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PROFILING THE VALUE OF INDUSTRIAL MAINTENANCE SERVICES

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ABSTRACT

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Industrial maintenance can be executed internally, acquired from the original equipment manufacturer or outsourced to a service provider, and this concludes in many different kind of business relationships. To maximize the total value in a maintenance business relationship it is important to know what the partner values. The value of maintenance services can be considered to consist of value elements and the perceived total value for the customer and the service provider is the sum of these value elements. The specific objectives of this thesis are to identify the most important value elements for the maintenance service customer and provider and also to recognize where the value elements differ.

The study was executed as a statistical analysis using the survey method. The data has been collected by an online survey sent to 345 maintenance service professionals in Finland. In the survey, four different types of value elements were considered: the customer's high critical and low critical items and the service provider's core and support service. The most valued elements by the respondents were reliability, safety at work, environmental safety, and operator knowledge. The least valued elements were asset management factors and access to markets. Statistically significant differences in value elements between service types were also found. As a managerial implication a value gap profile is presented.

This Master's Thesis is part of the MaiSeMa (Industrial Maintenance Services in a Renewing Business Network: Identify, Model and Manage Value) research project where network decision models are created to identify, model and manage the value of maintenance services.

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Teollinen kunnossapito voidaan toteuttaa sisäisesti, hankkia laitetoimittajalta tai ulkoistaa erilliselle kunnossapitopalveluiden tarjoajalle ja tämän seurauksena syntyy monia erilaisia yhteistyösuhteita. Jotta kunnossapitoyhteistyön kokonaisarvo voidaan maksimoida, on tärkeää tietää mitä yhteistyökumppani arvostaa. Kunnossapidon arvo muodostuu arvoelementeistä, jolloin havaittu kokonaisarvo asiakkaalle ja palvelun toimittajalle on näiden arvoelementtien summa. Tämän työn tavoitteena on tunnistaa kunnossapitopalveluiden asiakkaan ja toimittajan tärkeimmät arvoelementit sekä tunnistaa, eroavatko ne toisistaan.

Tutkimus toteutettiin tilastollisena analyysinä käyttäen kyselytutkimusmenetelmää. Käytetty data on kerätty Internetissä täytettävän tutkimuslomakkeen avulla, joka lähetettiin 345 suomalaiselle kunnossapidon ammattilaiselle. Tutkimuksessa arvoelementtejä tarkasteltiin neljästä eri näkökulmasta: kunnossapidon asiakkaan kriittistä ja ei-kriittistä kohdetta sekä palvelun toimittajan ydin- ja tukipalvelua tarkastellen. Vastaajat arvostivat tärkeimmiksi arvoelementeiksi luotettavuuden, työturvallisuuden, ympäristöturvallisuuden ja tietotaidon. Vähiten arvostettuja elementtejä olivat omaisuuden hallinta ja markkinoille pääsy. Arvoelementtien välillä löydettiin myös tilastollisesti merkitseviä eroja ja johdon työkaluksi esitetään arvoelementtien profilointi-mallia.

Tämä diplomityö on tehty osana MaiSeMa (Teolliset kunnossapitopalvelut uudistuvassa yritysverkostossa: Tunnista, mallinna ja johda arvoa) tutkimushanketta. MaiSeMa:ssa rakennetaan verkostolle päätöksentekomalleja joiden avulla voidaan tunnistaa, mallintaa ja johtaa kunnossapitopalvelun arvoa.

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Thank you, this has been my most interesting and speedy summer, so far.

Lappeenranta, September 2013

Maaren Ali-Marttila

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LIST OF ABBREVIATIONS

AHP	Analytical hierarchy process
KPI	Key performance indicators
MaiSeMa	Industrial Maintenance Services in a Renewing Business Network: Identify, Model and Manage Value-research project
SHE	Safety, health and environment
SLA	Service level agreement
VDM	Value driven maintenance

1 INTRODUCTION

1.1 Background

Especially in asset-intensive industries 20-50% of the production costs are maintenance costs (Parida and Kumar, 2009, p. 17). This is a great amount of the operational costs but maintenance cannot be seen only as a cost factor anymore. Right implementation of maintenance services will contribute to overall business performance because of its impact for example on quality, availability, efficiency, and safety (Al-Najjar and Alsyouf, 2004, p. 643; Järviö et al., 2007, p. 23). Jonker and Haarman (2006, p. 3) conclude: "*The value of maintenance comes from delivering maximum availability at minimum cost*".

The companies have many different options to acquire maintenance services. The companies can have internal maintenance departments which are responsible for the maintenance functions or they can acquire the maintenance services from the original equipment manufacturer. The maintenance services can also be outsourced to an independent service provider (Rekola and Haapio, 2009, p. 28). Often maintenance is executed as a combination of these different options and customer, equipment manufacturer, and maintenance service networks are created.

Nowadays many companies have outsourced their maintenance services wholly or partially, and this underlines the need to evaluate the value of maintenance services and contracts to avoid disagreement and inadequate performance (Kumar et al., 2006; Tynninen et al., 2012). The value discussion is important also from the service provider's point, so that the provider is able to price the services correctly and develop trust between the parties based on common understanding of the value creating elements (Ojanen et al., 2012). Also the competition field has changed from being between companies to being between networks but from the industrial maintenance perspective the management tools for these networks are still missing. In addition, there is relatively little literature considering value or value elements of

industrial maintenance services, and this strengthens the need to formulate and assess the value of maintenance services based on customer collaboration (Ojanen et al., 2012; Tynninen et al., 2012).

This Master's Thesis is part of a three year research project MaiSeMa (Industrial Maintenance Services in a Renewing Business Network: Identify, Model and Manage Value) at the Department of Innovation Management in Lappeenranta University of Technology. The project is divided into three parts: 1. Identifying the value of the maintenance service, 2. Modeling the value of the maintenance service, and 3. Managing the business network with the created tools. This thesis is part of the first part where the value of maintenance services is identified based on workshops and survey results, and a value element profile is created that provides managers a more concrete way of managing value. This study works as a pre-study by analyzing the survey results and examining if the value element approach is suitable for further research. It provides a stepping-stone for the further research of maintenance services value.

1.2 Goals and definitions

There is only little literature considering the value and value elements of maintenance services and also a need for modeling maintenance services and its value (Al-Turki, 2009; Tynninen et al., 2012). Therefore the main goal of this study is to identify the most essential value elements for the customer and the service provider of maintenance services and profile the value. In this thesis the word *profile* is used to describe the whole research process from recognizing the value elements, testing the value elements and developing a model to represent how the value could be profiled, not only to represent the final model.

Figure 1 presents the idea how value can be created in maintenance services by profiling the value elements and the intended win-win situation. In addition to value creation, the win-win situation is highlighted because it is essential that both parties

gain benefits from the provided maintenance service. In order to improve the competiveness of the relationship, the organizations need to understand what elements create value in maintenance service collaboration (Lapierre, 2000).

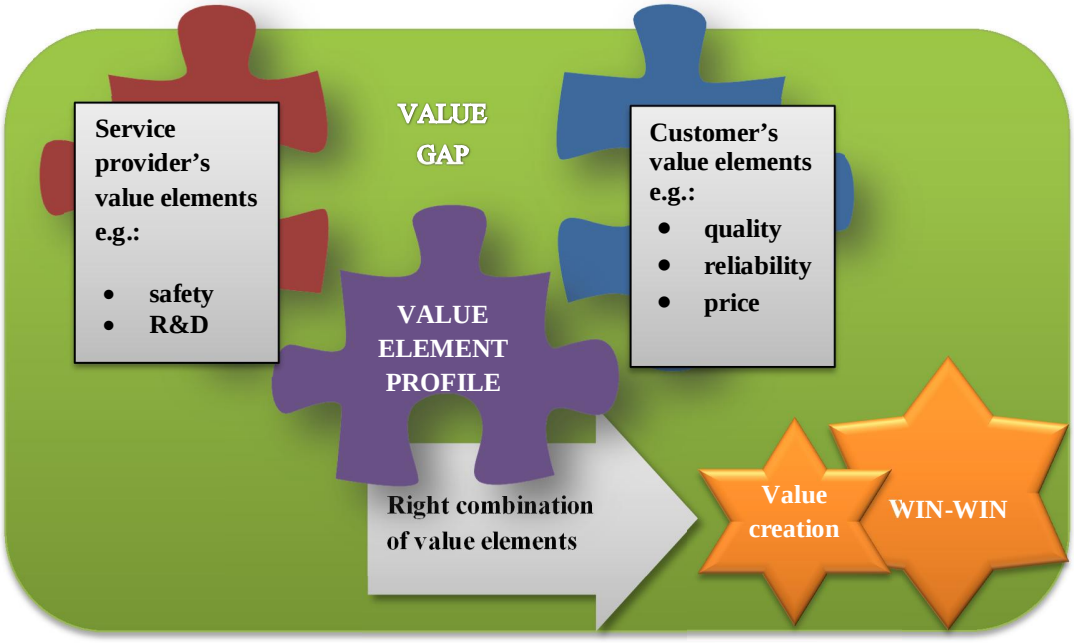

Figure 1. Value creation in maintenance services with the help of value elements

With the value element approach we offer one way to find out how the value of industrial maintenance services is modeled and created for each partner. Also the possible differences within the customer's and the service provider's value elements are tested. The main research question of this study is:

- What are the most important value elements for the customer and the service provider of industrial maintenance services?

The main question is divided into the following sub-questions:

- Do the customer's value elements differ depending on the maintained item?

- Do the service provider's value elements differ depending on the provided maintenance service?
- Where are the differences between the maintenance services customer's and service provider's value elements?
- How can the value elements be profiled for future business decisions?

In the research of value and value elements also other terms of value have been used, for example value driver and service attribute. However, in this thesis we use the term value elements of maintenance services that Ojanen et al. (2012) have discussed. When defining and discussing value and finding the value-creating areas the term value element is a suitable perspective to value.

The study is defined to consider only industrial maintenance services so other maintenance services are left out of the discussion. Also the review of the maintenance service risks and benefits are defined out of the theoretical part to keep the theory more focused around the definitions to understand the value element approach and the presented hypotheses. In addition the maintenance service KPI's (key performance indicators) and exact measuring of value are not discussed precisely in this study because they are studied in the second part of the MaiSeMa-research project. The goal of this thesis is to find the elements that could be measured.

The used theory focuses mainly on articles, previous studies of the university, and books relating the industrial maintenance services generally and the value element discussion. The theory also presents statistical methods that were used for the statistical analysis of the survey. From the previous studies of the university especially the literature research of Tynninen et al. (2012) and workshop results of Sinkkonen et al. (2013) are exploited in the value element discussion. They were also executed as part of the MaiSeMa-research project and were done as pre-studies for the survey. The empirical part of the study is defined to relate the analyzing of the

survey results. This study exploits a survey made with the help of the Finnish Maintenance Association Promaint in spring 2013, which data is now ready for use.

1.3 Methodology

This thesis is an empirical research, where the survey-method is used to gather the empirical data. The survey-data is analyzed statistically with the SPSS Statistics 21 program so the main research strategy is quantitative.

With quantitative study numerical questions are surveyed and they usually use standardized questionnaires. Propositions are presented with numerical figures and figures and tables are used to illustrate. Quantitative study is good for surveying but often it is not enough to explain phenomena (Heikkilä, 2008, p. 16; Hirsjärvi et al., 2013, p. 138). Its purpose is to find new viewpoints, find new phenomena, develop hypothesis, and decipher phenomena that are little known. A quantitative study needs theory to be able to explain the phenomena (Tuomi, 2007, p. 95). Typical features for a quantitative research are conclusions from previous studies, previous theory, presenting hypotheses, define concepts, data collected so that it can be statistically analyzed, precise sample planning, and making conclusions based on statistical analysis (Hirsjärvi et al., 2013, p. 140). Figure 2 presents the typical stages of a quantitative research process. This thesis starts from the analyzing the data stage. The previous stages were executed earlier by the research group of the MaiSeMa-project.

Developing hypotheses that can be tested is common especially in explanatory and comparative studies (Hirsjärvi et al., 2013, p. 158). Also in this study hypothesis testing is used to identify statistically significant differences in the value elements.

The results of the data analysis and hypothesis testing are exploited in the value element profile construct. The profile is used to deepen the discussion and to show how the results and value elements can be taken into advantage.

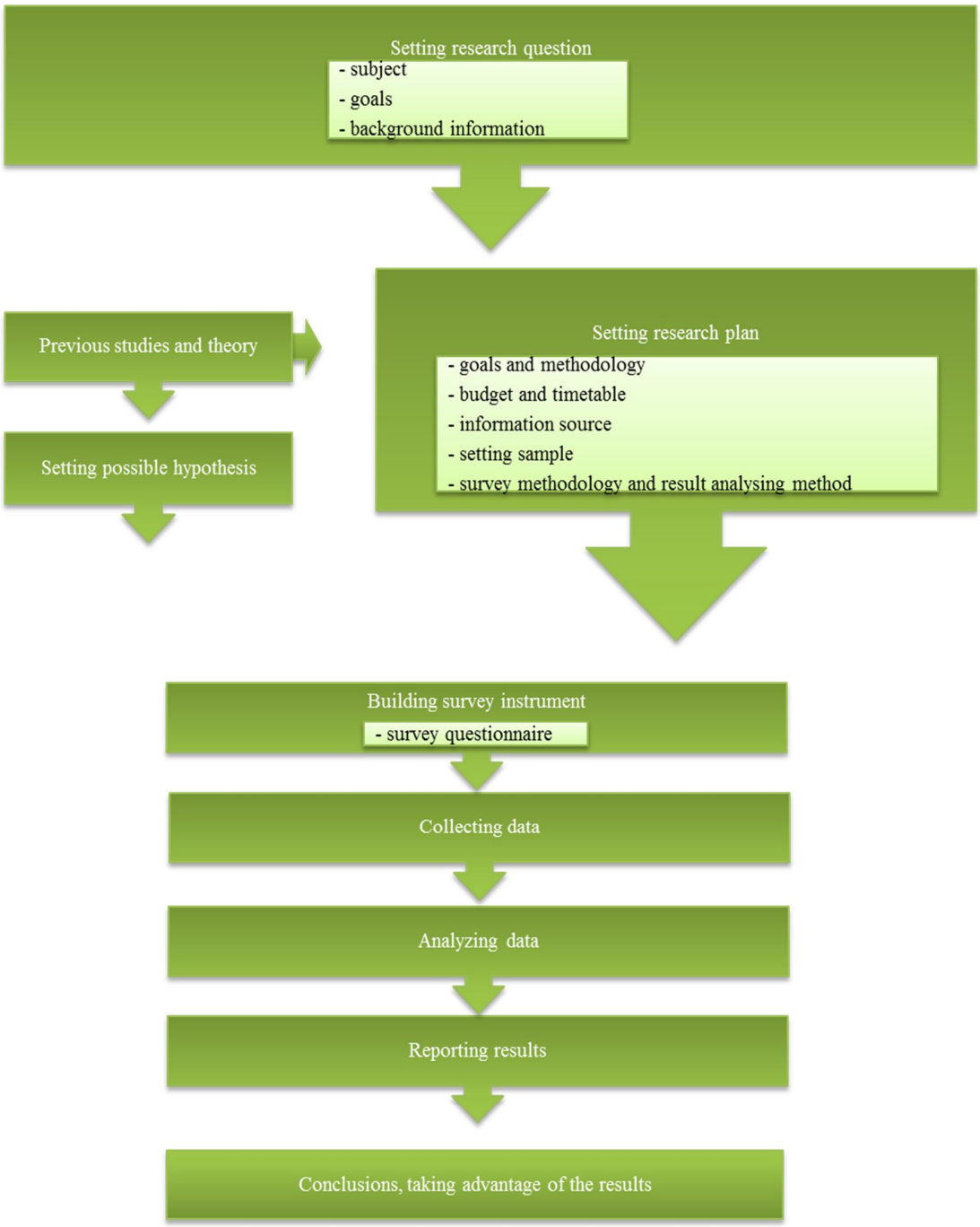

Figure 2. Stages of a quantitative research process (Heikkilä, 2008, p. 25)

1.4 Structure of the report

This thesis consists of 5 chapters and the thesis is structured as follows. Chapter 1 is the introduction where the background for the study, research questions, goals and definitions, and methodology are presented. The main theory starts from chapter 2 that introduces the industrial maintenances services in general and defines value. The chapter further presents the theory of value elements in maintenance services. The theory is looked from the service customer and the service provider point of view, and the tested hypotheses are formed based on this theory. Chapter 3 introduces the survey method and instrument and also the reliability is defined. In this chapter also the statistical analysis methods are presented that are further needed in analyzing the survey results. At the end of chapter 3 the sample descriptive data is presented.

Chapter 4 presents the survey and hypothesis testing results and discusses them. Also a value element profile is presented based on the survey results. Finally, chapter 5 presents the conclusions with future research objectives. A more specific view into the structure of the report can be seen in the input-output chart (figure 3).

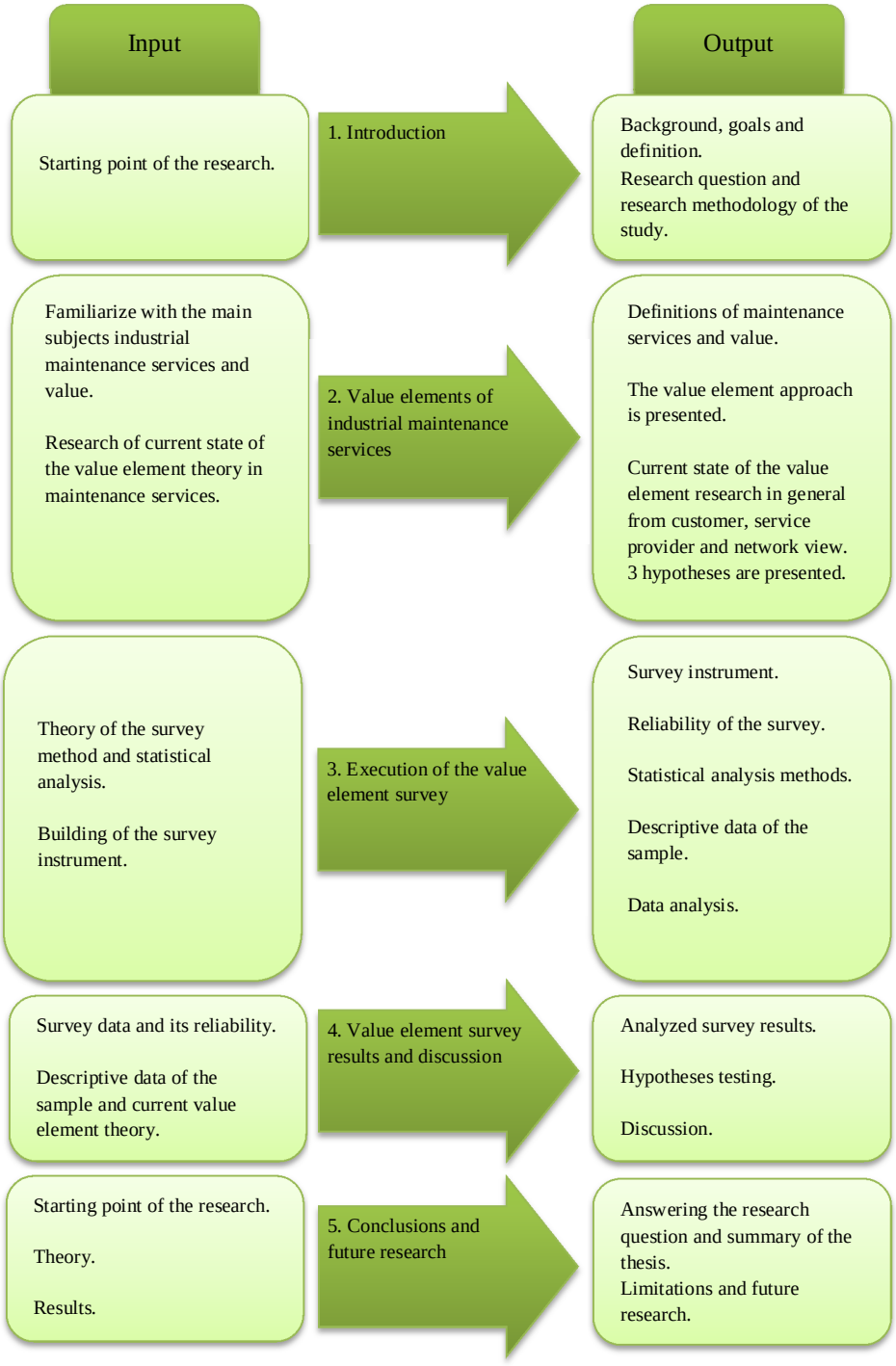

Figure 3. Input-output chart of the report structure

2 VALUE ELEMENTS OF INDUSTRIAL MAINTENANCE SERVICES

2.1 Definition and development of industrial maintenance services

Maintenance means keeping an item in good working condition and reliable by repairing the occurring faults, and controlling the environmental and safety risks. The item should be able to be used to its full productive capacity (Gulati, 2009, p. 46; Järviö et al., 2007, p. 15). The SFS-EN 13306 (2010, p. 9) standard defines maintenance as follows: *"Maintenance is a combination of all technical, administrative and managerial actions during the life cycle of an item intended to retain it in, or restore it to, a state in which it can perform the required function"*. Also many other definitions of maintenance service types can be found but the majority in one way or another define maintenance as an activity that keeps the items in the desired operating condition or repair them to the required condition (Pintelon and Parodi-Herz, 2008, p. 22). Sounds simple but in reality the maintenance context is complex.

