 on next page.
MJP has a close mutual cooperation with a handful of the actors involved in supplying the waterjets, in Figure 1-6 referred to as the strategic partners. These are briefly described below:

- **MTD (Marine Technology Development Ltd.)** is a St. Petersburg-based company specialized in designing advanced high performance marine craft, with high competence in hydrodynamics simulation and calculation. MJP has a long history of cooperation with MTD and a cooperation agreement has been settled regarding day-by-day calculations as well as product development. The former is used in order to quote the best configuration of existing waterjets to the customers as well as intake design, while the latter is a prerequisite for the development of more efficient waterjet models. MTD is also working as one of MJP’s sales agents, which in practice means that the company often designs vessels to be fitted with waterjets from MJP.

- **AWT (Andersson Wahlström Technic AB)** is a small firm that develops and manufactures the control systems that are included in MJP’s offer towards the customers. Every control system is tailor made for each vessel, which requires a close cooperation between MJP and AWT. MJP is by far AWT’s largest customer, constituting for about 90% of the company’s turnover.

- **CPAC Systems AB** is a fast-growing Volvo-owned company whose core business is control systems for Volvo Penta. MJP has initiated a cooperation with CPAC Systems regarding new hardware components for control systems (which includes e.g. wiring, computers and joysticks). The reason for this initiative is that the present HW Component named CONTRON will go out of production shortly forcing MJP and AWT to make a generation change of the control system. A decision was made to cooperate with C-PAC for a new system based on Volvo Penta Components. AWT provide the application knowledge and will continue to assemble complete systems for MJP with C-PAC as supplier of the new system platform including HW. First test runs in a delivery project to end-customer is conducted in October-November 2008. Compared to the current system, the new control system will be cheaper, faster, more standardized as well as easier to configure and repair.
- Österby Gjuteri AB is, as previously described, the foundry that supplies MJP with all casting components. The components are machined and ready to assemble when delivered to MJP. The majority of the parts in the pump units are delivered by Österby Gjuteri.

- MTU is a leading supplier of marine diesel engines and is by far the most common engine to be used with MJP waterjets. MTU offers complete packages for propulsion with propellers, but not (yet) for propulsion with waterjets. MJP does not have a strategic partnership with MTU at the time of writing (hence the dashed square in Figure 1-6), but discussions about cooperation have been held during a handful of meetings between the two companies. So far MTU recommends MJP waterjets to be used with its engines in some of its marketing brochures, and MJP recommends MTU engines when talking to its customers. It should be noted here that since MTU competes with Rolls-Royce on the engine side, it is not likely that the two companies will form a strategic partnership regarding propulsion packages (even though it is in practice not unusual that MTU engines are used with Kamewa waterjets, much due to that there are agents that represent the both companies).

In addition to the strategic partners, a number of suppliers have developed tailor made components for MJP’s waterjets, which means that these suppliers are not easily interchangeable with other suppliers on the market. In Figure 1-6 these suppliers are referred to as exclusive suppliers. The components are usually based on standard components that have been modified to suit MJP’s needs, as discussed in chapter 1.3. In addition to the exclusive suppliers of tailor made components, there are a number of other suppliers of simple standard components.

MJP has around 25 agents, whereof many are a combination of sales and service agents. There are however a number of agents that are dedicated to either sales or service. The sales agents work on commission – usually around 5 percent of the total sales price – which is paid after delivery. The sales agents are not exclusively dedicated to MJP, since the volume of sold waterjets is too low to provide sufficient income for the agents. In addition to waterjets the agents usually sell products such as gearboxes or propellers, which mean that they usually have a good contact with both ship builders and end users. Some agents can even offer packages including the whole propulsion system (engine, gearbox, waterjet and control system).

The service agents have various backgrounds, such as gearbox or hydraulics specialists, but they all have an established business with previous customers within marine service. The target is to be able to provide local and quick service to the customer regardless location in the world. MJP has also got agreements with a handful of freelancing service resources that are able to travel all over the world to support Michael in his work with customer service. There is a big difference in how competent the service agents are on servicing and repairing MJP’s waterjets. Some can only carry out basic service, while other have very good workshops and can service and repair the whole system (hydraulics, pump and control system). This variation is problematic for MJP, since it makes it difficult to guarantee an even service level to all customers. Situations that cannot be handled by the service agents must solved by MJP’s own personnel, which is the reason that the service manager Michael Näsström has to travel to 27

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27 The Maritune System Package, including engine, gearbox, hydraulics, propeller and surface drive, intermediate shaft arrangement and remote control. For more information, visit http://www.mtu-dononline.com/mtu/en/produ/prodmari/prodmariever.
the high extent he is doing. In addition, the poor competence of some service agents is one major reason for the vast number of support calls to Näsström (as described in chapter 1.2).

1.6 Customers
MJP sells to three different market segments, namely Navy/Coast Guard (from now on referred to as Navy/CG), Yacht and Commercial. Since 2003 the sales has been dominated by the Navy/CG segment, which can be seen in Figure 1-7.

![Number of waterjet sets delivered by MJP per year and business segment 1987-2007 (number of vessels)](image)

**Figure 1-7.** Number of waterjet sets delivered to each market segment since the start in 1987.

The sales process is largely similar for all customer segments. The sales agents are searching for business opportunities through their contacts with end users, designers and shipyards. There are however a number of different sales situations depending on business segment and what actor designs the vessel. In order to understand the customer segments characteristics, a brief description of the three segments will follow.

1.6.1 Navy/CG
The Navy/CG segment is, as earlier stated, the largest segment for MJP. MJP has delivered waterjets to e.g. the Swedish, Sri Lankan and Turkish Coast Guard. A typical boat for this segment is shown in Figure 1-8.

![A 29 meter, 49-55 knot patrol craft for the Turkish coast guard (built by Yonca-Onuk, MJP’s agent in Turkey).](image)
The boats in this segment are most often designed and built by shipyards located in the same country as the end customer (navies and coast guards, usually under direct control of governments). Most of the countries that MJP are selling to – including e.g. all EU members, Hong Kong, Korea and Singapore – are parties of WTO’s Agreement on Government Procurement (GPA), which means that they are bound to publically announce intended investments in new marine crafts. However, since investments in military gear are not necessarily covered by the GPA act\textsuperscript{28}, and coast guards in many countries are subordinated the military navy, public tendering procedures are not as common as one might think. This makes the role of the sales agents even more important, since good contacts within governments and among the shipyards that design the vessels are vital.

The buyer usually has a high technical competence and often different options are carefully evaluated. Reference projects from different manufacturers are important and it is common that the buyer visits several earlier customers to evaluate the waterjets in real life. This implies that a well-renowned brand is less important than proved performance for Navy/CG customers, which might explain MJP’s success in this segment.

A typical user and good reference customer for this segment is the Swedish Coast Guard (SCG), that has been operating ten patrol boats with MJP waterjets since 1995. Each boat is used on 2-3 patrol rounds each week with a total running-time of up to 12-13 hours a round, resulting in an average running-time of 600-1000 hours per year. The reliability of the boats is very important. A yearly maintenance and overhaul is conducted during 4-5 days in dry dock and every five years a major service is conducted during 3-4 weeks. The service is done by independent shipyards that are contracted by SCG. However, this service mainly concerns the engines and hull; there is no schedule scheme for the waterjets and no proactive maintenance is being conducted, despite that MJP often is often hired by the shipyards to repair the waterjets when problems arise. Consequently SCG does not stock any spare parts for the waterjets. The Swedish Navy keeps a small stock of some spare parts, although it mainly services its vessels in the same way as SCG. Despite the lack of service, SCG has encountered no major problems\textsuperscript{29} of the waterjets. SCG counts on the waterjets to last the whole life cycle of the boat, which is expected to be 25-30 years.

The purchasing criteria in the Navy/CG segment can of course vary for different applications, but based on interviews with SCG and the manager of the Turkish shipyard Yonca-Onuk that designs high-performance boats for this segment the following aspects are the most important:

- Performance
- Durability
- Reliability
- Life cycle cost
- Service

The criteria listed above are not ranked among them, since the preferences can differ depending on application. It should also be noted that the purchasing price is included in the life cycle cost, but that

\textsuperscript{28} For more detailed information, visit http://www.wto.org/english/tratop_e/gproc_e/gpa_overview_e.htm .

\textsuperscript{29} Problems that have been encountered have been related to the control system and cracking sacrificial anodes. The latter can probably easily be helped by redesigning the sacrificial anode as two small pieces instead of one large, but MJP has not got this feedback from SCG despite that the boats have been in service for more than ten years.
the purchasing price itself will be the most important criterion in a public procurement process (where the offer with the lowest price that fulfills the specified requirements will win the deal).

An interesting fact is that when SCG will purchase waterjets (during fall 2008) to its new patrol boats in the KBV 300-series that will be built the upcoming years, this will not be done separately from the engines and gearboxes; instead all propulsion components will be bought as a complete package. According to the project manager for the new patrol boats, SCG could be interested both in buying service contracts or the function “propulsion” instead of just purchasing the physical products.

1.6.2 Commercial
From being the largest business segment during the nineties, the commercial segment has during recent years become the smallest. The reason for this is probably increased fuel price and stricter environmental legislation, resulting in fewer fast-going ferries being built. A typical boat in this segment is shown in Figure 1-9.

![Figure 1-9. A 39 meter, 42 knot catamaran ferry operating between Southampton and West Cowes in England.](image)

Commercial ferries can have up to 4 500 running hours per year, although some ferries used on season based traffic lines are used only during parts of the year. Some larger shipowners do not operate all their ferries simultaneously, but use some of them as “spare” vessels, meaning that each vessel may be put in dry dock several months a year. More common is however that a ferry is used all year round and put in dry dock only one week a year for overhaul and hull repainting.

