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Customer value driven service business development

Outcomes from the Fleet Asset Management Project

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Customer value driven service business development. Outcomes from the Fleet Asset Management Project [Asiakasarvoon perustuva palveluliiketoiminnan kehittäminen. Fleet Asset Management -projektin tuloksia]. Toni Ahonen, Markku Reunanen & Ville Ojanen (eds.). Espoo 2010. VTT Publications 749. 42 p. + app. 87 p.

Keywords service business, customer value, asset management, maintenance

Abstract

Transformation in many companies from goods-dominant logic towards service-dominant logic has continued, and the present difficult economic situation in many companies has actually strengthened this motivation to develop new service businesses in addition to developing existing product-service solutions. The aim of this publication is to enhance the understanding of the industrial service business, with a focus on aspects deemed important in creating new successful business: the success factors and risks of a service provider, collaborative relationships and networking, information management in maintenance services and the customer value of services.

In the new service development process, there are numerous success factors to be considered in different phases. Our research has revealed some factors assessed high by industrial firms. We have found that, in addition to a profound understanding of the customers' production and business processes, the ability to build trust and a fast reaction to the changing client needs among other things are crucial for successful service development and implementation.

Collaborating more effectively with the customer has also been widely recognized as a prerequisite of successful service business. Our research contributes to this field, especially to the business scenarios of networked maintenance by exploring the forms of collaboration in a service provider-customer relationship. New, more collaborative, ways of working in a networked maintenance environment are needed and we propose a maintenance community model as a management framework for these environments. Information management and communication solutions for the purposes of complex maintenance networks are still underdeveloped. We propose ICT solutions that support the collaboration and information exchange in the network and at the same time allow individual members to operate effectively and independently on the terms of the nature of their business environment and related dynamics.

One challenge to systematic service innovation is the multidisciplinary nature of services integrating across technology, business, social, and client (demand) innovations. In many firms the success of selling and service provisions rests with a few individuals able to identify the customers' expectations and needs and to find appropriate solutions ad hoc. Despite the centrality of customer value to marketing, there is a lack of common systematic methods at organizational level for customer negotiations and composing service offerings based on customer value. This has also inhibited efficient utilization of existing customer data and gathering new relevant information. We propose a process for analyzing customer value when new services are created or for complementing the service offering, also when the customer specific benefits expected from the services are assessed.

Customer value driven service business development. Outcomes from the Fleet Asset Management Project [Asiakasarvoon perustuva palveluliiketoiminnan kehittäminen. Fleet Asset Management -projektin tuloksia]. Toni Ahonen, Markku Reunanen & Ville Ojanen (eds.). Espoo 2010. VTT Publications 749. 42 p. + app. 87 p.

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Tiivistelmä

Useissa yrityksissä siirtyminen tuotekeskeisestä liiketoiminnasta palvelukeskeisiin liiketoimintamalleihin on käynnissä ja palveluliiketoiminnan kehittäminen katsotaan nykyisessä haastavassa liiketoimintaympäristössä ja taloustilanteessa yhä tärkeämmäksi. Tämän julkaisun tavoitteena on lisätä ymmärrystä teollisen palveluliiketoiminnan kehittämisestä. Keskitymme erityisesti seuraaviin kannattavan palveluliiketoiminnan kehittämisen kannalta tärkeisiin näkökulmiin: palvelutoimittajan menestystekijät ja riskit, yhteistyö ja verkottuminen, kunnossapitopalveluiden tiedonhallinta sekä palveluihin liittyvä asiakasarvo.

Uuden palvelun kehittämisprosessin vaiheisiin liittyy useita huomioitavia menestystekijöitä. Tutkimuksessamme on tunnistettu tekijöitä, jotka teollisten yritysten näkökulmasta ovat erityisen tärkeitä. Asiakkaan tuotanto- ja liiketoimintaprosessien hyvän ymmärryksen lisäksi esimerkiksi kyky rakentaa luottamusta ja nopea reagointikyky muuttuviin asiakastarpeisiin ovat välttämättömiä kannattavien palveluiden kehittämiselle ja toteuttamiselle.

Tehokas yhteistyö asiakkaiden kanssa on merkittävä kannattavan palveluliiketoiminnan menestystekijä. Fleet Asset Management -hankkeessa toteutettu tutkimustyö keskittyy tällä alueella erityisesti verkottuneen kunnossapitoliiketoiminnan skenaarioihin ja palvelutoimittajan ja asiakkaan yhteistyösuhteen erilaisiin yhteistyökäytäntöihin. Verkottuneessa kunnossapitoliiketoimintaympäristössä ja hankkeessa tarvitaan uusia yhteistyötä painottavia käytäntöjä. Kehitetty Maintenance Community -malli on tarkoitettu johtamisen viitekehykseksi tällaisiin ympäristöihin. Tiedonhallintaa ja kommunikaatiota tukevien sovellusten on todettu olevan edelleen puutteellisia verkottuneen ja kompleksisen kunnossapitotoiminnan tarpeisiin. ICT-järjestelmien osalta Maintenance Community -malli ehdottaa kehityssuuntaa, jossa yhteistyötä ja kommunikointia tuetaan tehokkaasti yhteisillä työkaluilla, mutta yksittäisille toimijoille annetaan samanaikaisesti mahdollisuudet toimia tehokkaasti omaan liiketoimintaansa liittyvillä reunaehdoilla.

Palveluinnovaatioiden kehittämisen haaste on palveluiden monialainen luonne, jossa yhdistyvät teknologiset, liiketoiminnalliset, sosiaaliset ja asiakasinnovaatiot. Monissa yrityksissä palveluiden tarjonta perustuu nykyisellään yksittäisten osaajien kykyyn reagoida asiakkaan tarpeisiin. Huolimatta siitä kuinka keskeiseksi asiakasarvo koetaan palveluiden markkinoinnin näkökulmasta, asiakasarvon analysointiin pohjautuvia keinoja palvelutarjoaman kehittämiseksi on niukasti tarjolla. Tämä on vaikeuttanut olemassa olevan asiakastiedon tehokasta hyödyntämistä ja uuden tärkeän tiedon hankintaa. Fleet Asset Management -projektissa on kehitetty lähestymistapa asiakasarvon analysointiin tarkoituksena hyödyntää sitä uusien palveluiden kehittämisessä tai palvelutarjoaman täydentämisessä sekä palveluista odotettavien asiakashyötyjen arvioinnissa.

Preface

The demand for research and development in the field of services, and particularly customer focus and customer centric business models in services, has recently been increasing. Services have become major assets for companies in their attempt to gain competitive advantage. The transition from manufacturing economy to service economy requires multidisciplinary research with business, cultural and technology dimensions. Furthermore, from companies' point of view, the transition to service logic requires open-minded choices in strategy and managerial commitment as well as tools to implement the change in practice.

This final report of the Fleet Asset Management Project focuses on the core findings of the project by specifically addressing the aspects of how customer value is created, assessed and communicated. The report consists of a selection of publications written by the entire FleetAM work group and a series of contributions by the editors summarizing the findings regarding customer value creation. The latter part is based on the results of a comprehensive case study not previously published.

The Fleet Asset Management Project addressed a variety of aspects related to industrial services development by considering the path from identifying one's success factors to considering how successful service business concepts are created based on a sound understanding of customer value. The results presented in this report are targeted at both the research community and practitioners. The aim is to present new information of significant novelty value for those exploring the challenges of new service development and to create new methods and tools which can be easily applied in companies' processes.

The project resulted in a combination of new information, methods and tools, some of which are ready for companies to adopt and to be adjusted to fit into their processes. Some of the results serve as a good starting point for the development of company specific solutions.

Tampere, 5.10.2010

VTT Technical Research Centre of Finland
Lappeenranta University of Technology

List of original publications

This report consists of a summary and the following publications, which will be referred to in the text by their Roman numerals (Publications I–VII).

I. Ojanen, V., Lanne, M., Reunanen, M., Kortelainen, H. & Kässi, T. (2008). New Service Development: Success factors from the Viewpoint of Fleet Asset Management of Industrial Service Providers. In: Grubbström, R.W. & Hinterhuber, H.H. (Eds.). Pre-prints of the 15th International Working Seminar of Production Economics, March 3–7 2008, Innsbruck, Austria, pp. 369–380.

II. Ojanen, V., Lanne, M., Ahonen, T. & Tuominen, M. (2008) The customer-centric development of new industrial services: antecedents, risks and their management. Proceedings of the 1st ISPIM Innovation Symposium, December 14–17, 2008. Singapore.

III. Ahonen, T., Reunanen, M., Pajari, O., Ojanen, V. & Lanne, M. (2010) Maintenance communities – a new model for the networked delivery of maintenance services. International Journal of Business Innovation and Research, Vol. 4, No. 6, pp. 560–583.

IV. Rosqvist, T., Ahonen, T., Ojanen, V. & Marttinen, A. (2009) Assessing the subjective added value of value nets: which network strategies are really win-win? Proceedings of the Fourth World Congress on Engineering Asset Management (WCEAM) 2009. Athens, Greece, 28–30 Sept. 2009. Springer-Verlag London Ltd. London.

V. Tywoniak, S., Rosqvist, T., Mardiasmo, D. & Kivist, R. (2008) Towards an integrated perspective on fleet asset management: engineering and governance considerations. Proceedings of the 3rd World Congress on Engineering Asset Management and Intelligent Maintenance Systems, WCEAM-IMS 2008, October 27–30, 2008. Beijing, China. Springer. Pp. 1553–1567.

VI. Ahonen, T., Ojanen, V., Reunanen, M. & Lanne, M. (2008) Utilisation of product lifetime information across organizational boundaries in the development of maintenance services. Proceedings of the 2008 IEEE International Conference on Industrial Engineering and Engineering Management. Singapore, 8–11 Dec. 2008. IEEE Engineering Management Society, Singapore Chapter; IEEE Singapore Section. Singapore. Pp. 650–654.

VII. Ojanen, V., Kolehmainen, J., Ahonen, T. & Tuominen, M. (2010) Developing collaborative relationship between industrial service providers and their client: The case of industrial maintenance management. Proceedings of PICMET ’10. Technology Management for Global Economic Growth. Phuket, Thailand, July 18–22, 2010. ISBN 1-890843-22-9. Portland International Center for Management of Engineering and Technology.

Contents

Abstract 3

Tiivistelmä 5

Preface 7

List of original publications 8

1. Introduction 11

2. Methodology 14

3. Customer value driven service business development 17
   - 3.1 Analysis of success factors and risks related to new service development 19
   - 3.2 Analysis and development of collaborative relationships in industrial service business 21
   - 3.3 Provision of customer value focused maintenance services in a networked environment 23
   - 3.4 Asset information in new service development 25
   - 3.5 Service business development based on customer value 28

4. Discussion and conclusions 34

Acknowledgements 39

References 40

Appendices

Publications I–VII

1. Introduction

Customer demands for more services, the desire to be better protected against economic fluctuations, and the desire to achieve growth are among the drivers that make product manufacturers look for more profitable business opportunities in the field of services. This move towards service-dominant logic (Vargo & Lusch 2004; Lusch et al. 2010) is a current trend in the field.

As manufacturing companies increasingly focus on their core businesses, the interest in the utilization of external services provided by product manufacturers and service companies increases (Gebauer et al. 2006; 2008; Kumar et al. 2006). An increasing number of services are currently purchased from service supply networks (Riis et al., 2007). Furthermore, globalization, complexity of technological innovations and demand for integrated solutions also create needs for networking. On the other hand, the fact that the manufacturers often have access to information concerning a wide installed base, referred to as 'fleet' in this publication, offers an important success factor for the company when providing services. Thus, managing, developing and implementing services can benefit from the information content of the data gathered from field. However, all these aspects require the development of new capabilities.

In order to explore the new capabilities needed to respond to the new trends described above, the Fleet Asset Management Project was launched in 2007. Figure 1 gives an overview on the baseline for the project. The figure presents industrial services as an option for successfully managing the production assets and highlights the meaning of capabilities for collaboration and networked business.

Traditional success factor studies can only partly explain the factors influencing the new service development in the context studied, i.e. the transition of industrial companies from machine suppliers to high-value-added service pro-

viders. Therefore, the Fleet Asset Management Project aimed at a more specific exploration of the success factors of a service provider.

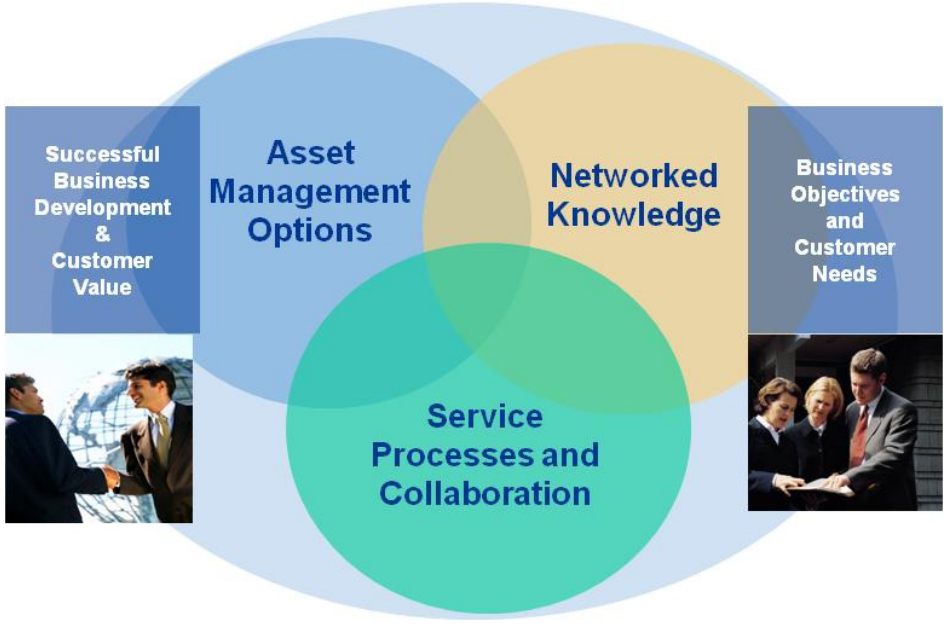

Figure 1. A framework presenting the baseline for service business development.

Moving towards service-oriented business models also entails multiple risks which must be carefully taken into consideration in the development of services. The aim in this project was been to form a picture of the potential risk factors. In addition to the customer centric approaches in service development, one needs to focus on information exchange across the boundaries of the service provider and client organizations. Furthermore, the provision of services in a networked environment with complex structures calls for new capabilities for collaboration and communication. These capabilities and models are explored in the project.

For a customer, purchasing services is an asset management option that needs to be justified in economic terms, i.e. the value elements of the services must be quantified and the optional scenarios compared. Tools and methods for structuring the benefits and sacrifices, identifying value creation mechanisms and quantifying customer value are lacking. The objectives of the Fleet Asset Management Project were derived from these needs.

In short, the purpose of the whole Fleet Asset Management Project is to support companies in their attempts to increase service businesses by effectively identifying their success factors and risks, promoting closer customer collaboration, exploiting gathered information and effectively analyzing the customers' value creation processes.

2. Methodology

In 2006, a preparatory study on industrial service business was started by VTT. The study particularly considered the integration of various aspects in service business development including the main topics in our service development framework; service business development, development of the physical products from the service point of view and development of enabling technology for services. At a very early stage we found that service business development lacked methods and tools that would especially focus on the engineering asset management, risk management processes, customer value creation and business scenarios and models in collaboration networks.

The Fleet Asset Management Project was initiated on the basis of the background presented above and later focused on the following primary research questions:

- Which are the service provider's most significant success factors and how to exploit them in new service development?
- How to manage the risks in industrial service business?
- Which approaches should be used to develop service provider – customer collaboration and how to build up a collaboration network in order to provide customer value focused industrial services effectively?
- How to utilize product related information in developing, managing and implementing new service concepts?
- What methods are needed to evaluate the customer value of new and potential service concepts and how to structure the benefits of a service in order to agree on the value with the customer?

An interview study was carried out at the beginning of the project by interviewing nine persons responsible for service business development in four compa-

nies. The interview study was continued by interviewing six persons from five manufacturing companies representing the customers for industrial service providers. Furthermore, in order to get a stronger grip on the ICT trends in networked maintenance service provision, a company providing enterprise asset management solutions was interviewed. The studies revealed commonalities in companies' needs to create methods and tools in order to enhance the service business. In addition, the customer interviews gave researchers an opportunity to further analyze the 'voice of the customer' and exploit the new information when carrying out the case studies. Moreover, the interview on the ICT solutions of networked maintenance provided a starting point for a wider debate on the requirements of advanced maintenance business scenarios.

The research approach applied in this project is based on both constructive and action analytical approaches (see Figure 2). In the action-analytical approach the empirical part is presented through selected cases. The results are often concept systems of different levels (Neilimo & Näsi 1980; Olkkonen 1994).

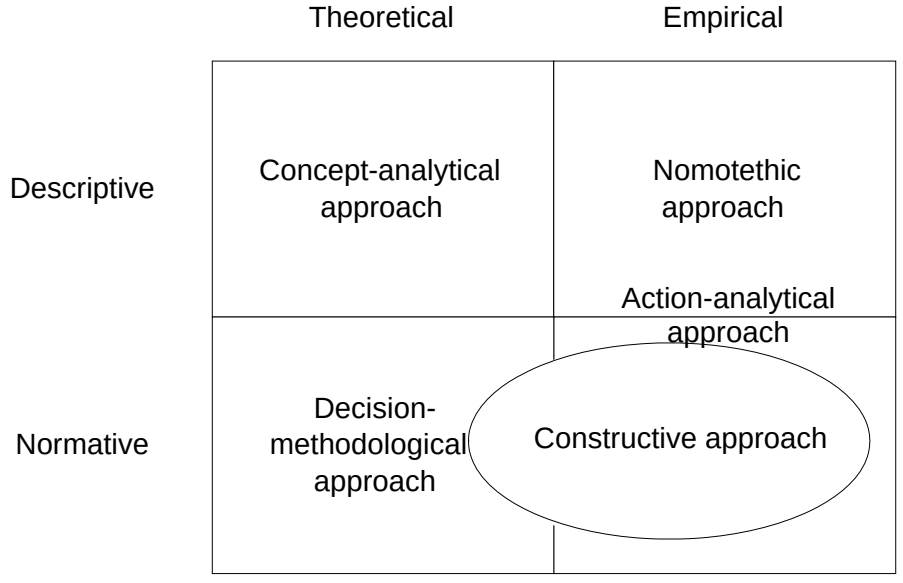

Figure 2. Research approaches. (Neilimo & Näsi 1980; Kasanen et al. 1991).

The purpose of constructive research is to solve practical problems and to test the functionality of the solutions (constructs) during the research process (Lukka 2000). The main goal in the constructive approach is to build new constructs that

can be tied into current doctrines and theories. This construct may be a model, plan, scheme or other construct designed for the purposes of practical problem solving. The results of the research are evaluated on the basis of novelty and applicability. Demonstration and validation of practical usability is also important in evaluating the results (e.g. Olkkonen 1994).

Most of the models and methods were created during the case studies in close collaboration with the industrial partners. As argued by Eisenhardt (1989), cases contribute some strength to theory building, e.g. the likelihood of generating novel theory, testability, and empirical validity, which arise from close linkage with empirical evidence. Second, case study research is particularly well-suited to new research areas or research areas for which existing theory appears to be inadequate (Eisenhardt 1989).

The aspects considered in the case studies carried out during the project address the research questions presented above, and thus the main purposes of the project as a whole. The cases included the following research topics:

- development of trust and new business scenarios in a collaboration network
- new information based service development
- customer value assessment process creation.

Customer concern and considerations of customer value creation form a crucial part of a service business model and thus customer value merits special attention in the development of new successful services. Therefore the aspect of customer value creation was considered in different ways in all three case studies carried out. The key results of the two first mentioned case topics were reported in various publications during the project while the last mentioned topic actually focusing on the assessment of the customer value will be discussed more thoroughly in this publication.

3. Customer value driven service business development

Figure 3 presents the structure of the Fleet Asset Management Project and the aspects addressed. The structure is based on the primary research questions presented in Section 2 and on an analysis of how these questions correlate and how the results of related research subtopics finally integrate into a customer value driven approach for service business development.

New service development (NSD) from the viewpoint of a company's success factors and risks is of special interest in Publications I and II. The topic is further contemplated in Section 3.1. The aspects of collaborative relationships are addressed specifically in Publication VII, from the perspectives of both the service provider and the client. The analysis and development of collaborative relationships are discussed in Section 3.2 on the basis of a case study. Networked service environment is considered in Publications III, IV and V and together they result in findings related to the governance structures and strategies of service supply networks, collaborative ways of working and guidelines for service network oriented technology development. These topics are further discussed in Section 3.3., with a special focus on a maintenance community model presented in Publication III. Information management is an issue in several publications, and Publication VI focuses especially on the potential and utilization of the information. Aspects of information management are further discussed in Section 3.4. from the viewpoint of networked business environments and efficient information utilization.

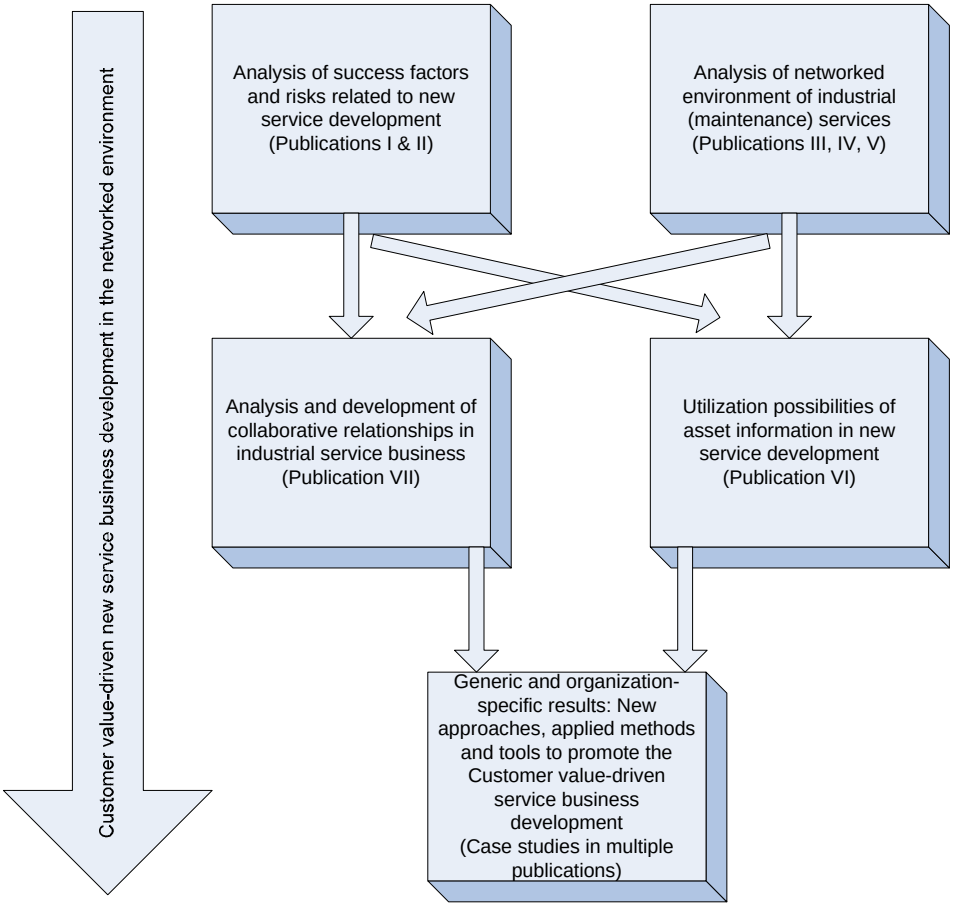

Figure 3. Research structure.

The service management literature widely argues that customer satisfaction is the result of a customer's perception of the value received in a transaction or relationship (e.g. Lam et al. 2004). Identification and delivery of customer value are seen as one of the most crucial elements from the viewpoint of service companies' success (Graf & Maas 2008). The analysis of customer value has a pivotal role in promoting customer value driven service business development and the subject has been explored in a case study focusing on asset management and optimization services. As a result, in Section 3.5 we present the Fleet Asset Management approach for the analysis of customer value.

In addition to the publications presented in Figure 3, the project resulted in a number of reports and publications with considerable influence in the develop-

ment of tools and methods for developing customer value driven service business.

3.1 Analysis of success factors and risks related to new service development

The services considered on the Fleet Asset Management Project are industrial services, typically maintenance and development services supporting the efficient use and the entire life-cycle of industrial assets. Such services and the factors affecting their success in this type of context have not yet been widely studied.

One of the main hypotheses on our project was the assumption that the management of information related to a global asset fleet is one of the main success factors of industrial service development in addition to the generic success factors reported in earlier studies. Our research reveals that traditional success factor studies can only partly explain the factors influencing new service development in the context studied, which is the transition of industrial companies from machine suppliers to high-value-added service providers.

The literature review reveals the multi-dimensionality of success factors in new service development and the characteristics (e.g. IHIP[1]) of the service affecting the management of the new service development (NSD) process. In the process, there are numerous success factors to be considered in different phases. Our research revealed some factors assessed high by industrial firms (see Publication 1). Especially for the Search stage in the NSD process, a thorough understanding of the customers' production and business processes, as well as efficient needs assessment are crucial for successful development. On the other hand, a fast reaction to changing client needs is also important at the implementation stage of the NSD process. Technological factors play a major role at the implementation stage, and the ability to network and build trust is important at all stages. The organizational factors are related especially to the successful development of radically new services. The next step is to ascertain more thoroughly which methods and tools are of help in taking better account of these influential factors, and in the effective development of new services.

Various risks must also be carefully taken into consideration during the transition process from equipment manufacturer to provider of value-based industrial

[1] Intangibility, heterogeneity, inseparability, perishability (e.g. Edvardsson et al. 2005)

services. Thus, a well-organized risk management process covering endogenous and exogenous risks is needed. The risks can typically be categorised as financial, strategic, operational and event risks. One example of external risks is the image risk resulting from losing the client's trust. This may happen for various reasons, for example, due to poor service functionality or unclear pricing of product-service solutions. Internal risks connected to organizational culture and behavioral processes are also typical in the transition process (see e.g. Gebauer et al. 2006; 2008). Loss of financial benefits is one reason why the implementation of organizational changes must be planned carefully, and behavioral dimensions should not be forgotten or underestimated. In the steps of the transition process, one must also consider the different risks that are connected, for example, to the customer relationship, contracts and responsibility (e.g. Rekola & Haapio 2009).

An essential, widely discussed success factor in industrial service business development is collaboration with customers. In industrial collaboration, there may be capability requirements concerning both parties, the client and the service providers. For example, according to Feeny et al. (2005) the competencies required of service suppliers can be categorized in three main groups; delivery competence, relationship competence, and transformation competence. Several types of competencies are needed to respond to several types of customer needs, which may be related to operational service needs, service improvement needs, and long-term viability needs.

In Publication II, we tried to extend the idea of assessing particular competencies of suppliers (for the purpose of outsourcing activities) for the purpose of collaborative new service development. Thus, we need to have a good picture not only of the success factors of collaborative development, but also of the potential risk factors that can jeopardize the early stage of collaboration or the future stages of collaboration. In Publication II we presented some propositions based on analyzing Finnish industrial machinery and service providers in light of our previously presented framework based on an extensive literature review of new service development and risks in interorganizational relationships.

In dynamic relationship development, strategic and organizational context related risk managerial challenges are especially important in the search stage and process-related challenges in the implementation stage of collaborative development. Content related challenges are important at both stages but may have different emphases. With regard to the main type of service considered in this report, i.e. maintenance services, the main aspect to be taken into account in risk man-

agement is, in addition to the stage of the relationship development, the type of the service partnership. Partnership types may include traditional transaction-based maintenance of physical assets, performance-based service or even value-based service. When moving towards higher value production it can also be assumed that the significance of strategic and organizational context related challenges increases while the share of content related challenges may lose some of its relational significance. Process-related challenges exist in all types of partnerships, but in traditional service provision the focus is more on understanding the client's production process while in performance-based and value-based partnerships the focus is on understanding the customer's business process.

Our research focused on industrial service development in collaborative environment where the customer's role is not merely a passive recipient of a service but a co-producer of a new service. The focus is on maintenance services which the manufacturing firms aim to develop by moving towards value-based service business, and on a more complete understanding of the customer's processes as well as of user involvement in the development process.

3.2 Analysis and development of collaborative relationships in industrial service business

The previous section discussed the success factors and risks related to new service business development in an industrial environment. Recognizing and diagnosing various types of influential factors and risks is essential, although not enough. Long-term success entails analyzing the influence of these factors and developing the activities for promoting the most significant success factors and reducing the risks identified.

In the present industrial environment, where companies are aiming to develop from being machinery and after-sales service providers to value-based partners with their customers, the success factors relating to collaboration and better understanding of customer's business processes have increased in significance (e.g. Edvardsson et al. 2007; Möller et al. 2008). The other side of the coin is that these emphases also include risk factors which need to be taken into account. Therefore, on the Fleet Asset Management Project we sought to develop a holistic overall picture of influencing and value-adding factors in collaborative industrial maintenance service business which helps in the systematic development of collaboration at various stages, especially at an early stage of the relationship development process.

In the case study described in Publication VII, the special focus was on developing collaborative relationship for maintenance service of the industrial asset fleet, where two industrial service providers and a client aim to form a deeper collaborative relationship, and co-develop a maintenance service concept further to provide benefits for all concerned. An essential objective in the case study was to form an analysis of the initial situation and its challenges from an objective perspective in order to take all collaborative parties into account (see Kolehmainen 2009). The main research question here was formulated as "what are the main prerequisites for developing a collaborative relationship based on the maintenance of industrial asset fleet and for realization of the common value?" The sub-questions were related to the benefit-risk analysis of collaboration in industrial services, to means to achieve value-added from maintenance, to the communication of benefits, to improving the customer perspective in service development and to measuring success in collaboration.

On the basis of our analysis of the literature in this multi-disciplinary area and especially of the real-world case study and qualitative research in the field of industrial maintenance, we were able to derive four major areas of development. These were derived from the analysis of a case study, but based on our other qualitative data they were also observed by the managers interviewed to occur on numerous occasions. The literature review again revealed the same problem areas in other, similar environments and helped to increase our understanding on the issue in order to focus on the correct development objects. These four areas of development in this context are; 1) strengthening the customer perspective, 2) collaborative capability development, 3) organizing and decision support, and 4) monitoring of relationship development.