To achieve the desired operation condition the maintenance function needs to cope with many different forces and requirements as can be seen in figure 4. In the maintenance field, a manager balances with technology, operations and logistics that need to be harmonized with production. Technology is considered to be the technical items which maintenance supports with adequate tools and equipment. (Pintelon and Parodi-Herz, 2008, p. 22)

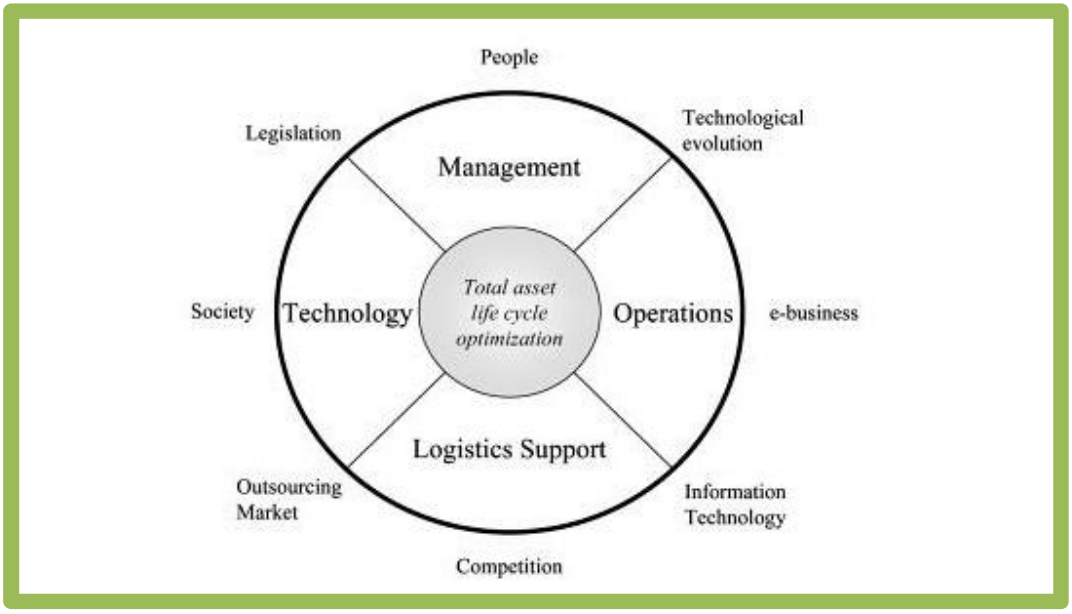

Figure 4. Maintenance in context (Pintelon and Parodi-Herz, 2008, p. 22)

Maintenance work tasks are most commonly divided into two major categories, preventive and corrective maintenance as can be seen in figure 5. Preventive maintenance is executed before a detected fault and it is carried out at predetermined intervals or according to prescribed criteria. The purpose of predetermined maintenance is to reduce the failure probability and the decreasing of item functionality. Corrective maintenance is executed after a detected fault and it aims at putting the item into a state that it can perform the required function again (Järviö et al., 2007, p. 47; SFS-EN 13306, 2010). This categorization is based on the fault recognition. There are also other ways to categorize the maintenance types, for example the process industry standard divides the maintenance types into planned maintenance and breakdown maintenance (PSK 6201, 2011 p. 22) and Järviö et al. (2007, p. 49) divide the maintenance types into preventive and corrective maintenance, overhaul, curative maintenance and the detection of fault causes. Further in this thesis we use the standardized maintenance type division into preventive and corrective maintenance.

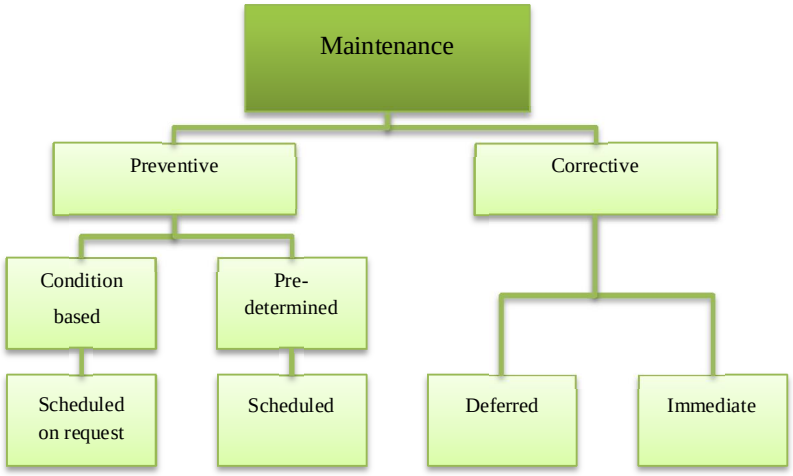

Figure 5. Maintenance types (SFS-EN13306, 2010, p. 39)

Maintenance has developed from a mere inevitable part of production into an essential strategic element (Pintelon and Parodi-Herz, 2008, p. 21). In the early stages of maintenance services until the 1960's it was viewed as the necessary evil and cost component, the maintenance was mainly corrective and the faults were repaired after a breakdown (Gulati, 2009, p. 46; Laine, 2010, p. 105). In the 1970's the idea of preventive maintenance started to raise its head. The importance of reliability and efficiency grew (Järviö et al., 2007, p. 17). New maintenance strategies were developed and the trend was to execute planned fixed time maintenance. This is a very expensive way and it does not necessarily even reduce unexpected breakdowns and shutdowns, because of its "over maintenance". The next development stage was in the 1980's where condition based maintenance thinking was developed. Condition based maintenance is focused on the actual condition of the maintained item. The item is checked regularly and the current condition of the item is measured continuously (Järviö et al., 2007, p. 17-18; Laine, 2010, p. 105).

At the same time as the strategies have developed also the maintained items have become more complex. Basically the maintenance function has developed from a

necessary evil to a technical matter and further as a profit contributor and cooperative partnership as can be seen in figure 6. Now, maintenance is treated as a part of business strategy development (Pintelon and Parodi-Herz, 2008, p. 26). The corporate world has begun to realize that maintenance can add value (Gulati, 2009, p. 47).

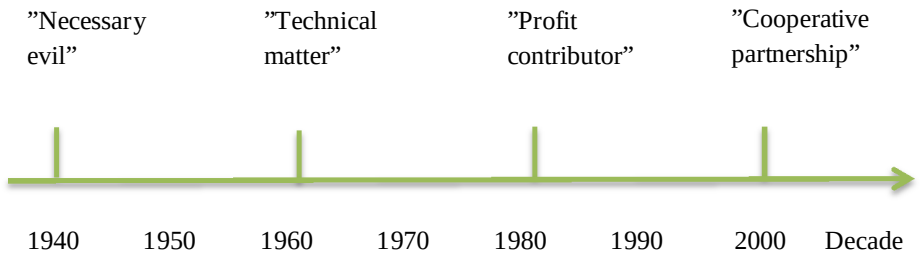

Figure 6. Development of maintenance (Pintelon and Parodi-Herz, 2008, p. 26)

In Finland, outsourcing has increased the demand for industrial maintenance services, and nowadays maintenance is a significant industry (Hatinen et al., 2012). The maintenance services employ over 200 000 people. Yearly about 24 billion euros are invested into maintenance services, of which 3,5 billion euros are into industry. This makes it the third biggest industry field in Finland. The main focus is on preventive (34%) and breakdown maintenance (35%) but also curative maintenance (15%) and other maintenance works (16%) are performed. The developing markets in Asia cannot be satisfied from Finland and therefore the new equipment investments are in majority directed overseas. The national capacity is for the own market and therefore in Finland the maintenance operators have to work with ageing capacity and make sure the capacity is high enough. This makes maintenance services a great challenge. The maintained items have to be kept as reliable and efficient as the new ones, so that the competition does not run over. (Järviö et al., 2007, p. 26-31)

2.2 Definition of value

Value, adding value and shared value in services have been a major focus in service literature and are often highlighted to the customers and the providers. However, the definitions of value are vague. Customer value is generally defined as the tradeoff between the give (sacrifices) and get (benefits) components (Zeithaml, 1988) as can be seen in figure 7. The benefits can include for example quality, whereas price can be seen as a sacrifice (Dumond, 2000, p. 1062). Customer value can also be viewed as customer desired value and customer perceived value, where the desired value is what the customer wants to receive and the perceived value what has happened (Flint et al., 1997). Customer value can also be split into perceived value and exchange value, where the exchange value is the amount the customer is prepared to pay for the service (Ramsay, 2005, p. 555). Lapierre (2000) has tested the customer value construct in three industrial service sectors. The study supports that the customer's total value proposition consists of product, service and relationship related value drivers.

Supplier value is seen as the benefit the supplier receives from acting with the customer, for example profit (Purchase et al., 2009; Ramsay and Wagner, 2009). The marketing literature focuses mainly on the customer, and supplier value is hence studied notably less than customer value (e.g. Purchase et al., 2009; Ramsay and Wagner, 2009). Chicksand et al. (2011) address that better defining is needed to explain what value is from both the buyer and the supplier perspective.

Value is created more and more in collaborative relationships and therefore also relationship value has been studied (Smals and Smits, 2012; Ulaga, 2003). For a customer and service provider, the creation of value can be considered as the essential purpose when engaging in a collaborative relationship (Walter et al., 2001, p. 366). The suppliers need to offer value to the customer but they also need to gain benefits from the customer at the same time. Both parties need to understand how the relationship creates value and the intended win-win situation is achieved, for example

the supplier benefits from expanding the markets and the customer from increased service levels. To explain how total value (monetary and non-monetary) is shared Chicksand et al. (2011) addresses that the key is to understand the power dynamics between the buyers and suppliers because the total value created in a relationship is not automatically shared equally. Payne (2006) explains that the value creation process consists of what value the customer receives, what value the service provider receives, and how the value exchange can be successfully managed to maximize the received total value.

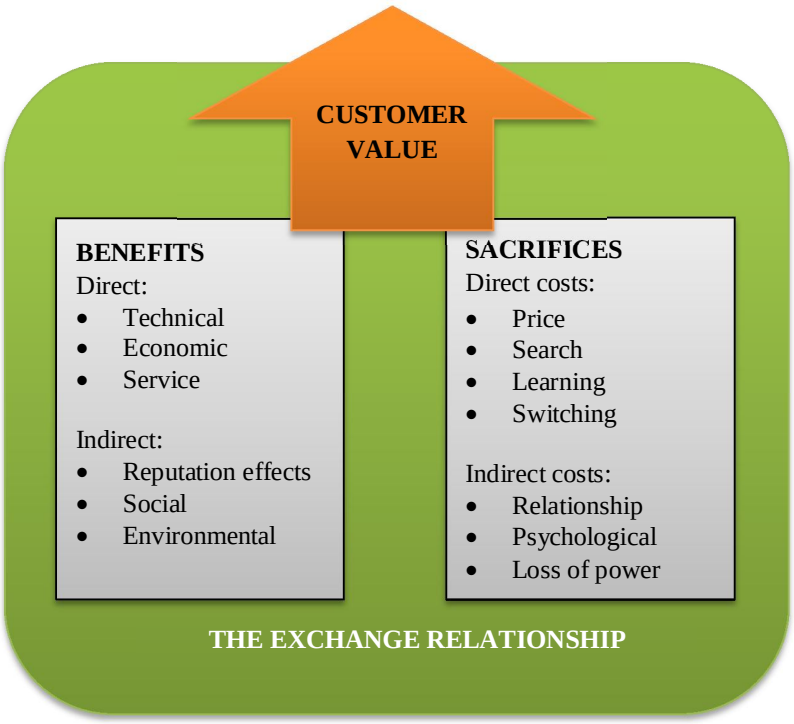

Figure 7. Customer value as a complex investment decision (Chicksand et al., 2011)

2.3 Value of maintenance services

Maintenance adds value by delivering maximum availability at minimum cost. Of course, in practice this is not as simple. Maintenance managers must constantly balance between different value drivers in order to achieve the best total value. If the market demand is high, the business wants the item utilization to be increased, so more focus is on maintenance and resource allocation. On the other hand, if the market is declining the focus is on controlling the costs, not increased item utilization. The Finnish Maintenance Society Promaint (2007) has listed factors how maintenance services add value to the overall business based on increase of profit, cost savings and society factors (figure 8). (Jonker and Haarman, 2006)

A new approach to increase the maintenance service value with profitability is asset management. This tackles especially the problems of overcapacity, low profitability of investments and great variation in demand. Asset management is a way to prepare for the economic changes with flexibility of the fixed assets. In best cases the operation costs are always optimal, because the factory capacity can be changed according to demand. (Järviö et al., 2007, p. 24; Ojanen et al., 2012, p. 75)

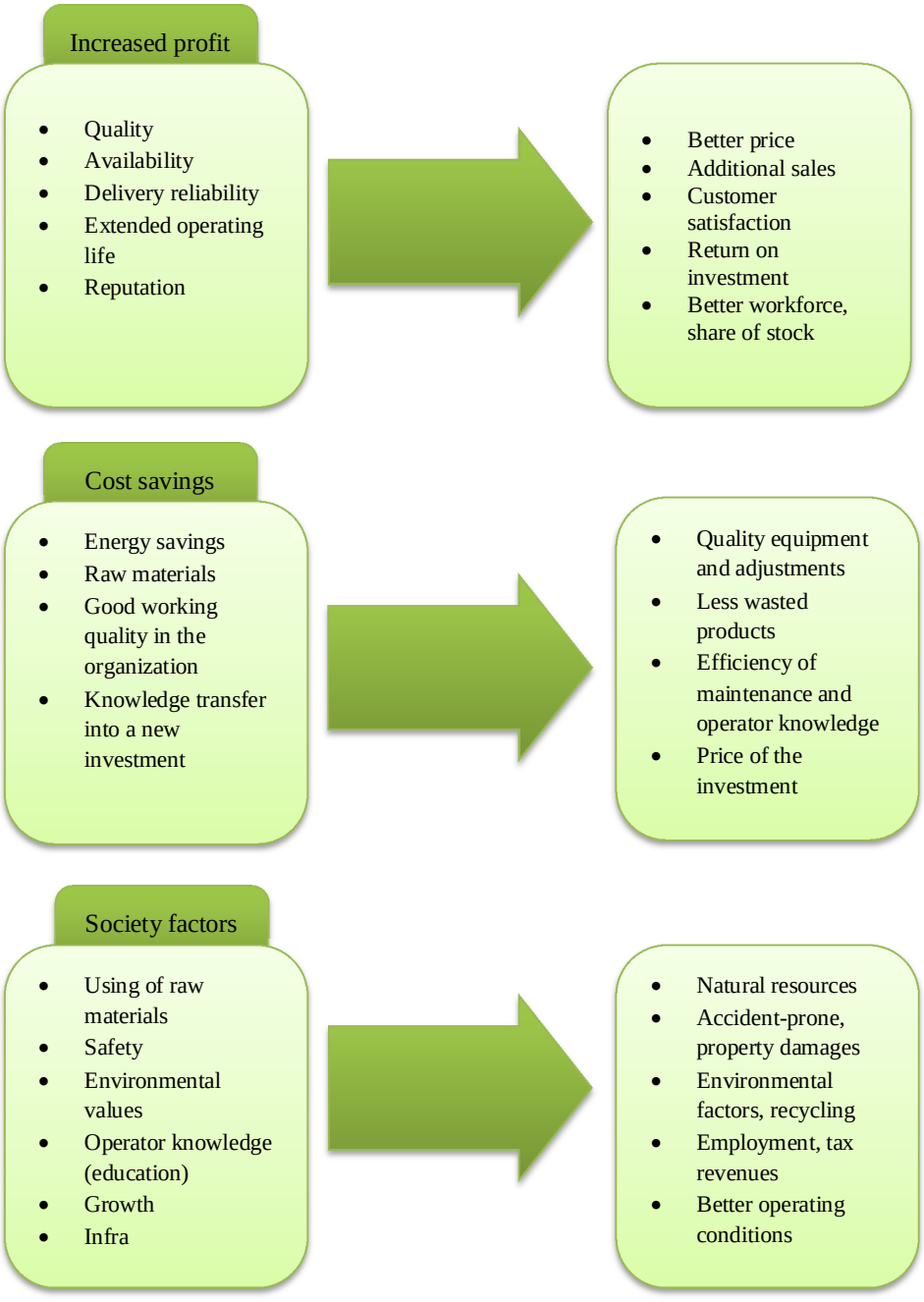

Figure 8. The effects of maintenance services into business operations (modified from The Finnish Maintenance Society Promaint, 2007, p. 22)

On the economical level, maintenance value can be considered to be equal to the sum of all future cash flows discounted to today. Based on the VDM (value driven maintenance) approach of Jonker and Haarman (2006) this would mean the future cash flow from item utilization, cost control, resource allocation and the SHE factors as can be seen in figure 9.