Shipowners with more than 5-6 vessels usually have their own service unit that carries out all the service, including the waterjets. If this is the case, MJP is rarely contacted for support or service other than for ordering of spare parts. Furthermore, some service units consider MJP’s original spare parts too expensive and with too long lead times, resulting in a market for piracy parts being manufactured or in some cases that the service units try to order parts directly from MJP’s suppliers (this has happened with e.g. Deep Sea Seals). The problem with long lead times can to some extent be avoided by a proper schedule for preventive maintenance where the parts can be ordered in good time, which is the case in e.g. Hong Kong where the Marine Department regulates preventive a yearly inspection and service of all moving parts. The latter is however very rare elsewhere.

Usually, shipowners operating only a few vessels do not have their own service units and often have poor or non-existing preventive maintenance; the ferries are run until a breakdown occurs. This further enhances the need of short lead times of service and spare parts.
In this business segment both the end customer (i.e. the shipowner) and the designer (most often the shipyard building the boat) can have substantial influence over the purchasing decision, since the detail level on the specifications made by the end user may vary. Some end users specify that they want a certain brand or even specific model of waterjets, but more commonly the customer just requires a certain top speed of the vessel. The latter gives room for the shipbuilder to choose suppliers of the equipment by themselves. Therefore, the purchase criteria will be somewhat different from that in the Navy/CG segment. For the shipyard, low price is more important than low life cycle cost, since the fuel and maintenance costs are paid by the shipowner. Also, performance (to fulfill the specified top speed) and delivery accuracy are important aspects for the shipyard.

The shipowners on the other hand value the life cycle cost more, meaning that durability, reliability, performance, service cost and fuel efficiency are the important aspects. The fuel efficiency is perhaps the most important aspect, since it will have great impact on the running costs of a vessel in commercial use. A problem for MJP is that the shipyard rarely reveals who the ordering shipowner is, meaning that it is difficult to market the offer to the end customer. The only way of doing this is by “figuring out” who the shipowner might be before the shipyard has decided which waterjet supplier to be used.

In summary, the following aspects are the most important when the purchasing decision is made by a shipyard:

- Price
- Performance
- Delivery accuracy

For the shipowner the following aspects are the most important:

- Fuel efficiency
- Durability
- Reliability
- Service cost
- Availability of spare parts and service
- Performance

Even though the commercial segment has stagnated during recent years, upgrades and modernizations of the vessels in use will be needed. The large and ageing installed base implies that this can be a growing future business for MJP.

1.6.3 Yachts

The yacht segment is currently fairly small for MJP, but the company hopes that this segment will grow in the years to come considering the market potential. The yacht industry is dominated by Italy, where 45 percent of all yachts over 80 feet are built (Ando and Soderborg 2007). An even greater share, 80-85 percent of all waterjet-propelled yachts, is built in Italy according to MJP’s estimation. 579 yachts in the size range 24-46 meters (80-150 feet, which is the relevant sizes for waterjet propulsion) were built in 2007 (Ando and Soderborg 2007). Only around 10 percent of these yachts were equipped with waterjets, since the four major waterjet suppliers sold only 50-60 sets to the yacht segment this year. A typical yacht in this segment is shown in Figure 1-10.
Figure 1-10. A 42 meter, 53 knot luxury yacht built by AB Yachts in Italy.

A yacht is usually not operated by the owner, but by a crew that is hired for maintaining the boat and keeping at “standby-mode”. A typical running-time for a yacht is 100-200 hours per year, often even less. This means that there are no parts of the waterjets that has to be changed due to wear for many years and that durability is not a vital purchasing criterion. When the yachts are dry-docked, either over the winter or just a couple of days, the waterjets are inspected but usually there is no service needed. Failures not directly related to wear, such as faulty sensors in the control system, cannot be eliminated by preventive maintenance. In summary the waterjet systems used in yachts are not serviced on a regular basis, although availability is very important for the owners the (few) times they want to use their yachts. When a problem arises, the crew contacts MJP or its agents for reparations.

In the yacht segment, the yacht builders are designing a number of models that the customer can buy “off the shelf”, as opposed to the other segments where most vessels are custom designed. Hence the shipbuilder will choose the equipment and machinery used without the involvement of the end user. Today, MJP has a close connection (initiated by the sales agent) to the yacht builder AB Yacht in Italy and hopes to sell to new customers in this segment in coming years.

The main buying criteria are performance and availability, i.e. that the machinery always works. These criteria are the natural result of the end customers use pattern of the yacht; it is only used a few times a year, but when it is used it must work and go fast. Since the waterjet units are not visible above the surface due to the bathing platform, esthetical design is not an important aspect (as one might believe considering the rest of the yacht). However, the brand can be of high importance – as opposed to the other business segments – as the yacht builders market the specifications to the customers and obviously the brand Rolls-Royce\textsuperscript{30} is better known for most yacht buyers than MJP. Price can be important for some yacht builders while fuel efficiency is not a major issue, since the end customers are obviously not very price sensitive. Hence, the purchasing decision is based on:

- Performance
- Availability
- Brand
- Price

\textsuperscript{30} The yacht builders do not usually use the brand Kamewa for the waterjets.
It should be observed that the relative importance between performance and brand varies depending on the purpose of the yacht. When performance is the most important aspect, the brand is less important and vice versa (in some yachts waterjets are not mainly used for top speed, but rather for comfort).

### 1.7 Competitors

There are four major competitors in the waterjet market, as well as a few very small players. The market leader in the segment 500-15 000 kW is Kamewa with over half the market, followed by MJP, Hamilton Jet and Lips as shown in Figure 1-11.

![Average market share year 2002-2007, 500-15 000 kW](image)

Figure 1-11. Average market share for the major competitors in the waterjet market 2002-2007.

It should be noted that the number of waterjet sets are based on reference lists achieved from the competitors, but there is no obvious reason for them to distort the information. Also, the fact that number of waterjet sets is regarded instead of number of units is a source of error in the estimation of market share, as well as the fact that the price is different among different sizes. The latter may in practice imply that Lips in terms of monetary value has a larger market share than Hamilton Jet.

**Kamewa** is a former Swedish manufacturer of waterjets that was bought by Rolls-Royce in year 2000. As Rolls-Royce is a large supplier of propellers and marine engines, Kamewa complement the propulsion range. Kamewa’s waterjet range is wide and covers engine sizes from 50 kW to 36 000 kW, and the construction is similar to MJP’s with all stainless steel. Even though the formerly patented flexible coupling has been copied by Kamewa lately, the performance has not proved to be fully on pair with MJP’s waterjets according to AB Yacht that has tested all the major brands on the market. Kamewa is however dominating the yacht segment with over 90 percent of the market, where the Rolls-Royce brand – which is promoted more than Kamewa in the marketing used by the yacht builders – seems to be a strong selling point. Interesting aspects are that Rolls-Royce offers not only complete propulsion packages, but also the function of propulsion in a “total-care” contract that guarantees availability.

**Lips** has recently been bought by Wärtsilä, a major competitor to Rolls-Royce in the marine engine and propeller segment. The construction differs from MJP’s in the way that the thrust bearing is located inside the impeller, with just a water-lubricated axial bearing on the outside, which result in lower efficiency as well as inferior durability especially in dirty water. Lips’ product range covers waterjets

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31 No such lists are available from Hamilton Jet, so the figures regarding the sales volume is based on the assumption that one third of the 60 waterjet sets the company delivered during 2007 is in the segment exceeding 500 kW and that Hamilton Jet’s market share has been constant since 2002.
suitable for 500 -25 000 kW and like Kamewa (or Rolls-Royce to be more accurate), Wärtsilä offers different service agreements.

**Hamilton Jet** is a New Zealand company mainly producing smaller waterjets in the range 150-3 000 kW. The pump housings are made of aluminum and the rear bearings are water-lubricated instead of oil-lubricated, making them less durable than MJP’s waterjets. They are however cheaper and the company has been successful on the American market.

### 1.8 Substitutes

The only known substitute for waterjets is propeller propulsion, which is a technology that continuously improves. The earlier mentioned Volvo Penta IPS propeller system, that allows vector controlled steering and has higher efficiency than conventional propellers, can surely be a substitute for small waterjets in the yacht segment. Decreasing demand for high-speed ferries can also imply that propeller propulsion may substitute waterjets in this segment, since waterjets are regarded as abundant below certain top speeds. For very large ships propeller propulsion is the only applicable option.

However, in the Navy/CG segment the unique benefits of waterjets does not seem to meet the same threat from propeller propulsion and neither does larger fast-going yachts.

### 1.9 Potential Entrants

There are high barriers for new entrants to the waterjet market. The R&D costs for a new series of waterjets are high and investments in production are required as well. Since many customers require references from earlier projects it is not easy get a beachhead on the market and furthermore the brand is important to some customers.

The relatively high entry barriers are also indicated by the fact that both Rolls-Royce and Wärtsilä chose to acquire established companies instead of starting new business units in order to enter the waterjet market. However, since Porter argue that this kind of acquisitions should be viewed as new entrants, there is still a possibility for other large companies related to marine propulsion to enter the waterjet market by acquiring one of the remaining stand-alone waterjet manufacturers such as Hamilton Jet, or MJP for that matter.