The main suggestions in the empirical study – namely the creation of a holistic picture to support decision-making, and open communication of benefits and risks in the collaborative relationship – aim to help in the mutual understanding of the targets and in the development of trust in the step-by-step approach. An essential prerequisite for developing a collaborative relationship in industrial service business and realizing the common value is that the potential benefits of a larger service package as well as the risks involved are well understood in both service provider's and customer's organizations. In addition, developing the relationship also requires monitoring and relevant ways to measure progress. On the basis of empirical studies consisting of a case study on maintenance management collaboration and other interview material and qualitative data, as well as a theoretical review of this multi-disciplinary issue, we were able to draw

conclusions and derive implications and also to make suggestions on the above-mentioned four main themes (see Publication VII).

3.3 Provision of customer value focused maintenance services in a networked environment

Publication III presents an advanced model for a networked business scenario where maintenance services are provided by a collaborative service supply network. The 'Maintenance Community' model, as described in Publication III, includes various aspects, such as business processes, resources and communication as well as rough outlines of the network governance structure and target setting. Publication IV deals in more detail with the governance structure of a value net.

The 'Maintenance Community' model highlights the significance of efficient information management and communications processes and technology. The aspects presented in Publication VI regarding the ways to utilize the information in the development, management and implementation of the maintenance services are to be considered as well. According to our research, information transparency and trust building issues are also deemed important. A central system solution for managing the information is not seen as a future solution. In practice, community members will all need their own ERP and information management systems, due to the individual nature and dynamics of their respective businesses. Furthermore, the best way to support the communities is to develop concepts involving efficient adaptation solutions with interfaces for the members, ways of supporting information mediation and dynamic decision-making and systems that contain the structures of the service products, and proper tools for work management.

A business network can be classified according to a combination of criteria, as presented by Valkokari (2009). On the basis of these criteria adopted from several authors, we classify our 'Maintenance Community' model as follows:

- **Business aspect:** The purpose of a maintenance community is not to create new business but a community focuses on basic maintenance business with the help of a new more efficient and collaborative business scenario.
- **Learning aspect:** Learning as an alliance is an important aspect of learning for a maintenance community. From the perspectives of individual members, learning in the alliance is highly relevant; however, the

community model encourages companies to improve the operations together at the network level. As a maintenance community is a dynamic structure where the combination of service providers may change, the aspect of learning about alliances and the governance principles is important, especially for occasional and new service providers.

- **Value chain and structure of the network aspect:** The community members work for the same objective and in order to maximise the customer value produced in close collaboration. The community members take their places in the customer's value chain according to their core competences and agreed responsibilities in close collaboration inside the community.
- **Knowledge based aspect:** Following the metaphor presented by Lamming et al. (2001) a community is not fully transparent because the rules created by the network will tell which part of information is common to all. Thus, the concept of translucency of information is fairly often used.
- **Objective aspect:** Loeser (1999) presents three network strategies; Efficiency Reengineering Strategy, Competence Leveraging Strategy and Competence Building Strategy. Competence Leveraging Strategy includes the features that are most dominant in the case of a maintenance community. Thus, the strengths and core competences of each community member are exploited. However, in some areas there is a need for the aspects of 'economies of scale' and the first network strategy presented is relevant.
- **Value creation aspect:** A maintenance community has features of a value shop in its way of combining skills and knowledge effectively in order to solve the customer's problems. Many of the tasks considered may be repeated, while the operations include a great amount of flexibility. The role of a service integrator is important in a community. Thus the presence of a mediator company is a strong link to the value network model.
- **Know-how aspect:** The community supports not only the integration of know-how but more importantly the utilization of existing know-how in co-operation. The aspects of creation of new know-how are relevant only on a small scale.

While Publication III focuses on the structure and policies of a maintenance service supply network and explores the development targets from the perspectives of trust, collaboration and information management, Publications IV and V pay more attention to asset management perspectives. Publication V *"Towards an integrated perspective on fleet asset management – engineering and governance considerations"* explores two perspectives of assets. The publication describes the potential problems related to integrating engineering asset management and asset governance perspectives as well as finding solutions to conflicting objectives. A Balanced Scorecard based measurement system is proposed as one potential solution to the multi-objective and multi-measurement challenge. Publication IV *"Assessing the subjective added value of value nets: which network strategies are really win-win?"* further explores the use of Balanced Scorecards in measuring partners' perceived value when operating as a player in a business network.

3.4 Asset information in new service development

The change towards service logic (Grönroos 2006) challenges previous ways of thinking and calls for new practices in collaboration, leadership, customer orientation as well as tools for carrying through the change in the organization. The intensity of stakeholder collaboration differs significantly between product and service development (e.g. Maglio et al. 2006). These changes also have effects on the requirements for information management.

Management and utilization of information have been regarded as an important and critical factor for the competitive advantage of the company when developing services. Gathering equipment level lifetime information from an extensive installed machinery base can offer the manufacturer, operating as a service provider, a competitive edge. Provision of services changes the way of thinking, also from the viewpoint of creation and utilization of information which should be studied not only regarding the service provider itself but from the point of view of a group of important stakeholders where customers have a crucial role (Hyötyläinen & Nuutinen 2010).

An increased number of opportunities for conversations and communication help in sharing information for the benefit of the whole organization, which is found very important from the viewpoint of successful business and competitive advantage (Nonaka & Takeuchi 1995). Transformation of tacit information into an electronic format that can be integrated into the knowledge base of the service

provider facilitates information sharing (Hyötyläinen & Nuutinen 2010). The information management systems, however, do not completely replace the need for verbal interaction (Kiritsis et al. 2003).

The changes and the increased complexity of machines and production systems have also increased the needs for various kinds of information, and decision-making related to services can no longer rely on technical information alone. Instead, one should take into account the varying nature and accuracy of information needed for different purposes. For instance, Quak et al. (2006) present the following stages for information utilization in the asset management decision process: 1) technical information, 2) economic information on assets and 3) economic information on business and societal information. Stages 2 and 3 combine the new information with the information produced or gathered during the previous stage. Another way to categorize the gathered information is presented in Publication VI *"Utilisation of product lifetime information across organizational boundaries in the development of maintenance services"*, which is based on the potential of information items and their various utilization possibilities. The following categories are presented

a) continuous development of maintenance services and maintenance planning based on technical information regarding the installed base

b) management of maintenance services

c) implementation of maintenance services; support for the delivery of individual services.

Publication VI provides a framework and an overall management perspective for sharing and utilizing information. The publication demonstrates the significance of lifetime information in the development, management and implementation of maintenance services. The aspects of close collaboration between the service provider and the customer are addressed, likewise the related demands for information transparency.

The results from the research activities on fleet information management and a case study on developing an information-based service are presented in Ahonen & Reunanen (2009). The report focuses on the aspects covered in short in the following text.

Until only a few years ago one of the greatest challenges of asset information management was the lack of maintenance, failure and use-phase data. More efficient use of information systems and increased automation have since then re-

sulted in large amounts of data whose potential has not yet been fully exploited. However, companies are increasingly keen to use information systems and gathered data for strategic planning and future decision-making instead of simple analyses of past events.

A production site does not always have the capabilities to develop the procedures to gather the right data or to analyze and effectively exploit the data gathered. A service provider can benefit from having access to the site records of data and from gathering experience on analyzing data from various cases. Developing an information-based service, however, requires thorough familiarity with the customer's processes in order to be able to deliver the added value related to each information item and to design the ways in which data is used.

The contents of a service should have clear interfaces with a customer's decision-making, resulting in instructions on how the information provided can best be exploited. Making structured data available is only one step forward. Integration of the service into the customer's processes is made easier when the service provider has the opportunity to demonstrate how the features in the service support the practices in the customer's organization or functionalities in the production processes. Following the trend of focusing on core businesses makes it even harder for the customer to keep up with the requirements for technological knowledge related to the production system and to manage all the information needed for the optimization of the assets. From the customer's point of view, there is a need for an outside view on the operational efficiency based on the ability to exploit the data and to have access to good reference cases.

The Fleet Asset Management approach for the development of an information-based service is based on two main phases, the first of which aims at describing the customer's production process with a Structured Analysis and Design Technique (SADT). The analysis results in a baseline for identifying where existing information items can be best utilized and for finding the part in the process where lack of information is a special problem. For instance, finding the exploitation paths of an information item from the viewpoint of maintenance is possible only after gathering adequate information on the failure behavior of the systems considered. The second phase of the approach consists of the following tasks and objectives:

- identify the most focal needs for information in the customer's operative management

- analyze the failure behavior of the target system from the viewpoint of which information items are needed when searching for solutions to failures and problems occurring
- give a profile of the normal use and operation scenarios of the machinery and identify the needs for related information.

As a result, the exploitation paths of data and information items are described and a list of development targets related to data collection is formulated. Exploitation of the various data may require the use of advanced methods to convert the data into applicable knowledge. The potential of text mining methods in a maintenance context were explored on the Fleet Asset Management Project by means of a practical case study (Lahdensuo 2008).

3.5 Service business development based on customer value

Our work on customer value focused on the methods needed for the qualitative description of industrial services from the viewpoint of customer value and for the quantification of the most significant elements. Understanding the various aspects of customer value is of vital importance when developing new services. It is also important from the marketing perspective because service marketing essentially includes “making promises about the value that can be expected to be captured from the service” (Grönroos 2006).

Value proposition, customer value creation, value capture and customer advantages are among the key elements of a successful service business model (Salkari et al. 2007, Osterwalder & Pigneur 2009). Value capture in this context elucidates the means through which a service provider is involved in the customers’ value creation processes, and demonstrates how the value is created.

When applying service logic, Grönroos (2008) emphasizes the role of the service provider as a facilitator of value and co-creator of value instead of considering the provider as the creator of the value. Value-in-use thinking puts the focus on the customer’s value creation processes and the auxiliary role of services in these. More direct interactions with the customer’s value creation processes are dominant when business is based on service logic. Instead of purely considering value propositions, service firms are more likely able to influence value fulfilment.

The current challenges in creating the value proposition and providing information on the customer benefits and value of the services result mostly from the fact that reliable information on the customers' value creation processes is lacking. Thus, information on the value potential of the services influencing these processes is also lacking. As services – as we see them – cannot be analyzed in the context of value-in-exchange and the analysis should go further into the processes where the customer creates the value; the practices created and developed in the product centric businesses are no longer applicable.

Grönroos (2006) states that services are value-supporting processes that support customers' value creation and that customer value is composed of a variety of elements in the customer interface which the service marketer should also manage. We propose the following process phases for the analysis of customer value (with a focus on functional/instrumental value, Smith & Colgate 2007), both including a structured methodology and related tools presented later:

- qualitative analysis of the content of the service portfolio, customer needs and value creation mechanisms
- quantitative analysis of value fulfilment, with a focus on the most significant value elements identified at the earlier phase.

The qualitative part of the proposed process describes a first step for outlining the value of the service. The Service Quality Function Deployment (SQFD) method (see e.g. Salkari & Ryynänen 2009 for further information on QFD in services) mainly represents this qualitative part, which in this context can also be called a service design and synthesis method because the main objective is to combine elements of existing services and then to develop and describe the potential services. Application of the method yields an analysis of how the elements of the service portfolio fulfil the existing customer needs. By analyzing how particular features of the services and customer needs meet, the value elements the services and value creation mechanisms are outlined and a basis is created for the quantification of service value.

Compared to the fashion in which quality function deployment is commonly applied, we emphasize the very detailed documentation of how specific features of the services reflect the needs of the customers and which stakeholders are influenced by the services. The analysis should result in a) a list of factors affected in the customer's value creation processes, b) information on how the service influences these processes and c) a better understanding of the value elements based on which the service is successfully provided. These elements

include, for instance, proactiveness, cost efficiency, high level of knowledge, technology advantage, fluency and management.

A more detailed quantification of the added value (value analysis) is possible only after the service portfolio is structured and services and their connections to customer needs are qualitatively described. The value analysis includes an assessment of the effects that the services considered have on the customer's cost elements.

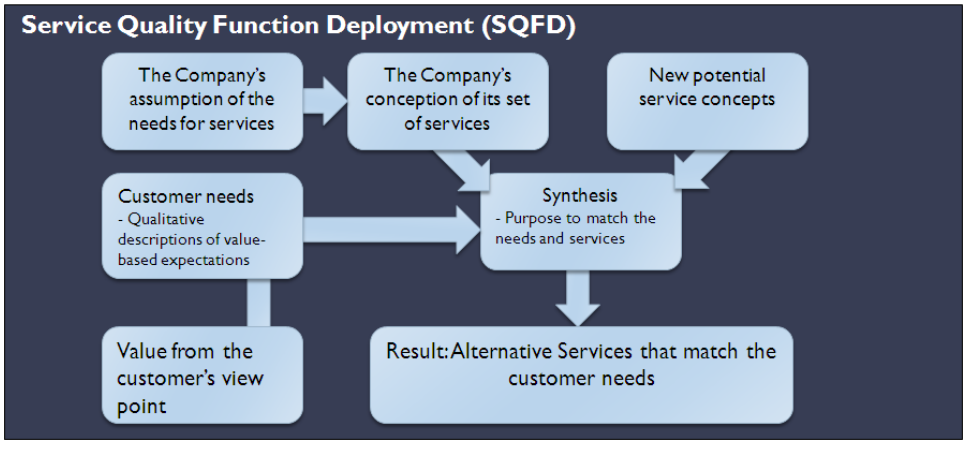

Figure 4. SQFD process.

With the aid of the SQFD analysis one can redirect the new potential service concepts as well as adjust the existing services in order to better fulfil the customers' requirements. When documenting customer needs, the focus is on the matters which are very close to the customer's practical business processes, related future challenges and the changes that the customer is willing to carry out. Thus, the perspective of future (latent) customer needs can also be taken into account in the progress of the SQFD process presented in Figure 4. It has been found important to identify the links between services and customer needs at a very early phase of service development. Based on the resulting information, service development can be focused on services and features found profitable and significant for the customer and knowing how at a very concrete level to meet the customer needs, makes it possible to quantify the customer value.

The process can and often should be performed iteratively so that an analysis of a single service can be completed when more information has been gathered and a better understanding on the whole service portfolio has been achieved.

Furthermore, not all the features in the SQFD process may be needed when starting the process. For instance, the links between service concepts may be taken into use when the process has resulted in an adequate amount of information on the individual services and related customer needs.

The SQFD process is implemented as follows:

- Customer needs are described, also with more detailed information on the background of the specific needs – the voice of the customer
- Customer needs are prioritized
- A portfolio of potential and existing services is composed for the analysis
    - Preliminary titles for the services are given.
    - Services are given more specific descriptions, the content of the services is outlined and specific features discussed
- The matrix which generates the links between services and customer needs is analyzed
    - An estimate is given on how strong the link is (on a scale weak-medium-strong)
    - The value mechanism is described – how the service correlates with a specific customer need
- The ’Roof’ part of the QFD house is filled
    - The correlations between the services are discussed
- The results are evaluated.

The advantage of the SQFD approach is that it helps the participants to commit to collaborative work in which the participants in a positive way are compelled to think quite thoroughly about certain aspects.

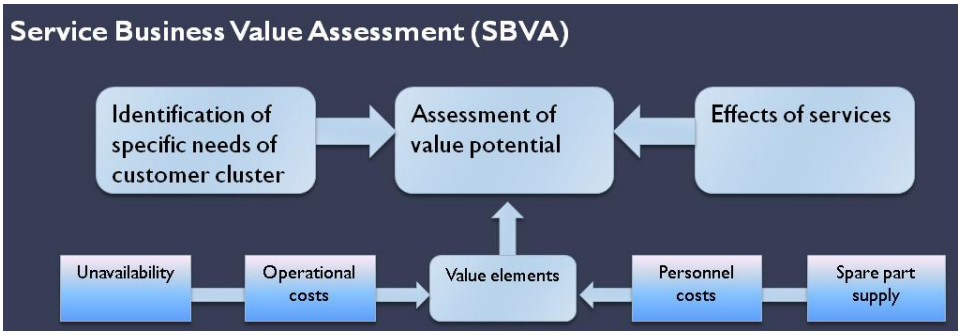

Figure 5. SBVA process.

The process for service business value assessment (SBVA) at its highest level is outlined in Figure 5. In more detail, the process includes following phases:

- analysis of the customer's business scenarios from the viewpoint of the key cost factors identified
- *The objective is to translate the understanding of customers' business processes into numbers and describe the crucial features of customer's business in financial terms.*
- analysis of the most significant failure modes related to the technical system considered and the challenges related to the business processes
- *One of the main targets of the asset management services considered here is to improve the availability of customers' production processes. In order to evaluate the significance of services in preventing failures that cause unavailability, one must identify and analyze the failure modes and gather information on their financial consequences*
- analysis of the impacts of the services on costs
- *The preceding phases provide information on the current situation regarding customer's business operations. The third phase will include the assessment of the effects of the services offered on the current situation, measured in financial terms.*
- analysis of the results
- *The results of the preceding phases are compiled according to the cost categories used and from both yearly and lifecycle perspectives.*

Determination of customer value can no longer rely on product-centric sources of information alone. It should be based on combinations of various information sources that go deeper into the customers' processes and business scenarios. Structured methods for collecting the information on those value elements that are most significant for the customer are helpful, likewise the data received from e.g. salesperson call reports, customer visits, competitors' offerings and customer complaint records. These data enable more detailed analysis based on the value elements.

When assessing customer value, one needs to focus on the assumed benefits based on which the value proposition is made but also on the value elements which are based on the capabilities and know-how of the service provider and the features of the services provided. These value elements have a strong connection to the success factors of the provider and define in practice how the service is provided. Furthermore, service value is always dependent on the customer's business model and processes. The closeness of the partnership may also be important to take into account because "loyal buyers are more likely to focus on long-term benefits and engage in cooperative actions beneficial to both partners in a relationship than disloyal partners" (Lam et al. 2004).

4. Discussion and conclusions

In this final section of our report we evince answers to our research questions posed in the first section. Then we will further analyze the results as a whole in order to form a comprehensive picture of the development of customer value driven service business. The main results are also self-assessed on the basis of common scientific criteria of qualitative constructive research approach. Finally, theoretical and managerial implications as well as limitations and future research areas are discussed at the end of this concluding section of the report.

The first research question was stated as follows:

- Which are the service provider's most significant success factors and how to exploit them in new service development?

Numerous types and dimensions of success factors in new service development and service business development were revealed in our literature review and empirical research focusing on industrial services. In the NSD process, numerous success factors and service characteristics need to be considered in different phases. For example, especially at an early stage, a profound understanding of the customers' production and business processes, as well as efficient need assessment are crucial for successful development. On the other hand, a fast reaction to the changing client needs is also important during the implementation stage of the NSD process. Here we can see the significance of the general crucial success factor of customer collaboration and customer-centric development in the context of the value-based service business studied. Other factors to be possibly considered include technological factors, organizational factors and factors related to abilities to network and to build trust.

In addition to these general success factors, the Fleet Asset Management Project emphasized the importance of managing the information based on the global asset fleet. This success factor is especially important for industrial equipment manufacturers and service providers who aim to develop knowledge-intensive

service businesses at a global level. Access to information and the ability to transfer and integrate as well as practically utilize the information and knowledge related to the asset base provide a significant source of competitive advantage.

The second research question was stated as follows:

- How to manage the risks in industrial service business?

In addition to the success factors, a large number of risk factors need to be considered. The success factor of close collaboration with the customer, for example, may also entail considerable risks depending on the phase of relationship development. Generally, both endogenous and exogenous risks need to be managed carefully. In the context of transformation to service business, traditional risk management methods may not be enough, and a wider perspective on risk management in organizations needs to be considered.

We could assume that strategic and organizational context related challenges pertaining to risk management are more important in the early search stage and process-related challenges in the implementation stage of collaborative development. Content related challenges are important in both stages but with a different emphasis. In addition to the developmental stage of the relationship, the main aspect to be taken into account in the risk management of maintenance services is the desired type of the service partnerships. When moving to value-based service production it can be assumed that the significance of strategic and organizational context related challenges increases while the share of content related challenges may lose some of its relational significance. With regard to process-related challenges, in traditional solution provision or maintenance the focus is more on understanding the client's production process, while in performance-based or value-based partnerships the focus is on understanding the customer's business process. Thus, new risk management methods may be crucial to success in future service business.

The third research question was formulated as follows:

- Which approaches should be used to develop service provider – customer collaboration and how to build up a collaboration network in order to provide customer value focused industrial services effectively?

Based on a literature review, an analysis of a case study and an interview study, the multi-disciplinary area of collaborative relationships focused on the following development objects; 1) strengthening the customer perspective, 2) collabo-

rative capability development, 3) organizing and decision support, and 4) monitoring of relationship development. On the basis of our research suggestions regarding the above-mentioned themes were made, namely the creation of a holistic picture to support decision-making, and open communication of benefits and risks in the collaborative relationship. In addition, we conclude that the potential benefits of a larger service package as well as the risks involved should be well understood in both service provider's and customer's organizations. Developing the relationship also requires monitoring and relevant ways to measure progress.

New, more collaborative, ways of working in a networked maintenance environment are needed and we propose a 'Maintenance Community' model as a management framework for these environments. The model highlights the significance of efficient information management and communications processes and technology. Information transparency and trust building issues are also found important.

The fourth research question was formulated as follows:

- How to utilize product related information in developing, managing and implementing new service concepts?

Developing an information-based service presupposes an understanding of the customer's business from the perspectives of the business models applied, the production systems used, the existing and future customer requirements and the technology in use. Excessively intensive focus on technology aspects may lead to unsatisfactory results and our contribution to the development of information-based services is particularly in strengthening the customer perspective and emphasizing the significance of process knowledge when creating services. In addition to the development of an information-based service, our research makes a contribution to information management related to the development, management and implementation of maintenance services by proposing guidelines for structuring the content of information. We found that a globally recognized service provider has significant potential in having access to information on an asset fleet, however, the lack of solutions and culture as well as adequate level of trust, commitment and transparency for information sharing may often prevent the potential from being fully exploited. The research on networked maintenance business resulted in new knowledge on requirements for ICT, trust building, governance structures and collaboration practices. We found that both customers and maintenance service suppliers should critically evaluate their processes from the collaboration perspective and direct efforts towards the management of the

service provider customer interface. In relation to ICT solutions, recent experiences have shown that centralized information management systems have not provided acceptable solutions for dynamic and wide ranging networks.

- What methods are needed to evaluate the customer value of new and potential service concepts and how to structure the benefits of a service in order to agree on the value with the customer?

The project resulted in a process for evaluating customer value together with tools which support service providers in creating new customer value driven services and show the added value in economic terms. A systematic approach to considering customer value in service business development requires a qualitative method for creating and describing the services in relation to customer needs and a quantitative method to more specifically assess customer value 'in terms of money'. We propose the Service Quality Function Deployment and Service Business Value Assessment methods and related tools to be used for these purposes.

The applicability of existing methods for the value assessment of engineering asset management services and the use of dynamic simulation in value assessment have been further explored by Hyppänen (2010).

In recent years we have witnessed a significant increase in the literature focusing on emergent industrial service process development. In addition, there are numerous studies on different perspectives of service supply networks. However, the number of studies integrating these areas and combining the various perspectives of industrial service business development and the complexities of service networks is still rather scarce. In Publication III we presented a novel approach, maintenance communities, which includes conceptual discussions on perspectives of maintenance service supply in a networked environment.

Furthermore, there is a limited amount of studies focusing specifically on the comprehensive assessment of customer value in industrial services. Our approach discussed here increases the understanding of the value-formulating elements and ways to assess value in the networked business environment of industrial firms operating as equipment manufacturers and maintenance service providers.

There is also a real practical need in companies to increase the understanding of the alternative approaches for the integration of services in a networked industrial environment in order to increase the added value for the customer. Firms need practical ways to measure value.

In our research project we were able to conduct case studies on several subareas of the research project, for example on developing the collaborative rela-

tionship between service provider and client, developing new asset information based services and value assessment methods for industrial maintenance service. All the individual case studies enabled a more profound understanding of value elements in the industrial service business.

When reflecting to our selected research approach, i.e. the constructive approach, we note that several small-scale constructs have been produced in several case studies. These are, for example, an Analytic Hierarchy Process based model and an information-based service design process, which are reported in the publications. Furthermore, in some cases weak market tests related to the managerial utility of the constructs have also been conducted. In the constructive approach this means that company managers have also tried out or utilized in practice the approach or methods constructed, but their final benefit to the company business has not yet been tested in the long run.

The studies presented in this report were restricted to industrial service business development, with a focus on maintenance and information-based services which support the engineering asset management activities of the customer. The services considered are provided by product manufacturers desirous of increasing the share of services in their turnover and developing their offerings by providing more services that assist customers in the operation phase of the product's lifecycle. Service business models were explored mostly from the value proposition point of view. However, certain multidimensional aspects of the project – such as analyses of collaboration practices and success factors of NSD – pay attention to a wider range of topics related to a service business model. Business environment and business scenarios are discussed only from the viewpoint of networked maintenance. The development of ICT solutions is not addressed in our study. However, guidelines for the development of these are provided from the viewpoint of the business scenarios and customer requirements identified during the research.

There is a need for further studies for the refinement and validation of the models, tools and methods developed on the Fleet Asset Management Project. The scope of further studies could also be broadened to include different types of services in different industrial sectors. A number of special challenges and future research to meet these challenges have been identified in the original papers attached to this report (Publications I–VII).

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References

Ahonen, T. & Reunanen, M. (2009) Utilisation of lifetime information in the development of industrial services. VTT Working Papers 136. VTT, Espoo. 62 p. (In Finnish). http://www.vtt.fi/inf/pdf/workingpapers/2009/W136.pdf

Edvardsson, B., Gustafsson, A. & Roos, I. (2005) Service portraits in service research: a critical review. International Journal of Service Industry Management, Vol. 16, No. 1, pp. 107–121.

Edvardsson, B., Gustafsson, A. & Enquist, B. (2007) Success Factors in New Service Development and Value Creation through Services. In: Spath, D. & Fähnrich, K.-P. (Eds.). Advances in Services Innovations, Berlin: Springer-Verlag.

Eisenhardt, K. M. (1989) Building Theories from Case Study Research. Academy of Management Review, Vol. 14, No. 4, pp. 532–550.

Feeny, D., Lacity, M. & Willcocks, L. P. (2005) Taking the measure of outsourcing providers. MIT Sloan Management Review, Spring 2005, pp. 41–48.

Gebauer, H., Friendli, T. & Fleisch, E. (2006) Success factors for achieving high service revenues in manufacturing companies. Benchmarking: An International Journal, Vol. 13, No. 3, pp. 374–386.

Gebauer, H., Krempl, R., Fleisch, E. & Friedli, T. (2008) Innovation of product-related services. Managing Service Quality, Vol. 18, No. 4, pp. 387–404.

Graf, A. & Maas, P. (2008) Customer value from a customer perspective: a comprehensive review. Working Paper Series in Finance. Paper No. 76. University of St. Gallen.

Grönroos, C. (2006) Adopting a service logic for marketing. Marketing Theory, Vol. 6, No. 3, pp. 317–333.

Grönroos, C. (2008) Service logic revisited: who creates value? And who co-creates? European Business Review, Vol. 20, No. 4, pp. 298–314.

Hyötyläinen, R. & Nuutinen, M. (2010) Mahdollisuuksien kenttä – Palveluliiketoiminta ja vuorovaikutteinen johtaminen. Tampere, Teknologiateollisuus. 264 p. ISBN 978-952-238-033-3. (In Finnish).

Hyppänen, S. (2010) Customer Value Formation and Assessment in Industrial Services. Master's thesis, Lappeenranta University of Technology, Lappeenranta, Finland.

Kasanen, E., Lukka, K. & Siitonen, A. (1991) Konstruktiivinen tutkimusote liiketaloustieteessä. Liiketaloudellinen aikakauskirja, 40, 3. Pp. 301–329. (In Finnish).

Kiritsis, D., Bufardi, A. & Xirouchakis, P. (2003) Research issues on product lifecycle management and information tracking using smart embedded systems. Advanced Engineering Informatics, Vol. 17, pp. 189–202.

Kolehmainen, J. (2009). Developing the Collaborative Relationship between Industrial Service Providers and their Customer. Master's Thesis, Lappeenranta University of Technology, Department of Industrial Management, Lappeenranta, Finland. (In Finnish).

Kumar, R., Markeset, T. & Kumar, U. (2006) Implementation and execution of industrial service strategy: A case study from the oil and gas industry. Journal of Quality in Maintenance Engineering, Vol. 12, No. 2, pp. 105–117.

Lahdensuo, V. (2008) Utilization of maintenance data by using the methods of text mining. Master's Thesis, Tampere University of Technology. (In Finnish).

Lam, S. Y., Shankar, V., Erramilli, M. K. & Murthy, B. (2004) Customer Value, Satisfaction, Loyalty, and Switching Costs: An Illustration From a Business-to-Business Service Context. Journal of the Academy of Marketing Science.

Lamming, R. C., Caldwell, N. D., Harrison, D. A. & Phillips, W. (2001) Transparency in supply relationships: Concept and practice. Journal of Supply Chain Management, Vol. 37, No. 4, p. 4–10.

Loeser, B. O. (1999) How to set up a cooperation network in the production industry. Industrial Marketing Management, Vol. 28, pp. 453–465.

Lukka, K. (2000) The Key Issues of Applying the Constructive Approach to Field Research. In: Reponen, T. (ed.) Management Expertise for the New Millennium. In Commemoration of the 50th Anniversary of the Turku School of Economics and Business Administration, Publications of the Turku School of Economics and Business Administration, A–1:2000.

Lusch, R. F., Vargo, S. L. & Tanniru, M. (2010) Service, value networks and learning. Journal of the Acad. Mark. Sci., Vol. 38, No. 1, pp. 19–31.

Maglio, P. P., Srinivasan, S., Kreulen, J. T. & Spohrer, J. (2006) Service systems, service scientists, SSME and innovation. Communications of the ACM (July).

Möller, K., Rajala, R. & Westerlund, M. (2008) Service innovation myopia? A new recipe for client provider value creation. California Management Review, Vol. 50, No. 3, pp. 31–48.

Neilimo, K. & Näsi, J. (1980) Nomoteettinen tutkimusote ja suomalainen taloustiede: Tutkimus positivismin soveltamisesta. Tampere University, Publications of the

Department of Business Administration and Private Law, A2: Research Reports 12. (In Finnish).

Nonaka, I.J. & Takeuchi, H. (1995) The Knowledge-Creating Company. How Japanese Companies Create the Dynamics of Innovation. New York – London: Oxford University Press.

Olkkonen, T. (1994) Johdatus teollisuustalouden tutkimustyöhön. 2nd ed. Teknillinen korkeakoulu, Tuotantotalouden laitos, Teollisuustalouden laboratorio, Report 152, Espoo (In Finnish).

Osterwalder A. & Pigneur, Y. (2009) Business Model Generation. ISBN 978-2-8399-0580-0.

Quak, B., Smit, J. J. & Gulski, E. (2006) Decision Support for Maintenance Management of High Voltage Components. 8th International Conference on Properties and applications of Dielectric Materials, 2006. Pp. 262–266.

Rekola, K. & Haapio, H. (2009) Industrial Services and Service Contracts – A Proactive Approach. Helsinki: The Federation of Finnish Technology Industries.