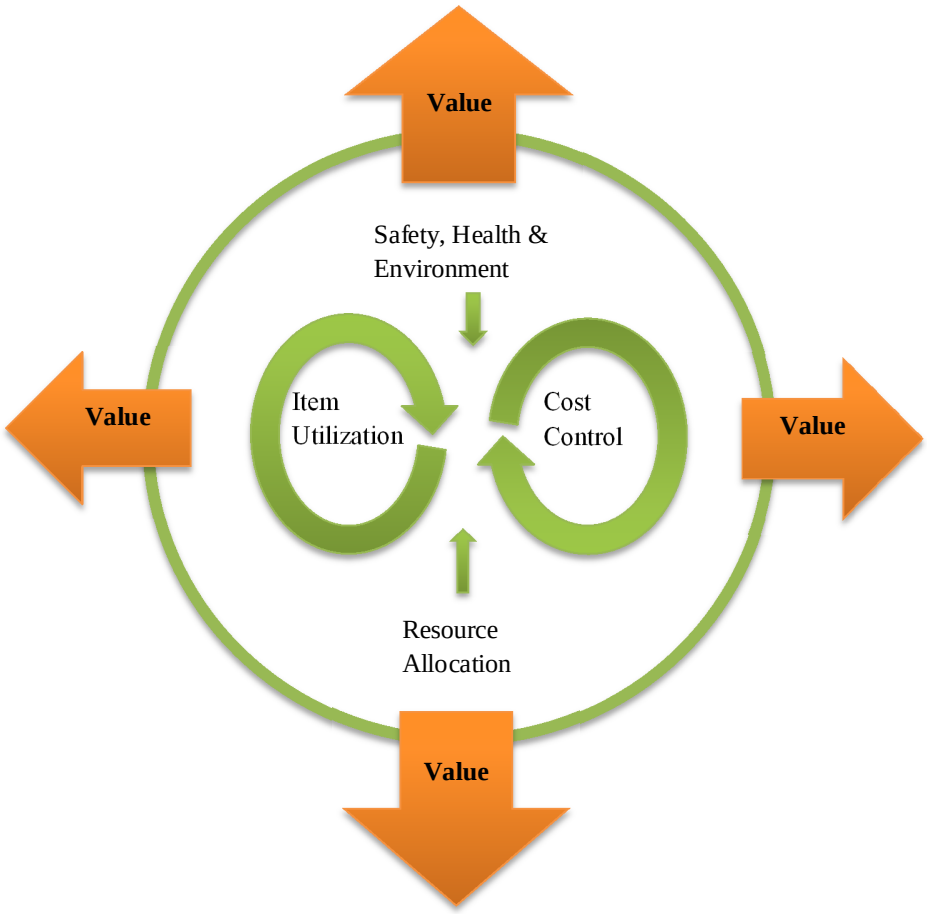

Figure 9. Value driven maintenance (Jonker and Haarman, 2006, p. 4-5)

There is a constant balancing act with the higher machine availability (item utilization), and lower maintenance costs (cost control) and at the same time the laws and regulations covering safety, health and environment must be taken into account.

In order the resources need to be allocated accordingly. (Jonker and Haarman, 2006, p. 4-5) Although the VDM discusses the value as drivers also in this approach the value is considered to consist of different segments that can be summed together.

Another way to consider total value of maintenance service is the value element approach where value is considered to consist of value elements (e.g. reliability, flexibility and quality), and total value is created with the right combination of these elements (figure 10).

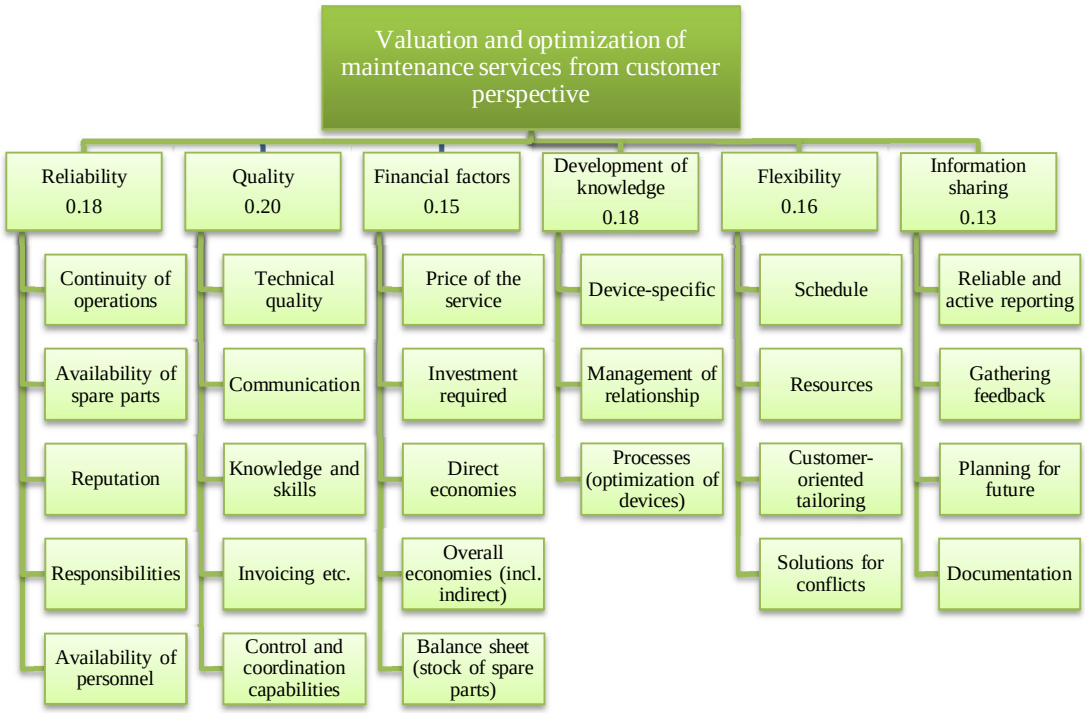

Figure 10. Maintenance services as value elements (Ojanen et al., 2012, p. 75)

Ojanen et al. (2012, p. 74-75) present the customer's total value as a sum of the weighted elements. The elements are further divided into sub-categories using the AHP (analytical hierarchy process). Also the sub-factors could be weighted, so that the weight of a value element sub-factor affecting the total value could be defined.

The example value elements presented in the figure are based on a single case. In this study the value element approach is used and surveyed with a bigger sample.

Komonen et al. (2007) research supports that maintenance service value can be considered as elements. Komonen et al. (ibid.) have not directly researched value or the total value of the network but they have researched especially customer and supplier satisfaction in maintenance and how customer satisfaction and job satisfaction are related to each other. In the research based on survey results five dimensions were recognized for customer satisfaction, they were quality of operations and service level, crew's professional skills, cost level, feedback to customer, orderliness of maintenance, and competence. For job satisfaction the dimensions were grouped into six categories, they were systematic leadership and co-operation, satisfaction with one's own job content, requirement set by superiors, collective responsibility for customer service, match of wage level with job requirements, and willingness to expand one's own job content. These divisions were further divided into sub-categories. The research concludes that high customer satisfaction can be achieved with high flexibility or systematic planning.

2.4 The research state of value elements in industrial maintenance services

Value elements are strongly industry bound and have been considered more in b-c businesses, such as hotel, banking and restaurant industries, and the focus in the value literature concerning services has been on the customer side (Purchase et al., 2009; Ramsay and Wagner, 2009). When articles related to the value elements of services were reviewed, 14 articles considering the customer view and only 4 articles considering the supplier view were found (Tynninen et al., 2012). None of the reviewed articles considered the value elements of industrial maintenance services. In the 21st century surveys considering industrial maintenance services have mainly discussed performance measurement, new maintenance service types, and safety issues (Luumi, 2012). A survey that considers specifically the value elements of

maintenance services has not been published in an academic journal. This stresses the need to research the value elements of industrial maintenance service to see what is valued and what are the differences between the customer and the service provider.

To get a starting point for the possible value elements of industrial maintenance, Tynninen et al. (ibid.) gathered the value elements suitable for industrial maintenance services from the reviewed service literature (figure 11). Then the recognized elements were discussed and modified in a workshop of company representatives as Sinkkonen et al. (2013) describe. The idea was to test if the value elements of the literature research were even close to the ones the operators consider as value elements of industrial maintenance service.

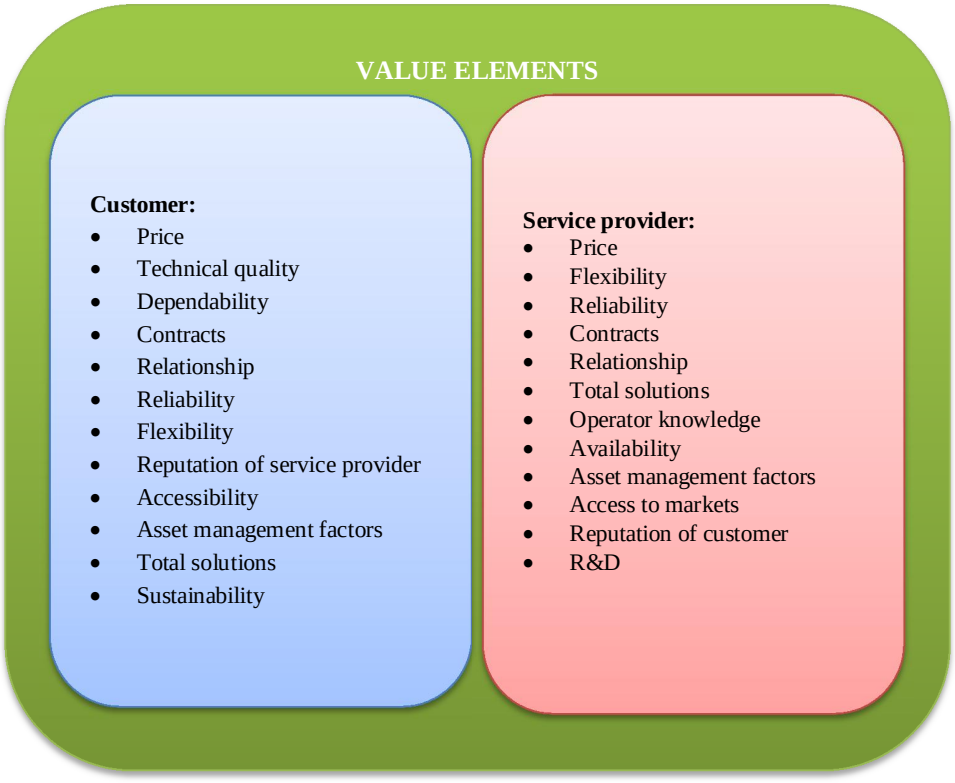

Figure 11. Preliminary value elements of industrial maintenance services (Tynninen et al., 2012)

In the workshop Sinkkonen et al. (2013) describe it was noticed that from the theoretical literature based list, Tynninen et al. (2012) present, lacks some elements the company world values. Especially safety at work was emphasized to be one of the most important criterions in customer-service provider relationships. Also environmental safety, service ability and orderliness were thought to be value creating elements.

Measuring the value of maintenance services is difficult because of their complex and multiform nature. However, the value element approach is one way to find out how the value of industrial maintenance services is modeled and created for the customer and the service provider.

2.5 Industrial maintenance service customer's value elements

To execute maintenance successfully an appropriate maintenance strategy has to be chosen for each item or process and this affects also the preferred value elements. The maintenance strategy should be linked with the manufacturing and business goals. If the strategy is not linked, this will affect negatively manufacturing performance in terms of quality, customer service, and cost. This is mainly understood within the businesses but in operational actions there is often a gap between the business and maintenance strategy. Linking maintenance and strategy throughout all decision levels is a major challenge for the future (Pintelon et al., 2006, p. 8; Robson et al., 2013).

At the operational level in maintenance planning, item criticality has to be categorized to make sure how the maintained items have to be prioritized and that the right maintenance method is identified (figure 12) (Márquez, 2007). The item criticality should always be considered individually for each company and item but the basic idea is that the intensity of the maintenance service lowers the less critical the item is (Dong et al., 2008, p. 862; Järviö et al., 2007, p. 87, 97). After there is a certain priority for the items the appropriate maintenance strategy should be

identified. For the high critical items effective maintenance should be used and it should focus on preventive maintenance, reach optimal reliability, maintainability, and availability levels. The less critical the item, the more simple the maintenance strategy should be. With the low criticality items the maintenance can be corrective and focus on sustaining. (Järviö et al., 2007, p. 86; Márquez, 2007, p. 124)

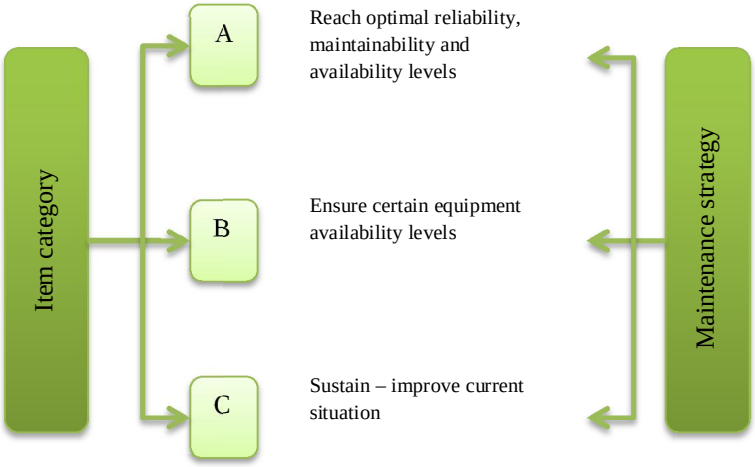

Figure 12. Maintenance strategy based on item criticality (Márquez, 2007, p. 124)

The items can be categorized into different criticality groups with many techniques. The standard SFS-EN 13306 (2010, p. 42) presents a criticality matrix where items are categorized depending on the failure frequency of the item and the severity of failure or fault (figure 13). Based on the matrix item criticality is high, if the severity of the failure is very severe or the failure frequency is high. Also Dong et al. (2008, p. 863-866) present a way to categorize items based on the failure frequency. In the model Dong et al. (ibid.) present, the reliability, economical, maintenance, safety, and environmental factors are considered. Based on these factors a numeric value is calculated, which ranks the items into three categories that are key items, important items, and secondary items. Based on these categories the suitable maintenance strategy is then chosen.

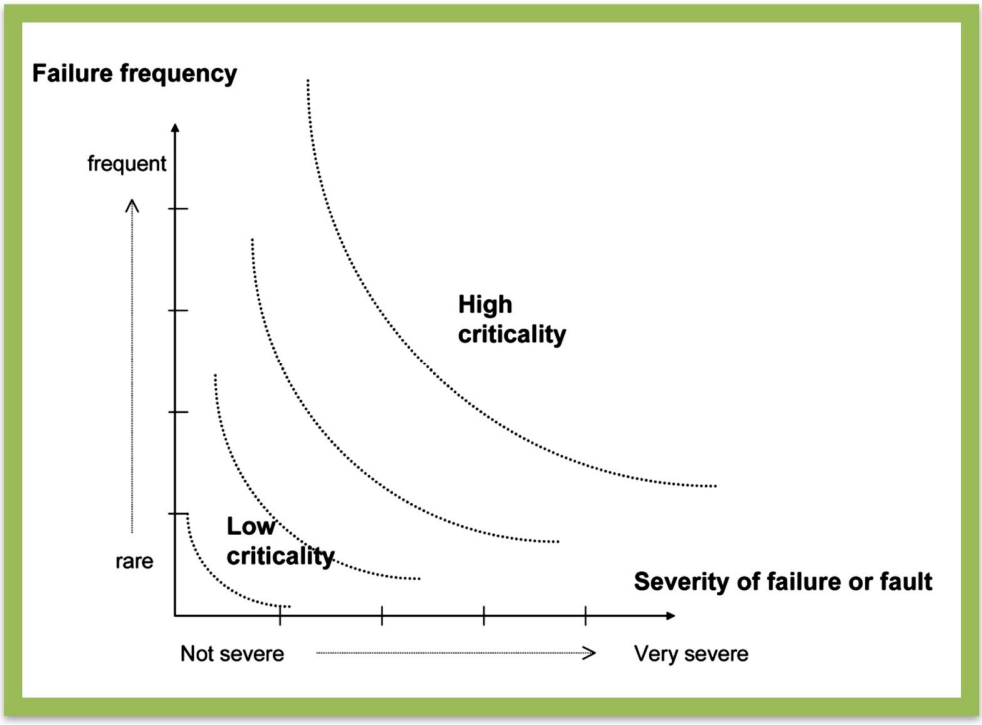

Figure 13. Criticality matrix (SFS-EN13306, 2010, p. 42)

Márquez (2007) presents criticality assessment methods that are based on the cost and consequence of the breakdown of an item. These are used especially in the chemical industry. Also the AHP-method can be used to find the most critical items in a process (Márquez, 2007, p. 116). There the criteria, for example failure frequency, detection, severity and cost and, processes are put in a hierarchical tree and with weighs for different situations the processes get a criticality rank. For example a critical pump can be considered as a critical item, and the maintenance should focus on continuous condition-based maintenance. Conversely, the maintenance of the company garden can be considered as a low critical item and the maintenance strategy could be weekly predetermined maintenance.

Price, technical quality, dependability, contracts, relationship, reliability, flexibility, reputation of the service provider, accessibility, asset management factors, total solutions, and sustainability were chosen as the industrial maintenance service

customer's value elements. After the workshop Sinkkonen et al. (2013) presented safety at work and environmental safety as new elements in addition to the preliminary list Tynninen et al. (2012) had made. Adding safety to the list makes sense, because the impact of maintenance work on safety issues comes up repeatedly in maintenance literature (e.g. Gulati, 2009; Järviö et al., 2007; Márquez, 2007). Also the increased amount of outsourcing emphasizes the safety at work-element in procurement situations (EU-OSHA, 2012; Lind et al., 2008).

For example with a high critical item, availability could be the most important value element, while for a low critical item it could be price (Tynninen et al. 2012). Also the workshop results suggested that there would be differences in the most important value elements depending on item criticality and occasion (Sinkkonen et al., 2013). Based on the literature and workshop results it is predicted that the value elements of the customer differ according to the item criticality, and we posit

Hypothesis 1: The customer's value elements differ depending on the item criticality.

2.6 Industrial maintenance service provider's value elements

To be successful in marketing, service providers need to differentiate their service offerings through people and processes that add value, in other words, choose the right value elements. When the customer is correctly assessed, the maintenance service company can offer customized services to each customer and at the same time increase the revenues of the company (Liang, 2010, p. 7489). The theory also suggests that companies that create superior customer value and regularly introduce innovations in service offerings will gain competitive advantage over their competitors (Guenzi and Troilo, 2007; Kotler and Keller, 2012).

The industrial maintenance services include many kind of different maintenance activities provided to the customers. For example Järviö et al. (2007, p. 29) has categorized maintenance services according to professionals into mechanical maintenance services, construction, electricity, IT and automation, and

administration, management and development services. Kumar et al. (2004, p. 400) list services that belong to maintenance services and are not professional related as providing different kinds of assisting services relating the product, providing spare parts, providing overhaul services, expert services, training, measuring, and fulfilling the actual maintenance service.

Kowalkowski et al. (2011, p. 182-184) characterizes the industrial services into eight different service offerings that are repair services, operations training, retrofit services, process optimization, safety inspection SLA (service level agreement), high-end SLA, short term rental and long-term rental. Repair services can be either corrective or preventive and they are restoring items to sound condition. Operation training is provided that the users have sufficient skills to operate the equipment. Retrofit services are performance upgrade services and the focus is on performance enhancement and minimizing life-cycle costs. Process optimization on the contrary, is solving a specific problem related to the customer's production process with technical expertise like engineering and IT tools. Safety inspection includes equipment inspection and safety and functionality testing. With the high-end preventive maintenance SLA's the service provider offers comprehensive service bundles for a fixed time period. Often it includes preventive maintenance, and also corrective maintenance services and repair including spare parts. Short time rental means that equipment is rented for a short time period in a case of emergency or breakdown, it is for temporary use. In long term rental agreements the customer generally leases a total solution including equipment, maintenance, financing, training and spare parts. The service offerings are provided more and more from the service provider's side and they often cover the whole life-cycle of an item (Kumar et al., 2004, p. 401).

Grönroos (2000, p. 166-167) notes that for managerial reasons, services should be distinguished into three groups: core, facilitating and support services. The core service is the service for which the company is on the market. Facilitating services are the services customers need to use the core service, for example a bank card for an ATM. Support services, on the other hand, are services that are not essential for the

company but are used to increase the value of the service or to differentiate the service from competitors' service offerings.

For this study we consider core and support services to be a wide enough separation to see possible differences in the value elements of maintenance service providers. In industrial maintenance services a core service could be for example mechanical maintenance, and a support service would be measurement services.