### 1.10 Waterjet Profit Pool

We defined the profit pool from activities or components starting from the sale of the waterjet set and control system and ending with the user of the boat. In this case the only end user segment generating revenues is the commercial segment, where ticket fees are paid by passengers. It is important to remember that all activities are related to waterjets, which means that the size of the pool is only estimated for ships that are built with waterjets. The identified activities are the following:

- Waterjet sets
- Control systems
- Design houses
- Ship building – Commercial
- Ship building – Yacht
- Ship building – Navy/CG
- Service
- Spare parts
- Upgrades on the control system
- Transport (High speed catamaran service)

The profitability estimations in each activity are mainly based on ratings done by executives at MJP. Since it is difficult to calculate accurate profit margins for each activity, the profitability is only judged on a three-step scale; low, medium and high. The rest of the vital assumptions and calculations are clarified below.

**Waterjet sets**

We have regarded waterjets in the size between 500 and 15 000 kW and the players in that segment are Hamilton, Kamewa, MJP and LIPS. From reference lists we know that Kamewa, MJP and LIPS sold 494 waterjet sets together in the period 2002-2007. We also know the number of waterjet sets that each player sold during that period. Hamilton sold 60 waterjet sets in total 2007 of which we assume one third to the relevant segment.

MJP had total revenues of 122 million SEK in 2007 of which 10 percent was regarding after sales. The remaining 110 million SEK is accounted to the waterjets (including control systems, hydraulics etc). Since we wish to treat control systems separately, we assume that 90 percent of an offer regards the remaining parts of the waterjet (based on MJP’s cost calculation for a typical offer). MJP therefore sells waterjets for 100 million SEK. With this in mind, in combination with the market shares illustrated in chapter 1.7, it is easy to calculate the total revenues for waterjets. The profitability of the waterjets is considered to be low, while the revenues are predicted to increase due to a growing luxury yacht segment.

**Total revenue: 494 Million SEK**
**Trend: Up**
**Profitability: Low**

**Control systems**

The control system makes up for 10 percent of the offer revenues, which is 1/9 of the total revenues for the waterjets. As control systems are needed for every sold waterjet set, the trend for revenues will follow that of waterjets, i.e. upwards. The profitability of control systems is also considered to be low.

**Total revenue: 55 Million SEK**
**Trend: Up**
**Profitability: Low**

**Engine**

According to MJP, an engine makes up for 35 percent of the value of a typical boat, while the waterjet sets constitute for approximately 5 percent of the total value. This implies that the engine revenues are seven times higher than the waterjet sets and control system revenues. The revenues will grow as the number of boats in the yacht segment is increasing. The profitability is assumed to be average.

**Total revenue: 3 850 Million SEK**
**Trend: Up**
**Profitability: Average**
Ship building - Commercial

According to the distribution of sold waterjet sets (during 2002-2007), the commercial segment buys 18 percent of all the waterjet sets. This, in combination with the engine’s share of the value in a complete boat, will give the total revenues of building commercial ships. In recent years the commercial segment has decreased the number of purchased waterjet sets, which indicates that this segment is on decline. The profitability is judged to be low.

Total revenue: 2 000 Million SEK
Trend: Down
Profitability: Low

Ship building - Yachts

The yacht segment buys 36 percent of all the waterjet sets. This in combination with the engine’s share of the value in a complete boat will give the total revenues of building yachts.

Another way of counting is that Kamewa and MJP sold approximately 50 waterjet sets to yachts during 2007, and with an average yacht price of around 80 million SEK the revenues for building yachts can be estimated. The yacht segment has been growing during recent years and with the increasing number of wealthy people in the world the trend in revenues is up. According to shipbuilder Dr. Ekber Onuk the profitability in the yacht segment is high.

Total revenue: 4 000 Million SEK
Trend: Up
Profitability: High

Ship building – Navy/CG

According to the distribution of sold waterjet sets, the Navy/CG segment buys 46 percent of all the waterjet sets. This in combination with the engine’s share of the value in a completed boat will give the total revenues of building Navy/CG ships. The profitability is considered to be low and there is no clear trend in total revenue.

Total revenue: 5 000 Million SEK
Trend: -
Profitability: Low

Design (not including shipyards)

There are only a few design houses for boats worldwide, since most shipyards also design the boats. It is difficult to estimate an accurate figure of the revenues in this segment, but it is clear that this is not a large activity compared to shipyards revenues. However, in order to get a figure we assume that there are ten independent boat designers in the world. If each invoices 10 million SEK per year from boat design projects, the total revenues will be 100 million SEK. The profitability is assumed to be average.

Total revenue: 100 Million SEK
Trend: -
Profitability: Low
Service

We assume that a typical service (we do not separate inspections, maintenance and repairs) of a waterjet set takes about 20 service hours in total, which should be carried out once a year when the boat is dry-docked for an overhaul. Looking at the installed base of waterjets from 1987 and onward the four major brands Kamewa, MJP, Hamilton Jet and Lips has delivered around 1,350 waterjet sets. For simplicity we assume that 1,000 of these are still in use, meaning that they should be serviced in one way or another every year. Furthermore, we assume that price for one service hour is 1,000 SEK. The trend for service is upwards due to the fact of an increasing installed base that requires more service. The profitability of service is high.

Total revenue: 20 Million SEK
Trend: Up
Profitability: High

Spare parts

The total revenue of selling spare parts was 12 million SEK for MJP in 2007, which represents 10 percent of the total revenues of MJP. We believe that this figure is lower than the average for the market, caused by delivery problems and lack of proactive marketing efforts of spare parts. We instead assume that the spare parts market has revenues of about 20 percent of the total waterjet sets revenues. With similar arguments as for service, the spare part market will increase. The profitability is considered to be high.

Total revenue: 110 Million SEK
Trend: Up
Profitability: High

Control System Upgrades

MJP sells upgrades at about 5 percent of the revenues for spare parts and we assume that this figure is the same for the whole industry. However, the aging installed base gives the potential for an increasing number of upgrades. The profitability for upgrades will be considered to be high, since both spare parts (which the new control systems will be sold as) and service have high profitability.

Total revenue: 5 Million SEK
Trend: Up
Profitability: High

Transport (High speed ferries)

Red Funnel is a high speed catamaran service operating in Great Britain that has four catamarans in use. We assume that this is a typical commercial shipowner. An average one-way ticket costs around 100 SEK and we assume that the average number of passengers on each sailing is 100 (two catamarans can take 138 passengers, one catamaran 190 passengers and the last catamaran 275 passengers; the catamarans are however operating almost 24/7 which means that during some hours the number of passengers is probably low). The Red Funnel company makes about 23,000 sailings a year with the catamarans. Based on the incomplete list of high speed catamaran routes listed on Wikipedia we assume that there are about 50 high speed catamaran companies operating in the world. This will give an estimate of the size of the catamaran passenger transport market. The trend for the revenues is sloping downwards, based
on higher fuel costs and the decline in number of commercial high-speed vessels being built. The profitability in this segment is considered to be low.

**Total revenue: 11 500 Million SEK**

**Trend: Down**

**Profitability: Low**

Since the waterjet segment was so small compared to the rest of the industry, we divided the profit pool to a macro and micro level. The output from the profit pool at the macro level, i.e. the waterjet-related industry, is presented in Figure 1-12.

![Figure 1-12. Profit pool of the waterjet-related industry.](image)

The micro level consists only of the components of the waterjet offer as were presented earlier. This profit pool is displayed in Figure 1-13.

![Figure 1-13. Profit pool of the waterjet industry.](image)
Appendix VI – Assalub

Assalub AB is a small Swedish company located in Åtvidaberg (a small village around 50 km southeast of Linköping). Assalub manufactures and markets lubrication products and systems for industrial use. This appendix will give a description of Assalub and its offer, as well as the market and business context.

1.1 History
Assalub started with manufacturing of lubricators back in 1928. Today the company has two product groups; equipment for lubrication handling and industrial lubrication systems. Lubrication is a crucial activity for all roller bearings used in machines. Assalub’s products are mainly used for lubrication of large machines in the process industry (paper mills, steel plants etc) with several thousand bearings. A bearing needs to be greased at regular intervals in order to prevent wear. The lubrication can be done either by grease or oil, depending on the application.

Assalub until recently had a third product group which was an oil management system for automotive workshops. In April 2008 this business was sold as one of the owner wanted to sell his share of the company. This means that the turnover of 55 million SEK 2007 is expected to be reduced to 36 million SEK in 2008. About 30 percent of the turnover is exported directly and another 20 percent is indirect exportation (i.e. through Sweden based distributors).

Assalub has always been driven by technological development and its products are known for their high quality. As an example, Assalub was the first company in the world to introduce a grease meter, and the innovative spirit is something the company continues to strive for. The latest result of this innovative spirit is LubeRight, a patented system that this appendix will focus on. The system is further described in chapter 1.3.

1.2 Organization
Assalub has 36 employees working in eight different areas, as illustrated in the organization chart in Figure 1-1. Pär-Olof Funck was appointed as CEO in 1980 and has had this position until 2008, when he chose to step back and focus on exportation issues. The new CEO is Kim Funck, the son of Pär-Olof Funck, who has worked as a salesman for Assalub since the end of the 1980’s.

In Sweden Assalub relies on its two salespersons (whereof Per-Olof is still considered to be one, but a new salesman will be hired in the near future) that have direct contact with the customers. One salesperson is based in the north of Sweden and the other in the south f Sweden. The sales force is highly competent with long experience in the business. Assalub also uses distributors for sales in Sweden, but distributors are mainly used for exportation.

As can be seen in the organization chart in Figure 1-1, the production unit make up for a large part of the organization, which is explained by the fact that Assalub produces most of the components used in its products. It should be noted however that LubeRight is an exception from the latter, since most of the components for the LubeRight system is purchased. This means that there are no problems for Assalub to increase the sales volumes of LubeRight with the current organization.
1.3 The Offer

Assalub’s latest offer is called LubeRight and is designed to help the maintenance department to keep track on when, where and how much a lubrication point should be lubricated. LubeRight is a patented solution and was introduced five years ago. The system uses RFID\textsuperscript{32} transponders for identification of lubrication points.