Riis, J., Johansen, J., Waehrens, B. & Englyst, L. (2007) Strategic roles of manufacturing. Journal of Manufacturing Technology Management, Vol. 18, No. 8, pp. 933–948.

Salkari, I. & Ryynänen, T. (2009) Getting a grip of customer value creation in developing industrial services. European Research in Innovation and Management Alliance Symposium – ERIMA Symposium 2008. Porto, Portugal, 6–7 Nov. 2008.

Salkari, I. Salminen, V. & Pylkkänen, J. (2007) BestServ – Managing Service Business Winning best practices and success stories. Tampere. Teknologiateollisuus. 32 p. ISBN 978-951-817-942-2.

Smith, J. B. & Colgate, M. (2007) Customer value creation: a practical framework. Journal of Marketing Theory and Practice, Vol. 15, No. 1, pp. 7–23.

Valkokari, K. (2009) Yhteisten tavoitteiden ja jaetun näkemyksen muodostuminen kolmessa erityyppisessä liiketoimintaverkostossa. VTT, Espoo. VTT Publications 715. 278 p. + app. 21 p. (In Finnish). http://www.vtt.fi/inf/pdf/publications/2009/P715.pdf

Vargo, S. L. & Lusch, R. F. (2004) Evolving To a New Dominant Logic for Marketing. Journal of Marketing, Vol. 68, January, pp. 1–17.

PUBLICATION I

New service development: success factors from the viewpoint of fleet asset management of industrial service providers

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NEW SERVICE DEVELOPMENT: SUCCESS FACTORS FROM THE VIEWPOINT OF FLEET ASSET MANAGEMENT OF INDUSTRIAL SERVICE PROVIDERS

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Abstract

Numerous studies in the last two decades have revealed that many factors of success and failure in new service development (NSD) do not significantly differ from the influencing factors on new product development in manufacturing environment [e.g. 1-3]. However, typical service characteristics, e.g. intangibility, heterogeneity, inseparability and perishability (IHIP) [4, 5] have a significant influence on the emphasis of the factors in NSD.

Several authors have also recently stressed that traditional boundaries between manufacturing firms and services are becoming obsolete [6, 7]. Many traditional manufacturing companies have increased their maintenance and other services for the whole lifecycles of their products while service firms tend to compete with tangible products like "productized" software also [8].

This study focuses on the industrial environment of machinery suppliers who aim to increase the volume of the service business and its share from the total turnover. It is hypothesized in the present study that management of fleet assets (for instance information and knowledge management related to the wide globally installed machinery base) is a key factor and precondition for successful new service concept development, which together with "generic" success factors lead to better competitive advantage.

This study is a part of a larger multi-disciplinary research project started in 2007. In this paper we aim to bring forth a framework for successful NSD and transformation towards more service-oriented business in the networked environment, and we will also study the influence and relations of success factors on effective asset management. In addition, we will make a preliminary analysis between NSD success factors from the literature and real challenges that the interviewed five Finnish manufacturing firms are facing in the areas of fleet asset management and NSD. Since the value of service is co-created in interaction of the provider and the customer, the interviews of selected client firms of machinery suppliers will also bring essential information for complementing the picture of this study. In the empirical research, the aim is not only to understand the value creation process but also to understand how to make the value of service more apparent for the customers.

Keywords: industrial services, fleet asset management, new service development, success factors.

1. Introduction

Many authors have recently stressed that traditional boundaries between manufacturing and services are becoming obsolete [6, 7]. Authors have noted that there are new forms of production for supplying physical products together with intangible services [6]. In the business life, traditional manufacturing companies have increased their maintenance and other services for the whole lifecycles of their products while service firms tend to compete with tangible products like "productized" software also [8].

Studies in the last two decades have revealed that many factors of success and failure in new service development (NSD) do not significantly differ from the influencing factors on new product development in manufacturing environment [1-3]. These "general" factors may include, for instance, the strategic focus on innovation [9, 10], the appropriate resource commitment [11, 12], the management support [13], and the formal new service development process [14-16]. On the other hand, service characteristics may require different emphasis of

factors and capabilities influencing the success in development of new services. Typical service characteristics, e.g. intangibility, heterogeneity, inseparability and perishability [e.g. 4, 5] have a significant influence on the emphasis of the factors in NSD. Therefore, new approaches for promoting the management and development of industrial services are needed. Also, the factors like highly trained experts in the company [17, 18], the learning environment in the company [19-21], and especially the customer involvement in the development process [13, 21, 22] may be more important in service development when compared to new product development.

As stated above, there are some differences in service firms and manufacturing firms, in development of products and services. In addition, there are differences inside the services sector between the different types of services as well. The services discussed in this paper are typically industrial services, e.g. maintenance and development services supporting the efficient use and the whole life-cycle of industrial assets. These types of services and factors affecting their success in this type of context have not yet been widely studied when considering the increased potential of the services related to industrial environment and physical assets. This study focuses on the industrial environment of machinery suppliers who aim to increase the volume of the service business and its share from the total turnover. It is hypothesized in the present study that management of fleet assets (for instance information and knowledge management related to the wide globally installed machinery base) is a key factor and precondition for successful new service concept development, which together with "generic" success factors lead to better competitive advantage.

The main aim in this paper is to bring forth a framework for successful NSD and transformation of business towards more service-oriented business in the networked environment. We will also study the influence and relations of success factors on effective management of industrial assets and development of new services. In addition, we will make a preliminary analysis between NSD success factors from the literature and real challenges that the interviewed five Finnish manufacturing firms are facing in the areas of fleet asset management and NSD.

This study comprises of four main parts. The first part, introduction poses the background, objectives and focus areas of the study. In the literature review we aim to summarize the wide literature on success factors in new service development especially from the view point of industrial services. The third part includes the description of empirical research in which we bring forth the main challenges and revealed success factors in the new service development and in transformation of business towards services in general on the basis of qualitative expert interviews and workshops in which several industrial firms participated together. In the discussion part we analyze the results of empirical research together with the literature viewpoints using the new service development process approach as a background framework. On the basis of synthesis we will present the theoretical and managerial implications of the research results. The final conclusions in the paper also include the suggestions for future research areas.

2. A Literature Review on Success Factors in New Service Development in Industrial Environment

This chapter aims to shed light on the different factors influencing the success in new service development. Our specific focus is on the new industrial services that are produced by (or in close collaboration with) manufacturing firms, e.g. machinery equipment suppliers.

According to Grönroos [23], services are activities or series of activities of a more or less intangible nature that normally, but not necessarily, take place in interactions between the customer and service employee and/or physical resources and/or systems of the service provider, which are provided as solutions for customer problems. There are various definitions of services. In several definitions, keywords involved in the services definitions are said to be activities, deeds or processes and performance [4, 24, 25]. Grönroos' definition [23] includes three major elements: 1) activities, 2) interactions and 3) solutions to customer problems. Grönroos [23] identifies two different aspects in categorizing services, the type of service and the type of customer. A service is either a professional service or another type of service and it can be offered to either customers or organizational buyers.

In last decades a remarkable number of researchers have attempted to identify factors that are crucial to success of innovative services. Success factors can be distinguished, for example, into internal and external success factors. Internal success factors are associated with strengths and weaknesses of the firm, including e.g. innovation competence, and the organization or design of the firm's new service development (NSD) process [15, 26]. External success factors in turn can be found in the way benefits of new services address opportunities and threats in the market environment. These include e.g. the fit between customer needs and benefits of the service offer, and the fit between the new service and the existing product portfolio. A number of studies have also focused on the contributions of supporting functions in the innovating organization, such as marketing, sales and distribution [26-28]. So far, a majority of studies has focused on the identification of external factors [9].

Regarding the external factors, as well as some of the internal factors, there are also studies presenting the factors that act as drivers of service innovations. For instance, Kuusisto and Meyer [29] have presented both drivers and barriers of service innovation based on Finnish and international expert views. According to their study, the phenomena acting as drivers of service innovation are: information and communication technology, complex technologies (complexity creates a need for support services), systematic development of new types of services, regulatory changes and competition (evolving markets create space for new services and business models as value-chains are being re-configured), and industry champions.

On the other hand, barriers to service innovations are [29]: rigid structures, lack of intensive competition, over-capacity, dot.com boom-bust cycle, demographics, lack of R&D funding and systematic service concept development, unbalanced business process development, lack of specialized development facilities, context-specific services and intangibility of services, availability of skilled staff, increased formality in purchasing practices, and diffusion of service innovations between firms.

Regarding internal success factors, evidence was found that the amount and quality of conducted market research, development speed, technological advantage and 'synergy between the new service and the organization' contribute to the success of financial service innovations [30]. Furthermore, in a research stream focusing on the relationship between innovation performance and organization design evidence was found that an appropriate organization structure and decision architecture [31, 32] as well as an appropriate design of the innovation process [30, 33] may contribute substantially to success. The importance of internal issues to the NSD process are confirmed in recent studies, which focus on the critical role of communication and information processes in NSD project success [34, 35]. Rapid technological change and turbulence in the market-place increase the importance of internal success factors, since they create a more sustainable competitive advantage [36].

De Brentani [16] has in a large-scale survey of experts studied new business-to-business service projects in order to gain insights about the influence of product innovativeness on the factors that are linked to new service success and failure. The research results indicate that there are so-called "global" success factors which appear to govern the outcome of new service ventures, regardless of their degree of newness. These include ensuring an excellent customer/need fit, involving expert front line personnel in creating the new service and in helping customers appreciate its distinctiveness and benefits, and implementing a formal and planned launch program for the new service offering.

On the other hand, regarding the new services she makes a distinction into "low-innovativeness" and "new-to-the-world" business services. For low innovativeness new business services, the results suggest that managers can enhance performance by: leveraging the firm's unique competencies, experiences and reputation through the introduction of new services that have a strong corporate fit; installing a formal "stage-gate" new service development system, particularly at the front-end and during the design stage of the development process; and ensuring that efforts to differentiate services from competitive or past offerings do not lead to high cost or unnecessarily complex service offerings. For new-to-the-world business services, the primary distinguishing feature impacting performance is the corporate culture of the firm: one that encourages entrepreneurship and creativity, and that actively involves senior managers in the role of visionary and mentor for new service development. In addition, good market potential and marketing tactics that offset the intangibility of "really new" service concepts appear to have a positive performance effect [16].

Client-focus is a significant element in service development process. Kumar [37], for example, has empirically examined the impact of long-term client relationships on the performance of business service firms and suggests that over the long run relationship-oriented business service firms achieve higher returns on their investment than transaction-oriented firms do. Moreover, recent research has suggested that in service environments a client-firm interaction occurs that can create higher levels of uncertainty for the firm. Thus, service organizations must adapt elements of their production process to address this uncertainty. The study of Skaggs and Youndt [38] extends this idea by suggesting that the strategic positioning of service production determines the level of uncertainty arising from the client-firm interaction, and hence the human capital required to handle this uncertainty. Additionally, in their study, partial support for performance differences among service firms as a result of their fit between strategic positioning and human capital was found.

Existing literature has also tried to explain new service development (NSD) as a process [e.g. 39, 40]. De Jong et al. [5] have also aimed to study NSD as a process that can be managed. The process is for most parts close to those presented in the new product development (NPD) literature [e.g. 31], but it is divided it into two main stages, searching and implementation, both including several activities (see Figure 1). The process together with direct and indirect success factors provide preconditions for service innovations including several dimensions, and innovative performance [5].

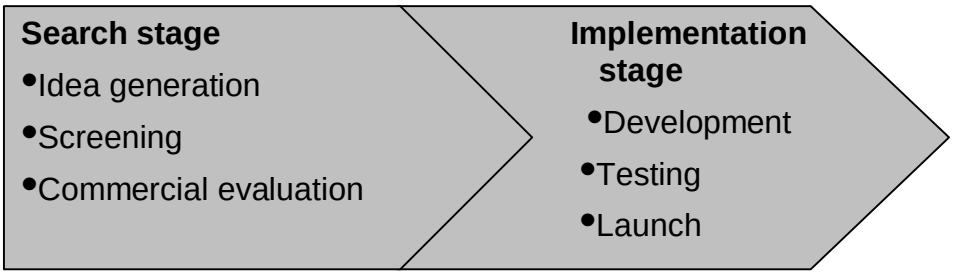

Figure 1. New service development process

In the case of industrial value-adding services we also need to take into consideration the physical asset element. Management of fleet is crucial for developing and selling maintenance and other services in global business environment. Hence, the success of new industrial services can be hypothesized to be strongly dependent on the management of information and knowledge that are related to the common success factors of developing new services and also to physical asset management.

If we summarize the success factors related to new service development that can be found in the literature, we can say that the influencing factors can be grouped in many different ways e.g. to internal and external success factors. On the other hand, barriers or risks related to new service development can be categorized similarly and in many cases they can be seen as "other side of the coin" to the success factors. An example of categorization of success factors could be

- strategic factors (clearly-defined directions, resource allocation, staffing etc.)
- organizational factors (cultural issues, inspiring environment etc.)
- structural/process factors (formal processes etc)
- technological factors (efficient use of ICT, technical competences etc.)
- market factors (changes in the market / in competition, regulations etc.)
- network-related factors (depth of relationship, level of communication, trust and communication between partners etc.)

Even though the current literature also stresses the similarity in many success factors of product development and service development, it can also be noted that there are some specific factors stressed in the service environment due to the service characteristics. For example, the organizational types of success factors seem to dominate more in the case of services. In the next chapter we will empirically analyze the significance of some success factors in the context of industrial services in Finnish companies and also compare them to the viewpoints found in the literature.

3. Empirical Research on Finnish Industrial Service Providers

This chapter is mainly based on qualitative expert interviews and workshops carried out in cooperation with several industrial firms. This study is a part of a larger multi-disciplinary research project started in 2007. In the first round of company interviews, totally 11 experts in five industrial companies were interviewed. The interviews included questions related to success factors and challenges in the industrial service business. Additionally, all the five studied companies participated in a workshop in which the main issues posed by the interviews were discussed further and in which their significance was assessed by the participants. The results from both interviews and the workshop were then analyzed by the researchers and compared to the literature review results.

The studied companies are machinery suppliers and industrial service provides (except one that plays a role of a client firm of service providers). The service providers aim to increase their share of service business of the total turnover. Typically, a major part of the turnover originates from industrial equipment and machinery. Their aim is also to develop new, more advanced type of services based on performance-based agreements and partnerships in addition to traditional spare parts and maintenance services. Figure 2 outlines a transition process where a machine supplier evolves into a value partner. This new situation for the companies poses new types of fundamental challenges like how to organize knowledge management, how to ensure adequacy of skilful employees, how to organize new service development process, how to handle networks and contracts, how to understand the manufacturing processes and the technologies used in the client organisation and how to adapt to changes in customer organisation. All of the companies also operate in a global environment and their machinery base is geographically distributed all over the world, which may multiply the effect of some of these challenges.

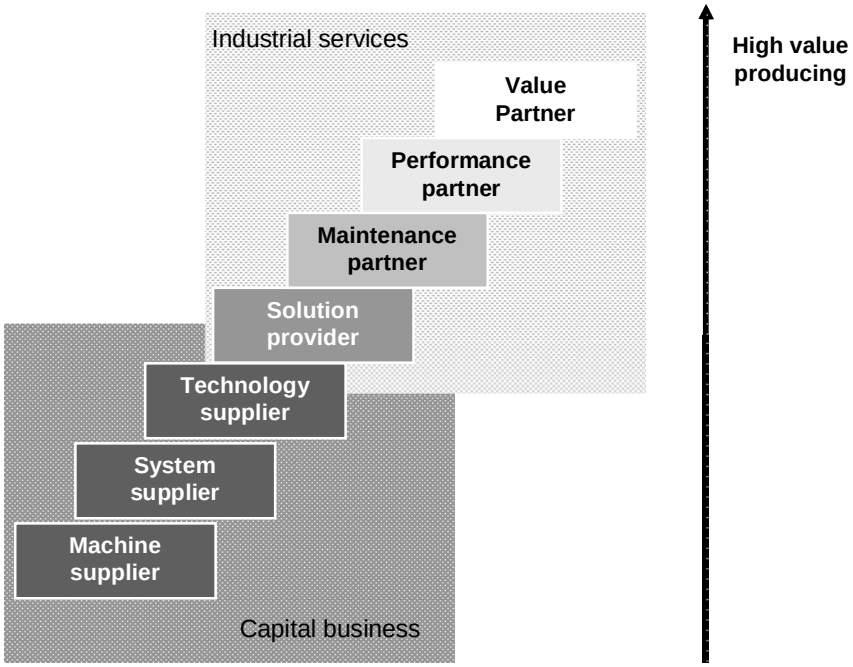

Figure 2. Vision : transition from machine supplier to industrial service provider.

Figure 3 below depicts different view points that need to be taken into account in industrial services (e.g. maintenance) in general when aiming to move from more conventional contracts to the performance-based agreements as suggested by Kumar, Markeset and Kumar [41].

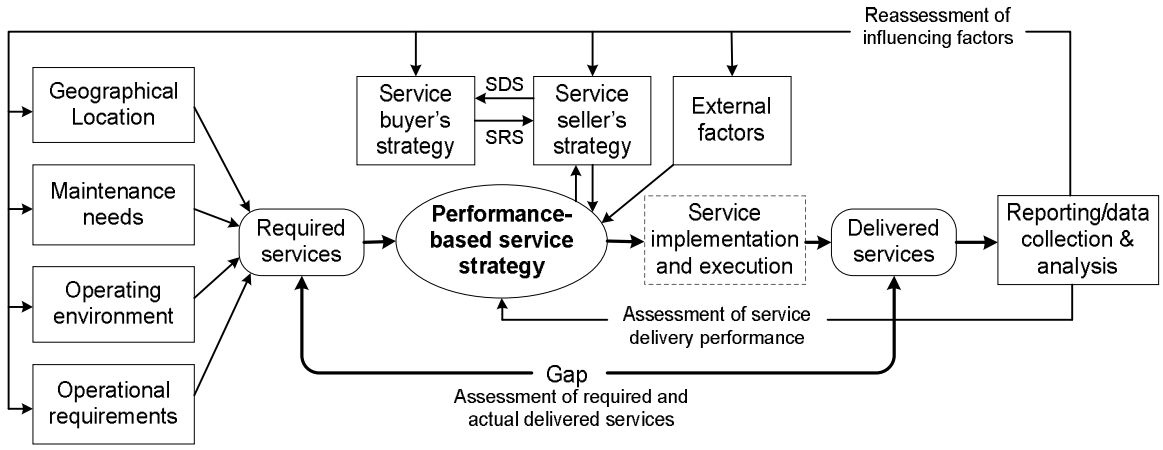

Figure 3. Development of a performance-based maintenance strategy [41].

Based on the first expert interviews few focal themes about influencing factors of successful service business were recognised. Examples of the themes are listed below:

a) Customer demands for the maintenance services concerning machines provided by other manufacturers
b) Adequacy of skilful employees
c) Adaptation to technological changes
d) Safety management and corporate security management at global level
e) Potential for leasing services in the future
f) Contract management
g) Harmonisation of acquisitions practices and processes
h) Networking ability
i) Internal flow of information in NSD process
j) Development of operating services on the client's core business area
k) Understanding of the manufacturing processes and the technologies used in the client organisation
l) Study of customer demands
m) Rapid response to the changes in customer demands
n) Information and knowledge management related to the wide globally installed machinery base
o) Management of worldwide sales and maintenance network
p) Standardisation
q) Attainment and maintenance of client's trust

These themes were discussed in more detail among company experts at the workshop meeting. The experts of five companies who participated in the workshop evaluated that the themes **a-e** of above mentioned themes were the ones that are most relevant for the success in the industrial service business. On the other hand, these factors are inter-related and the most relevant factors are dependent on the other factors as well. The workshop discussion was also analysed by identifying and coding categories from the content of the discussion. Based on preliminary categorization few important elements that need to be studied more carefully were found:

- Trust (connection between provider's openess and client's trust)
- Pricing (connection between provider's openess and transparency of pricing)
- Service offering (connection between service / product bundling and pricing)
- Information management (connection between new service development and information management related to the installed machinery base)
- Mixed cultures (balance between service oriented and product manufacture oriented organisation culture; connection between provider's cultural image and client's trust)
- Intermediate operator (ability to connect product and services from separate providers; connection between provider's networking ability, client's freedom of choice and client's trust)
- Knowledge management (connection between worldwide access to exploit provider's intellectual property and client's trust)

The prioritized main themes reflect the significance of both internal and external factors of success. As previously discussed in the literature, several organizational factors seem to dominate in this case also. For overcoming the challenges in this type of industrial environment, the information and knowledge management practices seem to play a major role as was hypothesized. The companies generally have a good access to the information related to the globally installed machinery base ("the fleet"). This is important for the competitive edge of their maintenance and spare part services. In the case of higher-end value solutions and partnerships, the situation is more complex, especially if the client would require services for the installed machinery-base delivered by other firms also. In this case the critical problems are related to these main questions:
How to build the organization for promoting both products and services and their development? What is the role of intermediate operator in this case?
How to effectively manage the information and knowledge related to the life-cycles of machines?
How to develop the service offering as lucrative as possible as and easy to purchase by the client? How to cope with the pricing in the service offering?

For overcoming these challenges and developing new services in this type of situation on the basis of new client requirements, there are some success factors which we can propose to be crucial. These are e.g. *deep understanding of clients' production and business processes and ability to react quickly to changing client requirements, networking ability and openness of a service provide as well as trust between the value partners in the background.* In addition to these "soft" factors we can assume that technological development in e.g. diagnostics and decision support systems will promote the information and knowledge management related to the new services. Moreover, the ability to make good contracts ("*contract competencies"*) is crucial for coping with the new organization as well as the service offering.

4. Discussion and Conclusions

Traditional success factors studies can only partly explain the factors influencing the new service development in the studied context, i.e. the transition of industrial companies from machine suppliers to high-value-added service providers.

The literature review reveals the multi-dimensionality of success factors in new service development and characteristics (e.g. IHIP) of service that have an influence on management of NSD process. The "synthesis approach" also suggests that service innovation brings forth thus far neglected elements of innovation that are relevant for both manufacturing and

services [e.g. 7]. This approach is increasing its significance at the same time when dichotomies and boundaries between manufacturing and services are becoming blurred.

In the following Figure 4 we aim to summarize and integrate the viewpoints from the literature review and empirical research in Finnish industrial companies. As a background framework we can study new service development as a simplified process as suggested by de Jong et al. [5]. Another framework from the practical point of view is the transition process from machinery supplier to successful industrial service provider. NSD process can be seen as a part of the transition. In the process, there are numerous success factors to consider in different phases. So far, our research has revealed some factors assessed high by industrial firms. The next step is to clarify more thoroughly the methods and tools that are of help in taking these influencing factors better in to account, and in developing new services effectively.

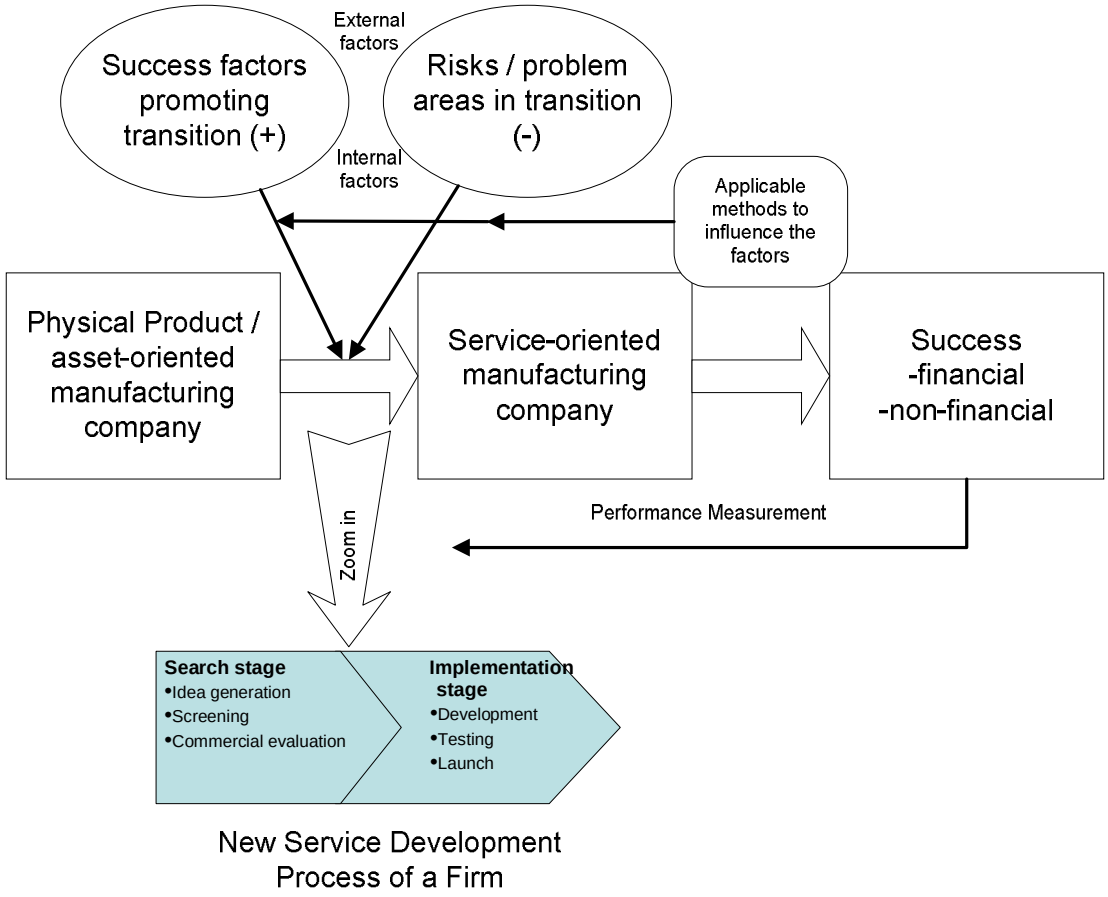

Figure 4. NSD process and success factors in the transition process of industrial service providers.

Especially for the Search stage in the NSD process, the deep understanding of customers' production and business processes as well as efficient need assessment are crucial for successful development. On the other hand, the fast reaction to the changing client needs is also important in the Implementation stage of NSD process. Technological factors play a major role in the Implementation stage, and the ability to network and build trust is important in all the stages. The organizational factors are especially related to the successful development of radically new services. In our framework, the NSD process may also deal

with incrementally new services. Measurement is also significant for management. Thus, for NSD process we also propose a "self-audit process" for NSD process, which could include questions taking the most crucial success factors better into account. The choosing of right measures for the audit depends on some fundamental questions: What is the type of service? What is the level of novelty in service? What is the stage of development to be measured? What is the purpose of measurement? In the audit framework we also need to consider the possibilities that installed machinery base, the fleet, can provide for measurements.

Organisations should also notice that new risks emerge and old ones change in the transition process from manufacturer to service provider. These risks must be carefully taken into consideration during the transition process, thus the well organised risk management process covering endogenous and exogenous risks is needed. Risks can be categorised as financial, strategic, operational and event risks. One example of risks is image risk that results from losing the client's trust. For example, low service functioning can affect negatively to the overall reputation of highly appreciated manufacturing company or machine supplier. Therefore, it is essential to have well-adjusted service concept when entering the service business. The trust of the customer can fade if machine and service selling are bundled together too tightly or pricing of the service is too unclear or hidden. Internal risks connected to organisation culture and behavioural processes are also typical in the transition process. According to Gebauer et al. [42, 43] cognitive phenomena limit managerial motivation to extend the service business. This can be seen as an important reason why manufacturing companies often fail to exploit the financial benefit of extending to the service business. Loss of the financial benefit is one reason why the implementation of organizational changes must be planned carefully and behavioural dimensions should not be forgotten or underestimated. In the steps of the transition process one must also consider the different risks that are connected for example to customer relationship, contracts and responsibility. Further studies of risks in the industrial service business are still needed.

The services discussed in this paper are industrial services, typically e.g. maintenance and development services supporting the efficient use and the whole life-cycle of industrial assets. These types of services and factors affecting their success in this type of context have not yet been widely studied when considering the increased potential of the services related to industrial environment and physical assets. Due to the limited focus in the present study, there is a need for further studies of success factors within different types of services in different industrial sectors. In addition to studying the influencing factors, the research of new methods and processes supporting the transition from machinery-based business to development of performance-based services and value partnerships are significant topics in future studies.

5. References

1. De Brentani, U., 1989. Success and failure in new industrial services. *Journal of Product Innovation Management*, 6, 239–258.
2. De Brentani, U., 1991. Success factors in developing new business services. European *Journal of Marketing*, 25 (2), 33–59.
3. Cooper, R. G. and De Brentani, U., 1991. New industrial financial services: what distinguishes the winners. *Journal of Product Innovation Management*, 8 (2), 75–90.
4. Edvardsson, B., Gustafsson, A. and Roos, I., 2005. Service portraits in service research: a critical review. *International Journal of Service Industry Management*, 16 (1), 107-121.
5. de Jong, J.P.J., Bruins, A., Dolfsma, W. and Meijaard, J., 2003. Innovation in service firms explored: what, how and why? EIM Business and Policy Research, Available at http://www.eim.net/pdf-ez/ B200205.pdf

6. Gann, D.M. and Salter, A.J., 2003. Innovation in design, engineering and project management services. In: Tidd, J. and Hull, F.M. (Eds.) *Service Innovation: Organizational Responses to Technological Opportunities and Market Imperatives.* Series on Technology Management – Vol. 9, Imperial College Press, London, 301-320.
7. Drejer, I., 2004. Identifying innovation in surveys of services: a Schumpeterian perspective. *Research Policy*, 33, 551-562.
8. Davies, A., Brady, T. and Hobday, M., 2006. Charting a path toward integrated solutions. *MIT Sloan Management Review*, 47 (3), 39-48.
9. Edvardsson, B., Haglund, L., and Mattsson, J., 1995. Analysis, planning, improvisation and control in the development of new service. *International Journal of Service Industry Management*, 6 (3), 24-35.
10. Johne, A. and Storey, C., 1998. New service development: a review of the literature and annotated bibliography. *European Journal of Marketing*, 32 (3/4), 184-252.
11. Edgett, S., 1994. The traits of successful new service development. *Journal of Services Marketing*, 8 (3), 40–49
12. de Jong, J. P. J., and Vermeulen, P. A. M., 2003. Organizing successful new service development: a literature review. *Management Decision*, 41 (9), 844-858.
13. Martin, C. R., and Horne, D. A., 1995. Level of success inputs for service innovations in the same firm. *International Journal of Service Industry Management*, 6 (4), 40-56.
14. Edvardsson, B., Gustafsson, A., Johnson, M. D., and Sandén, B., 2000. *New Service Development and Innovation in the New Economy*. Lund, Sweden: Studentlitteratur AB.
15. Froehle, C.M., Roth, A.V., Chase, R.B. and Voss, C.A., 2000. Antecedents of New Service Development Effectiveness: An Exploratory Examination of Strategic Operations Choices. *Journal of Service Research*, 3 (1), 3-17
16. De Brentani, U., 2001. Innovative versus incremental new business services: different keys for achieving success. *Journal of Product Innovation Management*, 18 (1), 169–187.
17. Johne, A., and Harborne, P., 1995. How large commercial banks manage product innovation. *International Journal of Bank Marketing*, 3 (1), 54-70
18. Evangelista, R. and Sirilli, G., 1998. Technological innovation in services and manufacturing: Results from Italian surveys. *Research Policy*, 27, 881-899.
19. Sundbo, J., 1997. Management of innovation in services. *The Service Industries Journal*, 17 (3), 432-455.
20. den Hertog, P., Broersma, L., and van Ark, B., 2003. On the soft side of innovation: services innovation and its policy implications. *Economist*, 151 (4), 433-452.
21. Herrmann, A., Tomczak, T., and Befurt, R., 2006. Determinants of radical product innovations. *European Journal of Innovation Management*, 9 (1), 20-43.
22. Bitner, M. J., Brown, S. W., and Meuter, M. L., 2000. Technology infusion in service encounters. *Journal of the Academy of Marketing Science*, 28 (1), 138-149.
23. Grönroos, C., 2001. *Service Management and Marketing: A Customer Relationship Management Approach*. 2nd ed., New York: Wiley.
24. Zeithalm, V. and Bitner, M.J., 2003. *Services Marketing: Integrating Customer Focus across the Firm*. 3rd ed., New York: McGraw-Hill.
25. Vargo, S.L. and Lusch, R.F., 2004. The four service marketing myths: remnants of a good-based, manufacturing model. *Journal of Service Research*, 6 (4), 324-335.
26. Storey, C., and Easingwood, C.J., 1998. The augmented service offering: a conceptualization and study of its impact on new service success. *Journal of Product Innovation Management*, 15, 335-351.
27. Cooper, R.G. and Kleinschmidt, E.J., 2000. New Product Performance: What Distinguishes the Star Products? *Australian Journal of Management*, 25 (1), 17-45.
28. Dutta, S., Narasimhan, O. and Rajiv, S., 1999. Success in High-Technology Markets: Is Marketing Capability Critical? *Marketing Science*, 18 (4), 547-568.