As the maintenance service provider's value elements Tynninen et al. (2012) suggest price, flexibility, reliability, contracts, relationship, total solutions, operator knowledge, availability, asset management factors, access to market, reputation of customer and R&D. In the workshop also safety at work, service ability and orderliness were presented as elements (Sinkkonen et al., 2013). According to Sinkkonen et al. (ibid.), differences between the core and support service elements of the service provider were recognized, but the differences were not as clear as with the item criticality. Based on the theory we suggest

Hypothesis 2: The service provider's value elements differ between core and support service.

2.7 Differences between the industrial maintenance service customer's and service provider's value elements

For example Smith et al. (2012) emphasize that value should always be considered from both sides, how much value can be derived by a company from its customers and also the derived value to the customers from the company. Value also depends upon the participants' perceptions, and even though the companies may work in a network, each of the customers and the suppliers have their own motivations, problems and strategies (Ford and McDowell, 1999). This, in addition to the vague definition of value, results in versatile value element listings. In order to create value and improve the competiveness of the maintenance service relationship, the customer

and the service provider need to understand what elements create value for each party (Lapierre, 2000). However, understanding the value creation process and improve the competitiveness is not self-evident. A functional and competitive network requires a lot of openness, mutual trust and co-operation between parties (Levery, 1998; Panesar and Markeset, 2008; Rekola and Haapio, 2009).

Kalliokoski et al. (2003) describe different levels of relationship deepness possible in maintenance services (figure 14). The relationship can be just simply traditionally transaction oriented and the service provider is a product supplier, or the service provider can go all the way to value partnering, where long term co-operation and openness is required. The closer the relationship gets to the value partner stage, it is characteristic for the relationships that the provided item or service is only a small part of the cooperation. The main focus is on improving the partner's operations and efficiency and the service provider has deeper knowledge about the customer's processes and actions.

Nowadays these kind of deep value partnerships are still quite rare and not everyone even aims for them because they involve complicated contractual issues (Markeset and Kumar 2005, p. 54; Rekola and Haapio 2009, p. 29-30). In the best cases value partnering however can be very lucrative. If value partnering is the goal and a mutual win-win situation acquired the value elements should be considered do develop deeper understanding. To maximize the total value for both parties the value elements of the customer and the service provider need to be managed successfully.

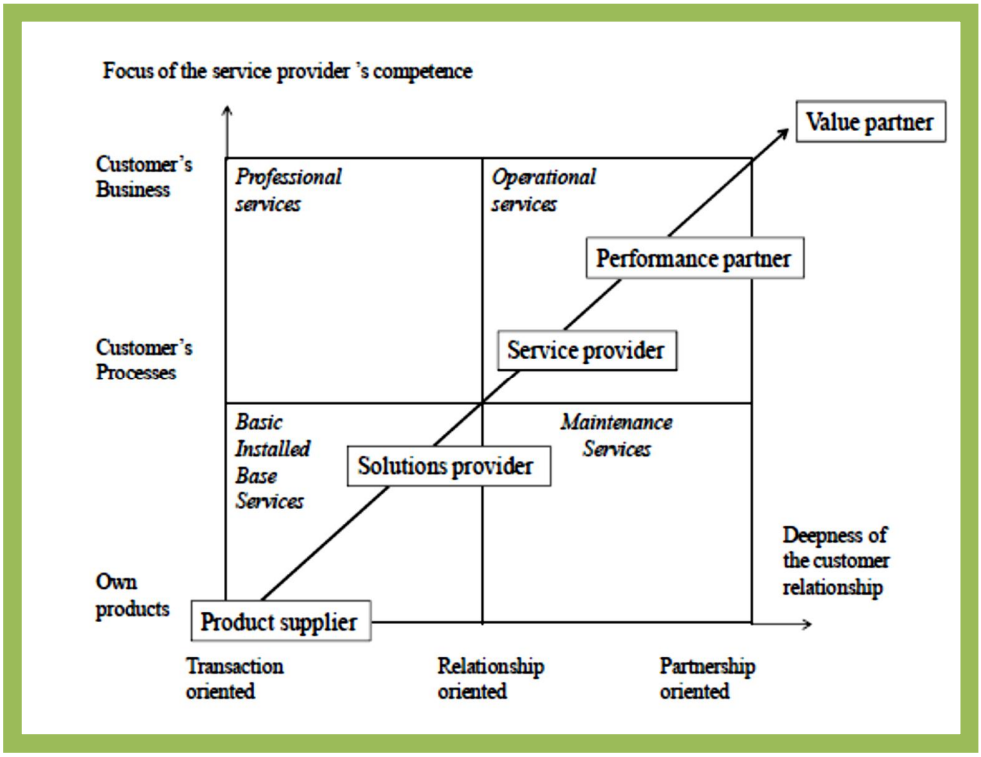

Figure 14. Competences and deepness of customer relationship (Ojasalo, 2009, p. 127)

As presented above as well as by Sinkkonen et al. (2013), when the item criticality and provided service are discussed, there are some differences in the listings of value elements when comparing the customer and the service provider. For example the service providers did not list environmental safety or asset management factors as value elements like the customers do. It seems that the value elements are partly similar, partly different between the customer and the service provider, but also depend strongly on the occasion, and therefore we posit as our concluding hypothesis

Hypothesis 3: There are differences (a value gap) between the customer's and the service provider's preferred value elements.

3 EXECUTION OF THE VALUE ELEMENT SURVEY

3.1 Survey-method

Survey-method is a planned questionnaire or interview study where standardized data is collected from a group of people. The data for the survey is collected with a questionnaire and in a qualitative study the questions are structured. The purpose of the data is to describe, compare and explain phenomena. (Heikkilä, 2008, p. 19; Hirsjärvi et al., 2013, p. 134)

The survey instrument is part of a larger survey process which includes setting objectives, planning and designing the survey, preparing the data collection instrument, validating of the instrument and survey, selecting participants, administrating the instrument and analyzing the data, and reporting the results (Pfleeger and Kitchenham, 2001, p. 16-17). The survey is already made as part of the MaiSeMa-research project so this thesis focuses especially on the final parts analyzing the data and reporting results.

The survey was conducted as an online-survey, where respondents were able to respond anonymously. The translated survey questionnaire for data collection can be seen in its entirety in appendix 1 (the original questionnaire was in Finnish). The respondents answered first questions about their background (questions 1-4) and after that they were routed either to the customer (questions 5-15) or the service provider (questions 16-26) side to answer more detailed background questions and questions considering value. Because value can be interpreted in many ways, in the survey instrument the 16 tested value elements were decided to represent two propositions each (table 1). The respondents did not see the assorted value elements but in the table they are shown for clarification. The final elements used in the survey were chosen on the basis of the preliminary study of Tynninen et al. (2012) and Sinkkonen et al. (2013).

Table 1. Value elements and they division into propositions

Proposition	Value element
1. The target of the maintenance work functions as expected, its maintainability and repair is easy. 2. The users look after their part of the in use maintenance operations and enhance the maintainability of the item.	Availability
3. The operational conditions and safety increase along the service. 4. The maintenance is performed according to safety policies.	Safety at work
5. The maintenance service performer recognizes the environmental safety hazards. 6. The maintenance is performed according to environmental safety policies.	Environmental safety
7. The maintenance service outcome is as expected. 8. The maintenance service outcome is sustained for the promised time.	Technical quality
9. The maintenance service partner bends from its claims (e.g. . delivery time) 10. The maintenance services are tailored based on need.	Flexibility
11. The maintenance service cooperation is executed on time and as promised. 12. The maintenance service cooperation is based on confidentiality.	Reliability
13. The maintenance service provider has the knowledge to solve upcoming problems. 14. The maintenance service operators are professionally skilled and qualified.	Operator knowledge
15. The resources and timetable of the maintenance service can be planned well in advance. 16. The maintenance service operations are developed in cooperation.	Orderliness
17. The current reputation of the maintenance service partner is good. 18. The previous experiences with the maintenance service partner have been positive.	Reputation
19. The maintenance service cooperation works well considering the conditions of all partners. 20. The information exchange works between the maintenance service partners.	Relationship
21. The maintenance service warranty and terms of payment are kept and executed as promised. 22. The risks and responsibilities considering the maintenance services are shared between the customer and the service provider.	Contracts
23. The maintenance service cooperation covers comprehensively the whole maintenance services (from management to execution). 24. The maintenance service covers the whole life span of the item.	Total solution
25. Own research and development can be developed with the maintenance service partner. 26. The maintenance service partner can provide information and knowledge related to the development of R&D activities.	R&D
27. The price paid for the maintenance service corresponds with the received service. 28. The price is negotiated in cooperation with the maintenance service partner.	Price
29. The maintenance service cooperation enables contact with new customers. 30. The maintenance service cooperation enables starting a new type of business.	Access to markets
31. The maintenance service partner is responsible for the spare part storage so that it does not tie your own resources and capital. 32. The maintenance service partner owns the fixed assets, for example the maintained items so that they do not stress your own balance sheet.	Asset management factors

The customer and the service provider were thus asked to value 32 propositions on a five-point Likert scale with end points of “strongly disagree” (=1) to “strongly agree” (=5). The customers responded first considering a high critical item to be maintained and after that the same claims were presented for a low critical item to be maintained. To be able to compare the differences of the customer and the service provider it was decided to present the same value elements and claims for both sides in the questionnaire, and so the service provider responded to the same propositions but considering a core service and support service it provided to the customers. It was emphasized to the service provider to respond from their own point of view, not the customer's. The survey instrument was pre-tested by a panel of experts which consisted of company representatives participating in the MaiSeMa-research project.

3.2 Reliability of the survey

A study is successful if it provides reliable answers to the research questions. The study has to be made with integrity, impartial and in that manner that the respondents do not disbenefit from responding (Heikkilä, 2008, p. 29). It is also important to use good measures that consistently measure what they are supposed to (Mooi and Sarsted, 2011, p. 34). The overall reliability of the survey is evaluated with validity and reliability using the information available (Heikkilä, 2008, p. 188).

Validity of the survey means that we are measuring what we want to measure. For some measures like length and income it can objectively be verified what the score should be but for unobservable phenomena like quality, satisfaction, value, and loyalty this is virtually impossible. Because there is no direct way to know what we are measuring, different types of validity aspects have been created including face, criterion, construct, and content validity. These different aspects help us to understand what we actually measure and what we should be measuring. (Mooi and Sarsted, 2011, p. 36)

Face validity is simply the indicator that the measure seems reasonable. For example, if you want to measure trust you ask a question like “this company is truthful and honest” which makes sense compared for example with a question like “this company is well known” which makes less sense. Face validity is commonly also called expert validity because it is often determined by using a sample of experts who discuss and agree on the degree of face validity of the used measure. Before the actual measurement is started the researchers should agree on the face validity of the measure. (Mooi and Sarsted, 2011, p. 36)

Criterion validity (also called predictive validity) is the degree to which the used measure relates to an external outcome. For example a measure for loyalty should lead to using the service or measuring satisfaction should be in line with people not complaining about a service. (Babbie 2013, p. 191; Mooi and Sarsted, 2011, p. 36)

Construct validity is similar to criterion validity. Construct validity is the degree how the measure relates to other expected variables measured in the long run. This means that if some variables are measured successful earlier the results should relate to the other measures in a logical way, in other words the results should stay logical if the same question poll is used. (Babbie, 2013, p. 192)

Content validity is the degree of what meanings are included in the content of a measure. Researchers need to discuss about the content and define what is included in the definition of the measure. For example, a test of mathematical ability cannot be limited to addition, it also needs to cover other concepts like subtracting and multiplication. After the measure is defined the questions used have to relate closely to the definition. Content validity is most often reached already before the actual measurement. (Babbie, 2013, p. 192)

In the value element survey the face validity and content validity were tested. To assess the content validity a workshop with company representatives was organized to discuss and modify the preliminary value elements found in the literature research. The value elements suitable for industrial maintenance services were chosen and

missing elements added. The final elements and definitions used in the questionnaire were based on this workshop. In the workshop 17 persons attended including top and middle managers from the energy and mining industry and university researchers. From the company representatives 4 represented the customer side and 5 the service provider side.

The survey instrument was also pre-tested by a panel of experts which consisted of company representatives participating in the MaiSeMa-research project. In the pre-test the testers filled out the questionnaire and provided comments related its functionality and content. This helped the face and also content validity of the survey.

Criterion validity is defined to be tested due its complicity. It would be too complicated to test if all value element measures would result in a certain outcome. Also the construct validity is not possible to measure in this study because the questionnaire is new and developed particularly for this survey. But in later executed surveys also the construct validity can be tested when the same questionnaire is used.

Reliability (also re-test reliability) of the survey means that if we measure something twice we get similar outcomes in other words the results are not random. Collecting two data samples is costly and can also prolong the research process and therefore the researchers often administer the same test on to different occasions to the test group and evaluate how strongly the two different samples are related. If the measure is stable over time the two measurements should correlate highly and this is also called outer reliability of the survey measure. Outer reliability means also that the measurement can be repeated also in other situations and surveys, and changing the interviewer has not an effect on the results. Testing the outer reliability can be hard because it is complicated to survey the same people twice. Furthermore in those cases the people are researched twice they can have the learning effect, where the survey can be easier the second time. Also the re-testing is not possible if the survey is about specific time points for example asking about a restaurant experience where the second time the responded may recall to a different restaurant experience. The test-

retest reliability can be assessed only for variables that are stable over time. (Heikkilä, 2008, p. 187; Mooi and Sarsted, 2011, p. 36-37)

Also the internal reliability of the survey can be tested. To test the internal reliability the researchers need to use simultaneously multiple variables to measure the same thing, for example two propositions for one tested quality. If these two propositions relate strongly to on another there is a considerable degree of internal consistency within the measure. Internal consistency can be measured in many ways, for example with the split-half reliability or Cronbach's alpha. (Heikkilä, 2008, p. 187; Mooi and Sarsted, 2011, p. 37)

The reliability of the variables used in this survey were tested by computing the Cronbach's alpha for the used sum variables. The values were mainly above the recommended 0.700 or close to it, which indicates that the sum variables were reliable and could be used for further analysis with some regard (Cortina, 1993). To test the outer reliability of the survey considering the interviewer is not relevant because the survey was conducted with a standardized questionnaire. Also the reliability over time is not measured because this is not a profile study.

3.3 Statistical analysis methods

This was a quantitative survey and therefore the questions were mainly structured which means that the response options were set in advance. The structured questions were presented on a five-point Likert scale with end points of "strongly disagree" (=1) to "strongly agree" (=5) or as multiple choice questions. The Likert scale was considered to be and interval scale so the distance between the response options is considered equal, in other words the "strongly agree" (=5) option is equally far as the "not agree nor disagree" (=3) option from the "somewhat agree" (=4).

To test the normal distribution of the data for further analysis the Kolmogorov-Smirnov was used. The reliability of the sum variables was tested by computing the Cronbach's alpha.

The data in the survey sample was not normally distributed. Therefore the non-parametric tests Mann-Whitney U and Wilcoxon were used to examine the statistically significant differences in the value elements and Spearman's correlation for the study of correlations (Dodge, 2008, p. 251, Metsämuuronen, 2005, p. 1047). The statistical analyses were conducted with the SPSS Statistics 21 program.

Kolmagorov-Smirnov is used to test if the variable is normally distributed. The test compares the data with a theoretical distribution which can be for example the normal distribution, Poisson-distribution or exponential distribution. The test results define the tests that can be used for the further statistical analysis because they are dependable of the normal or non-normal distribution of the sample. (Heikkilä, 2008, p. 235; Metsämuuronen, 2005, p. 913)

Kolmagorov-Smirnov presents as the null hypothesis, that the variable is normally distributed. The hypothesis testing results are interpreted so that with small sig. values (below 0.05*, 0.01** or 0.001***) the null hypothesis is declined and the variable is not normally distributed. In proportion if the values are higher than 0.05 the null hypothesis remains in force and the variable can considered to be normally distributed. (Heikkilä, 2008, p. 235)

Cronbach's alpha is used to test the internal reliability of variables. It measures specifically the internal consistency of the measure. The Cronbach's alpha is calculated based on the average correlations and number of variables. The high values of alpha tell about high reliability which shows that the propositions behind the sum variables measure similar things. There is no absolute boundary for the Cronbach's alpha result but often it is said that the value should be over 0.700 and no values under 0.600 should be accepted, but the rule is yielding. Now it is more emphasized to look at the values case-specific, because the count of values has a great impact on

the value (Cortina, 1993). In the survey-research are a lot of factors that cause random errors and therefore in practice often also lower values than the 0.700 are accepted. (Heikkilä, 2008, p. 187; Metsämuuronen, 2005, p. 69)

Spearman's correlation is used to measure correlation of data that is not normally distributed. It measures the existing relation between two sets of data. The variables measured can be on an ordinal, interval or ratio scale. To use the Spearman's correlation the data has to be at least on an ordinal scale. In the Spearman's correlation the coefficients have been normalized so that the values vary between -1 and + 1. This simplifies the analyzing process.

The sign of the coefficient presents the direction of the relation. If the value of the correlation coefficient is positive the correlating variable increases if the other variable increases and in proportion if the value is negative the value decreases. If the value is +/- 1 there is a perfect positive or negative correlation between variables and if the value is 0 there is no linear relation between variables. The correlation analysis can be quite complicated because it is often hard to be certain what variable is the cause and what the result. (Dodge, 2008, p. 503; Heikkilä, 2008, p. 203-204)

Mann-Whitney U and Wilcoxon test are non-parametric hypothesis tests that are used to identify differences between two variables. In a non-parametric test it is not necessary to specify the distribution of the underlying population (Dodge, 2008, p. 251). The Mann-Whitney test is one of the most efficient non-parametric tests and it is the non-parametric counterpart for the t-test. The variables for the test should be at least on an ordinal scale because the sample data is put into an order of magnitude based on the values, and after put in order the values are replaced with an order number. The actual testing is based on these order numbers. (Heikkilä, 2008, p. 233-234)

The SPSS 21 program calculates a Mann-Whitney U and Wilcoxon test value and further a significance level. The conclusions are made based on the significance level. The null hypothesis can be formed in many ways based on the situation but often it is presented as the equal of means or medians. In that case the test is used to test the statistically significant difference between two means or medians. The Mann-Whitney U test is used for two independent samples and the Wilcoxon for dependent samples. (Heikkilä, 2008, p. 233-234; Metsämuuronen, 2005, p. 878, 1038)

3.4 Sample data from maintenance professionals

The online-survey link with a request to participate was sent to 345 Finnish industrial maintenance professionals. The primary source for the contacts was the Finnish Maintenance Society Promaint, which is an important nationwide actor and has a diverse network of corporations in the maintenance field. In Finland, outsourcing has increased the demand for industrial maintenance services, and nowadays maintenance is a significant industry (Hatinen et al., 2012). Due to the developed and organized maintenance industry, Finland is a good testing ground for value element research.

The survey was conducted between January-March 2013, and the contact persons received two reminders after the first message. From the sent questionnaires 83 completed questionnaires were received back, representing a response rate of 24%. Compared to the other maintenance service surveys the response rate can considered to be average (Luumi, 2012).

3.5 Sample descriptive data

The responders were divided into three groups based on their organization unit (figure 15). Customers represented 39% of the responders and the rest 61% presented service providers. From the service providers equipment and service providers were 15 units but for the statistical analysis this is not a big enough sample (recommended

size 30 samples) and therefore in this study the data from the service providers and equipment and service providers is analyzed as one unit “service providers”.