The offer consists of three major components; lubrication device, lubrication points and PC software for lubrication management as illustrated in Figure 1-3. The price of LubeRight depends on the number of lubrication points in the system. The initial cost for a LubeRight system is around 60 000 SEK plus 80-300 SEK per nipple (one nipple per lubrication point is needed), depending on the number of nipples in the system. A typical LubeRight system contains a couple of hundred nipples, but hopefully the so far sold systems will gradually be completed with more nipples.

\textsuperscript{32}RFID is an abbreviation for Radio-Frequency Identification, which is a technology that uses a small integrated circuit that is activated when a certain radio frequency is sent to it. One example of RFID technology applied is the LiU access cards that all students at Linköping University have. The card has an embedded integrated circuit and is used for access to certain areas at the University and has a transponder (a MIFARE chip) inside of it which is activated when positioned close to a terminal.
The lubrication device is connected to the software, which keep tracks on the amount of grease that each lubrication point needs. Each lubrication point has a nipple with a transponder, and when the operator connects the lubrication device to the nipple, the transponder indicates to the device which lubrication point it is. The device can then display the exact amount of grease that this lubrication point needs. When the round is performed the device is again connected to the computer and information about which lubrication points that have been greased as well as the amount of grease used is transferred to the software. It is now easy to see if all lubrication points have been greased; the status of each lubrication point is clearly marked with colors and text in the software. The software also keeps track of previous lubrication rounds and amount of grease used at each lubrication point.

The offer also includes services such as education, support and warranty, as illustrated in the breakdown of the offer in Figure 1-3. The education means that when the LubeRight system is installed, a technician from Assalub is assisting the first round with the operator showing him how the system works. Support is provided in form of updates of software when new versions have been developed. In the future Assalub intend to charge the customers for software upgrades that add new features, but since the system still is relatively new to the market there are still improvements to be done on existing features. The software also enables logging of the customers’ processes, and information that can be transferred on-line. This is interesting for some specific customers to Assalub that act as OEM suppliers. They can use the logging function for warranty issues, to see if their customers are entitled warranty or not depending on if they have greased correctly or not. The LubeRight system is sold with a two-year functional warranty, but in practice the warranty has been extended since it is important to create credibility on the market in order to convince potential new customers. However, there have been few problems with the system.
Components that can be included in the offer at an extra cost are financing services and assembly of the system. If a customer wants to have an assembly of the system, i.e. mounting all the nipples, Assalub contacts other firms to carry out this service. However, most of the time customers carry out the assembly by themselves (often by employing summer workers).

A typical paper mill, for instance, has over 40 000 lubrication points which must be lubricated between once a week and once a year, depending on the type of bearing and application. To be able to lubricate the exact amount at the right time at each lubrication point does not only reduce the wear on bearings (overgreasing a fast-spinning bearing can shorten the lifetime almost as much as undergreasing), but also reduces the amount of grease used. Since improved grease nowadays enables longer greasing intervals – some bearings that used to be greased every 6 months can now be greased every 12 months – it becomes even more important not to miss a greasing point.

LubeRight hence gives an environmental benefit with less grease used as well as longer lifecycles for the bearings. This saves money not only for spare parts, but also the up-time of the machine can be increased. Bearings are usually changed during planned maintenance stops, which are held with certain intervals, since vibration analyses in most cases indicates when a bearing is to become worn out. However, if the bearings would last longer, the maintenance stops could be held more infrequent. Also, although breakdowns are rare on machines in Swedish paper mills, they still occur and they are very expensive. The standstill costs are typically in the range 100 000-250 000 SEK per hour.

Hopefully, LubeRight also increases the status of the greasers as it stresses the importance of lubrication. The greasers can get a confirmation that they have done their work properly before having

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33 As an example of the low status of greasers, they are often called “grease monkeys” in USA. The greasers do have slightly higher status in Sweden though, since the whole maintenance department is considered as more important in Scandinavia compared to in many other countries around the world.
the weekend off and they will always be able to prove that they have greased a bearing by a breakdown (today it is always assumed that the greaser is to blame if a bearing fails sooner than expected).

1.4 Product Life Cycle
At a product level the production has the biggest impact on the environment, as illustrated in Figure 1-4. However, the number of units used is so low that the product has no large environmental impact in itself. The lifetime of the LubeRight system is virtually unlimited, even though grease guns and grease meters may be worn out if handled careless.

It is at the system level – the process machinery - that LubeRight has its greatest environmental benefits. In the use phase of a machine the main environmental impact is caused by the use of energy, which cannot be more than fractionally affected by the use of LubeRight. The customers can however save both grease and bearings when using the LubeRight system, which will give substantial environmental savings in the long run.

![Figure 1-4. Conceptual distribution of the environmental impact of the LubeRight offer at a product level and the distribution of the environmental impact at system level.](image)

1.5 Suppliers and Business Network
The actors involved in providing the LubeRight system are shown in Figure 1-5.
Figure 1-5. Map of actors involved in providing the LubeRight system.

Assalub has strategic partnerships with its distributors as well as a maintenance program developer called Gurami. The strategic partners are only involved in the marketing of the LubeRight offer and selling the product to customers. The distributors are located in different parts of the world and as mentioned earlier about 30 percent of the total sales are exported directly through these distributors.

Gurami is a Stockholm-based company that sells maintenance management software to SMEs in Sweden. Its main software line is called Tribologen Underhåll, which is a maintenance support that Gurami markets together with LubeRight.

Many parts of the offer are purchased from exclusive suppliers, but they cannot be regarded as strategic partners as they just manufacture the products as specified by Assalub. These suppliers can hence be considered as exclusive but in the long term exchangeable; none of them hold any exclusive technologies.

Two interesting actors that currently is not part of the network that supply the LubeRight system are customer A and B that are OEM suppliers in connected industries. Both the customers have great market power and access to distribution channels superior those of Assalub.

1.6 Substitutes

There are different tools for lubrication. It can be categorized into systems for lubrication and general lubrication tools, i.e. grease guns and such (see Figure 1-6). The lubrication systems can be further divided into automatic and manual systems, where LubeRight is a manual system. The automated
lubrication systems can in turn be further divided, into a one-point lubrication and centralized lubrication.

Centralized lubrication is systems containing a central reservoir of oil or grease that is distributed to the lubrication points through a piping system. This system is useful for where a high number of lubrication points concentrated in a small area. It is also beneficial as no manual work is required after the installation, except for refilling of lubricant in the system. This gives a high accuracy of the lubrication. The drawback of centralized lubrication systems is the cost, especially where the lubrication points are spread out. The price for a centralized lubrication system is 2 500-7 500 SEK per lubrication point.

One-point lubricators are grease containers that is put on a lubrication point and destructed once they are empty. The grease is pushed into the greasing nipple either by gas pressure or by a battery-driven pump. This type of solution is suitable for lubrication of points that are hard to reach or hard to connect to a centralized system. It is also cheap in the short run since the initial cost is low. However, in the long run it can prove to be expensive as new lubricators have to be purchased and changed at regular intervals, usually only a few months. One-point lubricators are inaccurate and often cause over- or undergreasing. The price for a gas driven one-point lubricator is around 250-800 SEK depending on model.

General lubrication products include products such as grease guns and grease meters. These tools are used for manual lubrication, which is used where it is considered too expensive to use automated systems. This requires routines for handling the greasing, which sometimes can be generated through a maintenance software. Often a business system like SAP, which the whole company is using, is used for this purpose. However since the routines are performed by humans, and humans make mistakes, some lubrication points will most certainly be missed at times.

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34 When the engineering director of Assalub has educated greasers in the LubeRight system and followed them on a greasing round, it has never happened that the greaser has remembered to grease all the lubrication points he was supposed to grease.
The different product groups are used in different situations, mainly due to the calculated cost for
handling the greasing for a certain part of a machine. However to some extent they are still competing
with each other, and the LubeRight system is gaining market share. A drawback with LubeRight is that
the software is incompatible with SAP and cannot replace all the functions regarding preventive
maintenance that is handled in SAP (not only greasing is included in the preventive maintenance).

1.7 Customers
The potential customer base for LubeRight is broad with customers in different segments. LubeRight has
been implemented mainly in paper mills, but even in cement mortars, luxury cruisers, and steel plants.
Compared to the sales of automated systems, the sales of LubeRight are small but growing. A typical
example of process industry is paper mills and as Sweden is the fourth largest paper and pulp exporter in
the world\textsuperscript{35}, this type of process industry is important in Sweden. We have therefore looked into four
different paper mills in Sweden in order to get a picture over the buying process and their opinion on
LubeRight.

The paper mills in Sweden seem to be operating rather independently, with no large influence from
corporate levels in the daily business. This means that the buying processes and ways of working are
differing between the mills. Traditionally the greasers have a low status in the organization and if a
bearing breaks down quicker than expected the greasers get blamed. Nonetheless, the greasers have
power over purchasing decisions as if the greasers do not accept a certain system it is hard to implement
it. The mills that we have been in contact with are Stora Enso Skutskär, Stora Enso Hylte, Södra Mörrum
and Holmen Braviken. A common denominator for all mills is that emergency stops are very expensive
and has to be avoided. Hence, the mills consider preventive maintenance to be very important.