29. Kuusisto, J. and Meyer, M., 2003. *Insights into services and innovation in the knowledge intensive economy*. Tekes – the National Technology Agency of Finland. Technology Review 134/2003, Helsinki.
30. Storey, C.D. and Easingwood, C.J., 1993. The Impact of the New Product Development Project on the Success of Financial Services. *The Services Industry Journal*, 13 (3), 40-54.
31. Cooper, R.G., 1992. Stage Gate Systems for New Product Success. *Marketing Management*, 1 (4), 20-29
32. Tushman, M.L. and O'Reilly, C.A., 1996. Ambidextrous Organizations: Managing Evolutionary and Revolutionary Change. *California Management Review*, 38, (4), 8-30.
33. Cooper, R.G. and Edgett, S.J., 1996. Critical Success Factors for New Financial Services: A Stage-Gate Approach Streamlines the New Product Development Process. *Marketing Management*, 5 (3), 26-37.
34. Lievens, A. and Moenaert, R.K., 2000. New Service Teams as Information-Processing Systems: Reducing Innovative Uncertainty. *Journal of Service Research*, 3 (1), 46-65.
35. Moorman, C., 1995. Organizational Market Information Processes: Cultural Antecedents and New Product Outcomes. *Journal of Marketing Research*, 32 (3), 318-335.
36. Barney, J.B., 1991. Firm Resources and Sustained Competitive Advantage. *Journal of Management*, 17 (1), 99-120.
37. Kumar, P., 1999. The impact of long-term client relationships on the performance of business service firms, ISBM Report 12-1999, available at http://www.ebusiness.xerox.com/isbm/dscgi/ds.py/Get/File-107/12-1999.pdf
38. Skaggs, B.C. and Youndt, M., 2004. Strategic positioning, human capital, and performance in service organizations: A customer interaction approach. *Strategic Management Journal*, 25, 85-99.
39. Alam, I., 2002. An exploratory investigation of user involvement in new service development. *Journal of Academy of Marketing Science*, 30, 250-261.
40. Gruner, K.E, and Homburg, C., 2000. Does customer interaction enhance new product success. *Journal of Business Research*, 49, 1-14.
41. Kumar, R., Markeset, T. and Kumar, U, 2006. Implementation and execution of industrial service strategy. *Journal of Quality in Maintenance Engineering*, 12 (2), 105-117.
42. Gebauer, H., Fleisch, E. and Friedli, T., 2005. Overcoming the Service Paradox in Manufacturing Companies. *European Management Journal*, 23 (1), 14–26.
43. Gebauer, H. and Fleisch, E., 2007. An investigation of the relationship between behavioral processes, motivation, investments in the service business and service revenue. *Industrial Marketing Management*, 36, 337 – 348.

PUBLICATION II

The customer-centric development of new industrial services: antecedents, risks and their management

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The customer-centric development of new industrial services: antecedents, risks and their management

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Abstract: The focus in this paper is on developing new industrial services and bringing forth the risk management challenges in collaborative development of industrial solutions, i.e. product-service systems, which has not yet been widely discussed in the literature. This paper aims to clarify the relationship development between the service provider and its client as a dynamic process requiring particular collaborative capabilities for the recognized risks in different stages of the relationship development process. The empirical part of the paper considers this issue from the viewpoint of Finnish industrial machinery and service suppliers who aim to succeed in the collaborative development of new services for promoting the management of industrial assets.

Keywords: industrial services; new service development; customer-orientation, customer-centric service development; asset management; risk management; interorganizational relationships.

1 Introduction

In recent years, industrial companies, including traditional manufacturing firms, have increasingly aimed to extend their service business and increase the share of services from the total turnover of a firm. Development of new services can be seen as a process having similarities when compared to the new product development process [1, 2]. Due to the nature of services [e.g. 3, 4] there are, however, antecedents and factors that need to be carefully taken into account. The recent literature of success factors in new product and new service development has revealed that many of the known success factors seem to be important both in the development of physical products and more intangible services [5, 6]. One of the main factors, which is even more emphasized in the case of services is the *customer orientation of development activities* [7, 8, 9]. This customer-centric development can be generally seen as a major success factor for service development, but effective collaboration between service providers and their customers requires the careful consideration of at least two different company perspectives. The perspectives of value creation between a service provider and the customer may differ quite much, and thus, the uncertainties, risks and their management possibilities need to be analyzed in addition to the common benefits of collaborative parties.

The above-mentioned significance of putting the customer in the centre of the new service development process and co-producing service innovations with customers is widely discussed in the recent literature [3, 10]. However, there is still a need for presentation of valid methods for supporting the customer-centric development in various types of services. The focus in this paper is on developing new industrial services and bringing forth the risk management challenges in developing industrial solutions, i.e. product-service systems, which has not yet been widely discussed in the literature. This paper aims to clarify the relationship development between the service provider and its client as a dynamic process requiring particular collaborative capabilities for the recognized risks in different stages of the relationship development process. The empirical part of the paper considers this issue from the viewpoint of Finnish industrial machinery and service suppliers who aim to succeed in the collaborative development of new life-cycle services for promoting the management of industrial assets.

This study is a part of a larger multi-disciplinary research project started in 2007. In the first round of company interviews, the expert interviews in five industrial companies included questions related to success factors and challenges in the industrial service business. In the later parts, the interviews have been extended to several client companies to form a picture of relationships development between a service provider and a client.

In addition to the recognized success factors in service development, the transition process from a manufacturer to a service provider also includes multiple risks which must be carefully taken into consideration during the relationship development in customer-centric development of services. Thus, the well organised risk management process covering endogenous and exogenous risks is needed, and the value of a new service to customer needs to be shown in the early stages of service development process already. For example, internal risks connected to the organizational culture and behavioural processes are typical in the transition process. There are often cognitive phenomena limiting managerial motivation to extend to the service business [11, 12], which may cause manufacturing companies often to fail exploiting the financial benefit of extending to the service business. Thus, the implementation of organizational changes must be planned carefully and behavioural dimensions should not be forgotten or underestimated.

This paper contributes to the current literature in the field by presenting a framework for assessing and managing risks in the dynamic relationship development in industrial environment, and by providing a platform for detailed further studies in the customer-centric development of new industrial services. The empirical analysis clarifying the framework in this paper is also presented. The descriptive case example describes the development of collaborative, trustful relationship between the client and two service providers who aim to develop a new, networked industrial service platform for promoting maintenance planning and management of industrial assets by taking the customer requirements strongly into account.

2 A literature review

Customer-orientation and collaboration as main success factors of new service development

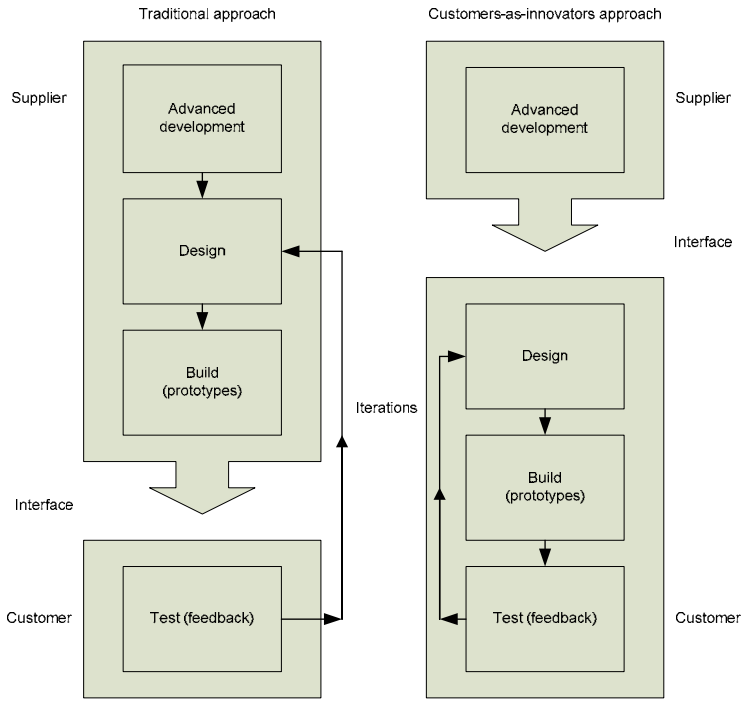
According to the definition of Grönroos [4], services are activities or series of activities of a more or less intangible nature that normally, but not necessarily, take place in the interaction between the customer and service employee and/or physical resources and/or systems of the service provider, which are provided as solutions for customer problems. This definition includes three major elements: 1) activities, 2) interaction and 3) solutions to customer problems. In our study, the main emphasis is on industrial services, which practically means development and delivery of product-service solutions to customers.

The recent literature shows that the "general" success factors influencing the new product and service development (NPD and NSD) would include, for instance, the strategic focus on innovation [13, 14], appropriate resource commitment [15, 16], management support [17], and formal new service development process [18-20]. The typical service characteristics, e.g. intangibility, heterogeneity, inseparability and perishability (IHIP) [e.g. 3, 4] may have a significant influence on the emphasis of the factors in new service development, The factors like highly trained experts in the company [21], the learning environment in the company [22-24], and especially customer involvement in the development process [17, 24, 25], may be more important in service development when compared to new product development. In relation to this, recent article by Thomke and von Hippel [10] suggest in certain cases the stronger user involvement in innovation process as depicted in Figure 1. In order to practically turn the customers into innovators, they suggest to develop a user-friendly tool kit for customers, and to carefully select the first customers to use the tool kit.

A customer-driven approach is especially important for service firms as they are more thoroughly connected to their customers than is usual for most manufacturing industries. Customers can even be co-producers of innovations if service firms design their products in interaction with the user. Kumar [26], for example, has empirically examined the impact of long-term client relationships on the performance of business service firms, and suggests that in the long run, relationship-oriented business service firms achieve higher returns on their investment than transaction-oriented firms. Recent research has also suggested that in service environments a client-firm interaction occurs that can create higher levels of uncertainty for the firm. Thus, service organizations must adapt elements of their production process to address this uncertainty. Skaggs and Youndt [27] suggest

that the strategic positioning of service production determines the level of uncertainty arising from the client-firm interaction, and hence the human capital required to handle this uncertainty.

Figure 1 The customers-as-innovators approach [10].



Bulk of the previous literature has focused on trying to explain new service development and its success factors more from the viewpoint of consumer services or from an integrated service perspective, but recently, there are also some published research [e.g. 28-30] focusing on the NSD and service innovation in industrial services. These recent research results also strengthen the picture of the customer orientation and efficient collaboration with the customer as an increasingly significant success factor in development and innovation processes of industrial services. This is why need to focus on value creation to customer. According to Woodruff [31], we can define customer value as follows: “Customer value is a customer’s perceived preference for and evaluation of those product attributes, attribute performances, and consequences arising from use that facilitate (or block) achieving the customer’s goals and purposes in use situations”.

Edvardsson et al. [8] summarize the findings of a number of projects and publications to e.g. following customer-centric critical success factors for developing new services:

- develop a deep and thorough understanding of the customer and what creates value through the eye of the customer
- create a customer-centric service culture within the company
- stay focused on your customers
- involve the customer in the development process
- focus on the whole integrated customer solution and the total customer experience

All of this requires deep understanding and management of customer knowledge on multiple subjects [8]:

- customers' needs and requirements, expectations and preferences
- customers' service context (when, how , why and where the service is used)
- customers' values and cognitive structures
- customers' experiences and behaviours

This indicates that firms striving to collaborate with their client in new service development should further developed their knowledge processing mechanisms to cope with the different dimensions of customer knowledge.

The risks and challenges in interorganizational relationships and service business transformation

The recognized motives for interorganizational relationships can be basically categorized in three groups: the motives related to effectiveness, capabilities and positioning [32, 33]. Companies may search for effectiveness through economies of scale, reducing time or by access to partner's resources. On the other hand they may search for appropriate capabilities to supplement their own competencies or to get new insights and knowledge. For improving their market position they may search for better market knowledge and building of better image and trust or to affect competitors' position.

However, on the basis of UK-based UMIST research [34], in which 100 alliances were studied, about half of the participants believed that collaboration made the product development more complex and expensive when compared to the option of developing on their own. Following risks were recognized by one third of the participants involved in collaborative innovation activities: Knowledge spillovers, losing control and ownership, and divergent objectives and targets.

It is typical that participants of innovation projects are often dissatisfied with the results. According to Swink [35], the barriers causing problems in collaborative development can be grouped into physical and resource constraints, organizational and hierarchical barriers, relationship- and culture-based barriers and the barriers caused by lack of information and knowledge. In addition, Doz and Hamel [32] have recognized three main groups of gaps (see Table 1) influencing the collaborative development: 1) the context of the alliance (strategic and organizational), 2) the content focus of the collaboration and 3) processes through which cooperation must be achieved. In all of these groups, there can be several divergent opinions or different practices of participants that may be reasons behind the failures. All of the factors causing uncertainties or risks in

the relationships can not be taken into account in the early stage of relationships, but it is common that participants learn during the collaboration, maybe change their (possibly unrealistic) expectations of the results and influence the change in patterns of collaboration.

Table 1 Groups of challenges in interorganizational relationships [32].

Strategic and organizational context related challenges	*Content related challenges*	*Process-related challenges*
expectations	skills	information
collaboration frame	task definitions	knowledge
culture	responsibilities	timing
confidence and trust		

From the manufacturing company's point of view new risks can emerge and old ones can change during the transformation process towards more service-oriented business. In those circumstances risk perceptions and risk management habits might need to be refreshed. There is, however, not enough research information concerning the risks and the role of risk management relating to circumstances of extending to the service business and collaborative service development.

The typical risk management process includes identification of risk factors, risk assessment and execution of mitigating actions. The usual definitions of risk management can be criticized for taking too strong command and control approach and also ignoring both shared management of uncertainties with external parties and social implications [36]. Actually, risk management can also be conceived as firm responses to deal with the identified uncertainties. There are also strategic moves that can potentially mitigate risks. Moving towards service business and collaborative new service development is one of those strategic decisions.

Experiences from the risk management practices give us an impression that the systematic hazard identification and risk assessing process is usually the most documented and guided part of risk management. Risk response, learning and a real-time threat management capability is, however, less tangible and thus more difficult to study. Because risk management is typically incorporated into other management activities, suggestions for effective risk management need to be absorbed into other managerial guidelines.

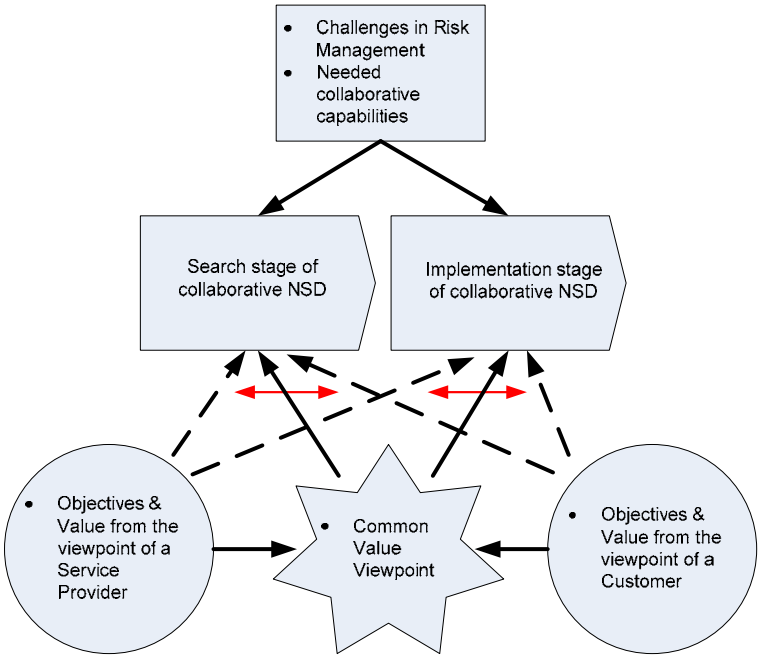
In real life, it is a challenge for companies to consider and manage a large range of various risks related to their operation and business. Effects of these risks can direct, for example, towards people, environment, corporate finance and operations, and even society. Some of the risks had influence inside the company or the business network, but some of them extend influence on the local or global business/area or even jeopardize functioning of the critical infrastructure. Awareness of different risks can help organization in operating and making decisions with the presence of uncertainty. In order to perceive risks and manage them systematically, organizations are typically applying formal risk management practises. However, it is argued that by formal risk management

practices companies are actually trying to organise area where total manageability is impossible. In addition to formal practises, it is stated that organisations need to increase flexibility for absorbing unexpected and be prepared also for the uncertainties that can not be assessed beforehand [36].

To better understand the meaning of risk management in the case of extending service business in manufacturing companies, more information about current risk management activities is needed.

For summarizing the literature review, in Figure 2 we introduce a reference framework to be utilized in the empirical analysis. The framework presents the collaboration in new service development as a dynamic process including two main stages adapted from the NSD-related literature. The value viewpoints of both parties, which may be partly conflicting, and common value perspectives influence the assessment principles of dynamic collaboration. In main stages of the process there also challenges, risks and needed collaborative capabilities that need to be recognized and taken strongly into account for improving the probabilities of success in the customer-oriented NSD process. Parts of the framework are analyzed more in detail in the empirical analysis discussed in the following Chapters.

Figure 2 A research framework.



3 Practical challenges in customer-centric service development: Case study of Finnish industrial service providers

This study is a part of a larger multi-disciplinary research project started in 2007. In the first stage of the project, the expert interviews in five industrial companies included questions related to success factors and challenges in the industrial service business. In the later parts, the interviews have been extended to several client companies to form a picture of relationships development between a service provider and a client.

The studied companies are machinery suppliers and industrial service providers as well as their clients. The industrial solution providers typically aim to increase their share of service business from the total turnover of which the major part typically comes from industrial equipment and machinery. They develop new, more advanced type of services based on performance-based agreements and partnerships in addition to traditional spare parts and maintenance services, and evolve from a machine supplier into a value partner through a transition process. For developing new services in this type of situation on the basis of new client requirements, there are some success factors which we can propose to be crucial in multiple stages of new service development on the basis of first round of interviews and workshops in the studied industrial firms. These are e.g. deep understanding of clients' production and business processes and ability to react quickly to changing client requirements, networking ability and openness of a service provide as well as trust between the value partners. In addition, technological development in e.g. diagnostics and decision support systems will promote the information and knowledge management related to the new services. Moreover, the ability and competencies to make good contracts is crucial for coping with the new organization as well as the service offering.

Based on the data collected from the company interviews (4 client organisations, 4 service providers) and workshop sessions, several risks concerning maintenance service business can be recognized (Table 2). The new situation where manufacturing companies are providing services poses new types of fundamental challenges, like *how to organize knowledge management, how to ensure the adequacy of skilful employees, how to organize the new service development process, how to handle networks and contracts, how to understand the manufacturing processes and the technologies used in the client organisation, and how to adapt to changes in the customer organisation*. All the companies also operate in the global environment and their machinery base is geographically distributed all over the world, which may multiply the effect of some of these challenges. These are also big challenges from the risk management point of view. Organisations should notice that new risks emerge and old ones change in the transition process from a manufacturer to a service provider. These risks must be carefully taken into consideration during the transition process, and thus a well-organised risk management process is needed. One example of risks is the image risk resulting from losing the client's trust. Therefore, it is essential to have a well-adjusted service concept when entering the service business. The trust of the customer can fade if the machine and service selling are bundled together too tightly or the pricing of the service is too unclear or hidden. Internal risks connected to organisational culture and behavioural processes are also typical in the transition process.

Table 2 Risks concerning the maintenance service business in studied companies.

Client organisation	**Both client and service provider**	**Manufacturing company & maintenance service provider**
Risks related to purchase/acquisitions/ outsourcing of the services:	*Risks related to co-operation:*	*Risks related to moving towards service business:*
loss of know-how	variances in the expectations	inadequacy of skilled staff
difficulties in problem solving	poor task definitions	lack of information or incorrect information from the client → wrong decisions, poor service
quality deviations	contractual risks	not enough maintenance know-how
unexpected production breaks	vague border lines of responsibility	wrong timing (clients are not ready for services)
safety and security risks	lack of information and accounting methods	risks related to acquisitions
lack of integrated services	poor / not enough communication	risks related to organizational and cultural changes → poor service culture
vague pricing	misunderstandings	wrong pricing basis
not clear how to influence maintainability with service	cultural differences	losing clients trust → image risks
circumstances and processes are not understood by the service provider	difficulties in managing the subcontractor network	choosing the wrong technology and e-tools
using several subcontractors in service providing upraises the price (contribution margins are multiplied)	other risks related to new service development	risks related to networking

Finally, from the qualitative analysis based on the data gathered from the studied companies, we can derive the main **challenges concerning the risk management** in this particular industrial environment:

- How to evaluate reliability, quality, efficiency, costs, etc. of maintenance
- Challenges in decision making concerning operational / business risks
- Understanding related to contractual risks
- How to deal with sharing of the risks between the management of the subcontractor and client network
- Assessment of risks relating to services developed together with client and service provider
- Cultural challenges (openness, communication)
- Information management procedures
- Learning from each other, knowledge management processes
- Evaluation of risks in pilot projects
- Recognition of changing risks and updating risk perceptions

Two of the studied companies in the larger research project look forward to overcome the recognized challenges in collaborative development in a business case of planning new maintenance services. The idea of the new service is based on management of information gathered in the client´s production site from industrial equipment - which have been manufactured by the two solution providers - and utilization of the measurement results of remote diagnostics in the preventive maintenance activities. The basics of the new service are previously developed in different environment by one of the service providers, without the active user involvement. Thus, the service providers now aim to actively include customer (a lead user) in the further development of the service. While the client firm could get benefits to their production process with efficient use of asset information, the service providers also seek to test the features of service for possible later use in other process environments. Even though the client firm and service providers have had a long, trustful business relationship, this particular development case requires the careful considerations in the search stage of collaborative development and the current activities are focusing on the description of the present state of collaboration and bringing forth the various motives and challenges of all the collaborative parties in order to build up a common value viewpoint for communicating it to the whole value network.

4 Discussion and conclusions

In industrial collaboration, there can be capability requirements from both parties, from the client and from the service providers. For example, according to Feeny et al. [37] the required competencies from service supplier can be categorized in three main groups:

- delivery competence
- relationship competence, and
- transformation competence

Several types of competencies are needed for responding to several types of customer needs, which can be related to operational service needs, service improvement needs, and long-term viability needs.

In this paper, we have tried to extend the idea of assessing particular competencies of suppliers for the purpose of outsourcing activities [37] for the purpose of collaborative new service development. Thus, we need to have a good picture of success factors of collaborative development, but also the potential risk factors that can exploit in practice in the early stage of collaboration or in the future stages of collaboration. In the following, we try to pose some propositions that are based on analyzing the Finnish industrial machinery and service providers in the light of our previously presented framework (Figure 2), which is based on an extensive literature review of new service development and risks in interorganizational relationships.

In the dynamic relationship development we could assume that **strategic and organizational context** related challenges related to risk management are more important in the *search stage* and **process-related** challenges in the *implementation stage* of collaborative development. **Content related** challenges are important in both stages but may have a different emphasis. With regards to the main type of service discussed in this

paper, i.e. maintenance service, the main aspect to be taken into account in the risk management in addition to the stage of the relationship development is the **aimed type of the service partnerships**, which could be *traditional maintenance of physical assets*, *performance- based service or even value-based service.* When moving to the higher value production it can also be assumed that the significance of strategic and organizational context related challenges increases while the share of content related challenges may lose some of its relational significance. The process-related challenges exist in all types of partnerships, but in the traditional solution providing or maintenance the focus is more on understanding the client's *production* process while in the performance-based or value-based partnerships the focus is on understanding the customer's *business* process.

This study is limited to the industrial service development in collaborative environment where the customer's role is not only a passive recipient of a service but a co-producer of a new service. The focus is on maintenance services which the manufacturing firms aim to develop by moving towards the value-based service business and deeper understanding of customer's processes as well as user involvement in the development process. In further studies, the various types of services with various aimed degrees of novelty and various customer roles could be taken into the comparative analysis. Furthermore, in the larger research project, which this study is a part of, the near future activities focus e.g. on the analysis of dynamic relationship development between the two service providers and their client in the light of the case example of new maintenance service development that was previously discussed in this paper.

References and Notes

1. Alam, I. (2002) An exploratory investigation of user involvement in new service development, *Journal of Academy of Marketing Science*, Vol. 30, pp. 250-261.
2. Gruner, K.E and Homburg, C. (2000) Does customer interaction enhance new product success, *Journal of Business Research*, Vol. 49, pp. 1-14.
3. Edvardsson, B., Gustafsson, A. and Roos, I. (2005) Service portraits in service research: a critical review, *International Journal of Service Industry Management*, Vol. 16, No. 1, pp. 107-121.
4. Grönroos, C. (2001) *Service Management and Marketing: A Customer Relationship Management Approach*, 2nd ed., New York: Wiley.
5. De Brentani, U. (1991) Success factors in developing new business services, *European Journal of Marketin*g, Vol. 25, No. 2, pp. 33–59.
6. Cooper, R. G. and De Brentani, U. (1991), New industrial financial services: what distinguishes the winners, *Journal of Product Innovation Management*, Vol. 8, No. 2, pp. 75–90.
7. O'Farrell, P.N. and Wood, P.A. (1999) Formation of strategic alliances in business services: Towards a new client-oriented conceptual framework, *The Service Industries Journal*, Vol. 19, No. 1, pp. 133-151
8. Edvardsson, B., Gustafsson, A. and Enquist, B. (2007) Success Factors in New Service Development and Value Creation through Services, In: Spath, D. and Fähnrich, K.-P. (Eds.): *Advances in Services Innovations*, Berlin: Springer-Verlag.
9. Möller, K., Rajala, R. and Westerlund, M. (2008) Service innovation myopia? A new recipe for client provider value creation, *California Management Review*, Vol. 50, No. 3, pp. 31-48.

10. Thomke, S. and von Hippel, E. (2002) Customers as innovators: A new way to create value, *Harvard Business Review*, April, pp. 74-81.
11. Gebauer, H., Fleisch, E. and Friedli, T. (2005) Overcoming the Service Paradox in Manufacturing Companies, *European Management Journal*, Vol. 23, No. 1, pp. 14–26.
12. Gebauer, H. and Fleisch, E. (2007) An investigation of the relationship between behavioral processes, motivation, investments in the service business and service revenue, *Industrial Marketing Management*, Vol. 36, pp. 337 – 348.
13. Edvardsson, B., Haglund, L. and Mattsson, J. (1995) Analysis, planning, improvisation and control in the development of new service, *International Journal of Service Industry Management*, Vol. 6, No. 3, pp. 24-35.
14. Johne, A. and Storey, C. (1998) New service development: a review of the literature and annotated bibliography, *European Journal of Marketing*, Vol. 32, No 3/4, pp. 184-252.
15. Edgett, S. (1994) The traits of successful new service development, *Journal of Services Marketing*, Vol. 8, No. 3, pp. 40–49.
16. de Jong, J. P. J. and Vermeulen, P. A. M. (2003) Organizing successful new service development: a literature review, *Management Decision*, Vol. 41, No. 9, pp. 844-858.
17. Martin, C. R., Horne, D. A. (1995), Level of success inputs for service innovations in the same firm, *International Journal of Service Industry Management*, Vol. 6, No. 4, pp. 40-56.
18. Edvardsson, B., Gustafsson, A., Johnson, M. D. and Sandén, B. (2000) *New Service Development and Innovation in the New Economy*, Lund, Sweden: Studentlitteratur AB.
19. Froehle, C.M., Roth, A.V., Chase, R.B. and Voss, C.A. (2000) Antecedents of New Service Development Effectiveness: An Exploratory Examination of Strategic Operations Choices, *Journal of Service Research*, Vol. 3, No. 1, pp. 3-17.
20. De Brentani, U. (2001) Innovative versus incremental new business services: different keys for achieving success, *Journal of Product Innovation Management*, Vol. 18, No. 1, pp. 169–187.
21. Evangelista and R., Sirilli, G. (1998) Technological innovation in services and manufacturing: Results from Italian surveys, *Research Policy*, Vol. 27, pp. 881-899.
22. Sundbo, J. (1997), Management of innovation in services, *The Service Industries Journal*, Vol. 17, No. 3, pp. 432-455.
23. den Hertog, P., Broersma, L. and van Ark, B. (2003) On the soft side of innovation: services innovation and its policy implications, *Economist*, vol. 151, No. 4, pp. 433-452.
24. Herrmann, A., Tomczak, T. and Befurt, R. (2006) Determinants of radical product innovations, *European Journal of Innovation Management*, Vol. 9, No. 1, pp. 20-43.
25. Bitner, M. J., Brown, S. W. and Meuter, M. L. (2000) Technology infusion in service encounters, *Journal of the Academy of Marketing Science*, Vol. 28, No. 1, pp. 138-149.
26. Kumar, P. (1999) The impact of long-term client relationships on the performance of business service firms, *Journal of Service Research*, Vol. 2, No. 1, pp. 4-18.
27. Skaggs, B.C. and Youndt, M. (2004) Strategic positioning, human capital, and performance in service organizations: A customer interaction approach, *Strategic Management Journal*, Vol. 25, pp. 85-99.
28. Ojasalo, K. (2007) Developing industrial services – an empirical study, *The Business Review, Cambridge*, Vol., 7, No. 1, pp. 58-62.
29. Gebauer, H., Krempl, R., Fleisch, E. and Friedli, T. (2008) Innovation of product-related services, *Managing Service Quality*, Vol. 18, No. 4, pp. 387-404.
30. Panesar, S.S. and Markeset, T. (2008) Development of a framework for industrial service innovation management and coordination, *Journal of Quality in Maintenance Engineering*, Vol. 14, No. 2, pp. 177-193.
31. Woodruff, R.B. (1997) Customer value: The next source for competitive advantage, *Academy of Marketing Science*, Vol. 25, No. 2, pp. 139-153.