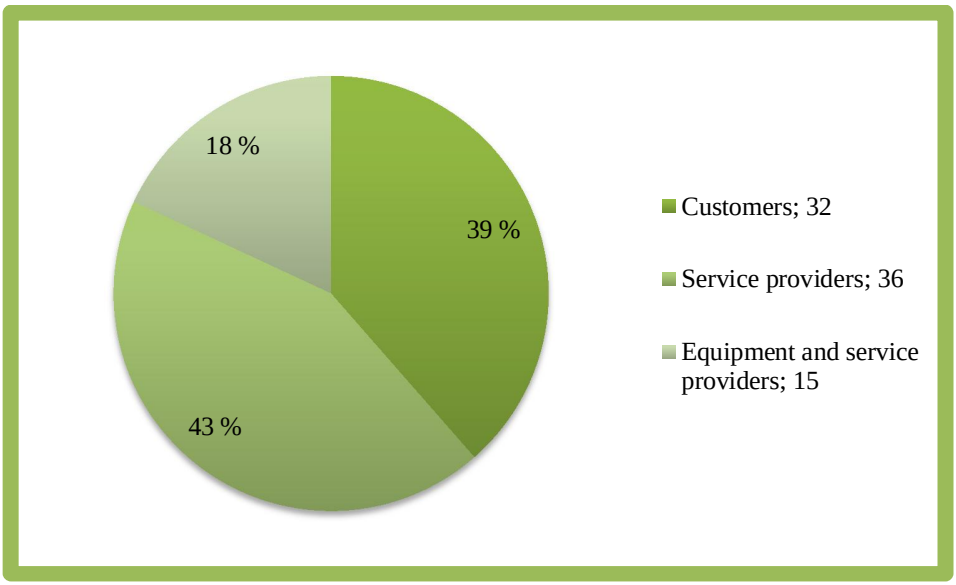

Figure 15. Division of the respondent group

The most common position (56%) of the respondent was working in middle management, for example as a maintenance manager, 21% of the respondents represented top management, and the rest (23%) represented mainly consultants and supervisors. In the responder group, 39% represented large companies (over 250 workers), and thus the majority represented small or middle sized companies. 90% of the respondents had thought somehow about the value related issues before the questionnaire but only 70% agreed that the maintenance was executed as part of the production strategy. Although the customer and the service provider were satisfied for the most part of the maintenance service, this shows the need for new models needed in assessing value especially on the strategic side.

The customer side represented mainly the industry line of business (69%), but also the electricity, gas and heating industry (15%). None of the customers executed the maintenance services wholly by themselves but 78% executed the maintenance only

partly outsourced. The majority (84%) had more than one service provider for the maintenance services.

The service providers represented mainly mechanical maintenance (58%) and electricity (33%), or a combination of different maintenance types. 51% of the service providers were responsible wholly of their customers' maintenance and the other half was responsible only of a certain part. 26% of the providers had only one key customer and, on the other hand, 37% had more than 10 key customers.

3.6 Data analysis

The normal distribution of the survey sample was tested with Kolmogorov-Smirnow. The significance level of the variables was constantly below 0.05 so the null hypothesis for normal distribution was declined and the variables are not considered normally distributed, and therefore the Spearman's correlation and non-parametric tests Mann-Whitney U and Wilcoxon are further used to examine the statistically significant differences in the value elements (Dodge, 2008, p. 251; Metsämuuronen, 2005, p. 1047). The variables were mostly skew to the left which means that positive responses were more common (4 and 5 on the Likert scale).

The possible correlations between value elements were tested with the Spearman's correlation. There were a lot of strong correlations (0.700 and above) within the value elements at all levels, see appendices 6-9. This supports though the value element view that value consists of multiple elements, certain elements go hand in hand, and that the value of maintenance services would consist of a value element package. But, on the other hand, the many correlations also need further research so that the value elements could be possibly divided into certain types of groups with a factor analysis.

The reliability of the sum variables was tested by computing the Cronbach's alpha, which can be seen in tables 2 and 3. The values were mainly above the recommended

0.700 or close to it, which indicates that the sum variables were reliable and could be used for further analysis with some regard (Cortina, 1993).

In some sum variables (e.g. flexibility 0.563, price 0.327, contracts 0.545 and total solutions 0.294) the values were substantially below the recommended value and therefore the results regarding these elements should be viewed and used with caution. The lower reliability in these elements can be due proposition setting which the respondents did not agree to. It is left for further research if these value elements should be divided into separate elements for example flexibility as flexibility and customization instead of just the value element flexibility.

Table 2. Cronbach's alpha for customer's sum variables

Propositions (see table 4)	Value element (sum variable)	Cronbach's α (high critical item)	Cronbach's α (low critical item)
1, 2	Availability	0,798	0,455
3, 4	Safety at work	0,407	0,696
5, 6	Environmental safety	0,816	0,819
7, 8	Technical quality	0,874	0,821
9, 10	Flexibility	0,563	0,384
11, 12	Reliability	0,656	0,737
13, 14	Operator knowledge	0,830	0,751
15, 16	Orderliness	0,667	0,890
17, 18	Reputation	0,596	0,881
19, 20	Relationship	0,923	0,803
21, 22	Contracts	0,700	0,545
23, 24	Total solutions	0,714	0,294
25, 26	R&D	0,813	0,959
27, 28	Price	0,327	0,682
29, 30	Access to markets	0,907	0,912
31, 32	Asset mgmt. factors	0,698	0,674

Table 3. Cronbach's alpha for service provider's sum variables

Propositions (see table 4)	Value element (sum variable)	Cronbach's α (core service)	Cronbach's α (support service)
1, 2	Availability	0,672	0,639
3, 4	Safety at work	0,602	0,730
5, 6	Environmental safety	0,682	0,877
7, 8	Technical quality	0,793	0,916
9, 10	Flexibility	0,440	0,676
11, 12	Reliability	0,502	0,555
13, 14	Operator knowledge	0,678	0,812
15, 16	Orderliness	0,801	0,791
17, 18	Reputation	0,628	0,674
19, 20	Relationship	0,758	0,785
21, 22	Contracts	0,429	0,382
23, 24	Total solutions	0,586	0,767
25, 26	R&D	0,799	0,865
27, 28	Price	0,580	0,497
29, 30	Access to markets	0,812	0,889
31, 32	Asset mgmt. factors	0,352	0,584

4 VALUE ELEMENT SURVEY RESULTS AND DISCUSSION

4.1 Results regarding the customer's value elements

In the open ended responses the customers were asked what item or process they considered of when rating the value of different propositions (questions 10 and 31). As high critical items were considered most commonly different kinds of boilers, filters, pumps, lifting machines, and furnaces. As high critical processes were named dissolution, gassing, reduction and crushing. Also distribution of electricity and quality measurement were considered as highly critical. Whereas, as low critical items the customers considered maintaining of the outdoor areas, maintaining of the buildings and infra, heating, air-conditioning, and cleaning.

Descriptive statistics of the customer's value elements can be seen in table 4 considering the high critical item (question 11) and in table 5 considering the low critical item (question 14). The exact response counts for each proposition can be seen in appendices 2 and 3.

For the critical items the customers ranked as the most important value elements *reliability, safety at work, environmental safety, operator knowledge, price, and technical quality,* which all had means above 4.2 (pretty much agree). Also reputation, orderliness, availability and flexibility were ranked high with means above 4.0. Relationship, contracts and total solutions were ranked in the middle with means under 4.0 but above 3.5. The lowest scores were given to R&D, access to markets and asset management factors, they only had means a little above 3.0 (not agreeing nor disagreeing) or even below. The lowest rated elements had also higher standard deviation compared to other elements, and it seems that the customers were less unanimous considering these elements.

Table 4. Customer's value elements for the high critical item

High critical item					
Value element	Mean	Std. Error (Mean)	Std. Deviation	Mode	Rank
Availability	4.11	0.19	1.10	5.00	9
Safety at work	4.45	0.11	0.58	4.50	2
Environmental safety	4.39	0.14	0.76	5.00	3
Technical quality	4.26	0.15	0.85	5.00	6
Flexibility	4.09	0.12	0.67	4.50	10
Reliability	4.55	0.09	0.49	5.00	1
Operator knowledge	4.31	0.12	0.67	4.00	4
Orderliness	4.13	0.15	0.82	5.00	8
Reputation	4.18	0.10	0.54	4.00	7
Relationship	3.98	0.16	0.87	4.00	11
Contracts	3.87	0.16	0.88	4.00	12
Total solutions	3.72	0.16	0.89	3.50	13
R&D	3.22	0.18	1.01	4.00	14
Price	4.27	0.12	0.64	4.00	5
Access to markets	3.06	0.20	1.13	3.00	15
Asset mgmt. factors	2.53	0.20	1.13	2.00	16

When considering the low critical items to be maintained, the customers valued most *environmental safety, safety at work, operator knowledge, reliability, and price* with means 4.2 or higher. Relationship, technical quality and reputation were also ranked quite high with means above 4.0. Value elements with means under 4.0 but higher than 3.5 were contracts, orderliness, flexibility, availability, and total solutions. The value elements with the lowest means, clearly below 3.0, were asset management factors, R&D and access to markets. Also when considering the low critical item the standard deviations were higher in the less valued elements and the value of the propositions was more disagreed on.

Table 5. Customer's value elements for the low critical item

Low critical item					
Value element	Mean	Std. Error (Mean)	Std. Deviation	Mode	Rank
Availability	3.76	0.14	0.80	4.00	11
Safety at work	4.41	0.12	0,67	5.00	2
Environmental safety	4.45	0.11	0.64	5.00	1
Technical quality	4.03	0.17	0.95	4.00	7
Flexibility	3.76	0.12	0.69	4.00	11
Reliability	4.21	0.14	0.80	4.50	4
Operator knowledge	4.29	0.12	0.66	4.50	3
Orderliness	3.77	0.21	1.17	4.50	10
Reputation	4.02	0.14	0.78	4.00	8
Relationship	4.05	0.16	0.87	4.00	6
Contracts	3.84	0.14	0.80	3.50	9
Total solutions	3.68	0.14	0.77	3.00	13
R&D	2.50	0.18	1.01	2.00	15
Price	4.20	0.14	0.77	4.50	5
Access to markets	2.45	0.20	1.10	3.00	16
Asset mgmt. factors	2.69	0.20	1.11	3.00	14

It is interesting to see that with the high critical items, reliability was valued even higher than safety at work, as can be seen in figure 16. Overall safety was valued very high, though, and it seems that companies value the safety risk assessment methods that also Lind et al. (2008) emphasize. Comparing the means also refers that there would be differences between the value elements. For the high critical items, the value elements had substantially higher means. This is understandable because a high critical item is something that can stop the whole production, so the maintenance strategy is overall valued more for a high critical item than for a low critical item (Järviö et al., 2007; Márquez, 2007).

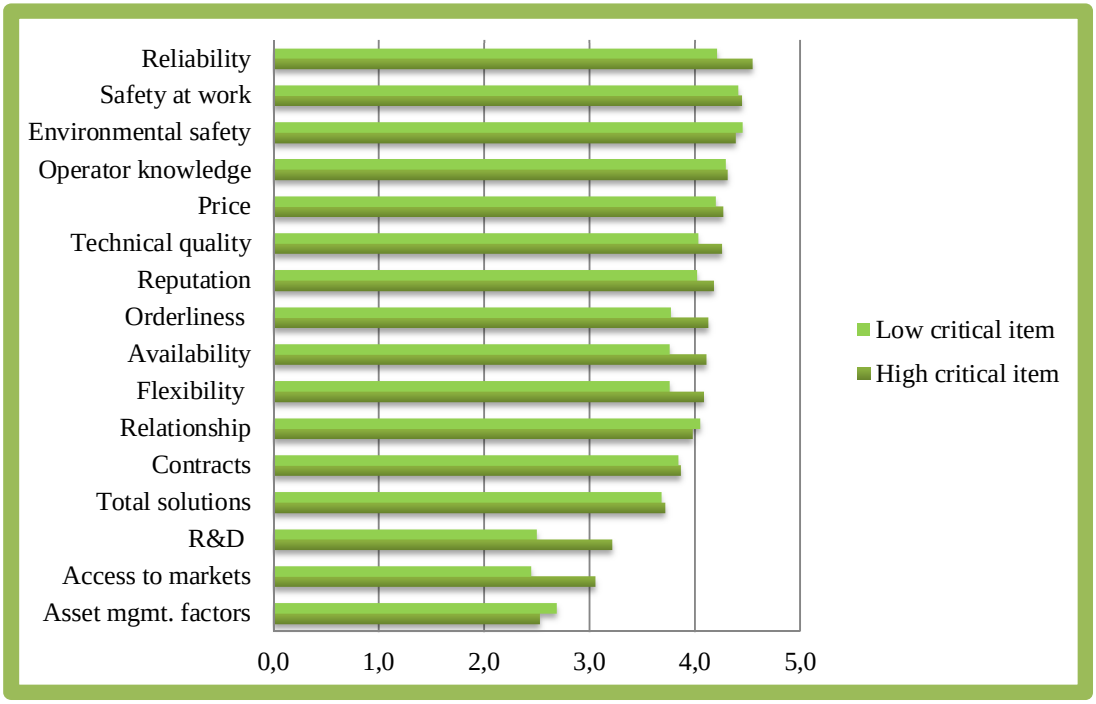

Figure 16. Comparing the value element means of high and low critical items

Hypothesis 1 stated that the customer's value elements differ depending on the item criticality. The hypothesis was tested with the Wilcoxon by comparing the results considering the customer's high critical and low critical item. The results of the Wilcoxon test can be seen in table 6.

Statistically significant differences ($p<0.05$) between the value elements based on the Wilcoxon test can be seen in availability, technical quality, flexibility, reliability, orderliness, R&D, and access to markets. Of all the statistically differentiating value elements, the customers valued higher the element of the high critical maintenance items than of the low critical items. This confirms the assumption that item criticality affects the importance and prioritizing of maintenance strategy (Márquez, 2007). Because hypothesis 1 is supported in almost half of the value elements and there are recognizable differences in what the customers' valued within a high critical item versus a low critical item, it can be stated that the value elements differed depending on item criticality, and this should be considered when profiling the value elements. It

is also important that the service provider sees the difference to make the right offering for each item to be maintained and be successful, as Liang (2010) suggests.

Table 6. Hypothesis 1 testing results

Value element	Wilcoxon Z score/sig.level a)	Hypothesis 1
Availability	-2.102/0.036*	Supported
Safety at work	-0.618/0.537	Not supported
Environmental safety	-0.479/0.632	Not supported
Technical quality	-2.385/0.017*	Supported
Flexibility	-2.226/0.026*	Supported
Reliability	-2.644/0.008**	Supported
Operator knowledge	-0.534/0.593	Not supported
Orderliness	-2.067/0.039*	Supported
Reputation	-1.907/0.057	Not supported
Relationship	-0.087/0.931	Not supported
Contracts	-0.378/0.706	Not supported
Total solutions	-0.383/0.701	Not supported
R&D	-3.089/0.002**	Supported
Price	-0.915/0.360	Not supported
Access to markets	-3.593/0.000***	Supported
Asset mgmt. factors	-0.793/0.428	Not supported

a) 2-tailed test *p < 0.05, ** p < 0.01, *** p < 0.001

4.2 Results regarding the service provider's value elements

Like the customers were asked to tell what item they considered while responding the value questions also the service providers were asked to define the thought core and support service. The service providers considered as their core services (question 21) mechanical maintenance, overhaul, repairs, corrective maintenance, IT-services, high-end SLA's, and providing spare parts. As support services the service providers considered measuring services, R&D, inspections, life-cycle management and personnel services. Repeatedly mechanical services, IT and overhaul were considered as support services as well.

Descriptive statistics considering the service providers core service are presented in table 7 (question 22) and support service in table 8 (question 25). The exact response counts for each proposition can be seen in appendices 4 and 5.

Table 7. Service provider's value elements for the core service

Core service					
Value element	Mean	Std. Error (Mean)	Std. Deviation	Mode	Rank
Availability	4.26	0.11	0.74	4.50	9
Safety at work	4.60	0.06	0.44	5.00	3
Environmental safety	4.43	0.09	0.59	5.00	5
Technical quality	4.48	0.08	0.56	5.00	4
Flexibility	3.98	0.11	0.75	4.00	13
Reliability	4.63	0.06	0.46	5.00	2
Operator knowledge	4.65	0.07	0.47	5.00	1
Orderliness	4.26	0.11	0.78	5.00	9
Reputation	4.28	0.08	0.57	4.00	8
Relationship	4.39	0.09	0.61	5.00	7
Contracts	4.19	0.09	0.62	3.50	11
Total solutions	4.08	0.11	0.78	4.00	12
R&D	3.93	0.11	0.82	4.00	15
Price	4.40	0.09	0.59	5.00	6
Access to markets	3.94	0.12	0.85	4.50	14
Asset mgmt. factors	3.35	0.10	0.70	3.00	16

The service providers rated the highest in core services *operator knowledge, reliability, safety at work, technical quality, environmental safety, and price*, which all had mean values 4.40 (pretty much agree) or higher. Other highly valued elements with means above 4.0 were relationship, reputation, orderliness, availability, contracts and total solutions. The service providers valued least in core services flexibility, access to markets, R&D, and asset management factors. They all had means above 3.30, so still quite high.

Table 8. Service provider's value elements for the support service

Support service					
Value element	Mean	Std. Error (Mean)	Std. Deviation	Mode	Rank
Availability	4.32	0.09	0.62	4.00	7
Safety at work	4.53	0.08	0.53	5.00	1
Environmental safety	4.48	0.09	0.61	5.00	4
Technical quality	4.47	0.10	0.67	5.00	5
Flexibility	3.98	0.11	0.75	4.00	14
Reliability	4.52	0.08	0.51	4.50	2
Operator knowledge	4.52	0.09	0.61	5.00	2
Orderliness	4.20	0.11	0.72	4.00	10
Reputation	4.28	0.09	0.56	4.00	8
Relationship	4.33	0.10	0.66	4.00	6
Contracts	4.05	0.11	0.71	4.00	12
Total solutions	4.11	0.13	0.85	4.00	11
R&D	4.00	0.14	0.87	3.00	13
Price	4.27	0.10	0.63	5.00	9
Access to markets	3.87	0.15	0.98	4.00	15
Asset mgmt. factors	3.30	0.15	0.98	3.00	16

When looking at the support services, the providers rated highest *safety at work, reliability, operator knowledge, environmental safety, and technical quality*. Like in the core services these elements had means above 4.40. Not far behind ranked were value elements relationship, availability, reputation, price, orderliness, total solutions, contracts and R&D with mean values above 4.0. The least valued elements were flexibility, access to markets and asset management factors. Also these had fairly high means 3.30 and above.

Based on the theory, we predicted that the core and support services would differ, and overall there were differences in the ranking of value elements between the core and support services, but they were minor and the most important and least valued elements were almost identical and this can also be seen in figure 17. The differences were small and definitely less clear than with the customer's high and low critical items.

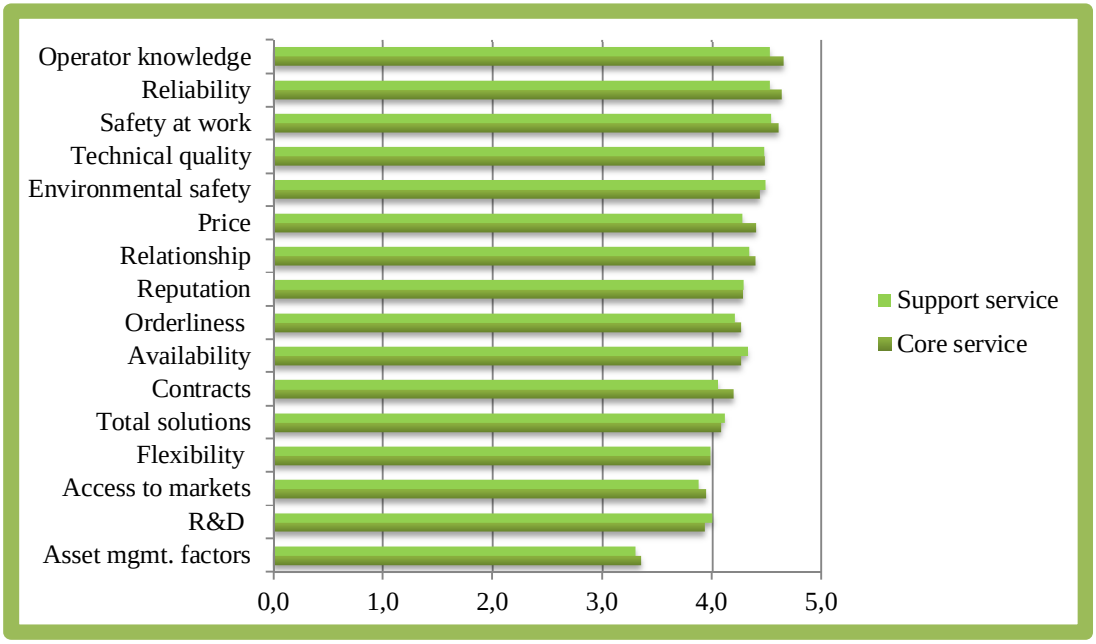

Figure 17. Comparing the value element means of the core and support service

Hypothesis 2 stated that the service providers' value elements differ between core and support service. The hypothesis was tested with the Wilcoxon by comparing the results considering the core and support service. The results of the Wilcoxon test can be seen in table 9.