At Stora Enso Skutskär, there is a maintenance department in charge of both preventive and corrective
maintenance. The preventive maintenance group is responsible of lubrication and bearing condition
control. Apart from the team of 12 greasers, the preventive maintenance group also has a technical
assistant team with three staff members. The technical assistance team has the role of developing the
technical aspects of preventive maintenance, improving the quality of greasing. The team is responsible
for looking into new technologies and methods and evaluating it. If the team finds it necessary to
purchase new equipment or systems, it asks the head of the maintenance department for money. For
larger investments the management of the mill takes the decision. Stora Enso Skutskär has implemented
the LubeRight system, and runs it parallel with their business system SAP. The interviewee at Skutskär
believes that the LubeRight system is foolproof and will decrease the number of bearing breakdowns. In
fact he is such a strong supporter of the LubeRight system that he has written an article published in an
industry journal.

Another mill in the same company group is Stora Enso Hylte. The buying process is similar for Hylte as it
is for Skutskär. However, Hylte decided not to implement the LubeRight system as it was considered to
be too expensive in regard to the potential savings. Hylte has SAP implemented as business system
which generates the orders to the greasers about rounds. Implementing LubeRight would mean that

\textsuperscript{35}http://www.pappers.se/home/pappers2/home.nsf/pages/1B4F21E262ABA976C1256B250044C92B?OpenDocument
both systems have to be used as LubeRight and SAP are incompatible, which is considered to complicate to work of the greasers (even though this is done at Stora Enso Skutskär). The interviewee at Hylte responded that the positive side of LubeRight was the control of greasing that it gives and the negative sides are the incompatibility to SAP and the costs to implement the system.

At Södra Cell Mörrum, the manager of preventive maintenance applies for money for investments directly from the management. About 40 percent of the lubrication points in the mill are greased by automated centralized lubrication systems. The team of preventive maintenance is relatively small compared to the other mills with only three greasers employed. During the years Södra Cell Mörrum has invested in more reliant systems for lubrication, something that has had to results in increased accuracy in lubrication. The mill has recently invested in LubeRight to a small part of the mill. There will be a testing period with LubeRight and if it works well it will be implemented in other parts of the mill as well. Södra Cell Mörrum has a young team of greasers and they have been positive to the LubeRight system. The interviewee at Södra Mörrum stated the accuracy of LubeRight saves grease and bearings as no bearings will be overgreased. The negative side of LubeRight that the interviewee picked out was the double work to handle separate computer systems as Södra Cell Mörrum has a business system which handles other maintenance working orders.

Holmen Braviken has the same structure and buying process as the other interviewed mills. There is a technical group responsible of investigating possible improvements in lubrication. If the group finds an interesting investment it presents it to the management of the mill after discussing it with the maintenance manager. The management takes the decision of the investment. Holmen Braviken looked into the LubeRight system some years ago, but decided not to implement it. Since then no further investigation about it has been carried out.

1.8 Competitors
As LubeRight is a patented system, there are no real competitors. However, there are several competitors among the substitutes (described in chapter 1.6) LubeRight. The most significant competitors are SKF and Lincoln Industrial, that both are large international companies. SKF is focused around bearings but has a complete range of lubrication products, while Lincoln Industrial has its core business in lubrication systems. The ways of communication within these organizations are longer and creates a clear distinction between the sales and product development functions. However, both SKF and Lincoln Industrial have market power and distribution channels that are superior to the ones of Assalub.

1.9 New entrants
There might be a threat from new entrants that try to introduce competing systems (there are often ways to avoid patent intrusion) if Assalub do not let them act as distributors.

1.10 LubeRight Profit Pool
The profit pool for the lubrication industry was created with Assalub during a workshop. Since it is difficult to get accurate information about the size and profitability of each activity (the companies undertaking the activities are often performing more than one activity), we chose just to both the size
and profit of each activity on a three-grade scale. This means that there in reality are much larger differences in size between the sizes of the activities in Figure 1-7, which illustrates the profit pool of the lubrication industry.

Figure 1-7. Profit pool of the bearing maintenance industry.
Appendix VII – Polyamp

Polyamp is a world-class supplier of DC/DC converters, used in a wide variety of applications within the industry. The company is divided into three business segments, whereof one is a system supplier and two are pure product suppliers. This appendix will focus on the largest product business unit, which is located in Åtvidaberg.

1.1 History
Polyamp AB was founded in 1966 in Sollentuna by Alf Östlund (the father of the current CEO Eric Östlund). Alf had spent some time at the CERN particle physics laboratory in Switzerland and saw the need for better power conversion equipment. In 1970 the company’s first switch-mode DC/DC converter was launched and already from the start a substantial part of the converters was sold on export to Switzerland via a friend that Alf had got during the time at CERN. This agency developed so well that a production plant was set up in Switzerland in 1979 through a subsidiary named Switch Craft, which still today operates as a pure production plant. 1976 a production plant was set up in Åtvidaberg, some 200 km south of the main office in Sollentuna. For many years the product development was done in Sollentuna, but today the product development is located in Åtvidaberg as well.

In 1982 Polyamp started the military division Polyamp Systems located in Sollentuna, which supply total solutions mainly for degaussing systems for naval ships and submarines (in order to avoid mines). The system division was started as a result from a cooperation with a software supplier and another component supplier on the request of the Swedish military (FMV), which wanted to buy the whole degaussing system instead of its components. Since Polyamp was the largest company of the three, it took the system responsibility and today it designs and supplies the whole system, including installation and education. Polyamp Systems has accounted for around half of Polyamp’s total turnover the last years and the business has moved to Åtvidaberg (only the market unit is kept in Sollentuna).

However, since Polyamp Systems already supplies a PSS offer, it is more interesting to focus on the DC/DC converters. These are basically sold as pure of the shelf products, even though some customization can be done if requested by the customer. This business segment has historically sold a majority of its products to large Swedish companies such as ABB (former Asea), SJ and Telia. Today the exportation share is around 60 percent and the product range has also been complemented with a distribution assortment of AC/DC converters, DC/AC converters, battery chargers and insulators. The whole company had a turnover of 44 million SEK during 2007.

1.2 Organization
The company structure of Polyamp is illustrated in Figure 1-1. Since only the Swedish DC/DC converter business unit is focused, the remaining part of the company is marked with grey boxes.

36 DC/DC converters convert one direct current (hence “DC”) voltage level to another, e.g. from 110 volts to 48 volts.
Figure 1-1. Company structure of Polyamp.

The mother parent company Polyamp Instrument AB is “on the paper” run by Michelle Östlund, while her son Eric Östlund is CEO of Polyamp AB. In practice however, Eric is the manager of the whole company group, including the Swiss business unit. Bengt Hellerstedt is the site manager of the Åtvidaberg plant, for which the organization chart is shown in Figure 1-2.

Including the production plant in Switzerland Polyamp has 49 employees, whereof 30 are working at the plant in Åtvidaberg. As can be seen in Figure 1-2, the main part of the employees at the Åtvidaberg plant are working with production, since building DC/DC converters in small series is a labor intensive activity. It should also be noted that the two product developers have been more or less occupied by the system business unit the last two years, since three large military projects have been developed and delivered simultaneously. This has resulted in a neglected product development of the DC/DC converters in recent years, but this will hopefully change at the time of writing as the product developers can go back to their ordinary work tasks. Another problem caused by the small organization is that the marketing unit is much smaller than most competitors.
1.3 The Offer

The DC/DC converter offer can be divided into the parts shown in Figure 1-3.

![Diagram of Polyamp's DC/DC offer]

Figure 1-3. A mapping of Polyamp’s DC/DC offer towards the customers.

Since Polyamp has a deep knowledge about its products and how the products can be integrated to different systems, customers sometimes ask for advice on what type of DC/DC converter to use for a certain purpose. This can be viewed as consultation, and even though only a few customers need this help it can take a considerable amount of time. Since it is viewed as a part of the sales process, it is not charged for. The consultation can lead to either that a standard of the shelf model is recommended or that a customization is needed. The latter was common until a few years ago, when new EMC (ElectroMagnetic Compatibility) requirements needed in order to get a CE-approval made it expensive to customize electronic products. If the design or a component is changed a new EMC test is required, which cost 40 000 – 80 000 SEK, resulting in very high cost per unit in small series (often only a handful converters are built). Customization still exists for slightly larger series though and Polyamp is very flexible in this area compared to most competitors.

The offer mainly consists of the physical product itself; the DC/DC converter. The product range is built up by six different series, mainly based on the power that needs to be handled (Polyamp’s power range span from 30-2 000 watts while the price range is approximately 2 000-14 000 SEK per unit). Three of the product series are shown in Figure 1-4.

![Images of three polyamp DC/DC converters]

Figure 1-4. Three out of six DC/DC converter series built by Polyamp.
As earlier described in a footnote, DC/DC converters convert one direct current voltage level to another, e.g. from 110 volts to 48 volts. Switch-mode DC/DC converters do this by storing the input energy temporarily and then releasing it to the output at a different voltage. This temporarily storing is made by one or more capacitors, which are the only components that can be considered as a wear part (except for cooling fans that are used on a few larger models). The capacitors used before the mid-nineties had an expected lifetime of 15-25 years, while the type that is used nowadays has an expected lifetime of more than 50 years. Other electronic components can be considered to have a virtually unlimited lifetime. TÜV\textsuperscript{37} has certified the life expectancy of Polyamp’s DC/DC converters to 55 years\textsuperscript{38}. The longevity of the converters is one key selling point that Polyamp uses.

In addition to superior lifetime, Polyamp’s converters are well-renowned regarding other quality aspects such as resistance against moisture and vibrations, cooling via the casing without ventilation holes for most models (where competitors use fans that will wear out) and screening from electro-magnetic emissions. For tough applications where these aspects are important, Polyamp is regarded as a top brand and Polyamp uses the quality aspect as a key selling point.