32. Doz, Y., Hamel, G. (1998) Alliance *Advantage: The Art of Creating Value through Partnering*, Harvard Business School Press, Boston, Massachusetts.
33. Nooteboom, B. (2004) *Inter-firm collaboration, Learning and Networks: An Integrated Approach*, Routledge, London.
34. Tidd, J., Bessant, J., Pavitt, K. (2005) *Managing Innovation: Integrating Technological, Market and Organizational Change*, 3rd Edition, Wiley, Chichester.
35. Swink, M. (2006) Building collaborative innovation capability, *Research Technology Management*, March-April, pp. 37-47.
36. Williamson, D. (2007) The COSO ERM framework: a critique for systems theory of management control, *International Journal of Risk Assessment and management*, Vol. 7, No. 8, pp. 1089–1119.
37. Feeny, D., Lacity, M. and Willcocks, L.P. (2005) Taking the measure of outsourcing providers, *MIT Sloan Management Review*, Spring 2005, pp. 41-48.

PUBLICATION III

Maintenance communities – a new model for the networked delivery of maintenance services

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Maintenance communities – a new model for the networked delivery of maintenance services

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Abstract: Emerging industrial service process development combined with managing complexity in service supply networks is an area where literature is still scarce. This paper seeks to critically analyse traditional maintenance business practices and to present a model to support the new production paradigm based on collaborative, value-adding networks.

This paper is based on interviews and structured discussions with experts in different fields, and analysis of the results of industrial case studies. Our constructive research approach includes formulation of an advanced model to support a collaborative and networked maintenance business based on the identification of the current key challenges.

Value networks are still lacking methods, models and practical business scenarios that support the collaborative provision of maintenance services. Adoption of the model presented in this paper is assumed to support service suppliers in coping with the challenges in dynamic maintenance service supply networks. The originality of our work lies in providing an integrated depiction of our model from several perspectives.

Keywords: industrial services; maintenance; service supply network; maintenance community.

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1 Introduction

As manufacturing companies increasingly focus on their core business, the interest in the utilisation of external services provided by product manufacturers and service companies increases (Gebauer et al., 2006, 2008; Kumar et al., 2006). An increasing number of services are currently purchased from service supply networks. Furthermore, globalisation, complexity of technological innovations and demand for integrated solutions also create need for networking.

The new production paradigm where services are purchased from a service supply network sets new requirements for collaborative and customer-centric planning (e.g., Salkari et al., 2007; Wise and Baumgartner, 1999; Kumar et al., 2004; Kindström and Kowalkowski, 2009) of the range of services offered in order to meet the customer needs in a dynamic business environment. As the ability for dialogue between partners is regarded as a requirement, collaboration between the players in the network should be supported.

The main motive for this paper is derived from the facts that:

1 the current literature combining the emerging industrial service process development and the complexity of the service supply networks is still rather scarce

2 there is a real practical need in companies to increase understanding of the alternative approaches for integration of services in the networked industrial environment in order to increase the added value for the customer.

The purpose of this paper is to critically analyse traditional maintenance business practices, make comparative analyses based on literature reviews and empirical analyses, and especially to present a vision of a model to support the new production paradigm based on collaborative, value-adding networks. The study is limited to industrial maintenance service business.

This paper is structured as follows: first, we present the results of the literature reviews on the new networked production paradigm, and on trust, collaboration and technological development in the supply networks. Then, a maintenance community model is presented, followed by detailed comparisons between the new, alternative model and the more conventional maintenance business practices. Finally, discussion and conclusions sum up the main results of the study and their theoretical and managerial implications.

2 Literature review

The success of a networked industrial service provision is dependent on the partners' capability to collaborate, even in case of conflicting targets from the viewpoint of competition. The integration of competitive and collaborative aspects in the relationships has, in fact, been stated to be most advantageous (Bengtsson and Kock, 2000).

The networked production and services are a broad research area with a variety of aspects to consider. The following literature review specially highlights the importance of collaboration and technology supported knowledge and information transfer in the network. It also points out the general development targets related to current understanding of the maintenance business scenarios.

2.1 Towards networked production and services

There is a transition from pure in-house maintenance organisation models towards deep partnerships in complex company networks or value webs (Riis et al., 2007). Partnerships are motivated by, e.g., the need to achieve production efficiency and flexibility, and gain access to new markets and skills (Lorenzoni and Lipparini, 1999) as well as the need to share risks, resources and knowledge, and make new innovations, also globally (e.g., McDonough et al., 2006). Furthermore, a demand for integrated solutions and full service concepts (Stremersch et al., 2001), and the needs for networking and collaboration when answering the new market demands (Camarinha-Matos et al., 2009), form the basis for the new production paradigm where an increasing number of operations are purchased as services delivered by external service providers. Production manufacturers may have contracts with several service providers and they typically constitute a complex value network.

New organisational structures, business models, theories, processes and technologies are called for from the partners (Camarinha-Matos et al., 2009), and key partners in the service supply networks are faced with the challenge of building up the competence to control and manage the network efficiently (Stremersch et al., 2001). From a single service provider's point of view, the ability to provide services for equipment regardless of the original equipment manufacturer, while also assuring the adequacy of skilful resources and adaptation to technological changes, were recognised as being success factors from among other focal factors by the study of Ojanen et al. (2008). Furthermore, the service providers' capability for continuous improvement and related data and reporting management are also deemed to be important (Persona et al., 2007).

From the customer's point of view, the products and related technologies used in production processes are becoming more complicated and maintaining the required skills and special know-how or resources in the in-house organisation may not be profitable – making outsourcing the more desirable asset management option. The benefit aspects related to outsourcing can be classified as follows (Persona et al., 2007): business improvement (cost reduction and enhancement of efficiency); business impact (improving contribution to companies' performance within existing lines of business) and commercial improvement (focus on leveraging technology-related assets). Furthermore, Lorenzoni and Lipparini (1999) state that the ability to integrate knowledge that resides both inside and outside company's boundaries emerges as a distinctive organisational capability and has a positive effect on company growth and innovativeness. According to Allee (2000), complex company networks engage in more than just transactions around goods, services and revenue. The two other currencies are knowledge value and intangible value or benefits. Positive effects of collaborative agreements and partnerships on revenue and profit have been identified in the manufacturing industry. The findings of Stuart's (2000) study suggest that alliances can be highly advantageous even when they fail to achieve the strategic objectives that led to their formation.

2.2 Trust and collaboration in service supply networks

The new networked business scenarios require a great amount of trust and collaboration between the members. According to Vangen and Huxham (2003), trust is best understood in terms of the ability to form expectations about the aims, and the partners' future behaviours in relation to those ai

can be seen to be rooted either in the anticipation that something will be forthcoming or on previous common satisfactory experiences. The positive experiences become part of history of the relationship, increasing the chance that partners will have positive expectations about joint actions in the future. The increased trust reduces the sense of risk for these future actions.

According to our results from an empirical study of Finnish manufacturing and service firms, the trust building process between industrial organisations is affected by, i.e., the following factors: company reputation and references, integrity of the parties, excellence of the products, level of know-how, capability to reach the common goal, ability to respond to customer needs, ability to solve problems, suitability of relationship contacts, ability to describe services and costs, capability to change suppliers, availability of local services, level of customer orientation, and the role of personal chemistry in the relationship.

According to Head (2003), at the simplest level collaboration comprises a range of closely related acts such as coordinating, consulting, communicating and cooperating. Deutsch (1949) defines that cooperation occurs when individuals believe that their goal achievements are positively correlated; i.e., the others' goal attainment helps them to reach their own goal. Success is then achieved together. To promote the achievement of cooperative goals, people expect each other to perform effectively and resolve issues for their mutual benefit. In general, the benefits of collaboration among individuals, groups, and organisations are related to the coordination of responsibilities and functions as well as to experiential learning (Fisher and White, 2000; Tjosvold et al., 2004). Our empirical studies reveal, e.g., the following benefits related to collaborative relationships: sharing technological know-how and new ideas, improving processes and quality, moving towards more comprehensive services, experimental learning, improving resource management and knowledge management, reducing problem situations, making problem-solving easier and motivating personnel.

It has been concluded that most partnerships fail to achieve the hoped-for goals (e.g., Stuart, 2000; Harrigan, 1985). Stuart (2000) also states that interorganisational collaboration is fraught with the potential for opportunistic behaviour and is inherently difficult to manage. Furthermore, according to Mathieu (2001), the costs of running the collaboration increase with both service specificity and organisational intensity. The costs are derived from a higher complexity in describing role specifications, higher adaptation problems, higher performance evaluation problems, and greater difficulties in solving incentive issues.

A suitable organisational structure and collaborative environment is required for overcoming the above-mentioned challenges, and for increasing the possibility to develop trust and succeed in partnerships between organisations. Pournaras and Lazikidou (2008) also stress the fact that information and communication technology (ICT) tools have an important role, but they are not the only solution in the development of trust between organisations. They have studied relationships between trust and innovativeness in virtual organisations and presented a model for supporting the consideration of various factors affecting the transition of trust into new innovations. In the new type of networked supply of services, which we can also see as an organisational innovation, understanding the significant roles of individual and organisational trust is required for the desired results. Furthermore, in their empirical study of communities of practice, Hemmasi and Csanda (2009) came to the conclusion that member connectedness and job relevance can be even more important than trust for the satisfaction of community experience.

Maintenance has no intrinsic value and its objectives should be based on the strategic objectives of the asset owner (Rosqvist et al., 2009a); however, a successful partnership in the service supply network requires a common view of the network objectives. Rosqvist et al. (2009a) propose value tree representation of the value structuring for the maintenance function with both strategic key performance indicators and operational maintenance performance indicators attached to the objectives to enable performance measurement. Rosqvist et al. (2009b) propose strategy maps, which have been formerly utilised in the strategy development of a single corporation, to be used in the strategy development of a value net.

2.3 Technology and ICT development for collaborative decision-making and information exchange in a service supply network

The provision of services in complex networks challenges the network members to create effective multi-channel communication and allow information sharing to ensure efficient functionality of the complex business and service processes. Managing the variety of service requests and supply chains with dynamic work flows, as well as material supply chains and complex planning and scheduling information chains, requires functional collaboration supported by proper enabling technology. Lack of information in the networked production is claimed to result in poor decision-making (Egri et al., 2007) and improved information technology is seen to lead to improvements in productivity and equipment uptime (Persona et al., 2007). Incorporating all the available information for maintenance management is important (e.g., Waeyenbergh and Pintelon, 2002); however, the collection and dissemination of information, and the introduction of related technology, should be based on real needs as identified in the collaboration network. The need for aligning ICT development with business development or deriving the objectives for technology development from the business objectives has been emphasised in a multitude of studies (e.g., Pulkkinen et al., 2007; Kortelainen et al., 2008). Currently, the utilisation of information produced in the maintenance function is too restricted to operational control, instead of overall maintenance decision support (Tsang et al., 2006). The study of Pulkkinen et al. (2007) emphasises the adoption and collaborative planning of the enterprise architecture (EA) concept in business networks of multiple enterprises. An EA Grid presented by Hirvonen and Pulkkinen (2004) is proposed to be exploited in business networks bringing forth the following four aspects in the development of the multi-enterprise view for collaborative architecture:

1 business dimension

2 information dimension

3 application dimension

4 technology dimension.

Collaboration and related information exchange is relevant from the integrated perspective of production and maintenance planning. For example, Sloan and Shanthikumar (2000) have studied the combined production and maintenance models and concluded that combined models result in significantly greater (25%) reward compared to the traditional method. Furthermore, streamlining the information and knowledge management in a multi-vendor maintenance environment is seen to have a significant

impact on performance. For instance, the development of the e-maintenance concept aims at facilitating information and data flow into the decision-making process at all organisational levels by networking the sources of information and enabling transparency (Muller et al., 2008). Herein we still identify the lack of solutions for complex service supply networks. Moreover, the incompatibility of systems and lack of mutual trust are seen as barriers, as suggested in Uusipaavalniemi and Juga (2009). Efficient management of a network with a proper coordination structure is an antecedent for the network success.

The study of Dyer and Nobeoka (2000) shows that by creating a means to help partners identify with the network, by establishing rules or norms for the network regarding knowledge sharing, and by creating processes that allow multiple pathways among partners, a network can achieve effectiveness in the generation, transfer and recombination of knowledge.

The networked service provision and business environment sets new requirements for maintenance management information systems. However, the lack of research in the area is identified, e.g., in Kans (2008). When determining the requirements, one should start with the desired impact, i.e., define the organisational goals and divide them into individual goals. Finally, the analysis of the purpose of the ICT solution and its use will result in the requirements for the ICT systems' functionality and characteristics (based on Delone and McLean, 1992). Kans (2008) states that the user's needs are different at operational, tactical and strategic levels and, because different maintenance strategies and policies result in different needs for information system functionalities, maintenance service supply network partners will need systems according to their own business driven goals. Possibilities for the integration of existing systems are seen to be important, especially when regarding the emerging trend of e-maintenance platforms (Han and Yang, 2006) and from the perspective of integration platform (Bangemann et al,. 2006). However, a lack of coordination is seen to result in missed opportunities to leverage existing systems by integration (Pulkkinen et al., 2007). The challenge is emphasised in the complex networked environments.

2.4 Further research needs

In summarising the literature review, we conclude that value networks are still lacking methods, models and practical business scenarios that support the collaborative provision of maintenance services where a variety of services are integrated in order to maximise the customer received value.

3 Research design

The current paper is part of a larger multi-disciplinary research project that started in 2007. The overall project objectives included developing and demonstrating the methodology and tools for improving new service development (NSD), increasing the exploitation of product lifecycle information in the development of industrial services and, in general, the creation of added value for the customer's value chain. The material presented in this current paper is based on inferences drawn from both general results of the project and the industrial case studies.

The current study included interviews, structured discussions with industrial experts, as well as an analysis of the previously mentioned industrial case studies. Our constructive research approach included the identification of the key challenges related to current traditional maintenance business practices and the development of an advanced model to support the new networked service production paradigm. The research approach has been selected on the basis of our observation that there is a practical need to develop new models for the networked provision of maintenance services. Our research approach has resulted in a comparison of the maintenance community model with more traditional ways of organising maintenance and an analysis of the model from a variety of perspectives. The features of the maintenance community model are presented in the following section.

4 Maintenance community model

The development of the maintenance community model presented in the following sections is based on the need to support service supply networks and their clients by introducing new models for the collaborative relationship which considers the key challenges of the new maintenance business scenarios. Positive effects of collaborative agreements and partnerships on revenue and profit have been reported, not only in IT (Mortehan and van Pottelsberghe de la Potterie, 2007) and high-tech industry (Stuart, 2000) but also in the manufacturing industry (Lorenzoni and Lipparini, 1999).

4.1 Scope and principles of a maintenance community

There is an evident transition from traditional contractual relationships towards networked collaboration models in industry, as illustrated in Figure 1 which introduces maintenance communities as an advanced way to support the collaborative and networked maintenance business. The maintenance community is a dynamic network that aims to jointly provide industrial services regarding a customer's production assets. Thus, the adoption of the maintenance community model results in new business scenarios in networked environments with a holistic view and common value creation targets. These scenarios call for a new and more broadminded way of thinking from each individual service provider in the community, in association with shared tools, technology, models and trust between the community members. What is also called for is the ability to move from a single partnership (service provider – manufacturing company) into a coherent networked decision-making arrangement based on joint- and customer-oriented planning and coordination.

As members join a community, they must identify their role and key success factors in the business and how they relate to the objectives of the customer. In practice, maintenance service supply networks can be established based on any of the following scenarios:

1 a machine manufacturer builds up a limited service network on the basis of its own after sales services

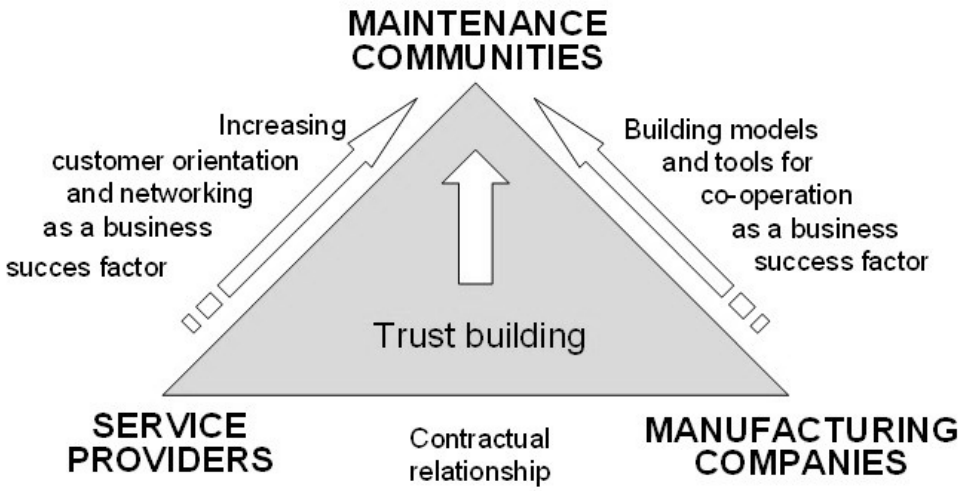
2 an asset owner outsource particular operations to be provided by service providers, however, keeping in-house the responsibility of managing the operations

3 a consortium takes over a wide range of outsourced operations and the overall responsibility, including management.

In this paper, our focus is on the last mentioned scenario where the consortium that produces the services is called a maintenance community.

Typically, in a service supply network, one company works as an orchestrator that provides total services with the help of the network. The company in these cases is in charge of the characteristics of the service and manages the relationship with the customer. In some cases, time does not allow the development of a profound partnership between the companies, but there is a requirement for starting the business immediately with a certain level of trust and collaboration. These cases favour the presence of an orchestrator who has the required level of trust from each party of the network.

Figure 1 Transition from contractual relationships to maintenance communities



The presented maintenance community model includes development in all the four dimensions of the EA grid presented by Hirvonen and Pulkkinen (2004), i.e., the business, information, application and technology dimensions. The main impacts, however, can be illustrated by focusing on the business, information and application dimensions. In addition to these dimensions, important aspects of operational maintenance management are addressed in Table 1 and Table 2, which introduce key features of the presented model and compare them with two more traditional business practices. We summarise the key benefits as follows: The need for improving operation efficiency is addressed in a community by rationalisation of operations and efficient utilisation of complementary and redundant resources based on common objectives, utilisation of the potential for synergy, maximisation of the total value provided by the network instead of optimising single service delivery processes, and sharing the knowledge which can result in shared benefits when utilised. The need for continuous development of the business in the network is addressed in a community by ensuring adequate information sharing and practices for learning from others, and by combining

skills and knowledge to create new innovations. Moreover, success in increasing competition is ensured by developing capabilities to provide a wide range of services and by efficiently orchestrating the service deliveries to produce the most value for a customer's processes.

Table 1 Comparison of the maintenance community model with more traditional ways of organising maintenance – business, information and application dimensions

Dimension	*Features of maintenance operations*	*Traditional in-house maintenance organisation*	*Outsourced service supply*	*Maintenance community model*
Business dimension	Productivity management	Low utilisation rate of specialised expert resources leading to high unit costs and poor productivity.	Higher utilisation of expert resources due to possibilities to utilise the resources for the benefit of several customers; ensuring constant workload.	High productivity of expert resources due to well established practices for the utilisation of the specific resources together in the community and the utilisation of common information on the installed base (equipment to be maintained) to support the operations.
		Productivity of basic resources fairly good due to the knowledge related to local environment and production processes.	Productivity of basic resources only moderate due to lack of knowledge of local issues and production processes.	Productivity of basic resources is challenged by the lack of local knowledge; however, tools for information sharing and management lead to high productivity.
	Business processes	Established functional practices between production and maintenance organisations. Good site supervision and informal collaboration can generate significant efficiency.	Outsourcing leads to demand for the definition and optimisation of business processes in the customer – service provider interface.	The processes of each community member are optimised with relation to the network and supported by appropriate applications. However, the community model also includes challenges regarding the optimisation of collaborative business processes.

Table 1 Comparison of the maintenance community model with more traditional ways of organising maintenance – business, information and application dimensions (continued)

Dimension	*Features of maintenance operations*	*Traditional in-house maintenance organisation*	*Outsourced service supply*	*Maintenance community model*
Business dimension	Business processes	Maintenance response time to urgent issues can be very good due to permanent resources at site.	New needs for, e.g., formal work planning and acceptance procedures and definition of stakeholders' roles in these.	Efficient communication tools enable the relevant persons, regardless of their position, to be informed (figures, data, video etc.).
		Flexibility in prioritisation of tasks.	Distance between the sites of the service provider and the customer increases response time.	
			Lack of flexibility in resources management.	
	Business strategy level optimisation	Maintenance strategy is composed purely based on the requirements of production at site.	Business is mainly planned and optimised based on the objectives for fulfilling the customer site's requirements.	Community members can focus the optimisation based on the nature of their business, including partnerships with a group of customers to be served, and thus take a broader view on the optimisation. Scale advantage results in cost efficiency and improvements in service quality.
	Business process level optimisation	Limited possibilities for utilisation of knowledge of best practices. Methods primarily based on internal knowledge and experiences.	More potential for sharing best practices; lack of tools and methods for implementation.	Potential for holistic optimisation and formulation of the community best practices is improved as history data is shared and databases exist for optimising the community level processes and utilising the gathered knowledge in, e.g., problem solving.

Table 1 Comparison of the maintenance community model with more traditional ways of organising maintenance – business, information and application dimensions (continued)

Dimension	*Features of maintenance operations*	*Traditional in-house maintenance organisation*	*Outsourced service supply*	*Maintenance community model*
Information and application dimension with collaboration and communication aspects	Daily communication	Easy daily communication with informal practices.	Poor possibilities for informal communication as often no regular resources on site and no adequate supporting information technology.	Well managed formal communication with appropriate technology resources and tools to ensure the required level of informal communication.
	Information quality	Faulty or lacking information can be compensated by the benefits of having resources on site and ways of getting real time information informally.	The need for formal and reliable information on the service target increases when no regular resources at site. Lack of tools and scale advantage for developing such tools often exists.	The need for formal and reliable information on the service target increases when no regular resources are at the site. Possibility to meet the demand by introducing ICT.
	Transparency of information and security issues	Need for well-organised information sharing between production and in-house maintenance organisation. Lack of solutions exists. The lack can be compensated with the ease of human interaction.	No adequate transparency of information concerning maintenance processes due to business reasons and lack of solutions.	Established collaborative practices for the definition of required transparency and information sharing issues. Access to the relevant data concerning maintenance processes is allowed for all community members.
		No significant additional demand for security.	Some security demand.	High security demand.

Table 1 Comparison of the maintenance community model with more traditional ways of organising maintenance – business, information and application dimensions (continued)

Dimension	*Features of maintenance operations*	*Traditional in-house maintenance organisation*	*Outsourced service supply*	*Maintenance community model*
Information and application dimension with collaboration and communication aspects	Flexibility of information systems integration	No need for integration.	Service providers operate based on the requirements of the customer's systems and applications.	Community members can optimise their own business and use ERP systems which are integrated to the environment. Flexible integration solutions are provided with a range of possibilities to integrate both large stakeholders and occasional smaller service providers. Partners utilise applications that are designed to support the collaborative environment.

Table 2 Comparison of the maintenance community model with more traditional ways of organising maintenance – operational maintenance management dimension

Dimension	*Features of maintenance operations*	*Traditional in-house maintenance organisation*	*Outsourced service supply*	*Maintenance community model*
Operational maintenance management	Special human resources and maintenance equipment	Capability to maintain special skills and tools is fairly poor due to high costs in proportion to utilisation rate.	Capability to maintain special skills and tools very good in areas of high utilisation rate.	Capability to maintain special skills and tools very good.
			Availability of the special skills fairly poor due to long distances and travelling required.	Long distances are a challenge but the availability of the resources is improved by proper ICT.

Table 2 Comparison of the maintenance community model with more traditional ways of organising maintenance – operational maintenance management dimension (continued)

Dimension	*Features of maintenance operations*	*Traditional in-house maintenance organisation*	*Outsourced service supply*	*Maintenance community model*
Operational maintenance management	Knowledge management	Maintenance staff has very good knowledge in local plant specific issues.	Service provider typically lacks the best expertise and knowledge of the customer's processes. Due to lack of daily contact in operations, demand for more formal information to be utilised in maintenance operations increases significantly.	By ensuring adequate information sharing through the common knowledge databases, the demand for information can be met.
		Lack of required knowledge and skills related to special tools.	Required special knowledge and skills exist.	The required special knowledge and skills exist and are improved by 'learning from others' following the established community collaboration practices.
	Resource availability and flexibility	In the in-house organisation, special resources can be reached with established informal practices. Flexibility exists in operations.	Formal practices for reaching required resources. Lack of flexibility and tools for giving one's contribution remotely.	Online meetings with advanced tools can be arranged to allow the required resources to contribute, e.g., in a problem solving situation and access is given to all the required material. The arrangement has no limits with respect to location and generates cost savings by decreasing the need for working at a customer site.

Table 2 Comparison of the maintenance community model with more traditional ways of organising maintenance – operational maintenance management dimension (continued)

Dimension	*Features of maintenance operations*	*Traditional in-house maintenance organisation*	*Outsourced service supply*	*Maintenance community model*
Operational maintenance management	Materials, inventory and logistics management	Management is to large extent based on the needs and requirements of the individual site.	Volume advantage is achieved in purchasing materials and inventory turnover.	In addition to volume advantages, in cases where customer sites are in close proximity to each other, the inventory levels can be optimised for the group of customers. In the community, the logistic and work chains can differ and tools exist for synchronising them.
	Safety management	In the in-house organisation, one can rely on more simple processes and well-trained expert supervisors.	Additional safety processes that meet the requirements of more complex situations are needed and one cannot rely on the efforts of individual supervisors and established informal practices alone. Processes to meet the requirements are often lacking.	Formal processes for safety management in the complex network are established with defined links in the interfaces between companies. Transparent ways of operation.
	Risk management	In the in-house organisation, risk management process is easier to describe, guide, organise and execute. Inter-company cooperation is needed.	Risk environment is more complex and several informal practices exist. Sharing of risk knowledge and cooperation among supply chain partners is needed in order to assess and manage risks.	Common guidelines and methods for risk assessment, risk management and knowledge sharing are needed for ensuring an adequate level of risk management.
				Risk management practices are improved by 'learning from others' following the established community collaboration practices.

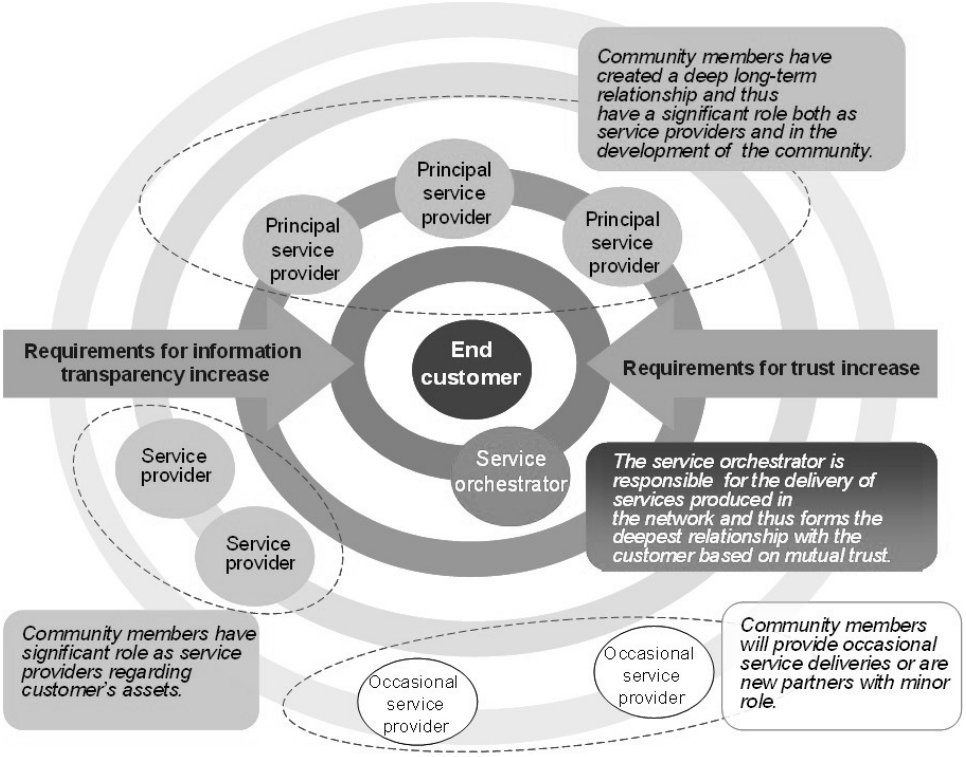
4.2 Development of trust and collaboration

The behaviour of the partners is affected by how the partners see the future of the network. If the partners see the operations, development targets and objectives of the network very differently, the collaboration may be affected and inconveniences may arise. Thus, the development of the network should be discussed and the development scenarios should be outlined and further detailed together in the network.

The community model supports both the presence of long-term partners and the dynamics of the network with changing community members. In addition to trust, in general, requirements for the transparency of information exist. In the community model, however, the requirement level for each community member can vary depending on the nature of the member's role, and thus also the relationship with the community and the end customer. The requirement levels are depicted as circular layers in Figure 2.

Trust and fruitful collaboration cannot be achieved without an initial willingness of the business partners to move towards a deeper partnership. It is expected that this transition will occur in a step-by-step fashion at the pace the mutual trust grows within the community.