That there were only minor differences in the mean ranks was also supported by the Wilcoxon test. The only statistical significant difference ($p<0.05$) was in operator knowledge. A potential reason comes up when looking at the survey respondents' open-ended responses. Only a few of the respondents had differentiated the core and support services from each other. Also the few who had responded the questions with different core and support services in their mind did not differ in their responses regarding the valuation of different value elements. It seems that the clear definition in theory had not yet reached the practice. Based on these results the profiling of the value does not necessarily need to be expanded to different offerings for the service provider, although this might also change after it becomes clearer to the service providers that they need to specify their service offering.

Table 9. Hypothesis 2 testing results

Value element	Wilcoxon Z score/sig.level a)	Hypothesis 2
Availability	-1.306/0.192	Not supported
Safety at work	-0.708/0.479	Not supported
Environmental safety	-0.443/0.658	Not supported
Technical quality	0.000/1.000	Not supported
Flexibility	0.000/1.000	Not supported
Reliability	-1.882/0.060	Not supported
Operator knowledge	-2.072/0.038*	Supported
Orderliness	-0.291/0.771	Not supported
Reputation	-0.759/0.448	Not supported
Relationship	-0.041/0.967	Not supported
Contracts	-1.148/0.251	Not supported
Total solutions	-0.186/0.852	Not supported
R&D	-0.041/0.967	Not supported
Price	-0.984/0.325	Not supported
Access to markets	-1.040/0.298	Not supported
Asset mgmt. factors	-0.447/0.655	Not supported

a) 2-tailed test *p < 0.05, ** p < 0.01, *** p < 0.001

4.3 Results regarding the differences between the customer's and the service provider's value elements

The identification of the differences between the maintenance service customer's and service provider's value elements was executed by comparing how the preferred value elements differed when the service provider would wish to maintain the customer's high and low critical items with its core service. Comparison of the provider's support service and customer's preferred value elements was left out because there were no statistically significant differences between the service provider's core and support services and also the respondents' separation between the services was questionable. Figure 18 shows the differences between the value elements when comparing descriptive means. It seems that the service provider values the elements notably higher and also differences can be recognized, especially

in the less valued elements like R&D, access to markets, and asset management factors.

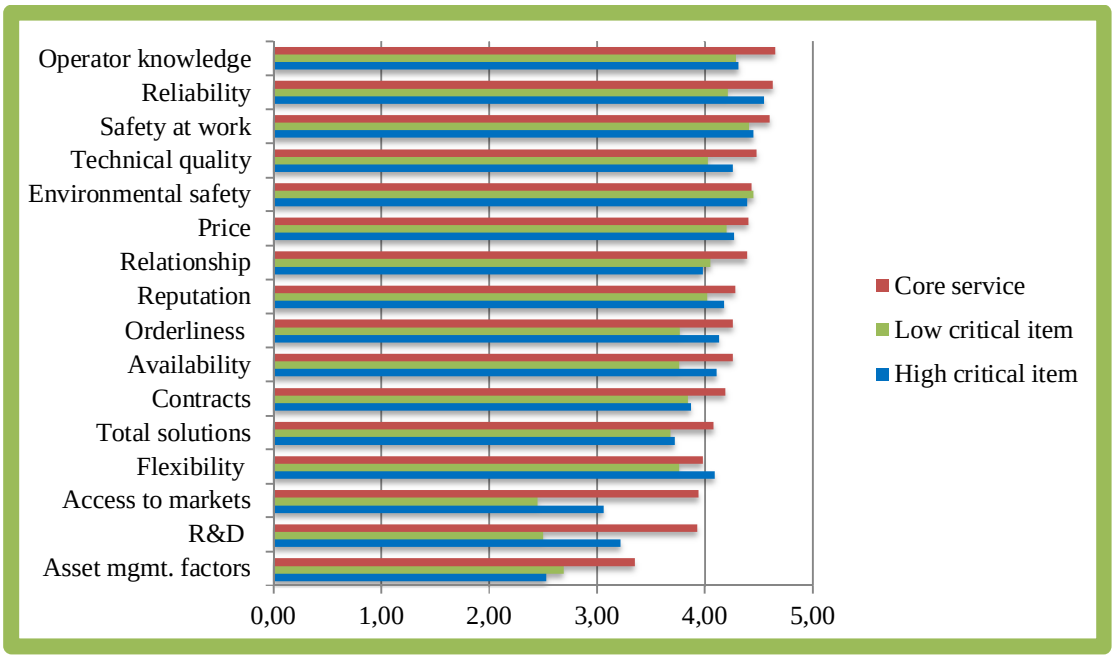

Figure 18. Differences in value elements when comparing the service provider's core service and customer's high and low critical item

When considering the elements that had issues with the low reliability score there could be identified some differences as well in addition to the statistically tested results. When looking at availability the customer valued more that the maintained item worked properly (proposition 1) on contrary the service provider valued more that the maintainability of the item is increased (proposition 2). Also when looking at the price the customer valued more especially for the critical item that the price was negotiated (proposition 28) instead the service provider valued more the paid price (proposition 27). On the rest of the questionable elements the customer and service provider agreed on the higher valued proposition; conforming the safety policies (proposition 4) at safety at work, customization in flexibility (proposition 10), confidentiality in reliability (proposition 12), current reputation (proposition 17) and

asset management of spare parts (proposition 31). This supports that the value elements should be reviewed more closely and possibly separated in further research. New arrangement of the value elements probably also emphasizes better the differences between the customer and the service provider.

Hypothesis 3 suggested that there are differences (a value gap) between the customer's and the service provider's preferred value elements. The hypothesis testing was done with the Mann-Whitney U by comparing the service provider's core service and customer's high critical item and the service provider's core service and customer's low critical item. The hypothesis 3 testing results can be seen in table 10.

Table 10. Hypothesis 3 testing results

Value element	Mann-Whitney U Z score/sig.level a) b)	Hypothesis 3	Mann-Whitney U Z score/sig.level a) c)	Hypothesis 3
Availability	-0.295/0.768	Not supported	-3.225/0.001**	Supported
Safety at work	-1.000/0.317	Not supported	-0.972/0.331	Not supported
Environmental safety	-0.166/0.868	Not supported	-0.972/0.331	Not supported
Technical quality	-0.871/0.384	Not supported	-2.118/0.034*	Supported
Flexibility	-0.811/0.418	Not supported	-1.390/0.165	Not supported
Reliability	-0.731/0.465	Not supported	-2.442/0.015*	Supported
Operator knowledge	-2.539/0.011*	Supported	-2.587/0.010*	Supported
Orderliness	-0.752/0.452	Not supported	-1.656/0.098	Not supported
Reputation	-0-756/0.450	Not supported	-1.320/0.187	Not supported
Relationship	-2.082/0.037*	Supported	-1.645/0.100	Not supported
Contracts	-1.435/0.151	Not supported	-1.878/0.060	Not supported
Total solutions	-1.903/0.057	Supported	-2.250/0.024*	Supported
R&D	-3.090/0.002**	Supported	-6.743/0.000***	Supported
Price	-0.804/0.422	Not supported	-1.037/0.300	Not supported
Access to markets	-3.544/0.000***	Supported	-5.251/0.000***	Supported
Asset mgmt. factors	-3.804/0.000***	Supported	-3.336/0.001**	Supported

a) 2-tailed test *p < 0.05, ** p < 0.01, *** p < 0.001
b) When comparing the differences between the high critical item and core service
c) When comparing the differences between the low critical item and core service

Hypothesis 3 was supported ($p<0.05$) when comparing the customer's critical items and the service provider's core services in operator knowledge, relationship, total

solutions, R&D, access to markets, and asset management factors. When the customer's low criticality items and the service provider's value elements were compared, there were in addition statistically significant differences ($p<0.05$) in availability, technical quality and reliability.

There were statistically significant differences especially when considering the customer's low critical items and the service provider's core services. Compared to the customer, the service provider valued the different value elements substantially higher. The service providers did not value any elements under 3.30, and for example one of the least valued elements, asset management factors, was still valued notably higher than at the customers' side (3.35 versus 2.54).

The biggest value gaps seem to be in the least valued elements R&D, access to markets and asset management factors, and the difference is also supported statistically. The low valuation of R&D was expected at least from the customer side, because R&D in industrial services has many contract-related issues and cooperation is considered complicated (Panesar and Markeset, 2008). In the service providers' side this was slightly surprising, because in the workshop it was discussed to be one of the most important value elements in support services (Sinkkonen et al. 2013). To be able to gain competitive advance it would be important for the customer and the service provider to work on this value gap and identify innovation activities that would create value for both parties and get closer to value partnering (Guenzi and Troilo, 2007; Kotler and Keller, 2012).

The low score of asset management is also interesting, because asset management has been emphasized in current research and it has been shown that with asset management the customers and the service providers can affect the company's operation and capital greatly (Kärri, 2007; Ojanen et al., 2012). The service providers seemed to have recognized this slightly better than the customers, at least they valued it with a notably higher score. The low level of top manager respondents probably

had some influence on the score because normally top managers have a broader view of total asset management within the company than middle managers.

Overall it can be seen that there were differences between the value elements of the customer and the service provider also statistically not only in ranks. Especially in business to business relations the differences show more clearly because the deviations are not event out like in this sort of survey-sample. Like Tynninen et al. (2012) suggests there is a need for profiling the value so that the service provider and customer can recognize differences in their value elements while doing contracts and measuring the service.

4.4 Value element profile

There were a lot of strong correlations (0.700 and above) within the value elements at all levels and no new elements were suggested in the answers to the open-ended questions. This supports the view that the presented value elements can be considered at some levels as industrial maintenance service value elements, and that the value of maintenance services would consist of a value element package.

Overall the most essential value elements were safety at work, environmental safety, reliability, operator knowledge, technical quality and price and with some regard customization. In practice this means that safety should be performed according to safety policies and that safety should also be increased along the service. Also environmental safety policies should be followed and possible environmental hazards recognized. The customer and the service provider also expect that the service operators are skilled and qualified and the providers have the ability to solve upcoming problems. The operators should make sure continuous training is provided. Maintenance service outcome should be as expected and case specific tailoring is important. The prices should be negotiated together and made sure that service corresponds to the paid price.

Also differences in value elements were recognized and the organizations should notice these differences so that they would be able to provide the best combination of value elements, and minor the gap between what the customer values compared to the service provider's values. In the future, longer service contracts are pursued between the partners in a maintenance service network and benefit sharing is considered more important (Ojanen et al., 2012). When the value partnering is pursued the value element profile provides a model to assess the value.

With a value element profile, the identification of the right value elements for each situation would be made easier and more concrete for the managers. The service provider and the customer could use profiling to recognize differences in their value elements while making contracts and measuring the service. Also the expected benefits and value can be made clear in the total offer for the customer when buying (Payne, 2006). The service provider would work as a co-creator of value, like Grönroos (2008) emphasizes.

In practice the customer and the service provider would go through the different value elements in different situations and rank the values according to their importance for them. Then the responses would be reviewed and the most differing elements chosen and put into a radar diagram. A first draft of the value element profile is presented in figure 19. In the figure the chosen elements are based on the hypothesis testing, where the statistically significant differences between the customer's and the service provider's value elements were "supported". With the statistical results it is shown how the value element survey results could be applied. After the elements are put into a profile the maintenance service customer and service provider would recognize where the biggest gaps are, and they could negotiate about these key differences more specifically before making the final contract, and also consider this in the overall decision making, for example pricing related to improved safety or possible R&D cooperation in exchange for better technical quality.

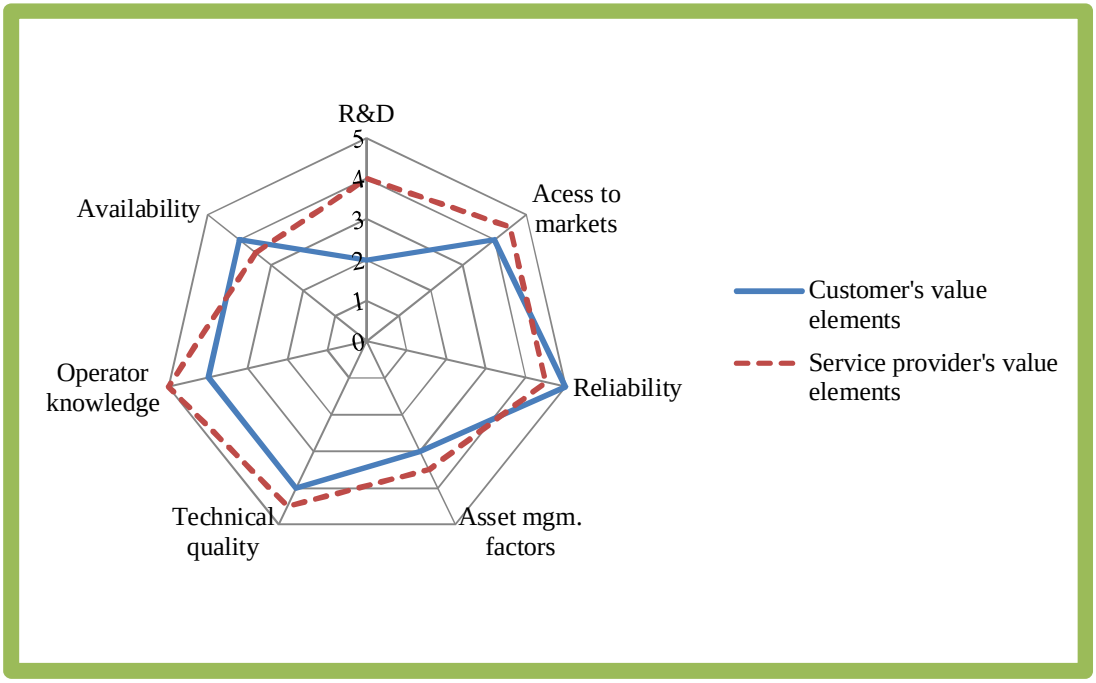

Figure 19. Value element profile for identifying the right value elements and the "value gap"

In the best scenarios this would result in a situation where both parties would gain more value of the contract than originally expected. The organizations would understand what elements create value in the maintenance service collaboration (Lapierre, 2000), and this would result in a win-win situation where the overall value of the relationship would grow and also the competitiveness of the relationship would improve. It should not be forgotten, however, that contract-related issues are always complicated and require openness and mutual trust (Levery, 1998; Panesar and Markeset, 2008; Rekola and Haapio, 2009).

In future development the value element profile could also get weights for the value elements like in the original AHP model Ojanen et al.(2012) presented. The weighted value elements could be integrated for example in the maintenance service lice-cycle measurement tool Sinkkonen et al. (2013) presents. With the integration the value elements could get also economical values and the value adding or non-value adding

activities could be named by calculating the value based on the cumulative profit or loss the maintenance services have provided. With the help of the economical values also the money available for future investments for a certain value adding element could be seen (e.g. safety equipment). The value element profile would merge into a comprehensive network management tool.

In future development also a cluster analysis could be used to recognize certain types of maintenance service customers and service providers so that a suitable profile model could be provided to the operating parties. The survey is also planned to be repeated in Sweden which provides a larger data group to be used in future research and this helps the recognizing of different situations and possibly new differences and groups can also be identified. With a larger sample also the original equipment provider can be statistically analyzed (requiring of course that the summed sample would be now at least 30 units) and added to the value profile so that the whole network view could be seen (figure 20).

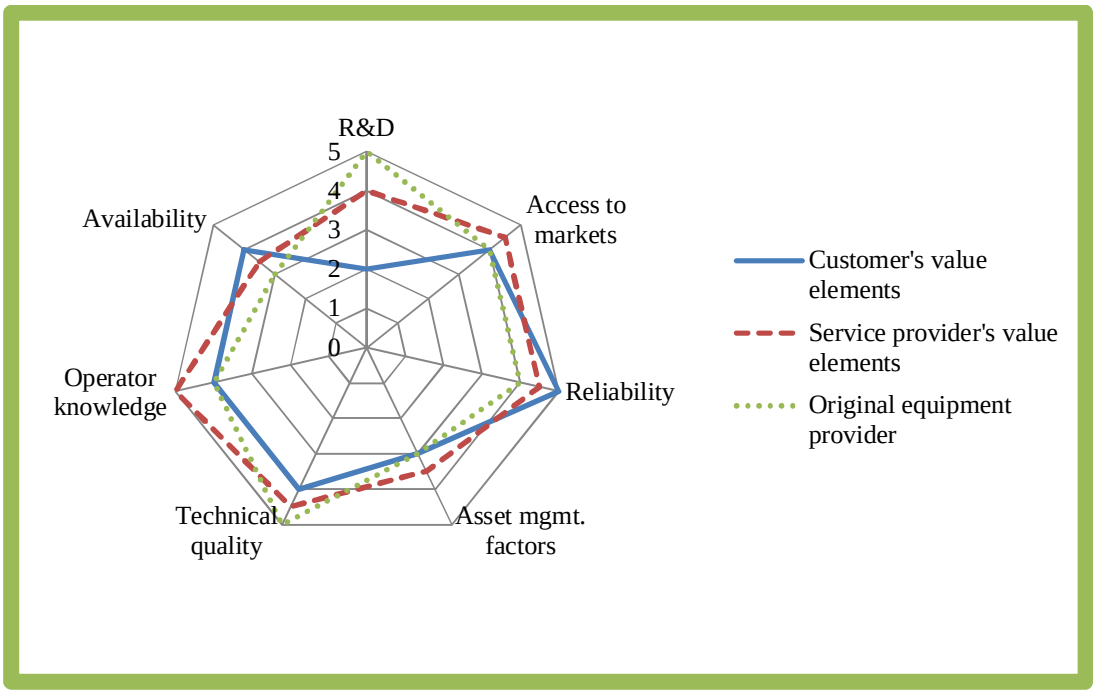

Figure 20. Value element profile for the maintenance network

5 CONCLUSIONS AND FUTURE RESEARCH

The objective of this thesis was to identify the most important value elements from the industrial maintenance service customer's and the service provider's perspective, and to find the differences between the parties as well. Overall, all the suggested value elements got quite high valuations with means between 3.0 and even 4.60 (not agreeing nor disagreeing to strongly agreeing), so they can be considered to be elements that at least somehow affect the experienced value of maintenance services. It also shows that value is constituted of different elements.

On the basis of the survey results, there are clearly maintenance service value elements that arise above others in all categories, namely reliability, safety at work, environmental safety, and operator knowledge. Also technical quality and price were rated high. On the other hand, there were also value elements that were constantly rated as less important value elements in all categories. These were access to markets, asset management factors and R&D. Especially the low valuation of asset management factors was surprising, because there has been a lot of discussion and research regarding the importance of asset management factors, but it seems that the customers and the service provides have not yet understood their profit potential. Overall, comprehensive value elements like total solutions, asset management factors, access to markets, and R&D were rated lower. The possible win-win potential and development of these elements should be emphasized.