The converters are usually sold with a two-year warranty, but the salesmen are free to give up to five years warranty if they believe that it can help win an order. However, the five-year warranty is rarely offered, since the customers do not usually ask for it. Protocols from research institutes seem to be more important for the customers than warranty, according to a salesman at Polyamp who has tried to sell – with limited success – by offering longer warranty a couple of years ago.

Support is given to the customers by phone if needed. However this is not very common and when it is needed it is usually during the installation phase. In order to make it easier for the customers to avoid errors in the installation phase, detailed manuals are provided for each product. If a converter fails, it usually fails during the installation phase, almost always due to errors done by the customers. The failure frequency is however very low around 10-20 converters are returned to Polyamp each year out of the whole installed base including units with expired warranty (the production is 3 000-4 000 units per year). Around half of the failures of the returned converters can be derived to incorrect handling by the customers, such as exceeding the allowed input level. An interesting aspect here is that the DC/DC converters included in the degaussing systems include electronics that monitor e.g. temperature and input power in order to get an overview of failure causes (which then can be loaded to a computer).

When the warranty has expired the customers can send the converter to Polyamp for a free of charge quotation of repair. When doing the quotation the cause of the failure is analyzed. This may work as a failure analysis of the customer’s system that the converter was built in to. Even converters that are so old that components are not available on the market can sometimes be repaired by redesign of old components.

\textsuperscript{37}TÜV is a well-renowned German Technical Monitoring Association validating the quality and safety aspects of technical products.

\textsuperscript{38}It should be noted that this certification provide a working temperature of 40°C. For every 10°C increase in working temperature, the life expectancy is halved. This gives an estimated lifetime of only a couple of years by a working temperature of 80°C, which can be the case if a DC/DC converter is constantly operated near its marked peak power in a closed space.
1.4 Product Life Cycle
As mentioned earlier, a Polyamp DC/DC converter can last at least 20 years. This means that the time for the product being used is long compared to the other phases of the life cycle, diminishing the effects of the environmental impact of these phases. The converters have an average efficiency of around 87 percent, meaning that much energy is lost as heat during the use phase. An increase in efficiency hence means that less power is needed for input and thus saving energy, but this can only be done by improving the physical product, not by changing the business model. This may become a severe problem for Polyamp, since a new EU environmental legislation regarding the energy use of power converters (originally intended for consumer electronics) will be voted during the fall 2008. If the EU’s Environmental Committee votes for the legislation, it will come to effect one year after the vote. It is doubtful if Polyamp can handle the required product development and testing in one year.

However, the aluminum casings used for the DC/DC converters requires a substantial amount of energy in the material production phase. If the casings could be reused when the electronics (usually the capacitor) are failing, instead of destructed or in best case recycled as is the case today, environmental savings would be achieved. This can be done by changing the business model rather than the product itself. The schematic product life cycle of a DC/DC converter is displayed in Figure 1-5.

![Figure 1-5. Conceptual distribution of the environmental impact during the product life cycle of a DC/DC converter.](image)

No product life cycle can be done on system level, since there are a countless number of applications for DC/DC converters to be used in.

1.5 Suppliers and Business Network
The structure of Polyamp’s business network is simple, as illustrated in Figure 1-6.
In the supply of DC/DC converters, Polyamp has no close cooperation with any supplier. The “exclusive suppliers” can easily be changed, at least over a period of time, since all the drawings and specifications belong to Polyamp. There are already three different suppliers of aluminum profiles, although each model series is bound to one supplier in the short term. There are some electronic components that are custom made for Polyamp, but these suppliers can be changed as well if need be.

The converters can be sold either to a systems integrator (such as e.g. ABB), the end customer or a distributor (who in turn can sell the converters to a systems integrator or the end customer). Distributors are present all around the world, although the main part of the sales is concentrated to Europe. The distributors usually sell a wide range of products within power handling, not just DC/DC converters. Some of the distributors even sell competing (cheaper) brands of DC/DC converters that in some situations substitute Polyamp’s converters. More commonly the distributors market Polyamp’s DC/DC converters as a complement for the rest of the product range and some of them have a close relation with both Polyamp and the customers.

Within the customer’s organization, the engineering department usually has the power over what specifications to be used, while the purchasing department tries to find the cheapest solution that fulfill the required specifications. It is therefore important for Polyamp to get in early in a project to be able to influence the engineering department (since Polyamp’s converters are more likely to be chosen the more detailed a specification is due to superior qualifications, as will be discussed in chapter 1.7). Another aspect is that in recent years the role of technology consultant firms has proved to be increasingly important. Polyamp tries to cooperate with several firms in order to get them to make detailed specifications for the DC/DC converters used in the systems that are being designed. This is a mutual cooperation, since the technology consultant firms can benefit from Polyamp’s knowledge about converters in order to avoid mistakes (such as high electrical emissions causing interference in a system). There are however no official partnerships.
1.6 Customers

A DC/DC converter can be used in a countless number of applications, both in consumer electronics and industrial applications. Polyamp’s converters are only sold to the latter segment, but even within this segment there is a wide range of applications. Polyamp’s DC/DC converters are used in applications with tough physical or electrical environment and where the demands are high on accuracy and reliability. Polyamp is a well-renowned brand in this segment. The major customers can be divided into the following segments:

**Power industry.** Typical customers in this segment are power producers and distributors, as well as systems integrators such as ABB, Alstom and Siemens. The converters are typically used in control systems and battery stations. Neither power suppliers nor nuclear power plants seem to have any pre-determined exchange intervals for DC/DC converters, due to the long expected lifetime of the converters and in the case of nuclear power plants the systems are quadrupled which means that a failure of one or two converters is not critical.

However, when speaking to a projection manager at the mid-sized power producer and supplier Jämtkraft with several hundred installed DC/DC converters, a new approach was requested. Failing DC/DC converters are one of the most common reasons for system failures, which cause extensive economical impact. It is not often Polyamp converters that fail – they are considered to be outstanding compared to the competitor’s converters (several brands are used since a specific brand cannot be specified in the procurement process) – but the problem creates a need for a new way of handling the converters. Instead of using the converters until the break down, the projection manager would prefer to get help with preventive maintenance by keeping track on the converters and get suggestions when it is time to change (or renovate) a specific converter to secure a certain lifetime. He would also like to get an inventory of the installed base of Polyamp’s DC/DC converters in order to be able to change the converters that are so old that their expected remaining lifetime is short. When asked about it, the projection manager would not mind buying the function of power conversion instead of the physical product power converters. The projection manager is very open for cooperation with Polyamp regarding this issue, but point out that he does not perceive the company as market oriented. He is convinced that Polyamp would be able to grow substantially if it changes its business model, since the price of the products would be much less important if Polyamp would offer services that reduce the operating costs and failure risks for e.g. power suppliers. It can also be noted that the projection manager had never heard of that it was possible to send failing converters to MJP for repair and failure analysis.

**Traction.** This segment is mainly made up by companies related to train building or operating, such as Bombardier, SJ and Siemens. The converters are built into the trains in order to convert power for various applications using different current levels, such as wipers, control systems, lighting, power outlets etc. When a train set is renovated, the DC/DC converters are usually re-used after a functional test, which means that there are no scheduled exchange intervals.

**Forklifts.** The customers in this segment usually deliver control or logistics system for forklifts, for example MA-System, LXE, Alfa-Laval Controls and Jungheinrich.
Telecom. The converters sold to this segment are typically used in base stations for mobile networks with customers such as Telia, Ascom and Motorola. However, this seems to be a declining segment since new technology reduces the need of external DC/DC converters.

Military. Converters can be used in a wide range of applications within the military (in addition to the systems delivered by Polyamp Systems). Major customers are Royal Swedish Navy, FMV and Kockums.

In summary it can be observed that most of Polyamp’s customers are large companies that use the DC/DC converters as a small component in a large system. The system is then used by the customer itself or delivered to an end customer. An interesting fact is that around 95 percent of all sales are return business, indicating that the customers are pleased with the products. The people we have talked to within the power and traction industries are all very pleased with Polyamp’s converters and confirm the picture of superior lifetime of the products.

1.7 Competitors
Polyamp belongs to the premium segment of power converters, where high quality, durability and flexibility are regarded more important than price. There used to be one competitor, the Swiss company Melcher, considered to be equal to Polyamp on these aspects. However, since Melcher was acquired by the large American power supply company Power-One in 1998, the company has moved its production to low-cost countries and focused on a more standardized production in larger series. The same trend seems to be true for the rest of the companies selling their converters world-wide. The competition for customized DC/DC converters in small series has therefore declined in recent years, leaving only small local competitors in this segment.

For standardized DC/DC converters on the other hand, the competition has increased lately since the quality on the products manufactured in low-cost countries has improved. There is a big difference in price level between the cheapest competitors, often a factor two or three. However, it is not only the quality in sense of durability that is important for the customers that Polyamp sells their converters to. Other important aspects are high accuracy, low electrical emissions as well as resistance against moisture and vibrations, which is more difficult to achieve. Another aspect is that not many competitors offer converters in the higher power ranges. Regardless, Polyamp cannot compete about contracts where large quantities are requested (not even for customized converters, as even the larger companies find it attractive to do customization for large series), since a more automated production process is required in order to lower the costs.

1.8 Substitutes
In general there is no substitute for DC/DC converters, even though there seems to be a trend that external converters can be substituted by integrated converters. This is however only the case for low-power-applications, since the heat generated by high power cannot be handled by integrated converters.