Figure 2 Illustration of the requirements for trust and information transparency and the roles of community members



Further evidence on the challenges and possibilities to overcome them, related to the development of trust in collaborative relationships can be found from our case study of networked maintenance service development. In the case study, two industrial service providers have aimed to achieve a deeper partnership with their client with a larger service package including step-by-step development via the audit of industrial assets, spare part services and finally, in remote diagnostics and management of maintenance-related information.

Several benefits, especially in relation to the production efficiency, could be observed from the customer's viewpoint. In general, customers seem to seek long-term relationships when acquiring services more actively than when purchasing tangible goods (Barry and Terry, 2008). In addition, the potential benefits from the service providers' point of view were seen to be associated with the creation of new business opportunities and improvement of competitive positions. Even though the benefits in this case study were relatively clearly seen by all parties in the collaboration, various challenges were also observed in association with the practical realisation of these potential benefits. In particular, the problems in communicating the benefits widely in different organisations was one of the main reasons for the inadequate level of trust during the initial stages of the partnerships. The main development efforts in this case were therefore related to taking the customer viewpoint more strongly into account, developing knowledge related to the required capabilities of the client and service providers, as well as the organising, decision support and monitoring of activities.

The development needs, in this case, were gathered from the interviews held in all the organisations. The main suggestions in the case study – namely creation of the holistic picture to support decision-making and open communication of benefits and risks in the collaborative relationship – aimed to help in the mutual understanding of the targets and in the development of trust in the step-by-step approach. The transparency and increased level of trust have then helped the companies overcome challenges at the initial stage and gain the benefits that were seen in the early starting stage.

4.3 Building up business driven community objectives

Composing the community's objectives so that the overall value is maximised from the customer's perspective requires a new mindset from the community members who are often only familiar with negotiating one-to-one contracts. Typical ways of setting the objectives may have led to situations where an individual service provider is only interested in the matters concerning its own contract. The significance of a service providers' focus on the entire value proposition for the customer is emphasised (e.g., Stremersch et al., 2001). However, there exists a challenge on how to generate a genuine common value creation mindset, earning principles and rules of value sharing that can be accepted by all.

When establishing a maintenance community, common objectives should be defined taking into account the possibility of conflicting objectives as a natural phase of the process. Examples of potential conflicts in a service supply network follow, the risk of which can be reduced by introducing the community model:

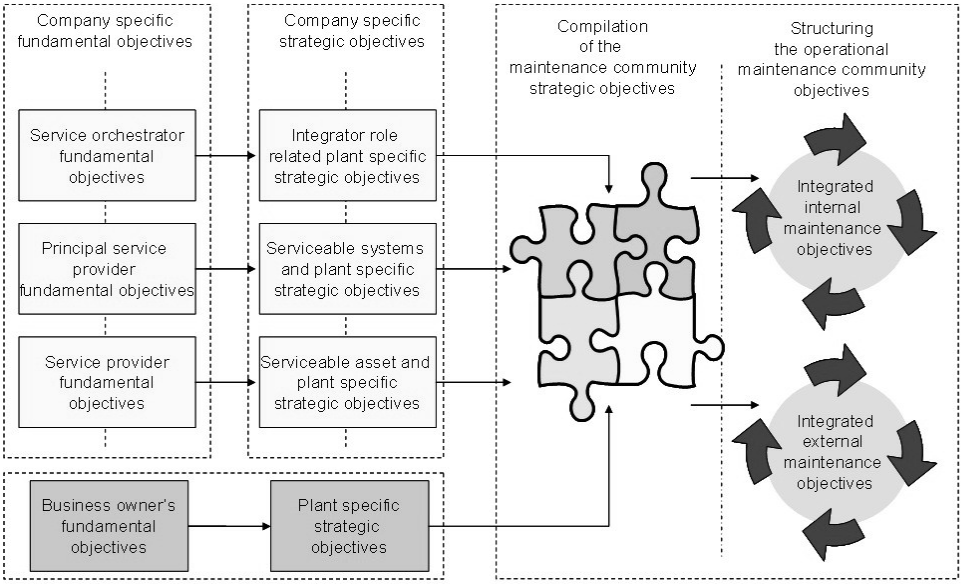
- Objectives for efficient utilisation of resources may lead to situations where the required service resources are busy carrying out tasks at other plants. Matching the schedules of all the relevant members of the network in a given situation may result

in conflicts. A community-based network can better handle the demand related conflicts with a certain level of resource redundancy and provide more efficient coordination for the definition of practical maintenance intervals.

- A single maintenance service contract includes performance related objectives; e.g., overall equipment efficiency (OEE) and availability that tend to increase spare parts inventory levels. Again, logistics services typically tend to decrease the levels, and may result in conflicting situations.
- Without a reasonable community-driven coordination, the selection of key development and focus areas for each service provider may lack an overall view and result in only partial optimisation. Furthermore, the actions of individual service providers purely based on their benefits may prevent the previous synergy benefits; e.g., utilisation of common spare parts.

Maintenance services are typically driven by availability related objectives and performance measures such that system performance development may be overlooked. In cases where adequate information sharing is not assured, the maintenance decisions may even be in conflict with development plans. Furthermore, business processes should be developed based on how the customer value is maximised, even if this on a short term would decrease the business revenue of an individual service provider. The community should therefore create incentive structures and value sharing mechanisms. According to, e.g., Rese (2006) revenue distribution in a network can be based on either a customer value-based approach or an internally driven cost-based approach. Compensation rules and new appropriate performance indicators promoting joint value creation should also be established. It has been shown that models for value sharing can be built (Jarimo and Kulmala, 2008) based on open-book accounting, but finding common ground here between the partners and customer value measurement may turn out to be extremely difficult.

Figure 3 Maintenance community value and objective hierarchy



Strong emphasis on the definition of common objectives for the network, however, may lead to frustration by the partners and result in efficient collaboration never being started. With insufficient understanding of what the future may be and how the jointly agreed principles will work, individual partners may feel that they are losing their freedom in decision-making, while the corresponding benefits are not as yet clear. Therefore, it is sometimes more reasonable to define the common objectives loosely, and start building the common ground and finding best practices by working together. However, fundamental objectives (Keeney, 1992) should exist from the start. Hereby, we conclude that a systematic approach is needed for the development of community objectives and present our framework for doing this in Figure 3. In our view, the company specific strategic objectives of service providers and customer are seen side by side and are integrated as community objectives.

4.4 Community technology and dynamic decision-making

The information and communication technology used in novel complex environments must support the special characteristics of the business. Therefore, traditional tools need to be replaced or enhanced. The enabling technology developed must be in line with the new challenges that have their base in services that are produced in a complex network.

The Deloitte (2006) study reveals that companies are lacking "capabilities for planning, managing, and monitoring the service business more effectively". As maintenance is outsourced, many daily ways of informal communication may be lost. Many of the service concepts provided by a maintenance community are typically implemented with no regular resources at site. The importance of the quality of formal information is therefore increased. Communication in a community requires development of generic models and interface solutions in order to allow the integration of community members' separate systems effectively. A central system solution for managing the information is not seen as a future solution. In practice, community members will all need their own ERP and information management systems, due to the individual nature and dynamics of their businesses. Furthermore, the best way to support the communities is to develop concepts involving efficient adaptation solutions with interfaces for the members, ways of supporting information mediation and dynamic decision-making and systems that contain the structures of the service products, and proper tools for work management.

The community should be offered a collaborative working environment with solutions providing partners with both formal and informal ways of communication regarding day-to-day problem solving situations. In practice, virtual group meetings with adequate facilities for managing all the relevant material would offer a solution for rapid problem solving situations whereas more traditional communication solutions are applicable in the strategy work, planning and scheduling of shutdowns, and identification of development targets. Thus, we propose the following range of applications and solutions to be utilised in the collaborative environment:

- informal community communication, messaging and group meeting solutions to allow efficient utilisation of all knowledge and resources available in daily operations

- shared knowledge management solutions and repositories for data, information and knowledge, in order to provide community members with common access to information on the installed base
- workflow and logistics management and work management solutions integrated with community members' solutions, and allowing access to information for all necessary stakeholders
- dynamic and integrated asset and maintenance management solutions
- shared business and information chain modelling and management solutions
- measurement, business control and benchmarking solutions integrated with agreed sources of information.

The preceding applications and solutions can guarantee the information sharing, processing and further development at all strategic, tactical and operational levels.

4.5 Risks and their management

The members of a community can be associated with various networks at the same time. In these circumstances, members may also have several different objectives for operating as a part of the community. All of the aims may probably never be shared with other members, when common objectives are discussed. This is understandable behaviour in business, but it also raises fears for opportunistic behaviour. A lack of commitment, often regarded as opportunism, leads to problems in the implementation of the network's strategy. The risk may be reduced by making visible the advantages from efficient collaboration of the network as well as value destroying effects of actions against the common objectives and principles of collaboration. The network orchestrator plays a crucial role in providing the governance of the maintenance community that is balanced in terms of value and risk sharing, and is not burdened by complicated contracting and rule setting. It can be argued that a real 'community' is governed by a minimum of formal rules and common problems are flexibly solved, and in good faith. It is also important that the basis of trust is between the companies, and not personified to some key people. The most important role of the network orchestrator may be argued to be a relationship manager.

According to our empirical research, the key challenges related to risk management in the collaborative relationships of industrial maintenance are:

- how to evaluate the reliability, quality, efficiency, costs, etc. of maintenance
- challenges in decision-making concerning operational/business risks
- understanding related to contractual risks
- how to deal with sharing of the risks between the management of the subcontractor and client network
- assessment of risks relating to services developed together with client and service provider
- cultural challenges (openness, communication)

- information management procedures
- learning from each other, knowledge management processes
- evaluation of risks in pilot projects
- recognition of changing risks and updating risk perceptions.

In the early phase of the life-cycle of a maintenance community, we may assume that strategic and organisational and also content-related challenges dominate, while the process-related challenges only increase their relational significance in the later phases of dynamic relationship development in the maintenance community. In order to overcome the challenges, the companies in maintenance communities need first to recognise the current state of the level of each risk category, and find case-specific solutions for the prioritised most important risks to manage. Some technological and other practical means to manage the various types of risks have already been discussed earlier in this paper, and generally, the clear message here, when compared to more traditional types of maintenance services, is that there is a visible need for the development of more advanced ways to support organisational learning and utilisation of organisational memory in the maintenance community.

5 Discussion and conclusions

Service supply networks are increasingly challenged to meet dynamic customer requirements by providing cost-efficient and timely services of good quality with an adequate level of flexibility, these being the features especially emphasised in interviews. Thus, in a dynamic business environment, business models and maintenance service strategies need to be dynamic. Furthermore, business and operational level planning needs to be provided with modern tools. At present, there is no adequate debate ongoing regarding the future business models associated with the maintenance service business. Nevertheless, future models need to be outlined so that proper ICT tools can be developed in time.

In this paper, we have presented a vision of an enhanced business scenario, the maintenance community, where particular focus has been put on developing collaborative processes and proper ICT tools for compensating the weak points associated with outsourcing. The developed construction of the maintenance community is based on the practical needs revealed in our empirical qualitative research of maintenance business, together with the extensive reviews of earlier studies on the sub-topics of the constructed model.

We have found that both customers and maintenance service suppliers should critically evaluate their processes from the collaboration perspective and direct efforts towards the management of the service provider customer interface. In relation to ICT solutions, recent experiences have shown that centric information management systems have not offered acceptable solutions for dynamic and wide ranging networks. Instead, in order to enhance the business in maintenance communities, solutions need to be developed to offer the higher integration of the company specific tools, to assure the quality of information and thus to enable the dynamic networked operations. However,

further research is needed to test our proposals in relation to the functionality of the maintenance community.

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References

Allee, V. (2000) 'Reconfiguring the value network', *Journal of Business Strategy*, Vol. 21, No. 4, pp.36–39.

Bangemann, T., Rebeuf, X., Reboul, D., Schulze, A., Szymanski, J., Thomesse, J-P., Thron, M. and Zerhouni, N. (2006) 'PROTEUS – creating distributed maintenance systems through an integration platform', *Computers in Industry*, Vol. 57, No. 6, pp.539–551.

Barry, J. and Terry, T. (2008) 'Empirical study of relationship value in industrial services', *Journal of Business & Industrial Marketing*, Vol. 23, No. 4, pp.228–241.

Bengtsson, M. and Kock, S. (2000) ''Coopetion' in business networks – to cooperate and compete simultaneously', *Industrial Marketing Management*, Vol. 29, No. 5, pp.411–426.

Camarinha-Matos, L.M., Afsarmanesh, H., Galeano, N. and Molina, A. (2009) 'Collaborative networked organizations – concepts and practice in manufacturing enterprises', *Computers & Industrial Engineering*, Vol. 57, No. 1, pp.46–60.

Deloitte. (2006) 'The service revolution in global manufacturing industries', available at http://www.deloitte.com/dtt/cda/doc/content/dtt_manufacturing_ServiceRevolutionInGlobalManufacturing012006%281%29.pdf (accessed on 10/10/2009).

Delone, W.H. and Mclean, E.R. (1992) 'Information systems success: the quest for the dependent variable', *Information Systems Research*, Vol. 3, No. 1, pp.60–96.

Deutsch, M. (1949) 'A theory of co-operation and competition', *Human Relations*, Vol. 2, No. 2, pp.129–152.

Dyer, J.H. and Nobeoka, K. (2000) 'Creating and managing a high-performance knowledge-sharing network: the Toyota case', *Strategic Management Journal*, Vol. 21, No. 3, pp.345–367.

Egri, P., Karnok, D. and Váncza, J. (2007) 'Information sharing in cooperative production networks', *Proceedings of IFAC Workshop on Manufacturing Modelling, Management and Control*, 14–16 November, pp.115–120, Budapest, Hungary.

Fisher, S. and White, M. (2000) 'Downsizing in a learning organization: are there hidden costs?', *Academy of Management Review*, Vol. 25, No. 1, pp.244–251.

Gebauer, H., Friendli, T. and Fleisch, E. (2006) 'Success factors for achieving high service revenues in manufacturing companies', *Benchmarking: An International Journal*, Vol. 13, No. 3, pp.374–386.

Gebauer, H., Krempl, R., Fleisch, E. and Friedli, T. (2008) 'Innovation of product-related services', *Managing Service Quality*, Vol. 18, No. 4, pp.387–404.

Han, T. and Yang, B-S. (2006) 'Development of an e-maintenance system integrating advanced techniques', *Computers in Industry*, Vol. 57, No. 6, pp.569–580.

Harrigan, K.R. (1985) *Strategies for Joint Ventures*, Lexington Books, Lexington, MA.

Head, G. (2003) 'Effective collaboration: deep collaboration as an essential element of the learning process', *Journal of Educational Enquiry*, Vol. 4, No. 2, pp.47–62.

Hemmasi, M. and Csanda, C.M. (2009) 'The effectiveness of communities of practice: an empirical study', *Journal of Managerial Issues*, Vol. 21, No. 2, pp. pp.262–279.

Hirvonen, A. and Pulkkinen, M.A. (2004) 'Practical approach to EA planning and development: the EA management grid', *Proceedings of 7th International Conference on Business Information Systems*, 21–23 April, pp.284–302, Poznan, Poland

Jarimo, T. and Kulmala, H.I. (2008) 'Incentive profit-sharing rules joined with open-book accounting in SME networks', *Production Planning & Control*, Vol. 19, No. 5, pp.508–517.

Kortelainen, H., Ahonen, T., Jantunen, E. and Salkari, I. (2008) 'Future service concepts as a strategic choice for machinery manufacturers', *Conference on Asset Management & Production Reliability, Euromaintenance '08*, 8–10 April, Brussels, Belgium.

Kans, M. (2008) 'An approach for determining the requirements of computerised maintenance management systems', *Computers in Industry*, Vol. 59, No. 1, pp.32–40.

Keeney, R.L. (1992) *Value-Focused Thinking. A Path to Creative Decision-Making*, Harvard University Press, Cambridge, London.

Kindström, D. and Kowalkowski, C. (2009) 'Development of industrial service offerings: a process framework', *Journal of Service Management*, Vol. 20, No. 2, pp.156–172.

Kumar, R., Markeset, T. and Kumar, U. (2004) 'Maintenance of machinery: Negotiating service contracts in business-to-business marketing', *International Journal of Service Industry Management*, Vol. 15. No. 4, pp.400–413.

Kumar, R., Markeset, T. and Kumar, U. (2006) 'Implementation and execution of industrial service strategy: A case study from the oil and gas industry', *Journal of Quality in Maintenance Engineering*, Vol. 12, No. 2, pp.105–117.

Lorenzoni, G. and Lipparini, A. (1999) 'The leveraging of interfirm relationships as a distinctive organizational capability: a longitudinal study', *Strategic Management Journal*, Vol. 20, No. 4, pp.317–338.

Mathieu, V. (2001) 'Service strategies within the manufacturing sector: benefits, costs and partnerships', *International Journal of Service Industry Management*, Vol. 12, No. 5, pp.451–475.

McDonough, E.F. III, Athanassiou, N. and Barczak, G. (2006) 'Networking for global new product innovation', *International Journal of Business Innovation and Research*, Vol. 1, Nos. 1/2, pp.9–26.

Mortehan, O. and van Pottelsberghe de la Potterie, B. (2007) 'The impact of collaborative agreement on firm's performances: the case of the IT industry in the 90s', *Technology Analysis & Strategic Management*, Vol. 19, No. 2, pp.127–144.

Muller, A., Crespo Marquez, A. and Iung, B. (2008) 'On the concept of e-maintenance: review and current research', *Reliability Engineering and System Safety*, Vol. 93, pp.1165–1187.

Ojanen, V., Lanne, M., Reunanen, M., Kortelainen, H. and Kässi, T. (2008) 'New service development: success factors form the viewpoint fleet asset management of industrial service providers', *15th Working Seminar on Production Economics*, 3–7 March, pp.369–380, Innsbruck, Austria.

Persona, A., Regattieri, A., Pham, H. and Battini, D. (2007) 'Remote control and maintenance outsourcing networks and its applications in supply chain management', *Journal of Operations Management*, Vol. 25, pp.1275–1291.

Pournaras, E. and Lazakidou, A. (2008) 'Trust and innovativeness in virtual organizations', *International Journal of Business Innovation and Research*, Vol. 2, No. 2, pp.262–274.

Pulkkinen, M., Naumenko, A. and Luostarinen, K. (2007) 'Managing information security in a business network of machinery maintenance services business – enterprise architecture as a coordination tool', *The Journal of Systems and Software*, Vol. 80, pp.1607–1620.

Rese, M. (2006) 'Successful and sustainable partnerships: how to select the right partners', *Industrial Marketing Management*, Vol. 35, No. 1, pp.72–82.

Riis, J., Johansen, J., Waehrens, B. and Englyst, L. (2007) 'Strategic roles of manufacturing', *Journal of Manufacturing Technology Management*, Vol. 18, No. 8, pp.933–948.

Rosqvist, T., Laakso, K. and Reunanen, M. (2009a) 'Value-driven maintenance planning for a production plant', *Reliability Engineering and System Safety*, Vol. 94, pp.97–110.

Rosqvist, T., Ahonen, T., Ojanen, V. and Marttinen, A. (2009b) 'Assessing the subjective added value of value nets: which network strategies are really win-win?', *The 4th World Congress on Engineering Asset Management*, 28–30 September, Article in Press, Athens, Greece.

Salkari, I. Salminen, V. and Pylkkänen, J. (2007) 'Managing service business winning best practices and success stories', The Federation of Finnish Technology Industries, available at http://www.bestserv.fi/files/bestserv_managing_service_business.pdf (accessed on 10/10/2009).

Sloan, T.W. and Shanthikumar, G. (2000) 'Combined production and maintenance scheduling for a multiple-product, single-machine production system', *Production and Operations Management*, Vol. 9, No. 4, pp.379–399.

Stremersch, S., Wuyts, S. and Frambach, R.T. (2001), 'The purchasing of full-service contracts: an exploratory study within the industrial maintenance market', *Industrial Marketing Management*, Vol. 30, No. 1, pp.1–12.

Stuart, T.E. (2000) 'Interorganizational alliances and the performance of firms: a study of growth and innovation rates in a high-technology industry', *Strategic Management Journal*, Vol. 21, No. 8, pp.791–811.

Tjosvold, D., Yu, Z. and Hui, C. (2004), 'Team learning from mistakes: the contribution of cooperative goals and problem-solving', *Journal of Management Studies*, Vol. 41, No. 7, pp.1223–1245.

Tsang, A.H.C., Yeung, W.K., Jardine, A.K.S. and Leung, B.P.K. (2006) 'Data management for CBM optimization', *Journal of Quality in Maintenance Engineering*, Vol. 12, No. 1, pp.37–51.

Uusipaavalniemi, S. and Juga, J. (2009) 'Information integration in maintenance services', *International Journal of Productivity and Performance Management*, Vol. 58, No. 1, pp.92–110.

Vangen, S. and Huxham, C. (2003) 'Nurturing collaborative relations. Building trust in interorganizational collaboration', *The Journal of Applied Behavioral Science*, Vol. 39, No. 1, pp.5–31.

Waeyenbergh, G. and Pintelon, L. (2002) 'A framework for maintenance concept development', *International Journal of Production Economics*, Vol. 77, No. 3, pp.299–313.

Wise, R. and Baumgartner, P. (1999) 'Go downstream, the new profit imperative in manufacturing', *Harvard Business Review*, September–October.

PUBLICATION IV

Assessing the subjective added value of value nets: which network strategies are really win-win?

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ASSESSING THE SUBJECTIVE ADDED VALUE OF VALUE NETS: WHICH NETWORK STRATEGIES ARE REALLY WIN-WIN?

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As manufacturing companies increasingly focus on their core business, the interest in the utilisation of external services provided by system suppliers and service companies increases. Currently an increasing number of services are purchased from service supply networks. Furthermore, globalisation, complexity of technological innovations and demand for integrated solutions also create need for networking and collaboration. Establishing or improving the performance of the networked service providers, the value net, is a long-term effort, requiring the build up of trust between the partners. The necessary condition of moving from a subcontractor relationship to a strategic network or partnership is the sharing of the view of joint gains in a prospective value net. How do we then evaluate the added value of moving to a new partnership? What network strategies provide the win-win network solution? This paper is a tentative effort in answering these questions based on Decision Analysis.

Keywords: value net, strategic network, network orchestrator, win-win strategy, collaborative maintenance network

1 INTRODUCTION

A current trend is to outsource operations that do not belong to the core competence of a company. The main rationale for this development is the assumption that by subcontracting, the company can buy certain services cheaper and receive them better managed and implemented, thus providing more added value compared to keeping the same functions in-house. Furthermore, embedded technology in the assets, ever-increasing demand for production efficiency, and dynamic end customer requirements increase the need for a variety of services. The main assumption here is that there exists, or will rapidly emerge, a competitive market of services that is able to provide collaborative services cost-effectively. Of course, there is always a tendency in the area of manufacturing and servicing, that some services may be based on know-how that is restricted to only some service providers, resulting in the creation of an oligopolistic service market which is not cost-effective (market effect of scarcity power). The strive to get competitive edge on a special area will naturally lead to this type of oligopolistic service market, but on the other hand companies must avoid to seize all the customer value of their related service. This is characteristic in networked environments. where the market players aim at strategic partnering, forming a value net, which can be characterised as in Fig. 1, showing the 'strategic' differences between the network partners and the role of a network orchestrator.

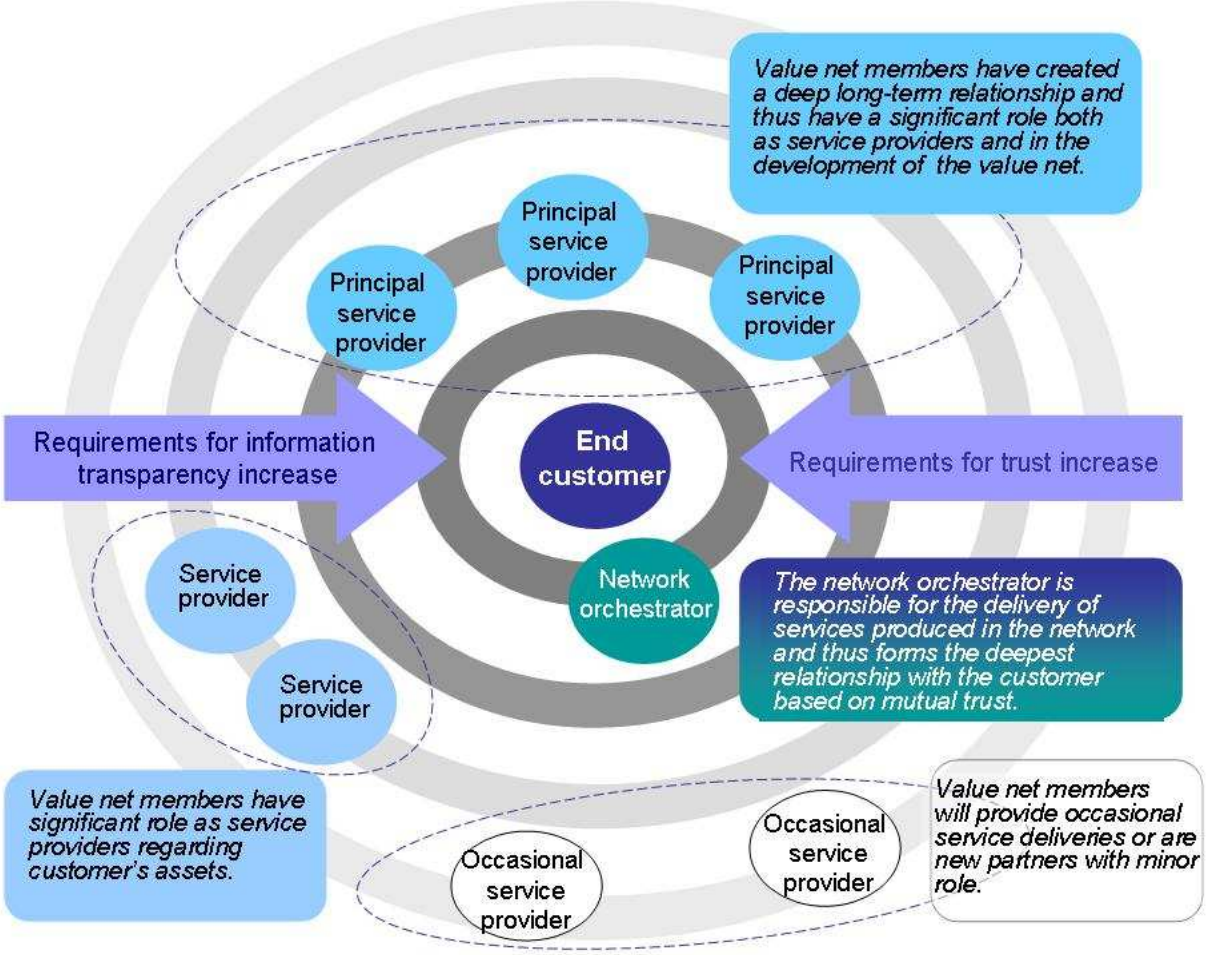


Figure 1. Illustration of the requirements for trust, information transparency and the roles of the value net partners.

As the figure shows service providers have different strategic roles in the value net: the principal service providers belonging to the core of the network whereas other service providers lie at the fringe of the value net with decreasing strategic significance. Such a governance structure is typically worked out by the *network orchestrator* or *network leader* who has the closest relationship with the customer. From customer's perspective, there has been a clear need to actually decrease the number of closest partners in order to ease the management. This favours the one stop shops that can integrate solutions and services and act as the main partner in the customer's direction.

The network leader establishes the values and culture of the network, developing its guiding principles (e.g. centralisation vs. decentralisation, incentive systems, accountability rules - all these issues entangled with their own tensions and trade-offs) while utilising the best practices from the network itself. In contrast to rigid control systems used to manage production units, the network orchestrator relies not just on rewards, but also upon a combination of empowerment and trust, as well as training and certification, to manage a network that it does not own. Finally, orchestrators have a different way of creating value: value in the traditional firm comes from specialisation, refining skills in specific areas, protecting trade secrets, and keeping out rivals and even partners, whereas value nets create value by integration, bridging borders, leveraging intellectual property across the network. In other words, the social rationale of a value net is simply: i) *doing* 'more' than the organisation knows, and ii) *knowing* 'more' than the organisation does. Of course, this has implications in managerial areas such as contracting / strategic partnering, relationship management (culture, trust), knowledge management (social networks, IT systems), and change management (strategy, leadership, 'integrator') – all looking at organisational boundaries from their own perspectives: legal, physical, work/activity and knowledge.

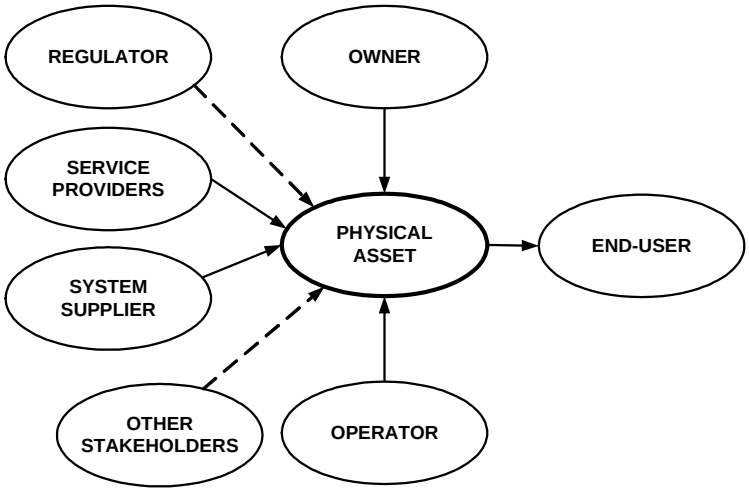
The managerial challenges of strategic networks or partnership are best illustrated by the results from a survey made in Finland between 2007-08 on challenges that Finnish industrial service providers meet in offering a client extended services in managing the technical and economic life time of fleet assets [1]. In the survey covering 5 industrial partners (4 vendors, 1 client) and 11 interviewees, success factors for a service network where identified. The following key elements are crucial for building trust between the network partners:

- Pricing in relation to the added value created - How transparent should the price and added value determinants of the services be?
- Service offering (coupling between service bundling and pricing) - What kind of bundling of product/services will satisfy the client's need of getting everything from 'one hatch'?
- Information management (open access to reliability performance of equipment and maintenance performance and plans) - To what extent should the information systems be open, or even shared, based on a common platform?
- Mixed cultures (balance between service oriented and product manufacturing cultures) – How to reconcile effectiveness of production to flexibility of services?
- Intermediate operator / system integrator (ability to connect product and services from separate vendors) - 'Is an intermediate operator or system integrator' needed – in the beginning of the new service development process only, or over the life time of the physical assets serviced?
- Knowledge management (scope of access to each others data, IPR, business models, etc.) - What kind of knowledge-related asymmetries [2] do we need to worry about?