The survey results suggested also that there are differences between the value elements of the customer and the service provider, and also different situations affect the value elements preferred. The statistically significant differences were not as great as expected on the basis of theory, but because there were at least some statistical differences in a big population like this, in business-to-business relations the differences are probably even greater because the means are not evened out. As in negotiation situations the differences play a great role, it is convenient to develop a value element profile to recognize the differences. For example if the service provider

rates operator knowledge as the most important value element and the customer places it as the fourth element, there are three elements that the customer values higher than the service provider. When the service provider is aware of this difference, they can pay attention to this and provide the best combination of value elements, and make a better offer.

The study contributes to the value discussion of industrial maintenance services and provides value elements that can be considered as the value elements of industrial maintenance services. Until now there has been a lack of knowledge about the specific value elements concerning the industrial maintenance service customer and service provider. The study also points out that there are differences in maintenance service value elements that should be considered in negotiations. The study also provides a first draft of a value element profile, which could be used in negotiation situations. It provides a method for assessing value and making it more concrete for the customer and the service provider by visualizing a possible gap in the value elements of the customer and the service provider. By closing the gap, the customer and the service provider can reach their maximum value creation potential, and an overall win-win situation in the cooperation can be reached. Of course profiling the value elements would require openness and interest in honest cooperation.

There are also limitations in the study that should be taken into account in future research. The mean values and sum variables had a high weight in this paper to get an overall view of the situations, but for future research also the value elements should be reviewed in closer detail because in some cases the reliability of the sum elements (Cronbach's alpha) was considerably low. Possible dividing and regrouping of elements should be considered. Also correlations received little attention because the focus was on finding differences. But because there was a great amount of significant correlations, it would be interesting to test the correlations further and also make a factor analysis to see whether some value elements could be merged.

The difference between the core and supplementary service was already researched in this survey but because the responses were questionable also this area should be researched more specific. This could be broadened as a research focusing on the service provider's overall knowledge relating their services and how they differentiate their service offerings.

A major future research target is the building and focusing of the maintenance service value framework based on the value element profile. The framework should be tested in different situations, like preventive and corrective maintenance, and also specified for different customers, for example according to size or maintenance service area by clustering the respondents. The survey is planned to be executed also in Sweden which provides additional data for profiling. Later the framework could be added with weights for example to the life-cycle model developed by Sinkkonen et al. (2013) and also included in service offering discussions and presented as a comprehensive manager tool.

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Appendix 1. Survey questionnaire

Value Elements of Industrial Maintenance Services

1. Size of the unit (e.g. factory/ power plant/…) (employees) *

- ◯ under 10
- ◯ 10-49
- ◯ 50-249
- ◯ over 250

2. Turnover of the unit (e.g. factory/ power plant/…) (€)*

- ◯ under 1 million
- ◯ 1-20 million
- ◯ 21-100 million
- ◯ over 100 million

3. Position of the respondent *

- ◯ Top management
- ◯ Middle management (maintenance manager, maintenance service manager, plant manager or something similar)
- Other, what?
- ◯ _____

(continues)

(appendix 1 continues)

4. The organization unit is primarily *

- ◯ An industrial maintenance service customer
- ◯ An industrial maintenance service provider
- ◯ An equipment and industrial maintenance service provider

5. What is your units line of business*

- ◯ Mining and quarrying
- ◯ Industry
- ◯ Supply of electricity-, gas- and heat, cooling business
- ◯ Water supply service, drain- and sewage disposal, waste disposal and other sanitation services of the environment
- ◯ Construction
- ◯ Other, what?

_____

6. Production format of the unit*

- ◯ One-off production
- ◯ Serial production
- ◯ Uniform production (one product, e.g. chemical pulp)

7. Primary execution of maintenance services in your unit*

(continues)

(appendix 1 continues)

- ◯ Executed wholly by ourselves
- ◯ Executed partly by ourselves
- ◯ All maintenance services are outsourced

8. Maintenance service performance in your unit *

- ◯ No external maintenance service providers
- ◯ One external maintenance service provider
- ◯ Many external maintenance service providers

9. I am satisfied with the current way the maintenance services are organized in our unit*

- ◯ Totally disagree
- ◯ Pretty much disagree
- ◯ Neither agreeing nor disagreeing
- ◯ Pretty much agree
- ◯ Totally agree

10. Next we ask you to respond to the propositions considering the maintenance of a ***high critical*** object (e.g. a machine or process). An object that stops the operation when failing is critical.

What object to be maintained are you considering of when responding to the questions?

_____

_____

(continues)

(appendix 1 continues)

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11. How important do you consider these things considering the value of maintenance services?

I value that…

	Totally disagree	Pretty much disagree	Neither agreeing nor disagreeing	Pretty much agree	Totally agree
The target of the maintenance work functions as expected, its maintainability and repair is easy.	○	○	○	○	○
The users look after their part of the in use maintenance operations and enhance the maintainability of the item.	○	○	○	○	○
The operational conditions and safety increase along the service.	○	○	○	○	○
The maintenance is performed according to safety policies.	○	○	○	○	○
The maintenance service performer recognizes the environmental safety hazards.	○	○	○	○	○
The maintenance is performed according to environmental safety policies.	○	○	○	○	○
The maintenance service outcome is as expected.	○	○	○	○	○

(continues)

(appendix 1 continues)

The maintenance service outcome is sustained for the promised time.	○	○	○	○	○
The maintenance service partner bends from its claims (e.g. . delivery time)	○	○	○	○	○
The maintenance services are tailored based on need.	○	○	○	○	○
The maintenance service cooperation is executed on time and as promised.	○	○	○	○	○
The maintenance service cooperation is based on confidentiality.	○	○	○	○	○
The maintenance service provider has the knowledge to solve upcoming problems.	○	○	○	○	○
The maintenance service operators are professionally skilled and qualified.	○	○	○	○	○
The resources and timetable of the maintenance service can be planned well in advance.	○	○	○	○	○
The maintenance service operations are developed in cooperation.	○	○	○	○	○
The current reputation of the maintenance service partner is good.	○	○	○	○	○
The previous experiences with the maintenance service partner	○	○	○	○	○

(continues)

(appendix 1 continues)

have been positive.					
The maintenance service cooperation works well considering the conditions of all partners.	○	○	○	○	○
The information exchange works between the maintenance service partners.	○	○	○	○	○
The maintenance service warranty and terms of payment are kept and executed as promised.	○	○	○	○	○
The risks and responsibilities considering the maintenance services are shared between the customer and the service provider.	○	○	○	○	○
The maintenance service cooperation covers comprehensively the whole maintenance services (from management to execution).	○	○	○	○	○
The maintenance service covers the whole life span of the item.	○	○	○	○	○
Own research and development can be developed with the maintenance service partner.	○	○	○	○	○
The maintenance service partner can provide information and knowledge related to the development of R&D activities.	○	○	○	○	○
The price paid for the maintenance service corresponds	○	○	○	○	○

(continues)

(appendix 1 continues)

with the received service.					
The price is negotiated in cooperation with the maintenance service partner.	○	○	○	○	○
The maintenance service cooperation enables contact with new customers.	○	○	○	○	○
The maintenance service cooperation enables starting a new type of business.	○	○	○	○	○
The maintenance service partner is responsible for the spare part storage so that it does not tie your own resources and capital.	○	○	○	○	○
The maintenance service partner owns the fixed assets, for example the maintained items so that they do not stress your own balance sheet.	○	○	○	○	○

12. What other factors do you consider as valuable in maintenance services?

_____

_____

_____

13. Next we ask you to respond to the propositions considering the maintenance of a ***low critical*** object considering the production activities (e.g. maintenance of the company yard could be something like this).

(continues)

(appendix 1 continues)

What object to be maintained are you considering of when responding to the questions?

_____

_____

_____

14. How important do you consider these things considering the value of maintenance services?

I value that…

	Totally disagree	Pretty much disagree	Neither agreeing nor disagreeing	Pretty much agree	Totally agree
The target of the maintenance work functions as expected, its maintainability and repair is easy.	○	○	○	○	○
The users look after their part of the in use maintenance operations and enhance the maintainability of the item.	○	○	○	○	○
The operational conditions and safety increase along the service.	○	○	○	○	○
The maintenance is performed according to safety policies.	○	○	○	○	○
The maintenance service performer recognizes the	○	○	○	○	○

(continues)

(appendix 1 continues)

environmental safety hazards.					
The maintenance is performed according to environmental safety policies.	○	○	○	○	○
The maintenance service outcome is as expected.	○	○	○	○	○
The maintenance service outcome is sustained for the promised time.	○	○	○	○	○
The maintenance service partner bends from its claims (e.g. . delivery time)	○	○	○	○	○
The maintenance services are tailored based on need.	○	○	○	○	○
The maintenance service cooperation is executed on time and as promised.	○	○	○	○	○
The maintenance service cooperation is based on confidentiality.	○	○	○	○	○
The maintenance service provider has the knowledge to solve upcoming problems.	○	○	○	○	○
The maintenance service operators are professionally skilled and qualified.	○	○	○	○	○
The resources and timetable of the maintenance service can be planned well in advance.	○	○	○	○	○
The maintenance service	○	○	○	○	○

(continues)

(appendix 1 continues)

operations are developed in cooperation.					
The current reputation of the maintenance service partner is good.	○	○	○	○	○
The previous experiences with the maintenance service partner have been positive.	○	○	○	○	○
The maintenance service cooperation works well considering the conditions of all partners.	○	○	○	○	○
The information exchange works between the maintenance service partners.	○	○	○	○	○
The maintenance service warranty and terms of payment are kept and executed as promised.	○	○	○	○	○
The risks and responsibilities considering the maintenance services are shared between the customer and the service provider.	○	○	○	○	○
The maintenance service cooperation covers comprehensively the whole maintenance services (from management to execution).	○	○	○	○	○
The maintenance service covers the whole life span of the item.	○	○	○	○	○
Own research and development can be developed with the	○	○	○	○	○

(continues)

maintenance service partner.					
The maintenance service partner can provide information and knowledge related to the development of R&D activities.	○	○	○	○	○
The price paid for the maintenance service corresponds with the received service.	○	○	○	○	○
The price is negotiated in cooperation with the maintenance service partner.	○	○	○	○	○
The maintenance service cooperation enables contact with new customers.	○	○	○	○	○
The maintenance service cooperation enables starting a new type of business.	○	○	○	○	○
The maintenance service partner is responsible for the spare part storage so that it does not tie your own resources and capital.	○	○	○	○	○
The maintenance service partner owns the fixed assets, for example the maintained items so that they do not stress your own balance sheet.	○	○	○	○	○

15. What other factors do you consider as valuable in maintenance services?

_____

(appendix 1 continues)

_____

_____

16. Maintenance service type (choose max 2 options) *

- ☐ Electricity and automation
- ☐ Piping, valves, sealing
- ☐ Mechanical maintenance
- ☐ Consultation, measuring and IT services
- ☐ Hydraulics and transportation systems
- ☐ Combination of many previous service types
- ☐ Total solutions for specific line of business
- ☐ Something else

17. Production format of the customer*

- ○ One-off production
- ○ Serial production
- ○ Uniform production (one product, e.g. chemical pulp)

18. Primary execution of maintenance services*

- ○ Only one key customer
- ○ Some key customers
- ○ Many key customers (more than ten)

(continues)

(appendix 1 continues)

19. We manage the customer's/ customers' maintenance services*

- ◯ Comprehensively
- ◯ Only a certain part

20. I am satisfied with the current position of our unit in the market (amount of customers, amount of services etc.) *

- ◯ Totally disagree
- ◯ Pretty much disagree
- ◯ Neither agreeing nor disagreeing
- ◯ Pretty much agree
- ◯ Totally agree

21. Next we ask you to respond the propositions from the company's own view (not based on the presumptions/ or desires of the customer) based on the ***core services*** you provide. The existence of the company is based on core services (=core know-how).

What maintenance core service are you considering of when responding to the questions?

_____

_____

_____

22. How important do you consider these things considering the value of maintenance services?

(continues)

(appendix 1 continues)

I value that…

	Totally disagree	Pretty much disagree	Neither agreeing nor disagreeing	Pretty much agree	Totally agree
The target of the maintenance work functions as expected, its maintainability and repair is easy.	○	○	○	○	○
The users look after their part of the in use maintenance operations and enhance the maintainability of the item.	○	○	○	○	○
The operational conditions and safety increase along the service.	○	○	○	○	○
The maintenance is performed according to safety policies.	○	○	○	○	○
The maintenance service performer recognizes the environmental safety hazards.	○	○	○	○	○
The maintenance is performed according to environmental safety policies.	○	○	○	○	○
The maintenance service outcome is as expected.	○	○	○	○	○
The maintenance service outcome is sustained for the promised time.	○	○	○	○	○
The maintenance service	○	○	○	○	○

(continues)

(appendix 1 continues)

partner bends from its claims (e.g. . delivery time)					
The maintenance services are tailored based on need.	○	○	○	○	○
The maintenance service cooperation is executed on time and as promised.	○	○	○	○	○
The maintenance service cooperation is based on confidentiality.	○	○	○	○	○
The maintenance service provider has the knowledge to solve upcoming problems.	○	○	○	○	○
The maintenance service operators are professionally skilled and qualified.	○	○	○	○	○
The resources and timetable of the maintenance service can be planned well in advance.	○	○	○	○	○
The maintenance service operations are developed in cooperation.	○	○	○	○	○
The current reputation of the maintenance service partner is good.	○	○	○	○	○
The previous experiences with the maintenance service partner have been positive.	○	○	○	○	○
The maintenance service cooperation works well considering the conditions of	○	○	○	○	○

(continues)

(appendix 1 continues)

all partners.					
The information exchange works between the maintenance service partners.	○	○	○	○	○
The maintenance service warranty and terms of payment are kept and executed as promised.	○	○	○	○	○
The risks and responsibilities considering the maintenance services are shared between the customer and the service provider.	○	○	○	○	○
The maintenance service cooperation covers comprehensively the whole maintenance services (from management to execution).	○	○	○	○	○
The maintenance service covers the whole life span of the item.	○	○	○	○	○
Own research and development can be developed with the maintenance service partner.	○	○	○	○	○
The maintenance service partner can provide information and knowledge related to the development of R&D activities.	○	○	○	○	○
The price paid for the maintenance service corresponds with the received	○	○	○	○	○

(continues)

(appendix 1 continues)

service.					
The price is negotiated in cooperation with the maintenance service partner.	○	○	○	○	○
The maintenance service cooperation enables contact with new customers.	○	○	○	○	○
The maintenance service cooperation enables starting a new type of business.	○	○	○	○	○
The maintenance service partner is responsible for the spare part storage so that it does not tie your own resources and capital.	○	○	○	○	○
The maintenance service partner owns the fixed assets, for example the maintained items so that they do not stress your own balance sheet.	○	○	○	○	○

23. What other factors do you consider as valuable in maintenance services?

_____

_____

_____

24. Next we ask you to respond the propositions from the company's own view (not based on the presumptions/ or desires of the customer) based on the ***support***

(continues)

(appendix 1 continues)

services you provide. The support services complement the core services.

What maintenance support service are you considering of when responding to the questions?

_____

_____

_____

25. How important do you consider these things considering the value of maintenance s

I value that…

	Totally disagree	Pretty much disagree	Neither agreeing nor disagreeing	Pretty much agree	Totally agree
The target of the maintenance work functions as expected, its maintainability and repair is easy.	○	○	○	○	○
The users look after their part of the in use maintenance operations and enhance the maintainability of the item.	○	○	○	○	○
The operational conditions and safety increase along the service.	○	○	○	○	○
The maintenance is performed	○	○	○	○	○

(continues)

(appendix 1 continues)

according to safety policies.					
The maintenance service performer recognizes the environmental safety hazards.	○	○	○	○	○
The maintenance is performed according to environmental safety policies.	○	○	○	○	○
The maintenance service outcome is as expected.	○	○	○	○	○
The maintenance service outcome is sustained for the promised time.	○	○	○	○	○
The maintenance service partner bends from its claims (e.g. . delivery time)	○	○	○	○	○
The maintenance services are tailored based on need.	○	○	○	○	○
The maintenance service cooperation is executed on time and as promised.	○	○	○	○	○
The maintenance service cooperation is based on confidentiality.	○	○	○	○	○
The maintenance service provider has the knowledge to solve upcoming problems.	○	○	○	○	○
The maintenance service operators are professionally skilled and qualified.	○	○	○	○	○
The resources and timetable of	○	○	○	○	○

(continues)

(appendix 1 continues)

the maintenance service can be planned well in advance.					
The maintenance service operations are developed in cooperation.	○	○	○	○	○
The current reputation of the maintenance service partner is good.	○	○	○	○	○
The previous experiences with the maintenance service partner have been positive.	○	○	○	○	○
The maintenance service cooperation works well considering the conditions of all partners.	○	○	○	○	○
The information exchange works between the maintenance service partners.	○	○	○	○	○
The maintenance service warranty and terms of payment are kept and executed as promised.	○	○	○	○	○
The risks and responsibilities considering the maintenance services are shared between the customer and the service provider.	○	○	○	○	○
The maintenance service cooperation covers comprehensively the whole maintenance services (from management to execution).	○	○	○	○	○

(continues)

(appendix 1 continues)

The maintenance service covers the whole life span of the item.	○	○	○	○	○
Own research and development can be developed with the maintenance service partner.	○	○	○	○	○
The maintenance service partner can provide information and knowledge related to the development of R&D activities.	○	○	○	○	○
The price paid for the maintenance service corresponds with the received service.	○	○	○	○	○
The price is negotiated in cooperation with the maintenance service partner.	○	○	○	○	○
The maintenance service cooperation enables contact with new customers.	○	○	○	○	○
The maintenance service cooperation enables starting a new type of business.	○	○	○	○	○
The maintenance service partner is responsible for the spare part storage so that it does not tie your own resources and capital.	○	○	○	○	○
The maintenance service partner owns the fixed assets, for example the maintained items so that they do not stress your own balance sheet.	○	○	○	○	○

(continues)

(appendix 1 continues)

26. What other factors do you consider as valuable in maintenance services?

_____

_____

_____

27. What do you think of the following claims?

	Totally disagree	Pretty much disagree	Neither agreeing nor disagreeing	Pretty much agree	Totally agree
I have thought about the above presented value related issues at my job already before this questionnaire.	○	○	○	○	○
I my opinion maintenance is a profit factor not a cost item.	○	○	○	○	○
In my opinion maintenance is executed in my unit as part of the production strategy.	○	○	○	○	○
My unit has measures to estimate the maintenance services.	○	○	○	○	○
The measurement information is used to develop our own operations.	○	○	○	○	○
The measurement information is used to evaluate partners.	○	○	○	○	○

(continues)

(appendix 1 continues)

28. Evaluate how your unit has performed (compared to competitors) in the resent 5 years

	Badly	Sufficiently	Good	Excellent
Financial performance	○	○	○	○
Operative performance	○	○	○	○

29. In maintenance services are often situations where some important information is not available at the right time. How have you coped in these kind of situations or have the operations stopped?

What have been the time table effects?

Who has finally provided the missing information or has the situation finalized with ”best information available” without clarifying the missing information?

_____

_____

_____

(continues)

(appendix 1 continues)

The next question is only for the maintenance service customers

30. What cases result in information gaps in maintenance services; are they due to the maintenance service provider's or your own unit's actions. How do you think that information gaps can be prevented?

_____

_____

The next question is only for the maintenance service providers

31. What cases result in information gaps in your operational work; are they due to the maintenance service customer's or your own unit's actions. How do you think that information gaps can be prevented?

_____

_____

Thank you for your responds!

You can give other comments related to the subject in the field below.