1.9 New Entrants
There are low barriers for new entrants on the market, but since there are already a large number of competitors on the market this is not a major threat.
1.10 DC/DC Converters Profit Pool

As mentioned earlier, the DC/DC converters are used in both consumer electronics and industrial applications. In the former application the DC/DC converters are often small, integrated circuits that are manufactured in high volumes with a very low cost per unit. Even though the product characteristics are significantly different than for the stand-alone DC/DC converters that Polyamp manufacture, it is interesting to include the segment of converters with a power rating below 30 watts in the profit pool even though Polyamp are only supplying converters exceeding 30 watts. The reason for this is that larger competitors such as Power-One offer the whole range of DC/DC converters.

The suppliers of components to the converters have only a small part of their business towards converters, making it irrelevant to include them in the profit pool. Also the customers of the converters are left out from the profit pool, since they are being in such diversified industries (it would require one profit pool for each customer segment). Instead we divided the profit pool after the sizes of converters giving us the following activities:

- DC/DC converters with power rating less than 30 watts
- DC/DC converters with power rating 31-500 watts
- DC/DC converters with power rating exceeding 500 watts

The profit pool was estimated with the help from Polyamp and is illustrated in Figure 1-7. As the profit pool was made on a schematic basis, we have not displayed any exact figures on the share of industry revenue.

![Figure 1-7. Profit pool of the DC/DC converter industry.](image)

As can be seen in Figure 1-7, the market size is much smaller for large DC/DC converters, but at the same time the margins are increasing (due to less price sensitive customers and fewer competitors).
Appendix VIII – Managerial Guidelines

These managerial guidelines are briefly explaining how to carry out the PSS Offer Generation Method. One of your company’s current offers is used as a reference offer throughout the method. The purpose of the method is to develop the offer in order to eliminate threats or to exploit possibilities, and the focus will be on developing concepts of PSS offers. PSS (Product-Service System) refers to a combination of products and services that are put together to fulfill a customer need. This method may however also give inspiration for the development of conventional offer concepts.

The method is composed by three steps that each contains a set of tools to be used for analyzing the current situation, as well as potential new concepts. The figure below illustrates the method in its entirety.

**STEP 1**
Internal Analysis
- Assessment of the Firm
- Assessment of the Offer
- Life Cycle Perspective of the Offer

**STEP 2**
External Analysis
- Customer Requirement Analysis
- Market - Perceived Quality Profile
- Network Analysis
- Business Context

**STEP 3**
Planning the New Offer
- Identify the Gaps
- Identify the Fits
- Categorize the value

Concept Generation ➔ Evaluation of Concepts ➔ Feasibility Analysis ➔ Keep to current offer
- Detailed PSS Offer Concept (Input to Step 4 in the IPSE methodology)
- Detailed Conventional Offer Concept
How each step of the method is carried out is explained in the following sections. The work should be led by the management of the company. However, specific parts of step 1 and 2 may be delegated to appropriate persons within the organization if needed. The result of step 1 and 2 will be used as input for step 3 and therefore the execution of the two former steps is built around question guides.

**Step 1**

**Background**

Before carrying out this method, it is important that you chose an offer to develop as well as the drivers for doing so. The latter is a prerequisite for going in the right strategic direction when developing the offer.

1. Chose an offer to develop.
2. What are the drivers for developing the offer?
   a. Defensive
      i. Mature markets
      ii. Threats from low cost countries
      iii. Environmental aspects (i.e. legislation, customer requirements or rising resource costs)
      iv. Other
   b. Offensive
      i. Deeper understanding of the customer’s problem
      ii. Creating a complex business model that is difficult to imitate
      iii. Increased profitability
      iv. Create markets
      v. Other

**Assessment of the Firm**

An understanding of your firm’s capabilities is essential for business development. Your strengths can be used to gain competitive advantage and the knowledge about your company’s weaknesses is important in order to avoid pitfalls.

3. What strengths and weaknesses do we have as a company?
   a. What strengths and weaknesses do our competitors have?
4. What differentiates the providing of our offer compared to our competitors? Take a starting-point in the activities in the internal value chain displayed on the following page:
5. What works well and what needs to be improved in the providing of our offer?

**Assessment of the Offer**

An understanding of the current offer is essential in order to understand how it can be improved. The analysis can be structured in the following way:

6. What is included in the offer except for the physical product?
   a. Consultation (designing the offer)
   b. Finance
   c. Assembling
   d. Training of operators and/or service personnel
   e. Operators during use
   f. Logistics
   g. Consumable goods (lubricants etc.)
   h. Energy
   i. Support (help with problems regarding use of the product)
   j. Maintenance and service
   k. Repair
   l. Take back responsibility after the end of the contract
   m. Other

7. Who owns the physical products included in the offer?
   a. Our company
   b. The customer/user
   c. Another company (e.g. a leasing firm)

8. To what extent is the physical product adopted to fit the offer?
   a. Not at all (standard product)
   b. Adopted to the offer (modified standard product)
   c. Specifically designed for the PSS offer
   d. Other
9. Map the different components of the offer in a tree chart in order to illustrate all parts of the offer, as done in the example below:

![Tree Chart Example]

10. Categorize the offer along the product-service continuum. The product-service continuum is used to categorize the current offer according to the following framework:

![Product-Service Continuum]

The pure product offer consists mainly of a physical product, while the pure service offer does not include any physical product. In between these two extremes, there are three categories of PSS offers:

- **Product-oriented**: the product is the main part of the offer with the service as add-ons. Examples of offers are products with product-related services such as maintenance or financial services.
- **Use-oriented**: the product still plays an important part of the offer, but the focus is shifted towards the use of the product and the ownership of products is not transferred. Examples of offers in this category are leasing, rental or pay-per-use.
- **Result-oriented**: the offer is based on achieving a certain result, which means the product itself is not a concern of the customer. Examples of offers in this category are activity management and functional results.

11. What strengths and weaknesses does our offer have?
   a. What strengths and weaknesses do our competitors’ offers have?
12. What key selling points do we use?
Life Cycle Perspective of the Offer

An understanding of the environmental impact of the current offer can give inspiration for new ways to save resources in your own or your customers’ processes. If it is found that your offer has potential to save resources in the customers’ processes, this can be used in the sales process.

13. (If applicable) How large is the environmental impact of the offer according to the calculations made according to the requirements in ISO 14000?
14. How is the environmental impact of the offer distributed along the different phases of the life cycle? Distribute 100 points over the following phases:
   a. Material production (processes: production and recycling technologies)
   b. Manufacturing (processes: manufacturing and assembly)
   c. Transport (processes: transport and packaging)
   d. Use and product recycling (processes: function, maintenance and remanufacturing)
   e. Material recycling and disposal (processes: reprocessing, treatment, disposal)

15. Can we identify any unnecessary waste that we can affect?
16. Would it be possible to save resources (at the customer or in our own processes) if the customer would use the product in another way?
17. What are our commitments when the customer is using the product?
18. In general, what is the life expectancy for the physical products included in the offer?
19. Conceptually map the environmental impact of the offer at product level as well as system level (i.e. the system that product is used in, if applicable) as done in the following figure:
Step 2

Customer Requirement Analysis

The purpose here is to understand what the customers need, both their current known needs and anticipative needs. Since the customers’ processes must be understood in order to find out the anticipative needs, it is strongly recommended to visit the customers.

20. Ask what needs the customer currently has regarding the activities that the existing offer carry out.

If you (or someone within the organization, e.g. salesmen) can visit the most important customers, perform the following process:

21. Anticipative Customer Requirements Analysis (ACRA):
   a. Analyze the customer’s processes in which our offer is used, as well as the phases before and after.
      i. Create a flow chart
      ii. Identify critical problems in the customer’s processes
      iii. How is our product really used and what are the customers’ real needs?
   b. What are the customer’s values?
   c. Mirror the customer’s processes with its values; identify gaps.
      i. Are there process steps where the customer’s values are not met?
      ii. Are there any values that today are not addressed in the process, but that would be able to address by offering new services?

If it is not possible to visit the customers, you can instead try to interview them somehow else, preferably over the telephone. The information you want is the same as will be the output from the ACRA, but you cannot study the customers’ processes if you do not visit their sites. Hence, try to ask questions that make you understand the customer’s needs, both the ones they realize themselves and anticipative needs that you can come up with by thinking outside the box.

Market-Perceived Quality Profile

The purpose of this tool is to get an understanding what the important purchasing criteria are for the customers and how your offer performs on these criteria. The best result will be achieved by meeting the customers face-to-face.

22. Try to figure out who in the customer’s organization has the real power over the purchasing decision.

23. Market-Perceived Quality Profile:
   a. Ask customers in the market to list the factors that are important in their purchasing decisions. Both customers and, if applicable, competitors’ customers should be regarded.
   b. Ask the interviewed customers to describe how the different quality attributes are weighted in their purchasing process by letting the interviewees to distribute 100 points over the selected factors.
c. Ask the customers to rate the performance of each competing company’s offer on each competing factor (e.g. on a scale of 1 to 10).

d. Multiply each company’s score with the weight of the factors, which add up to an overall customer satisfaction score.

**Network Analysis**

24. What actors are involved in providing the current offer?
2. Map the actors involved in the network. An example is shown in the following figure:

![Network Diagram]

25. How does each actor contribute to the offer?
26. What capabilities does each actor have?
   a. What is the strength and weaknesses of the each actor?
27. How is the power distributed within the network?
28. What is the role of our company?
29. Does our company have “latent” relations with other suitable actors?
   a. What capabilities do these actors have?
30. Has our company gained business contacts through actors in the network?
   a. In that case, is it a specific actor who has given us business opportunities?