Good management of the key elements above can be viewed as a necessary condition of moving towards a true value net in the particular industrial area considered in the survey. It is obvious that this transition takes a lot of time and commitment of the managers of the companies in question.

The remainder of the paper is organised as follows: In section 1 the different roles in a value net are defined and some demarcations are made for presenting a framework supporting value judgments on alternative service networks, presented in section 2. Section 3 presents a value measurement framework based on value-tree analysis that is a key feature in the generic assessment process presented in section 4. The paper is concluded by a discussion of directions for future research in section 5.

2 ROLES IN A VALUE NET



In principle, the network leader has several governance choices for a value net servicing a physical asset. The choices are reflected in the management of the different roles, accountabilities and functions conducted in collaboration. The roles and functions should be defined with particular attention to customer needs which typically derive from the asset owner's needs together with end-users needs. This is to ensure that the established network processes are truly value adding for the customer. In practice, network and partnership choices have to be made based on current relationships and roles adopted. Basic roles tied together by the physical asset are illustrated in Fig. 2.

Figure 2. The basic question of the network orchestrator is: Which network strategies provide the highest joint gains in the value net, and at the same time meet possible constraints (e.g. regulatory)?

To narrow down the decision context of developing *network strategies* we will make following demarcations:

- the owner of the physical asset is also the user and customer in the value net
- one of the suppliers or service providers is also the network orchestrator (see Fig. 1)
- the 'value' of running and maintaining the assets is also assessed by 'other stakeholders' (e.g. environmentalists) and the regulator, but these are usually not considered as the principal partners in the value net
- the added value provided by the value net is basically determined by end-user, but the ultimate rationale of the value net is to provide 'value' for all partners i.e. a win-win or a joint gains outcome
- the service agents are not all 'equal' but have different strategic positions in the value net (Fig. 1), and accordingly different network strategies

Formulation of the strategic objectives of the value net aims at the maximisation of customer received value and thus the analysis of customer objectives lays the foundation for the derivation of the network objectives, together with the strategic objectives set by the individual service providers. In other words, the network strategy should be based on customer's strategic objectives. For instance in a situation where customer's objectives are highly influenced by the dynamics in business environment, network strategy must include aspects of these dynamics as well. Or, if the customer wants the (physical) assets to have a certain performance (availability, reliability, maintainability, etc), the value net has to manage its processes in a way that the corresponding performance levels are met.

Direct business related value of networking for the partners can be e.g. increasing business opportunities and profit, coping with the challenges resulted from a dynamic market, benefiting from network level reputation and reaching economy of scale in the business. In the following, we discuss the value measurement further.

3 VALUE MEASUREMENT

From the point of view of the individual partner, his/her perceived 'value' can be assessed using the standard Balance Scorecard approach [3-5]. The BSC perspectives are fourfold and for each of them, strategic objectives, goals and indicators can be defined according to the managerial plans. For instance, plant and maintenance objectives, and related Key Performance Indicators, are discussed in Rosqvist et al. [6].

The Learning & Growth Perspective

This perspective includes employee training and corporate cultural attitudes related to both individual and corporate self-improvement. In a value net, learning from each other and sharing knowledge can offer a competitive edge for the partners. The emphasis is therefore in increased understanding of openness, transparency requirements and construction of mutual trust, and promotion of systematised feedback and interaction mechanisms. Indicators can be developed to support managing these issues. Such indicators are usually interpreted as leading indicators, i.e. indicators that signal future outcome of customer satisfaction and financial performance.

The Business Process or Internal Perspective

This perspective refers to internal business processes. The managerial areas are the operations management, customer management, innovation management and the regulatory&social issues management. Proper indicators allow the managers to know how well their business is running, and whether its products and services conform to customer requirements. Again such indicators are usually interpreted as leading indicators. The above managerial areas may to large extent be jointly managed by partnering. It is thus important for a value net to identify key managerial areas where joint gains can be achieved by reallocating managerial tasks and responsibilities within the network. In particular, information sharing principles need to be addressed: what is openly accessible to all partners, what is restricted to certain partners, what information is entered by whom, what ICT is used and who maintains it, what happens with IPR, etc.

The Customer Perspective

Recent management philosophy has shown an increasing realisation of the importance of customer focus and customer satisfaction in any business: if customers are not satisfied, they will eventually find other suppliers that will meet their needs. The mutual trust between the customer and the network is crucial. As customer value is something perceived by customers rather than objectively determined by the supplier, the significance of understanding and management of customer knowledge has to be emphasised. The main responsibility of the network orchestrator is to read the customer's 'signals' and 'transmit' them properly up to the furthermost partner in the network (see Fig.1). The signals can relate to many attributes such as price, quality, service availability and selection, but also trust and branding and overall functionality of the network. In essence, the value propositions given by the value net need to be achieved, maintained and monitored.

The Financial Perspective

The financial perspective relates to immediate economic determinants and economic results. Currently, financial metrics have been criticised for their emphasis on short-term performance by moving into quarterly financial reporting. For each partner in a value net, the financial performance determines the success of the network in the eyes of the partners. How this affects the decision to continue as a partner or move somewhere else depends on the position and the role of the partner in the value net: the furthermost partners are expected to base their partnering decisions more on short term than long term financial performance. It is also expected that the financial performance is one key driver of changing the network structure: if revenues and risks are perceived to be distributed in an unfair way by some partners, then the cohesion of the network is clearly threatened.

Kaplan and Norton, augmented their performance measurement BSC system with a strategy planning tool – the *strategy map* – which depicts the cause-effect relationships between the four standard perspectives or objectives in the BSC system [7]. A key insight is that factors in the 'Learning&Growth', 'Business Process' and the 'Customer Perspectives' can be interpreted as leading indicators for the financial performance and competitiveness with their respective lagging indicators [8,9]. It has to be remembered that the developments by Kaplan and Norton are connected to the strategy development of a single corporation.

The strategy development of a value net, can, basically, utilise the strategy map idea. Any *prospective network strategy* can be formulated in terms of managerial objectives that the partners share and jointly try to achieve. The network partners may *value* a network strategy by assessing its impact on determinants of customer value, and even further on financial determinants. In principle, the added value related to a prospective network strategy may be subjectively assessed, by each partner, by comparing it to the existing network strategy. This is illustrated in Fig. 3 which is an adaptation of the strategy map by Kaplan-Norton [7]. The strategy map illustrates the structure of a shared network strategy in order for the value assessment to verify that a prospective network strategy is a win-win strategy.

It is important to note that a network strategy that yields added value to the customer may for the other network partners produce negative added value due to complexities introduced in contracting and knowledge management, inducing extra transaction costs.

In principle, the value assessment framework includes all the strategic elements relevant in the survey referred to in the Introduction, providing a direction for further application-specific refinement with respect to the concerned managerial areas. Some of these aspects are discussed next.

The role of a network orchestrator in a service supply network has been emphasised in our survey as, for instance, capabilities for structured strategic planning are often lacking particularly in smaller service companies. In the case, where an network orchestrator will take full responsibility network strategy development, smaller companies may compensate this lack by adopting dynamic working methods of good quality in the implementation of the strategy, making them an important partner in the service provision.

Also with respect to information management, our survey has identified strategically important differences between typical players in a service supply network, especially with respect to transparency requirements as indicated in Fig.1. Regardless of these differences, the internal managerial perspective to information management requires integrated solutions to align the combination of strategies.

Based on the survey, the surrounding business environment and the related dynamics create the most fundamental needs for partnership development with effects on pricing, service offering, as well as, leadership (culture) and knowledge management.

From the customer point-of-view, one of the most important, but at the same time most difficult aspects to control during the contract period, seems to be the network's capability to continuously develop the services found strategically important. Openness and transparency are found important when finding common ground for assessing and capturing opportunities for the added value of improved services and/or business processes in the network.

In the next section, a value assessment process is describe that operationalises the strategy map – based added value model in Fig. 3.

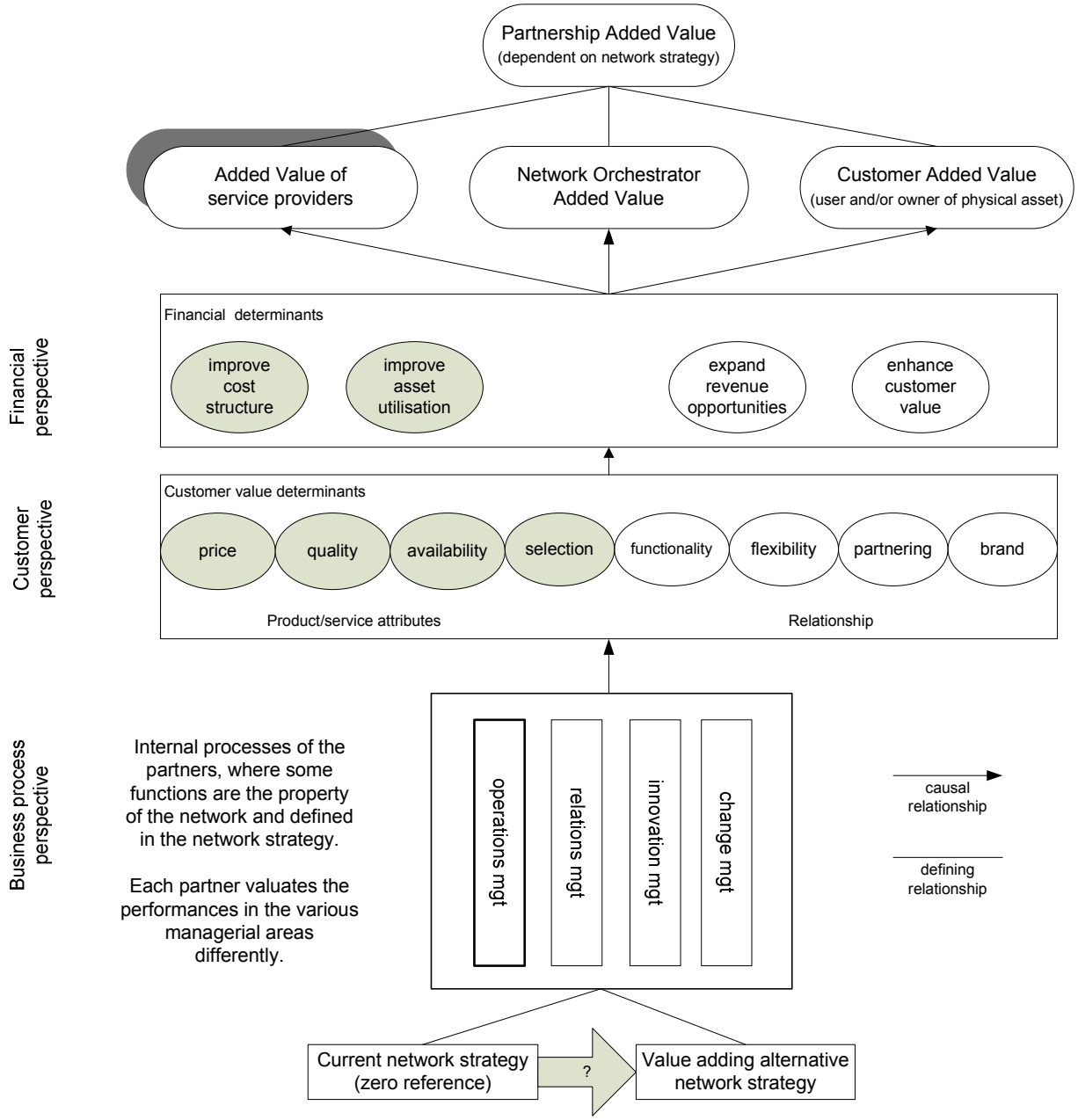


Figure 3. A strategy map linking the internal managerial perspective (objectives) with the customer and financial perspectives (objectives) for the assessment of added value of a prospective network, formulated in terms of shared managerial objectives and goals that are expected to lead to added value for the customer and the partners, i.e. a win-win situation. The added value assessment is subjective and comparative in nature. (The reader is referred to the work of Kaplan and Norton on strategy maps).

4 THE ASSESSMENT PROCESS OUTLINE

To be able to use the added value model in the previous section, following key issues need to be addressed, mainly by the network orchestrator:

- what managerial elements are incorporated in the current network strategy, and what changes could provide added value?
- how are the impacts of the prospective network strategy assessed?
- how are uncertainties (risks) incorporated in the assessment?

Figure 4 shows two distinct activities that are needed: the Network Strategy Formulation and the Added Value Assessment.

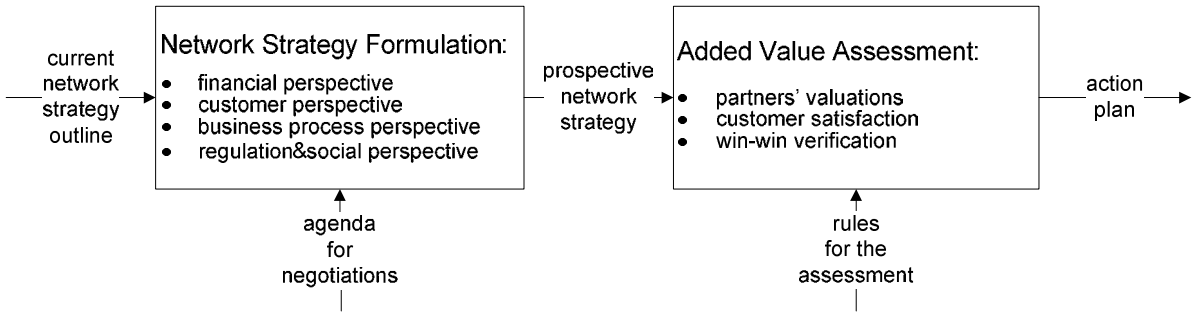


Figure 4. Activities to support network strategy development: the outcome is an action plan that outlines how the current partnership should be changed to create an improved win-win network strategy.

Network Strategy Formulation is expected to be a sensitive process led by the network orchestrator with numerous mutual discussions with the existing and potential partners on wanted or possible changes in roles, accountabilities, etc. with respect to the current network strategy. The sense of trust in the leadership and orchestration is crucial. Basically, the outcome of the activity could be in the format of Table 1 which shows how the current and the prospective network strategies are formulated. The structuring is based on the BSC perspectives. In addition, risk management issues can be included in the form of *real options* that can be executed conditional on the occurrence of random events. For instance, if there is a sudden price increase for a certain raw material or component, or a radical breakdown of one partner's production, there are options for the affected partner to switch the material/component to another, or an option for the network to be temporarily supplied by some other company outside the network, respectively. Such real options should be identified and agreed upon in the network strategy.

Table 1
Network strategy formulation – generic template

Management area	Current strategy	Prospective strategy
financial	What is in place to implement the current network strategy?	What should be in place to implement the prospective improved network strategy?
customer		
business process		
regulation&social		

The prospective new network strategy is then valuated in order to assess the added value for each partner, as well as for the customer. The valuation techniques follow the methods and techniques presented in Decision Analysis, e.g. [10,11]. The customer may, or may not be included in the assessment. This depends on the character of the customer-network relationship. At the same time will be verified that the new network strategy produces added value for each (principal) partner, i.e. the prospective network strategy is a win-win strategy. The outcome of this activity is an *action plan* that indicates the next concrete measures to be performed in order to implement the new network strategy.

In general, it is expected that the alternative network strategy entails only a small change in terms of strategy, but anyhow, reflects a major change in attitude and trust among the partners. Any formal change in strategy is always connected with changed expectations on the outcome and the way partners will act. If expectations are met, trust will build up, and the willingness to develop deeper partnerships will increase. Such a partnering process is incremental: evolving step-by-step.

The formulation and valuation activities may be supported by a Group Decision Support System (GDSS), allowing effective ways of generating ideas, commenting, voting and arriving at an action plan. The use of GDSS is focusing on supporting the whole multi-phased process of group decision making with certain technologies, and it can be seen to fall under the larger umbrella of the concept of GSS (Group Support Systems), which may include any technologies used to make groups more productive [12,13].

Earlier studies have revealed several benefits of GDSS that are worth noticing in coping with the problem area of this paper. These are, for example, process structuring, goal oriented process, parallelism (many people able to communicate at the same time), allowance of larger group sizes, automatic documentation, anonymity of group members, access to external information, and automated data analysis [13-16].

The problem area in this paper is a complex one, it needs structuring, it influences on several people, and several people are needed to make decisions with regards to it. Therefore, it can be assumed that the use of GDSS would provide significant benefits. A large amount of results could be done during, e.g. two strictly phased GDSS workshop sessions, of which the first one would formulate the prospective network strategy, and the second one would have the principles of value assessment, metrics, and action plans as outputs. However, earlier studies have also stressed the significance of a detailed pre-planning: In pre-planning meetings, the purpose and goals for each GDSS sessions need to be carefully defined in order to make the process itself as efficient and effective as possible, and in order to improve the likelihood of making the concrete results of the sessions the best possible.

5 CONCLUSIONS

In the proposed framework for assessing the added value of a network strategy value is a measure of the subjective preferences of the network partners. Thus, a win-win strategy cannot be proved other than by monitoring the customer-network relationship and the relationships between the partners. The partners have different roles, skills, expectations, etc. that need to be aligned in a network strategy for adding value to the customer and to each other. The Balance Scorecard perspectives and strategy maps provide a good basis for developing a value theoretic assessment framework that supports the network orchestrator in the formulation and the valuation of a prospective network strategy. In the framework, the valuation is comparative with the current network strategy as the reference point. The framework is developed as one answer to the needs to improve partnering for maintenance and production services for a customer in the fertiliser business in Finland. The presented approach needs many test cases for refinement and validation and should be viewed as a reference for further research rather than a readily implementable method to develop value nets.

6 REFERENCES

1 Ojanen V, Lanne M, Reunanen M, Kortelainen H & Kässi T. (2008) New service development: success factors from the viewpoint of fleet asset management of industrial service providers. Fifteenth International Working Seminar on Production Economics, Pre-Prints Volume 1, 369-380.

2 Cimon Y. (2004) Knowledge-related asymmetries in strategic alliances. *Journal of Knowledge Management*, 8(3), 17-30.

3 Kaplan RS & Norton DP. (1992) The balanced scorecard - Measures that drive performance. Harvard Business Review, Jan-Feb, 71-79.

4 Kaplan RS & Norton DP. (2001a) Transforming the Balanced Scorecard from Performance measurement to Strategic Management: Part I. Accounting Horizons, 15, 87-104.

5 Kaplan RS & Norton DP. (2001b) Transforming the Balanced Scorecard from Performance measurement to Strategic Management: Part 2. Accounting Horizons, 15, 147-160.

6 Rosqvist T, Laakso K & Reunanen M. (2009) Value-driven maintenance planning for a production plant. Reliability Engineering and System Safety, 94, 97-110.

7 Kaplan RS & Norton DP. (2004) Strategy maps: Converting intangible assets into tangible outcomes. Boston: Harvard Business School Press.

8 Neely A, Bourne M & Kennerley M. (2000) Performance measurement system design: developing and testing a process-based approach. International Journal of Operations & Production Management; 20 (10): 1119-1145.

9 Fitzgerald L, Johnston R, Brignall S, Silvestro R & Voss C. (1991). Performance measurement in service business, Chartered Institute of Management Accountants (CIMA), London.

10 Keeney L & Raiffa H. (1993) Decisions with Multiple Objectives: Preferences and Value Trade-offs. Cambridge University Press.

11 Keeney R. (1992) Value-focused thinking – a path to creative decision making. Harvard University Press.

12 Nunamaker J, Briggs R & Mittleman D. (1996) Lessons from a decade of Group Support Systems Research. Proceedings of the 29th Annual Hawaii International Conference on Systems Sciences, Jan 3-6, Maui, Hawaii.

13 Elfvengren K. (2006) Group Support System for Managing the Front End of Innovation: case applications in business-to-business enterprises. Lappeenranta University of Technology, Acta Universitatis Lappeenrantaensis 239, doctoral dissertation Lappeenranta, Finland.

14 Jessup L & Valacich J. (1993) Group Support Systems: New Perspectives. Macmillan Publishing Company.

15 Weatherall A & Nunamaker J. (1995). Introduction to electronic meetings. Technicalgraphics.

16 Turban E, Aronson J. & Liang TP. (2004) Decision support systems and intelligent systems, 7th ed. Prentice-Hall.

PUBLICATION V

Towards an integrated perspective on fleet asset management: engineering and governance considerations

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TOWARDS AN INTEGRATED PERSPECTIVE ON FLEET ASSET MANAGEMENT: ENGINEERING AND GOVERNANCE CONSIDERATIONS

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The traditional engineering perspective on asset management concentrates on the operational performance the assets. This perspective aims at managing assets through their life-cycle, from technical specification, to acquisition, operation including maintenance, and disposal. However, the engineering perspective often takes for granted organizational-level factors. For example, a focus on performance at the asset level may lead to ignore performance measures at the business unit level.

The governance perspective on asset management usually concentrates on organizational factors, and measures performance in financial terms. In doing so, the governance perspective tends to ignore the engineering considerations required for optimal asset performance.

These two perspectives often take each other for granted. However experience demonstrates that an exclusive focus on one or the other may lead to sub-optimal performance. For example, the two perspectives have different time frames: engineering considers the long term asset life-cycle whereas the organizational time frame is based on a yearly financial calendar.

Asset fleets provide a relevant and important context to investigate the interaction between engineering and governance views on asset management as fleets have distributed system characteristics. In this project we investigate how engineering and governance perspectives can be reconciled and integrated to enable optimal asset and organizational performance in the context of asset fleets.

Keywords: Engineering asset management, fleet management, governance, asset performance

1. INTRODUCTION

Asset-intensive organisations such as utilities, heavy engineering, mining, or transportation rely for their operations on assets that are expensive, extensive and/or complex, and have a major impact on organisational performance over extended periods (Jabiri, Jaafari, Platfoot and Gunaratram 2005; Lin, Gao, Koronios and Chanana 2007). The management of these organisations entails the reconciliation of potentially divergent objectives; generating satisfactory economic performance from the assets and complying with governance rules imposed by their environments (Mardiasmo, Tywoniak, Brown and Burgess 2008). Thus the management of the organisation's physical assets provides an exemplary context of how the two divergent objectives are reconciled.

Asset management is a process recognised in many fields, including engineering, information technology and information management systems, financial services and human resources. Many definitions of asset management exist (Mitchell and Carlson 2001; Wenzler 2005; Wittwer, Bittner and Switzer 2002; Woodhouse 2006a), however there is a broad consensus to recognise asset management as the process or cycle in which assets are "put through" in order to create a product or provide a service at optimum level. As Wittwer et.al (2002) define it, asset management is a set of decision-making tools that enable managers to create a framework for both long and short-term planning. The aim of asset management is to integrate the strategic planning of operations, maintenance and capital investment decision-making. The overarching goal is to increase the efficiency of assets, which comprises enhancing asset productivity, maximizing asset value through the life-cycle, and minimizing the total cost of ownership. This can be achieved by (Cornish and Morton 2001a):

- Understanding business costs and performance drivers
- Determining investments to optimize performance and operational costs
- Managing the delivery of network performance and investment programs
- Monitoring asset conditions
- Devising appropriate maintenance policies

.

The scope of asset management is broad as it encompasses "managing (operating, maintaining, repairing, replacing) physical assets including infrastructure and buildings" (Woodhouse, 2003). This wide scope has led to authors using a range of terms in relation to asset management, including "Enterprise Asset Management" (Kim, Ahronheim, Suzuka and King 2007), "Strategic Asset Management" (Davis 2007) or "Engineering Asset Management" (Andreou and Bontis 2007; Chen and Mohamed 2007). In this paper, we use the term "Engineering Asset Management" to designate the technical perspective on asset management.

VTT Technical Research of Finland refers to Mitchell (2002)and defines asset management as "a comprehensive, fully integrated strategy process and culture directed at gaining greatest lifetime effectiveness, value, profitability, and return from production and manufacturing equipment assets". In this definition, two objectives are emphasized:

(1) Maintaining and improving the profit-making capability of production assets, and

(2) Maintaining and optimising the net asset value (physical assets) in the long run

These fundamental objectives are not necessarily aligned at all times as there may be trade-off between short-term profitability and long-term asset values: high asset utilisation and productivity may entail obsolescence (Alchian and Demsetz 1972; Barney and Hesterly 2006; George, McFarlan and Marco 2006). Also, some asset values in particular for infrastructure assets may be impacted by market and industry factors beyond the control of management. Thus asset management entails a range of managerial trade-offs, and overall performance depends on maintaining an appropriate balance between these two objectives.

In recent years, asset-intensive organisations have been under an increased pressure to improve efficiency, in particular in the public sector (Guggenheim and Stahr 2006; Herder and Verwater-Lukszo 2006). A focus on governance and organisational factors has been a central tennet in the management of public assets. Governance is defined as the set of laws, policies, and procedures that ensure organisations run in the interest of owners and resources are allocated, managed, and redeployed to maximise productivity and value (Alles, Datar and Friedland 2005). Governance assists in determining appropriate management processes, organisational structures, and incentives systems to align managerial behaviour and attitudes with the interests of principals (Jensen and Meckling 1976), and the relevant reporting and disclosures that enable proper transparency and accountability (Dunis and Miao 2006). In this perspective, asset governance can be defined as a subset of organisational governance which specifies the policies and processes to acquire, utilise, maintain, and account for the assets of the organisation (Cornish and Morton 2001b). It follows that asset governance can be viewed as a management approach for assets that takes into account asset ownership and the management of distributed systems in a competitive and deregulated market (Bühner 2000; Considine and Lewis 2003; Gomez 2004; Narracott and Bristow 2001; Schmidt and Brauer 2006). Clear definition and differentiation of roles and responsibilities of the asset owner, asset governor, and service providers for operational and maintenance activities is central to asset governance (Cornish and Morton 2001b).

In this paper, we compare and contrast Engineering Asset Management and Asset Governance. Both perspectives approach the management of assets from valid and pertinent perspectives, but each highlights different aspect of asset management. We believe that these perspectives are not competing, but complementary and that valuable insights can be gained through analysing and integrating best practices from each approach.

The paper is organised as follows: section 2 provides an overview of Engineering Asset Management; section 3 describes the principles of Asset Governance; in section 4, both perspectives are compared, presenting basic metrics and methods for their assessment; section 5 concludes the paper with a discussion of how the perspectives can be integrated, outlining further research opportunities.

2. ENGINEERING ASSET MANAGEMENT

Engineering asset management can be considered from both a temporal and a spatial dimension. Typically, from this perspective, an engineered system is looked at through its whole lifetime e.g. daily maintenance, weekly shutdowns, monthly larger shutdowns, and annual overhauls. These activities are repeated over the (economic) life cycle of the system. It is not a surprise that cost calculations are performed to assess the Life Cycle Cost of alternative systems. Basically LCC covers the following cost types: research & development costs, production & constructions costs, operation & maintenance costs, and retirement & disposal costs (Fabrycky and Blanchard 1991).

An extension to Life Cycle Cost analysis is Life Cycle Profit analysis that also use forecasts on the price level of the products produced over the system's lifetime. In both type of life cycle analyses the result is given in the form of Net Present Value. In the case of a system that produces (public) services, we prefer to use the term *public value* (Moore 1995) instead of profit. Measures of public value could, for example, be the ratio of satisfied/dissatisfied service users, or the proportion of the target population using a public service. The measurement of value is in this case much more complex and entails the application of multiple criteria.

During its lifetime, a system is subjected to internal and external dynamics that change its profitability or perceived value. Figure 1 illustrates the forces that ultimately determine the end point of the useful lifetime of a system (Komonen, Kortelainen and Räikkönen 2006). Engineering asset management focuses on the systems' operational phase rather than the whole life cycle including the commissioning phase of the system (this is in contrast to life cycle cost / profit analysis).

It is important to note the system can be a production plant (e.g. a paper mill), a product (e.g. an elevator) or an infrastructure (e.g. a harbour or a railway station). Each of these systems are there to provide services for customers. Some of these systems can be viewed as members of a population of similar entities - in other words a *fleet*.

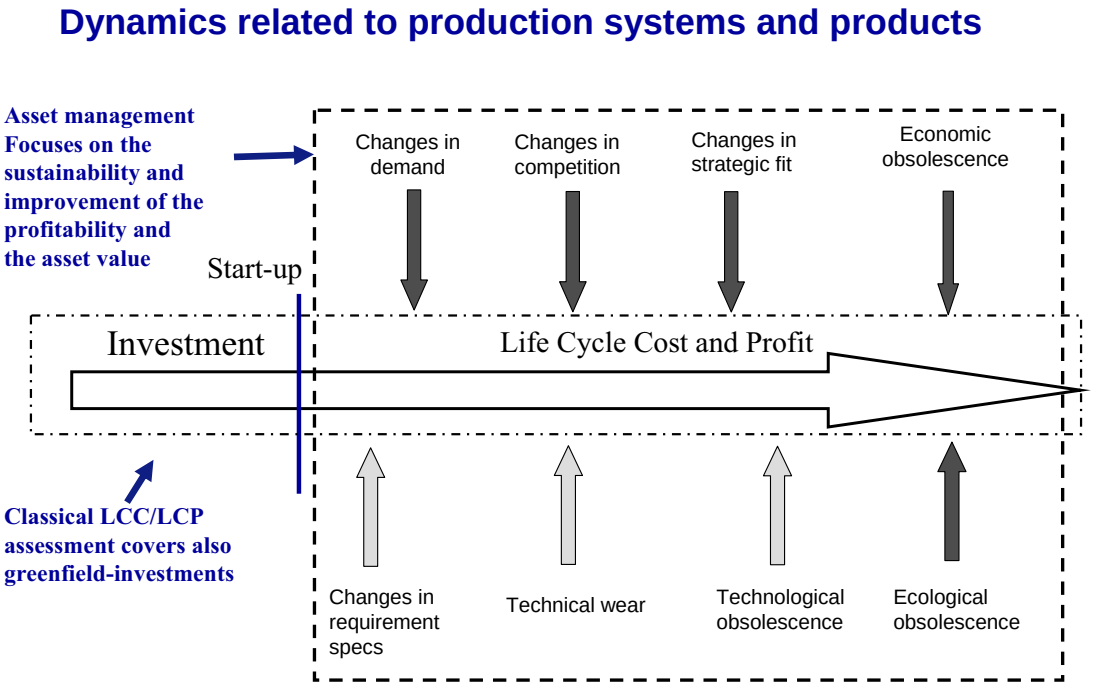

Figure 1. Internal end external dynamics that have to be taken into consideration in asset management

The typical technical perspective to engineering asset management focuses on those dynamics that are shown by the light arrows in Fig. 1. For example; technical wear, requirement specification and technological obsolescence. By performing maintenance and modifications on the system we can alleviate the effects of these dynamics that would otherwise 'kill' our system. The major part of the external dynamics are market and business related (the dark arrows in Fig. 1) and not usually controllable by the corporate or business unit managers. In practice, the external dynamics have a much more profound effect on the profitability and value of the physical assets than the technical dynamics (indicated by the light arrows in Fig.1).