_____

_____

_____

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Appendix 2. Specific response rates considering the high critical item (question 11)

Propositions considering the *high critical item* (I value that...)	**Totally disagree (1)**	**Pretty much disagree (2)**	**Neither agreeing nor dis-agreeing (3)**	**Pretty much agree (4)**	**Totally agree (5)**	**In total**	**Mean value**
1. The target of the maintenance work functions as expected, its maintainability and repair is easy.	1	3	2	9	17	32	4,19
2. The users look after their part of the in use maintenance operations and enhance the maintainability of the item.	2	4	1	9	16	32	4,03
3. The operational conditions and safety increase along the service.	0	2	4	14	12	32	4,13
4. The maintenance is performed according to safety policies.	0	0	1	5	24	30	4,77
5. The maintenance service performer recognizes the environmental safety hazards.	0	3	2	12	15	32	4,22
6. The maintenance is performed according to environmental safety policies.	0	1	0	11	19	31	4,55
7. The maintenance service outcome is as expected.	0	2	1	11	18	32	4,41
8. The maintenance service outcome is sustained for the promised time.	0	3	3	13	12	31	4,10
9. The maintenance service partner bends from its claims (e.g. . delivery time)	1	1	6	18	6	32	3,84
10. The maintenance services are tailored based on need.	0	1	1	16	14	32	4,34
11. The maintenance service cooperation is executed on time and as promised.	0	0	1	13	18	32	4,53
12. The maintenance service cooperation is based on confidentiality.	0	0	1	11	19	31	4,58
13. The maintenance service provider has the knowledge to solve upcoming problems.	0	1	4	17	10	32	4,13
14. The maintenance service operators are professionally skilled and qualified.	0	1	0	13	17	31	4,48
15. The resources and timetable of the maintenance service can be planned well in advance.	0	3	6	11	12	32	4,00
16. The maintenance service operations are developed in cooperation.	0	3	1	13	15	32	4,25
17. The current reputation of the maintenance service partner is good.	0	0	3	17	11	31	4,26
18. The previous experiences with the maintenance service partner have been positive.	0	0	5	18	8	31	4,10
19. The maintenance service cooperation works well considering the conditions of all partners.	0	3	3	18	8	32	3,97
20. The information exchange works between the maintenance service partners.	0	3	5	13	10	31	3,97
21. The maintenance service warranty and terms of payment are kept and executed as promised.	1	1	4	11	14	31	4,16
22. The risks and responsibilities considering the maintenance services are shared between the customer and the service provider.	1	4	6	17	4	32	3,59
23. The maintenance service cooperation covers comprehensively the whole maintenance services (from management to execution).	1	1	5	16	9	32	3,97
24. The maintenance service covers the whole life span of the item.	1	6	7	13	5	32	3,47
25. Own research and development can be developed with the maintenance service partner.	0	9	9	10	4	32	3,28
26. The maintenance service partner can provide information and knowledge related to the development of R&D activities.	3	7	7	12	3	32	3,16
27. The price paid for the maintenance service corresponds with the received service.	1	1	5	9	16	32	4,19
28. The price is negotiated in cooperation with the maintenance service partner.	0	0	1	17	13	31	4,39
29. The maintenance service cooperation enables contact with new customers.	5	2	12	9	4	32	3,16
30. The maintenance service cooperation enables starting a new type of business.	4	6	12	7	3	32	2,97
31. The maintenance service partner is responsible for the spare part storage so that it does not tie your own resources and capital.	5	4	9	9	4	31	3,10
32. The maintenance service partner owns the fixed assets, for example the maintained items so that they do not stress your own balance sheet.	16	8	4	2	2	32	1,94

Appendix 3. Specific response rates considering the low critical item (question 14)

Propositions considering the *low critical item* (I value that...)	**Totally disagree (1)**	**Pretty much disagree (2)**	**Neither agreeing nor dis-agreeing (3)**	**Pretty much agree (4)**	**Totally agree (5)**	**In total**	**Mean value**
1. The target of the maintenance work functions as expected, its maintainability and repair is easy.	0	3	3	19	6	31	3,90
2. The users look after their part of the in use maintenance operations and enhance the maintainability of the item.	1	6	4	13	7	31	3,61
3. The operational conditions and safety increase along the service.	0	2	3	12	12	29	4,17
4. The maintenance is performed according to safety policies.	0	0	2	7	22	31	4,65
5. The maintenance service performer recognizes the environmental safety hazards.	0	1	3	11	16	31	4,35
6. The maintenance is performed according to environmental safety policies.	0	0	1	12	18	31	4,55
7. The maintenance service outcome is as expected.	1	1	4	9	16	31	4,23
8. The maintenance service outcome is sustained for the promised time.	1	2	7	12	9	31	3,84
9. The maintenance service partner bends from its claims (e.g. . delivery time)	0	3	10	16	2	31	3,55
10. The maintenance services are tailored based on need.	0	4	3	14	10	31	3,97
11. The maintenance service cooperation is executed on time and as promised.	1	2	3	13	12	31	4,06
12. The maintenance service cooperation is based on confidentiality.	0	0	5	10	16	31	4,35
13. The maintenance service provider has the knowledge to solve upcoming problems.	0	2	1	17	9	29	4,14
14. The maintenance service operators are professionally skilled and qualified.	0	0	4	11	16	31	4,39
15. The resources and timetable of the maintenance service can be planned well in advance.	1	6	2	12	10	31	3,77
16. The maintenance service operations are developed in cooperation.	2	4	4	10	11	31	3,77
17. The current reputation of the maintenance service partner is good.	0	2	3	17	9	31	4,06
18. The previous experiences with the maintenance service partner have been positive.	0	2	5	16	8	31	3,97
19. The maintenance service cooperation works well considering the conditions of all partners.	0	3	2	14	11	30	4,10
20. The information exchange works between the maintenance service partners.	1	2	2	17	8	30	3,97
21. The maintenance service warranty and terms of payment are kept and executed as promised.	0	1	2	14	14	31	4,32
22. The risks and responsibilities considering the maintenance services are shared between the customer and the service provider.	2	5	9	10	5	31	3,35
23. The maintenance service cooperation covers comprehensively the whole maintenance services (from management to execution).	0	2	5	11	13	31	4,13
24. The maintenance service covers the whole life span of the item.	2	6	7	13	2	30	3,23
25. Own research and development can be developed with the maintenance service partner.	6	10	9	6	0	31	2,48
26. The maintenance service partner can provide information and knowledge related to the development of R&D activities.	6	9	10	6	0	31	2,52
27. The price paid for the maintenance service corresponds with the received service.	0	1	6	9	15	31	4,23
28. The price is negotiated in cooperation with the maintenance service partner.	1	0	3	14	12	30	4,20
29. The maintenance service cooperation enables contact with new customers.	6	8	9	6	1	30	2,60
30. The maintenance service cooperation enables starting a new type of business.	9	7	10	3	1	30	2,33
31. The maintenance service partner is responsible for the spare part storage so that it does not tie your own resources and capital.	4	5	8	9	5	31	3,19
32. The maintenance service partner owns the fixed assets, for example the maintained items so that they do not stress your own balance sheet.	11	11	4	2	3	31	2,19

Appendix 4. Specific response rates considering the core service (question 22)

Propositions considering the *core service* (I value that...)	**Totally disagree (1)**	**Pretty much disagree (2)**	**Neither agreeing nor dis-agreeing (3)**	**Pretty much agree (4)**	**Totally agree (5)**	**In total**	**Mean value**
1. The target of the maintenance work functions as expected, its maintainability and repair is easy.	0	3	4	23	21	51	4,22
2. The users look after their part of the in use maintenance operations and enhance the maintainability of the item.	0	3	4	18	24	49	4,29
3. The operational conditions and safety increase along the service.	0	0	2	23	26	51	4,47
4. The maintenance is performed according to safety policies.	0	0	0	14	36	50	4,72
5. The maintenance service performer recognizes the environmental safety hazards.	0	0	4	22	25	51	4,41
6. The maintenance is performed according to environmental safety policies.	0	0	6	15	27	48	4,44
7. The maintenance service outcome is as expected.	0	0	0	18	33	51	4,65
8. The maintenance service outcome is sustained for the promised time.	0	1	4	22	22	49	4,33
9. The maintenance service partner bends from its claims (e.g. . delivery time)	1	4	13	27	6	51	3,65
10. The maintenance services are tailored based on need.	0	3	1	31	16	51	4,18
11. The maintenance service cooperation is executed on time and as promised.	0	0	2	19	30	51	4,55
12. The maintenance service cooperation is based on confidentiality.	0	0	2	11	38	51	4,71
13. The maintenance service provider has the knowledge to solve upcoming problems.	0	0	0	16	35	51	4,69
14. The maintenance service operators are professionally skilled and qualified.	0	0	3	13	33	49	4,61
15. The resources and timetable of the maintenance service can be planned well in advance.	0	4	9	20	18	51	4,02
16. The maintenance service operations are developed in cooperation.	0	3	1	17	28	49	4,43
17. The current reputation of the maintenance service partner is good.	0	0	6	24	21	51	4,29
18. The previous experiences with the maintenance service partner have been positive.	0	0	6	25	19	50	4,26
19. The maintenance service cooperation works well considering the conditions of all partners.	0	1	5	24	20	50	4,26
20. The information exchange works between the maintenance service partners.	0	1	3	18	28	50	4,46
21. The maintenance service warranty and terms of payment are kept and executed as promised.	0	1	7	17	26	51	4,33
22. The risks and responsibilities considering the maintenance services are shared between the customer and the service provider.	0	2	9	23	14	48	4,02
23. The maintenance service cooperation covers comprehensively the whole maintenance services (from management to execution).	0	3	10	16	22	51	4,12
24. The maintenance service covers the whole life span of the item.	1	2	8	21	18	50	4,06
25. Own research and development can be developed with the maintenance service partner.	2	1	11	21	16	51	3,94
26. The maintenance service partner can provide information and knowledge related to the development of R&D activities.	0	3	9	28	11	51	3,92
27. The price paid for the maintenance service corresponds with the received service.	0	0	4	21	25	50	4,42
28. The price is negotiated in cooperation with the maintenance service partner.	0	1	5	19	24	49	4,35
29. The maintenance service cooperation enables contact with new customers.	1	1	7	20	21	50	4,18
30. The maintenance service cooperation enables starting a new type of business.	1	3	16	19	11	50	3,72
31. The maintenance service partner is responsible for the spare part storage so that it does not tie your own resources and capital.	1	4	20	15	11	51	3,61
32. The maintenance service partner owns the fixed assets, for example the maintained items so that they do not stress your own balance sheet.	5	10	17	12	6	50	3,08

Appendix 5. Specific response rates considering the support service (question 25)

Propositions considering the *support service* (I value that...)	**Totally disagree (1)**	**Pretty much disagree (2)**	**Neither agreeing nor dis-agreeing (3)**	**Pretty much agree (4)**	**Totally agree (5)**	**In total**	**Mean value**
1. The target of the maintenance work functions as expected, its maintainability and repair is easy.	0	1	3	21	20	45	4,33
2. The users look after their part of the in use maintenance operations and enhance the maintainability of the item.	0	1	4	20	19	44	4,30
3. The operational conditions and safety increase along the service.	0	0	5	17	22	44	4,39
4. The maintenance is performed according to safety policies.	0	0	0	14	29	43	4,67
5. The maintenance service performer recognizes the environmental safety hazards.	0	0	4	17	22	43	4,42
6. The maintenance is performed according to environmental safety policies.	0	1	3	14	25	43	4,47
7. The maintenance service outcome is as expected.	0	1	1	16	26	44	4,52
8. The maintenance service outcome is sustained for the promised time.	0	1	3	17	23	44	4,41
9. The maintenance service partner bends from its claims (e.g. . delivery time)	0	3	14	17	10	44	3,77
10. The maintenance services are tailored based on need.	0	3	2	22	16	43	4,19
11. The maintenance service cooperation is executed on time and as promised.	0	1	2	21	20	44	4,36
12. The maintenance service cooperation is based on confidentiality.	0	0	1	12	31	44	4,68
13. The maintenance service provider has the knowledge to solve upcoming problems.	0	0	2	17	25	44	4,52
14. The maintenance service operators are professionally skilled and qualified.	0	0	6	9	29	44	4,52
15. The resources and timetable of the maintenance service can be planned well in advance.	0	2	6	21	15	44	4,11
16. The maintenance service operations are developed in cooperation.	0	2	2	21	19	44	4,30
17. The current reputation of the maintenance service partner is good.	0	0	5	18	20	43	4,35
18. The previous experiences with the maintenance service partner have been positive.	0	0	4	26	14	44	4,23
19. The maintenance service cooperation works well considering the conditions of all partners.	0	2	5	21	16	44	4,16
20. The information exchange works between the maintenance service partners.	0	1	0	19	24	44	4,50
21. The maintenance service warranty and terms of payment are kept and executed as promised.	0	2	4	20	18	44	4,23
22. The risks and responsibilities considering the maintenance services are shared between the customer and the service provider.	1	3	10	17	13	44	3,86
23. The maintenance service cooperation covers comprehensively the whole maintenance services (from management to execution).	0	2	4	20	16	42	4,19
24. The maintenance service covers the whole life span of the item.	1	4	4	17	16	42	4,02
25. Own research and development can be developed with the maintenance service partner.	0	4	9	15	14	42	3,93
26. The maintenance service partner can provide information and knowledge related to the development of R&D activities.	0	3	8	15	16	42	4,05
27. The price paid for the maintenance service corresponds with the received service.	0	1	5	15	22	43	4,35
28. The price is negotiated in cooperation with the maintenance service partner.	0	0	8	17	17	42	4,21
29. The maintenance service cooperation enables contact with new customers.	1	3	9	14	16	43	3,95
30. The maintenance service cooperation enables starting a new type of business.	1	4	9	18	11	43	3,79
31. The maintenance service partner is responsible for the spare part storage so that it does not tie your own resources and capital.	2	3	15	16	7	43	3,53
32. The maintenance service partner owns the fixed assets, for example the maintained items so that they do not stress your own balance sheet.	7	7	11	12	6	43	3,07

Appendix 6. Correlations within the value elements of the high critical item

Value element (high critical item)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1 Availability															
2 Safety at work	,571**														
3 Environmental safety	,500**	,577**													
4 Technical quality	,806**	,635**	,574**												
5 Flexibility	,116	,236	,379*	,268											
6 Reliability	,228	,305	,352	,454*	,376*										
7 Operator knowledge	,688**	,542**	,367*	,687**	,386*	,553**									
8 Orderliness	,656**	,539**	,550**	,699**	,318	,526**	,673**								
9 Reputation	,412*	,486**	,696**	,446*	,644**	,466**	,545**	,496**							
10 Relationship	,609**	,600**	,491**	,708**	,596**	,623**	,843**	,645**	,694**						
11 Contracts	,327	,389*	,469**	,367*	,441*	,497**	,591**	,401*	,699**	,632**					
12 Total solutions	,064	-,142	,263	,166	,162	,197	,189	,312	,380*	,160	,286				
13 R&D	,193	,191	,572**	,172	,315	,318	,171	,457**	,567**	,326	,462**	,478**			
14 Price	,669**	,619**	,712**	,767**	,312	,421*	,636**	,730**	,546**	,536**	,397*	,246	,325		
15 Access to markets	-,219	-,229	,156	-,190	,040	-,086	-,208	-,020	,152	-,039	,069	,090	,469**	-,135	
16 Asset management factors	,400*	,371*	,363*	,514**	,141	,194	,400*	,265	,312	,556**	,275	,186	,328	,326	,269

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Appendix 7. Correlations within the value elements of the low critical item

Value element (low critical item)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1 Availability															
2 Safety at work	,579**														
3 Environmental safety	,437*	,585**													
4 Technical quality	,483**	,499**	,453*												
5 Flexibility	,197	,170	,410*	,135											
6 Reliability	,442*	,221	,465**	,458**	,528**										
7 Operator knowledge	,507**	,303	,359	,762**	,213	,548**									
8 Orderliness	,344	,244	,468**	,456**	,421*	,791**	,593**								
9 Reputation	,415*	,322	,530**	,421*	,468**	,494**	,408*	,539**							
10 Relationship	,524**	,248	,459*	,588**	,439*	,731**	,676**	,707**	,676**						
11 Contracts	,289	,310	,454*	,379*	,659**	,544**	,369*	,457**	,545**	,582**					
12 Total solutions	,274	,270	,309	,256	,163	,308	,236	,111	,242	,303	,394*				
13 R&D	,193	-,139	,284	-,088	,311	,347	-,063	,373*	,223	,293	,353	,003			
14 Price	,429*	,458*	,508**	,774**	,084	,610**	,578**	,424*	,424*	,579**	,357	,348	-,047		
15 Access to markets	,160	-,151	,329	-,224	,319	,135	-,167	,228	,250	,203	,342	-,056	,812**	-,114	
16 Asset management factors	,165	,030	,139	,146	,122	,285	,145	,131	,187	,229	,243	,288	,358*	,236	,252

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Appendix 8. Correlations within the value elements of the core service

Value element (core service)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1 Availability															
2 Safety at work	,589**														
3 Environmental safety	,421**	,441**													
4 Technical quality	,482**	,636**	,573**												
5 Flexibility	,337*	,278	,292	,297											
6 Reliability	,448**	,650**	,628**	,586**	,324*										
7 Operator knowledge	,576**	,611**	,456**	,685**	,426**	,668**									
8 Orderliness	,410**	,335*	,550**	,475**	,593**	,432**	,629**								
9 Reputation	,474**	,507**	,397**	,534**	,471**	,420**	,616**	,704**							
10 Relationship	,322*	,493**	,439**	,611**	,442**	,490**	,614**	,684**	,728**						
11 Contracts	,286	,236	,435**	,473**	,602**	,413**	,500**	,637**	,561**	,624**					
12 Total solutions	,175	,215	,366*	,333*	,351*	,299*	,333*	,473**	,306*	,249	,255				
13 R&D	,314*	,379**	,137	,316*	,478**	,285*	,389**	,504**	,509**	,483**	,433**	,344*			
14 Price	,362*	,223	,298*	,261	,584**	,261	,497**	,588**	,455**	,540**	,611**	,135	,220		
15 Access to markets	,203	,177	,201	,261	,343*	,204	,351*	,494**	,502**	,508**	,537**	,030	,440**	,417**	
16 Asset management factors	-,028	-,112	,171	,129	,000	-,128	,093	,149	,258	,220	,428**	-,028	,125	,162	,228

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Appendix 9. Correlations within the value elements of the support service

Value element (support service)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1 Availability															
2 Safety at work	,579**														
3 Environmental safety	,540**	,738**													
4 Technical quality	,724**	,706**	,702**												
5 Flexibility	,459**	,461**	,361*	,407**											
6 Reliability	,521**	,679**	,639**	,674**	,525**										
7 Operator knowledge	,543**	,566**	,501**	,699**	,442**	,699**									
8 Orderliness	,547**	,539**	,521**	,715**	,495**	,662**	,711**								
9 Reputation	,581**	,670**	,531**	,659**	,504**	,655**	,692**	,716**							
10 Relationship	,719**	,571**	,572**	,783**	,370*	,758**	,811**	,749**	,707**						
11 Contracts	,515**	,484**	,593**	,624**	,501**	,561**	,578**	,538**	,648**	,611**					
12 Total solutions	,369*	,446**	,342*	,494**	,324*	,420**	,471**	,460**	,725**	,437**	,474**				
13 R&D	,579**	,485**	,440**	,648**	,411**	,598**	,699**	,610**	,722**	,812**	,696**	,522**			
14 Price	,499**	,597**	,627**	,594**	,529**	,548**	,521**	,515**	,507**	,478**	,472**	,382*	,498**		
15 Access to markets	,506**	,409**	,363*	,585**	,246	,381*	,529**	,435**	,494**	,627**	,545**	,402*	,805**	,566**	
16 Asset management factors	,236	,166	,128	,315*	,054	,031	,231	,080	,279	,177	,444**	,104	,150	,103	,162

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).