**The Business Context**

By understanding the external business context of the company, new business opportunities can be identified and threats can be eliminated. A well-recognized approach for industry analysis is Porter’s five
forces model, which consists of the five competitive forces suppliers, buyers, industry competitors, substitutes and potential entrants as illustrated in the following figure:

31. Analyze the competitors and the rivalry within the industry.
32. Analyze the suppliers (you will have a good mapping of these from the previous network analysis).
33. Analyze the customers.
34. Analyze the substitutes of your offer.
35. Analyze the risk of potential entrants to the industry.

The most relevant competitive forces can be summarized as in the following table in order to get an overview:

<table>
<thead>
<tr>
<th>Suppliers</th>
<th>Industry Rivalry</th>
<th>Potential entrants</th>
<th>Substitutes</th>
<th>Customers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large but exchangeable suppliers of customized components</td>
<td>Several global competitors with automated production processes and many local competitors</td>
<td>Low barriers for new entrants, but this is no large threat for Company X since it takes time to build a reputation of quality in the premium segment</td>
<td>Product A are starting to substitute Product B in segment Y</td>
<td>Often large companies using the products in large systems</td>
</tr>
<tr>
<td>Standard components can be purchased from many suppliers</td>
<td>Few competitors in the premium segment, but cheaper competitors are increasing their quality</td>
<td></td>
<td></td>
<td>High quality is the most important purchasing criteria; some customers are not price sensitive</td>
</tr>
</tbody>
</table>

The profits will not be even distributed among the different activities in an industry. The profits and relative sizes of each activity will affect your company’s ability to earn money, both now and in the future. In order to get an understanding for the profit structure among the activities that affect your company, a “profit pool” can be displayed as in the following figure, which illustrates the profit pool of the US automotive industry:
You can create a profit pool for your own industry by following the following process:

36. Define the pool
   a. Which value-chain activities influence our ability to generate profits now and in the future? Think outside the box, not just about activities in your company’s traditional value chain.

37. Determine the size of the pool (use estimations)
   a. What are the total combined revenues generated by our company and the other actors in the value chain?
   b. What are the total combined profits generated by our company and the other actors in the value chain?

38. Determine the distribution of profits (use estimations)
   a. What revenue is generated by each activity in the value chain?
   b. What profit is generated by each activity in the value chain?

39. Reconcile the estimates

3. Do step 2 and step 3 generate the same result?

More than one profit pool may be needed for you to get a good overview of your industry. If, for example, the activities that your company currently undertake have very small revenues compared to the remaining activities in the pool, you may wish to focus on a certain part of the pool to get higher “resolution”. It should also be noted that if you find it difficult to find even approximate figures for the revenues and profits for each activity, you can use your experience to grade the size and profits on e.g. a three-grade scale in order to get a conceptual overview of the industry.
**Step 3**

The output from step 1 and 2 in the method will be the base for development of new PSS offers. Step 3 starts with the use of the three approaches on how to use this output to support the concept generation process. These approaches are: identifying the fits, identifying the gaps and categorizing the value. The two former approaches are illustrated in the figure below:

The connections (illustrated with arrows) should be used in the following way:

a) A gap between the current offer and the customer needs will work as inspiration for ideas of new PSS offers. This is probably the most obvious connection between the internal and external analysis.

b) An understanding of the environmental impact of the current offer, combined with an understanding of the customer’s needs and processes gives the possibility to create matches that reduce waste. The inspiration here should be changes in the business model that reduce waste at the same time as the customer’s value is increased.

c) A gap between the company’s key selling points and the customer perceptions about the offer might indicate how the company can change not only the market communication but also its offer to match the customer’s perception. This should of course only be done if desirable, i.e. if it is in line with the firms intended strategy.

d) The company should seek to identify a fit between the capabilities that it controls (internally or through its network) and attractive activities that have been identified in the analysis of the business context, where Porter’s five forces model and profit pool analysis is used. Both an inside-out perspective and an outside-in perspective should be used. The former will help the company exploiting its unused capabilities while the latter will help the company to undertake
new attractive activities (which might require that new capabilities are obtained from the network or developed in house).

When the gaps and fits have been identified, the product-service continuum (presented in stage 10 in step 1 of this method) can be used to create different scenarios for the offer. By trying to create different scenarios along the product-service continuum (i.e. depending on the product/service ratio) new ideas can emerge concerning how the offer can be developed.

**Generate New Concepts**
Creativity is important in this phase, and it is therefore suggested that the group that will participate (preferably the members of management) carry out the phase on a different location than the ordinary work space. Using all the ideas that emerged from the three abovementioned approaches – the gaps, the fits and the categorization of the offer – new concepts of offers can now be created. The focus should lie on developing PSS offer concepts, but if the method has generated ideas about new conventional offers or other ways to develop the business, these ideas should of course be regarded as well. Be creative in this phase and do not kill any ideas initially, since this will obstruct creativity. Create as many concepts as possible and then bring a handful of the most promising ones to the next phase.

**Evaluate the Concepts**
The concepts generated should now be evaluated by a qualitative assessment regarding four dimensions:

- **Environmental impact** – compared to the current offer, how will the environmental impact be affected by the new offer? Input to the current environmental impact will be the life cycle perspective of the offer.

- **Economical impact** – compared to the current offer, how will the economical impact be affected by the new offer? The concept should be analyzed both from a pure economical aspect, expected revenues versus costs, and take in consideration the possibility of future profits from new activities that are enabled by the new offer. No exact figures are required, rough estimates are sufficient at this stage.

- **Identity and strategy match** – compared to the current offer, how well will the new offer match the company’s identity and strategy? The aspects to consider are how well the new offer match the company’s intended strategy, if the capabilities needed to provide the offer are available within the organization or the business network and if third parties can be threatened by the new offer and hence will try to prevent it.

- **Customer acceptance** – will the customers accept the new offer? If there are reasons to believe that this would not be the case, there is no use in trying to provide the offer.

Each dimension should be rated on a -3 to 3 scale, where -3 means that the old offer is much better, 0 that the offers are equal and 3 that the new offer is much better than the current offer. These ratings can then be mapped in a diagram to get an overview of the attractiveness of the concept, as illustrated in the following figure:
If none of the generated concepts are found to be better than the current offer, you can perform the concept generation phase one more time, using the barriers found in the evaluation phase as inspiration for other concepts. If this does not lead to a concept superior the current offer either, the process should be aborted and your company should stay to the current offer. If this will be the case, you know that the current offer is well suited to the company’s current situation considering the available capabilities and constraints.

**Make a Feasibility Analysis**

One or two concepts should have been advanced from the previous phase and the feasibility of these concepts should now be analyzed. In this phase, a more in-depth analysis should be conducted. This analysis will take a more quantitative approach with more accurate figures about the economical and environmental aspects of the offer, as well as a more detailed evaluation of how to manage the network required to obtain the capabilities needed to provide the offer. Finally, the customer acceptance must be judged by the customer themselves, in order to confirm that no vital aspects that might prevent customers from purchasing the PSS offer have been overlooked. A dialogue and constructive discussion with the customers can increase the competitiveness of the offer, since opinions from the customers can be used to further improve the design of the offer.

The methods for quantitatively assessment of the economic and environmental impact are investment analysis (revenue and cost streams) and assessment of the environmental impact over the lifecycle of the offer. Although these methods have already been used in previous steps, it was at a more basic level. In this stage more accurate data is required, since the decisions made can have great impact – financial as well as strategic – on your company’s future development. The analysis has to be more in-depth in order to really test the feasibility in a reliable way.

If none of the concepts are found to be feasible, the process should be aborted and your company should stay to the current offer. Once again, if this will be the case, you know that the current offer is well suited to the company’s current situation.

If an offer is found to be feasible, you will hopefully have come up with a detailed concept of a PSS offer that is competitive, creating value for both the customer and the firm while decreasing the environmental pressure. You may also have come up with a concept that cannot be considered as a PSS offer, but that still will be attractive. The next step is to further develop the concept into an offer that can be put on the market.
Realize the New Offer
The chosen concept should now be realized. These managerial guidelines will give no guidance on how the realization should be performed. However, depending on what type of concept it is, different actions should now be taken. You will have one of the following types of concepts:

**PSS concept** – if the concept regards a PSS offer, it should be used as input to step 4 in the IPSE (Integrated Product and Service Engineering) methodology. The reason for not using conventional product development methods is that the physical product and the services should be designed integrated in order to achieve a successful offer. The IPSE methodology has been developed by researchers from Linköping University and Royal Institute of Technology (Stockholm) in collaboration with manufacturing smaller companies. More information about the IPSE methodology can be found in *Integrated Product Service Engineering (IPSE) – Final Report* that will be available at www.ipse.se.

**Conventional concept** – if the concept regards only the product or a change in the business model that does not require an integrated design process for the offer, conventional product design processes can be used to realize the concept. The concept may not even require any reengineering of the physical product or services, but instead new communication or market channels. In this case the realization of the concept can be regarded as a part of the daily work in the organization.

The Use of this Method
Congratulations! By carrying out this method, your company will have gained substantial benefits regardless the outcome in form of new offer concepts. You have now conducted an extensive analysis of your company’s situation, which hopefully has served you with a deeper understanding of both internal factors and the business context that the company acts in. This gives you better chances of eliminate potential threats and to exploit possibilities that will increase your competitiveness.

This method is a result of a Master Thesis conducted by two students at the Master of Science program in Industrial Engineering and Management at Linköping University during the fall 2008. Further research within the area will most certainly be done on the initiative of Center for Applied Management (CAM) at Linköping University. In order to stay updated, or if you are interested in being a part of the research, please visit www.cam.liu.se.