If we look at the maintenance processes related to a complex physical asset, we get an idea how demanding operational management can be. Fig. 2 shows a diagram how maintenance can be optimized based on maintenance and operational data. It also shows how investment needs are identified based on this data augmented by business intelligence (ref. to the dark arrows in Fig. 1).

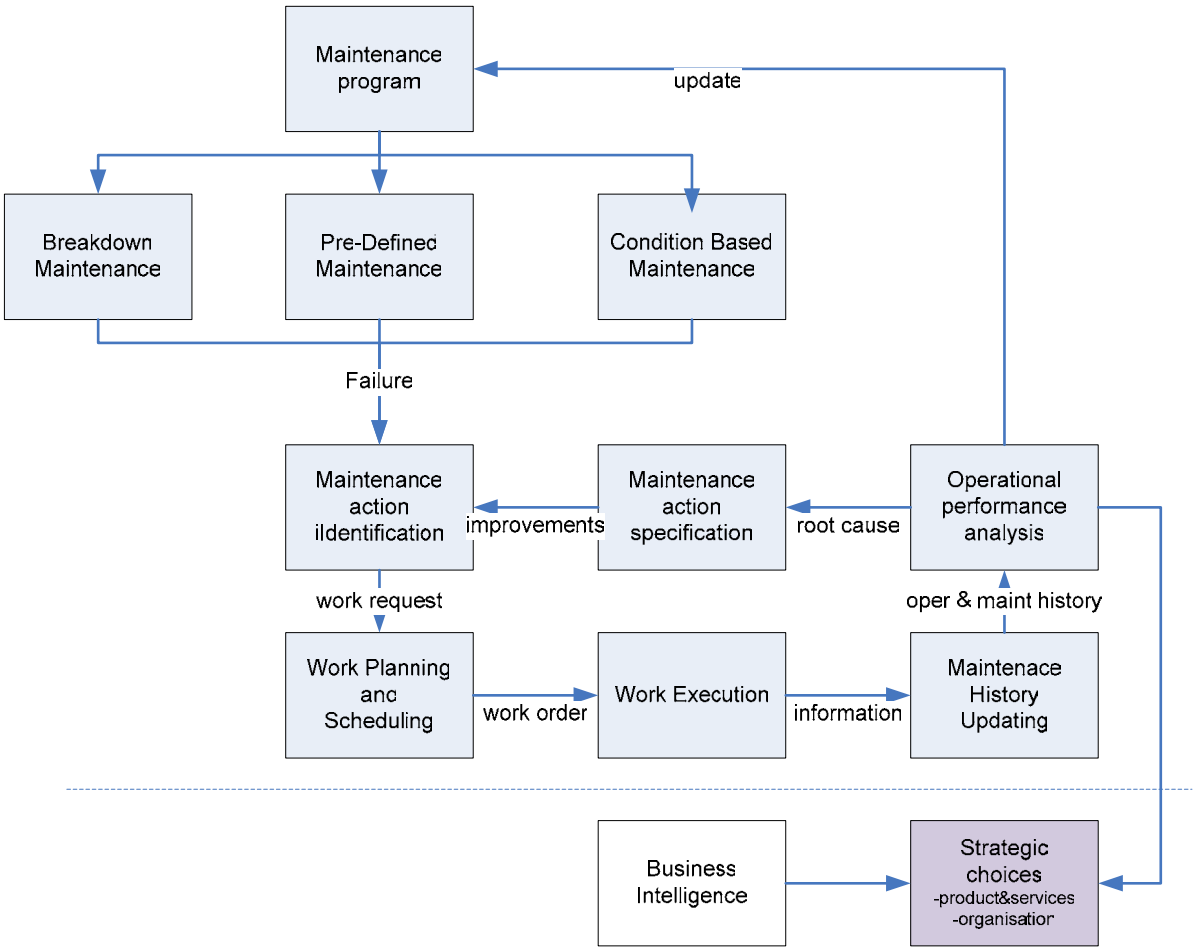

Figure 2. Learning loop related to maintenance to sustain and improve operational performance and asset value

The dashed line in Fig.2 demarcates operative optimization based on learning from experience from the strategic concerns. Details related to Fig. 2 can be found in Rosqvist et al. (2008, in press). It is important to note that based on operational performance and business intelligence asset strategy is updated and strategic choices are made related to, e.g. product mixes and production technology, business processes (e.g. outsourcing/insourcing maintenance work).

The feedback loop is activated by failure reports, work requests, work orders and technical information that have to be processed in order to update the maintenance program properly. In addition, asset fleets with similar entities are usually distributed along the life cycle of the system, demanding managerial attention for different prevailing dynamics relevant for the different groups (see Fig. 1).

Engineering Asset Management has an abundance of *metrics* that have been defined to support managerial decision-making. Every organization has its own collection of metrics that are of strategic significance for the company – the Key Performance Indicators (KPI). KPIs differ between different types of assets. Companies, whether profit-making or non-profit, use and manage different technologies, possess different skills, and provide different services as a function of their role in the service

network. Thus the KPIs for a company are always dependent on the context of its business and are based on the strategic analysis of the business environment and the success factors identified.

The Total Productive Maintenance (TPM) framework, a framework for continuous improvement is of particular relevance to Engineering Asset Management. TPM is a structured way to increase plant productivity by a better performance of the equipment lines, step by step, with the aim of creating an optimum co-operation between the production departments and maintenance. It encourages changes in the way things are done at the shop-floor level[1].

The principal metric of TPM is known as the Overall Equipment Effectiveness (OEE). This figure ties the 'six big losses':

1. Equipment failure
2. Setup & Adjustment
3. Small Stopps
4. Reduced speed
5. Startup rejects
6. Production rejects

to three measurables; Availability (Time), Performance (Speed) & Quality (Yield). When the losses from Time * Speed * Quality are multiplied together, the resulting OEE figure shows the *relative* performance of any equipment or product line compared to the ideal (theoretical) performance. Table 1 gives examples of typical losses in manufacturing systems. When we know what the Six Big Losses are and the primary events that contribute to these losses, we can focus on ways to monitor and correct them.

Table 1

The Six Big Losses, and how they relate to the OEE loss categories.

Six Big Loss Category		OEE Loss Category	Event Examples
6.1.1.1.1	Equipment failure	Down Time Loss	• Tooling Failures • Unplanned Maintenance • General Breakdowns • Equipment Failure
6.1.1.1.2	Setup and Adjustments	Down Time Loss	• Setup/Changeover • Material Shortages • Operator Shortages • Major Adjustments • Warm-Up Time
6.1.1.1.3	Small Stops	Speed Loss	• Obstructed Product Flow • Component Jams • Misfeeds

[1] The TPM program closely resembles the popular Total Quality Management (TQM) program. Many of the tools such as employee empowerment, benchmarking, etc. used in TQM are used to implement and optimize TPM. Differences are in the objectives, means and targets: TQM promotes quality whereas TPM reliability of equipment. TQM engages management and is more 'software-oriented', TPM engages operational personnel and is more 'hardware-oriented'. TQM looks at CriticalToQuality – metrics, TPM looks at waste and efficiency metrics.

			• Sensor Blocked • Delivery Blocked • Cleaning/Checking
6.1.1.1.4	Reduced Speed	Speed Loss	• Rough Running • Under Nameplate Capacity • Under Design Capacity • Equipment Wear • Operator Inefficiency
6.1.1.1.5	Startup Rejects	Yield Loss	• Scrap • Rework • In-Process Damage • In-Process Expiration • Incorrect Assembly
6.1.1.1.6	Production Rejects	Yield Loss	• Scrap • Rework • In-Process Damage • In-Process Expiration • Incorrect Assembly

Figure 3 shows how the 'TPM-metrics' can be approached by looking at how productive and non-productive activities are distributed along the time axis (SEMI 2000). Given the time definitions in Fig. 3 metrics for computing the OEE are defined as shown in Fig. 4.

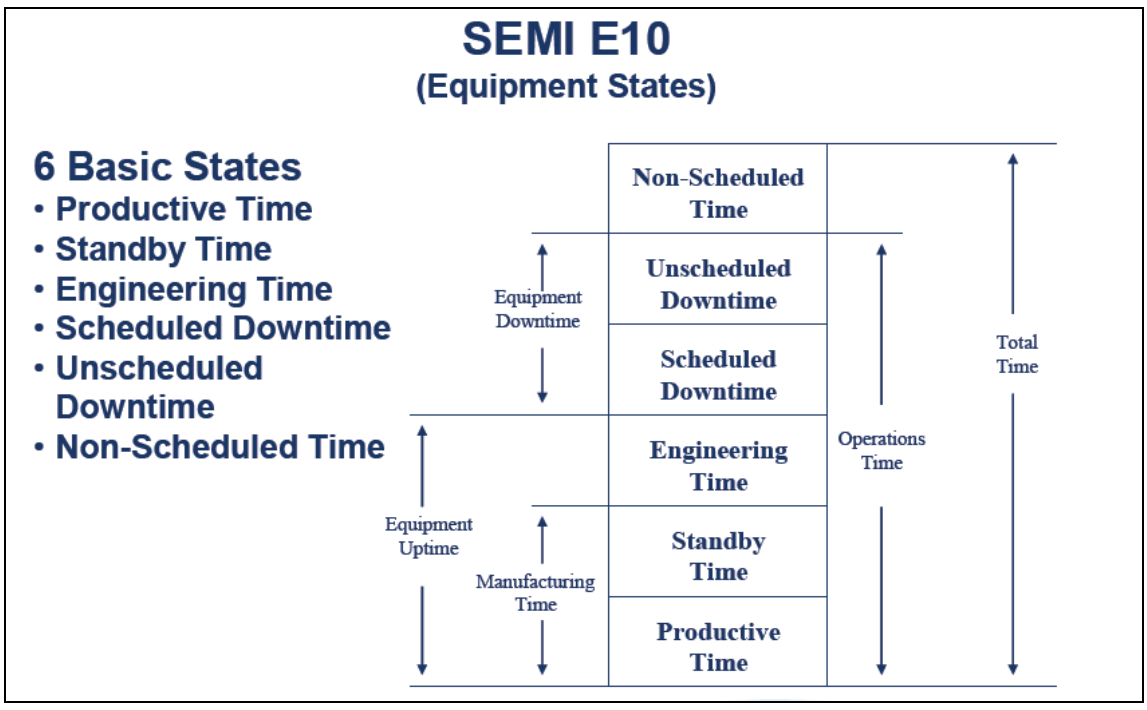

Figure 3. SEMI 10 time definitions and the six basic states of a production system.

Figure 4. SEMI E79 formulas for computing the Overall Equipment Effectiveness (OEE).

The OEE factors in Fig. 4 link to the time definitions of E10 according to the scheme in Fig. 5.

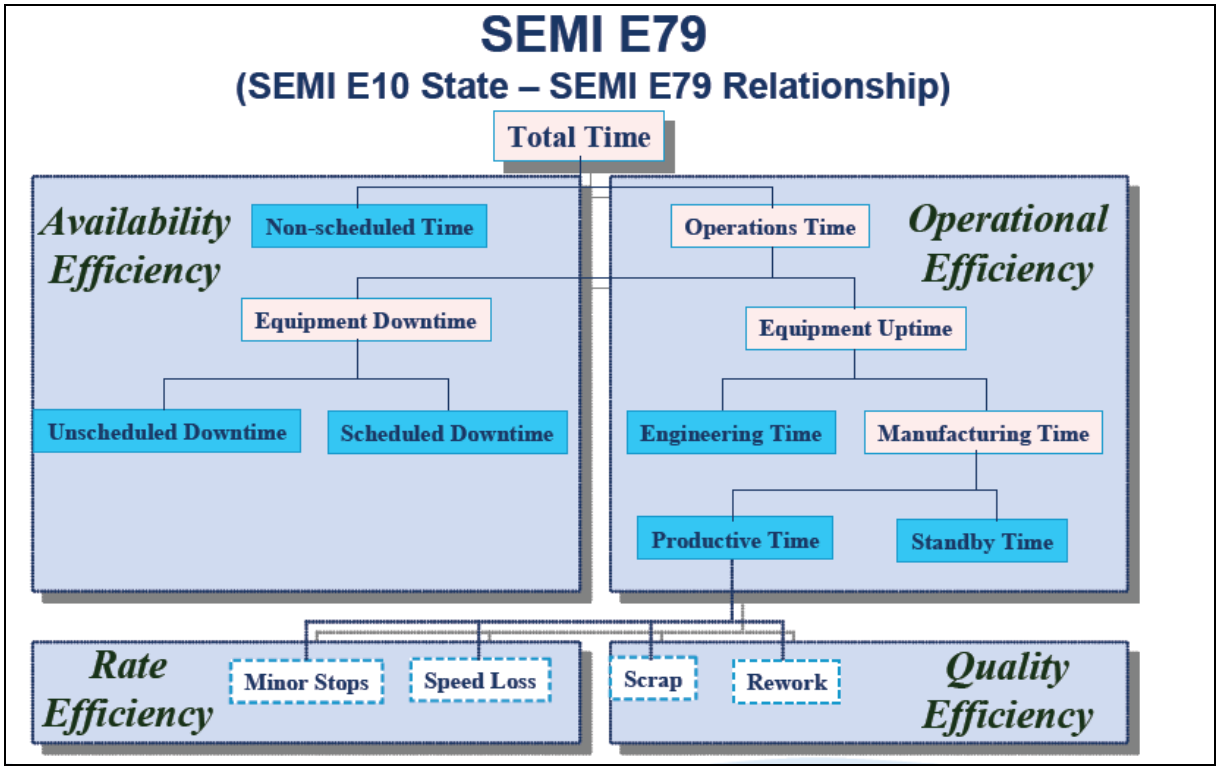

Figure 5. Time variables and their linkage to OEE parameters.

At the shop floor level we can identify several means to improve OEE:

- Advanced process control methods
- Condition – based maintenance
- Preventive maintenance scheduling
- Structural health audits

OEE is *the* measure for the reliability and production design engineers. A comparable metric for a production economist would be for example the Return on Investment (ROI). The metrics of the engineer, and those of the economist, only look at the system performance from a single perspective. This disjunction obviously calls for an integrative approach. However, before we can discuss how the engineering and financial perspectives can be aligned a number of issues need to be reviewed.

First among these is the issue of organization. The engineering view usually takes for granted that there is an organization that provides the infrastructure for skilled people to deliver services (Bhagwat and Sharma 2007). Whilst such an assumption is valid in the case of fully integrated organizations, it does not hold for many XXIst century organizations which have outsourced a range of activities to networks of providers (Sturgeon 2002). This dis-integration of organizations has several management implications: the focus of management is broadened from organizational boundaries to network boundaries, and the role of the asset owner emphasizes contracting, supervision and asset strategy, i.e. strategic management instead of operational management. This evolution highlights the need to better understand the dynamics of service providing networks, or *value nets* (Kleijnen and Smits 2003). The evolution towards dis-integrated organization and network management implies that we can no longer take governance for granted. In the next section we discuss the implications of governance for asset management.

3. ASSET GOVERNANCE

Asset management can be applied in many fields and have a vast interpretation. Each asset management concept and application (within different fields) shares the common theme of strategic importance, systematic processes, optimising efficiency, maximising performance and output, and minimising risks. However, as pointed out by Woodhouse (2006), asset management research and implementation has so far concentrated on the execution of activities that are considered to be asset management, without much thought or insight on the policy and governance structures that define, regulate, and control the execution of such activities. Therefore governance issues which detail the underlying structure of how assets should be managed from a business or management point of view have so far received limited attention.

As mentioned in section 2 asset management research originated from the maintenance of physical assets. However research in this area is limited to certain industries, such as water (Kitchen 2006; Matichich, Allen and Allen 2006; Mergelas 2005) and electricity providers (Cornish and Morton 2001b). Therefore the findings of these research projects were tailored to particular industries, leading to limited generalisability. Industry practitioners have advocated for asset management standards applicable to any organisation where physical assets are a critical factor in achieving effective service delivery. This has lead to the publication of the Publicly Available Specification for Asset Management (PAS 55) by the British Standards Institution (Farrell and Davies 2005; TWPL 2007; Woodhouse 2004). PAS 55 is relevant to managers of asset fleets and contains relevant metrics. In North America, a similar initiative is the publication of the Roadmap for Fleet Managers published by the National Association of Fleet Administration (Golubski 2002). Other national standards have also been published, but so far no universally accepted standard reflecting world best practice has been agreed upon.

This absence of universal standards is arguably due in part to insufficient knowledge about asset governance. As argued in section 2, the evolution of organisational forms requires to reconsider some assumptions that we used to take for granted. The vertical dis-integration of organisations (Hagel and Singer 1999) is leading managers and academics to rethink how the management and governance of assets is conceptualised. The recent emergence of research focusing on asset governance (Cornish and Morton 2001b) provides some initial ideas to begin this process.

Asset governance can be defined as a contemporary way to view the ownership and management of distributed systems in a competitive and deregulated market (Cornish and Morton, 2001). By advocating an asset management practice that is more transparent and accountable, asset governance outlines ways in which assets can effectively be managed in distributed networks in a context where the development, stewardship and operation of assets may be open to competition (Kitchen 2006). Therefore asset governance principles are hihgly relevant to the management of asset fleets. Clear definition and differentiation of roles and responsibilities of the asset owner, asset governor, and the service providers for operational and maintenance activities is central to asset governance (Cornish and Morton 2001b). Asset governance thus provides a framework to manage the separation of powers in asset management that characterises the management of networks (Moore 1993), enabling effective asset management distributed assets.

The application of asset governance principles is outlined theoretically in the UK's Publicly Available Specification for Asset Management (PAS 55) developed by the British Standards Institution (TWPL 2007; Woodhouse 2004; Woodhouse

2006b), and implemented by organisations in the electricity industry (Cornish and Morton 2001b; Farrell and Davies 2005; Kitchen 2006) and gas distribution industry (Woodhouse 2006b). It is recognised that similar opportunities exists in other capital intensive industries, such as infrastructure, railroads and airports (Cornish and Morton 2001b).

The PAS 55 emerged in 2002 to clarify and define a standardised meaning for physical asset management systems. At the time, many managers felt the need to construct a unified view of physical asset management and what it entails. The PAS 55 defines physical asset management as a system that requires a life-cycle view and optimal mix of capital investments, operations, maintenance, resourcing, risks, performance, and sustainability. PAS 55 has been recommended to industry regulators as a framework to audit governance (Woodhouse 2006b). Key asset governance principles embodied within PAS 55 include regulatory compliance, supply business satisfaction, risk-based, data supported, continuous improvement, pragmatic, and income maximisation and generation (Cornish and Morton 2001b; Woodhouse 2004).

Asset governance is still an emergent concept, and its introduction and application within organisations is at an early stage (Cornish and Morton 2001b; Woodhouse 2006b) (Guggenheim and Stahr 2006). Therefore there is a need to explore asset governance in greater depth; investigating possible integrations between asset management aspects and governance structures, applicability within an organisation and across different industries of asset intensive organisations, contingency factors that needs to be considered in formulating policies, and implementation plans that are consistent with other related business system standards and will facilitate its alignment or integration (TWPL 2007).

4. COMPARISON BETWEEN ENGINEERING ASSET MANAGEMENT AND ASSET GOVERNANCE

Comparison of engineering asset management and asset governance literatures show certain areas of convergence. One of the main overlap between the two concepts is that both advocate for a system that will maximise the performance or utilisation of an asset while minimising risk factors. Both concepts also stress the importance in strategic planning and integrating asset-related decisions with organisational/business goals, whilst ensuring equal or higher return on investment at the same time. Minimising cost, or total asset life cycle cost, through careful acquisition, maintenance, and disposal policies is also an area in which asset management and asset governance overlaps.

However there is a fundamental difference between the two concepts. Engineering asset management refers to the operations directing of how asset are managed – how they are acquired, maintained, and disposed in order to maximise operational performance. Asset governance on the other hand concentrates on the reasoning for a particular policy, transparency and accountability in writing and implementing of the policy, and intervention strategies to ensure effective implementation of the policy. Therefore the main link between asset management and asset governance is that asset governance provides the policy structure which determines the space for asset management implementation. Comparing the literature on both asset management and asset governance reveals eight dimensions where the two approaches differ (Table 2). These eight dimensions show the difference between the two approaches and suggest that conflating Engineering Asset Management and Asset Governance would be miguided and lead to failures in decision- and policy-making.

Table 2

A comparison between Engineering Asset Management and Asset Governance Source (Mardiasmo et al. 2008)

	Engineering Asset Management	Asset Governance
Focus	Engineering/Mechanical/ Operational	Policy structuring, decision making process, align operations and business goals
Compliance	Technical specifications, health & safety standards	Industry regulations/rules, international standards, benchmarks
Separation of Power	Asset Manager – day to day operational matters	Asset Governor – long term strategic corporate goals
Time Frame	Long term – whole life cycle	Short term – annual reporting
Application	Operational or divisional level	Corporate core level
Competitive process/edge	Cutting edge specifications. Proactive maintenance and operational risk management	Business level strategies: procurement processes & proactive risk management

Implementation	Technical and business capabilities	Organisational change, local management personalities, organisational structure
Planning Focus	Operational and maintenance planning	Corporate goals, decision making process

As evidenced in Table 2 there are differences in focus between engineering asset management and asset governance. Engineering asset management principles tend to focus on the engineering and operational aspects of an asset's life cycle. In terms of physical assets this focus suggests an asset management regime that is highly concentrated on writing technical specifications, acquiring the asset based on technical specifications, technical maintenance to ensure maximum performance of the asset, and a disposal system that will ensure equal or high return of investment. Asset governance on the other hand concentrates on the processes of rules and regulations development, ensuring the alignment of asset operations to business goals/strategies. Asset governance emphasise the how and why asset-related policies are developed, especially in ensuring policies are developed in alignment with organisational strategy and goals. Asset governance is also focused on how the organisational structure can support effective asset management practices, especially by creating a more streamlined decision making process and clearer lines of responsibility for the asset.

In line with the difference in focus between asset management and asset governance, there is a difference in the standards that each approach adheres to and are evaluated against. Due to its engineering/operational focus, engineering asset management refers to the compliance against technical specifications, health and safety standards, and other operational industry standard. Such a compliance evaluation is executed to ensure that the physical assets acquired are fit for use and will ensure high level operational performance. Asset governance on the other hand ensure the organisation is in compliance with business related industry regulations and rules, and international standards. An explicit example of the difference between the two perspectives is that while asset management concentrates on whether or not a physical asset fulfils technical specifications, asset governance ensures reporting of the physical asset is executed in a standardised manner across the organisation and is available upon request for audit.

One of the main differences between engineering asset management and asset governance according to Cornish and Morton (2001) is the separation of power between an asset manager and an asset governor. The asset manager is primarily concerned with developing the network in line with any contractual conditions and their impact on any risk/rewards mechanisms. This person is responsible for understanding business costs and performance drivers, determining investments to optimise performance and operational costs, managing the delivery of network performance, managing the delivery of investment programmes, monitoring asset conditions, and devising appropriate maintenance policies. Hence the asset manager needs to be able to balance medium term strategy and the day to day performance management. One of the difficulties in a traditional organisational structure is balancing asset managers' demands with those of reducing day to day operational costs. In establishing as asset management service provided and an informed client, the latter is in a position to consider the longer term governance of the assets in more detail and to take a more strategic overview. This leads to the role of an asset governor, who takes a more long term strategic view of the assets and assesses their impact on commercial, statutory, and regulatory requirements. An asset governor provides a skill set that comprises of understanding the lifetime performance and ownership costs of physical assets, understanding the business risk model and the balance between investment and performance, determining a high level overall investment strategy to create and release value, understanding the position of the business in relation to performance and efficiency frontiers, manage competitive procurement process, and identify other opportunities to generate value from the use of assets. Therefore an asset governor's main goal is regulatory compliance, supply business satisfaction, and income maximisation and generation. If we refer to Figure 1 section 2, then we can see that whilst the asset manager from an engineering perspective is concerned with the light arrows, the asset governor's role is focused on the dark ones.

The above description of asset manager and asset governor roles suggests that the management of assets from an engineering perspective may conflict with the governance view. One of the key differences between the two roles, which also lead us to the next difference between asset management and asset governance, is the time frame focus in which strategies are developed. The asset manager is more concerned about day to day operational matters and medium term strategies, whereas the asset governor's planning horizon is more long term. As well as a difference in the time frame of planning, there is also a difference in the planning focus. Cornish and Morton (2001) recognise a main challenge in separating the two functions, namely confusion in the line of responsibility and authority. It is possible for asset users and other asset related employees to be uncertain of whom they should report to.

The description of asset manager and asset governor above, along with their difference in time frame of planning, leads to the difference in the scope of application between asset management and asset governance. Engineering asset management has a greater focus on operational matters: as asset managers have a day to day operational and medium term planning time frame, their focus is primarily towards the engineering operation of the assets. Asset governors meanwhile have a planning focus that is concentrated at ensuring that asset management operates within an appropriate governance context. Hence asset governance

has a greater orientation towards corporate policies and strategy, with an emphasis on how assets can be utilised to meet business goals and create value for the organisation.

5. DISCUSSION

How to reconcile the different foci and orientations of engineering asset management and asset governance is a strategic governance issue that senior management and boards should address. Ignoring the need to differentiate between the roles of asset manager and asset governor may lead to overemphasize one role at the expense of the other, and trigger sub-optimal engineering asset performance, or poor asset governance outcomes.

One of the difficulties in resolving the management trade-offs associated with engineering asset management and asset governance is related to the need to take into account multiple measures of performance and multiple objectives. It has been suggested that a tool such as the Balanced Scorecard (BSC) (Kaplan and Norton 2001) could be useful in this endeavour, as the balance scorecard has been conceived with the need to reconcile and align multiple objectives at all levels of the organisation in mind.

The BSC provides a framework for studying dependencies between KPIs reflecting four perspectives (or dimensions) as shown in Fig. 6 (Kaplan & Norton 2001):

Financial: typically relates to profitability – measured by ROI, ROCE and EVA, for instance;

Customer: includes several generic measures of the successful outcomes of company strategies - for instance, customer satisfaction, customer retention, and market share in targeted segments;

Internal processes: focuses on the internal processes that will have significant impact on customer satisfaction and on achieving the organisation's financial objectives – classical measure is OEE;

Innovation: identifies the infrastructure the organisation sustains and develops in order to create long-term growth and improvement through technology, skills and organisational procedures.

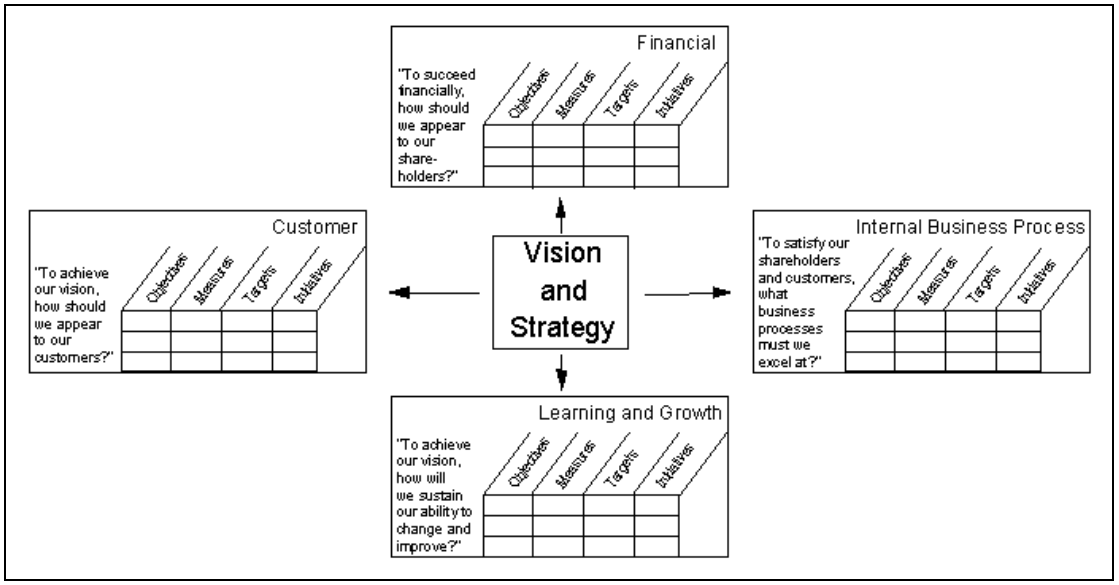

Figure. 6. Balanced Scorecard: the four original dimensions - each specified in terms of objectives, measures, targets and initiatives (Kaplan & Norton 2001).

Considering today's demand on efficiency and effectiveness competition is harder on all the basic dimensions. In a buyer's market it is obvious that customer objectives will be crucial (remembering that in a supply chain or supply network, one company's customer may be another company's supplier). The internal process objectives are key for meeting increasing competition in a deregulated market. Thus product and process innovations are important for staying in the business in the long run. Good performance in the above dimensions will obviously correlate positively with good financial performance.

By enabling to translate broad corporate strategic objective across a range of dimensions, the BSC provides a framework to identify potential conflicts and trade-offs between asset governance and engineering asset management. However, it is not sufficient to guarantee success on its own. Appropriate governance structure must be in place so that trade-offs are identified in a timely fashion, and reporting and accountability policies and processes must be architected in a way that incentivises managers to deal appropriately with these challenges, and conflict resolution and consultation forums must be in place to enable asset managers and asset governors to work in good intelligence.

One of the challenges for senior management in tackling this issue is to avoid over-governance and the bureaucratisation of the organisation (Gulati and Kletter 2005). Rather, the judicious application of well-designed simple rules has been suggested to be more effective (Eisenhardt and Sull 2001). Research in organizational design suggests that contingency models need to be continuously adapted to the changing needs of organisations in the context of rapidly changing environments (Miller 2005). This opens up the need to address research questions relating to the appropriate rules and contingencies for governance architectures that support high performance asset engineering management and asset governance.

6. FUTURE RESEARCH

We will conclude the paper with some remarks related to the special challenges of integrating the engineering and the governance perspectives for the asset management of fleets, and the needs for future research to meet these challenges. From the point of view of engineering asset management the key challenges is to define key performance indicators, operationalise their measurement, and evaluate the performance of the individual entities, as well as, the fleet as a whole. From the point of view of asset governance the key challenges are the definition of rules to by which a networked organisation comprising of an asset owner, asset user and service providers is constructed: What the roles, accountabilities, IPRs, required capabilities of the different actors in the network? How do we evaluate the added value of the network? More particularly, how do we define gains and responsibilities among the actors for a joint gains situation? What business models could provide this joint gains situation? What incentive models should be built in? These questions are implicit in Fig. 7 that sketches information flows between the fleet owner, fleet user and the network of service providers.

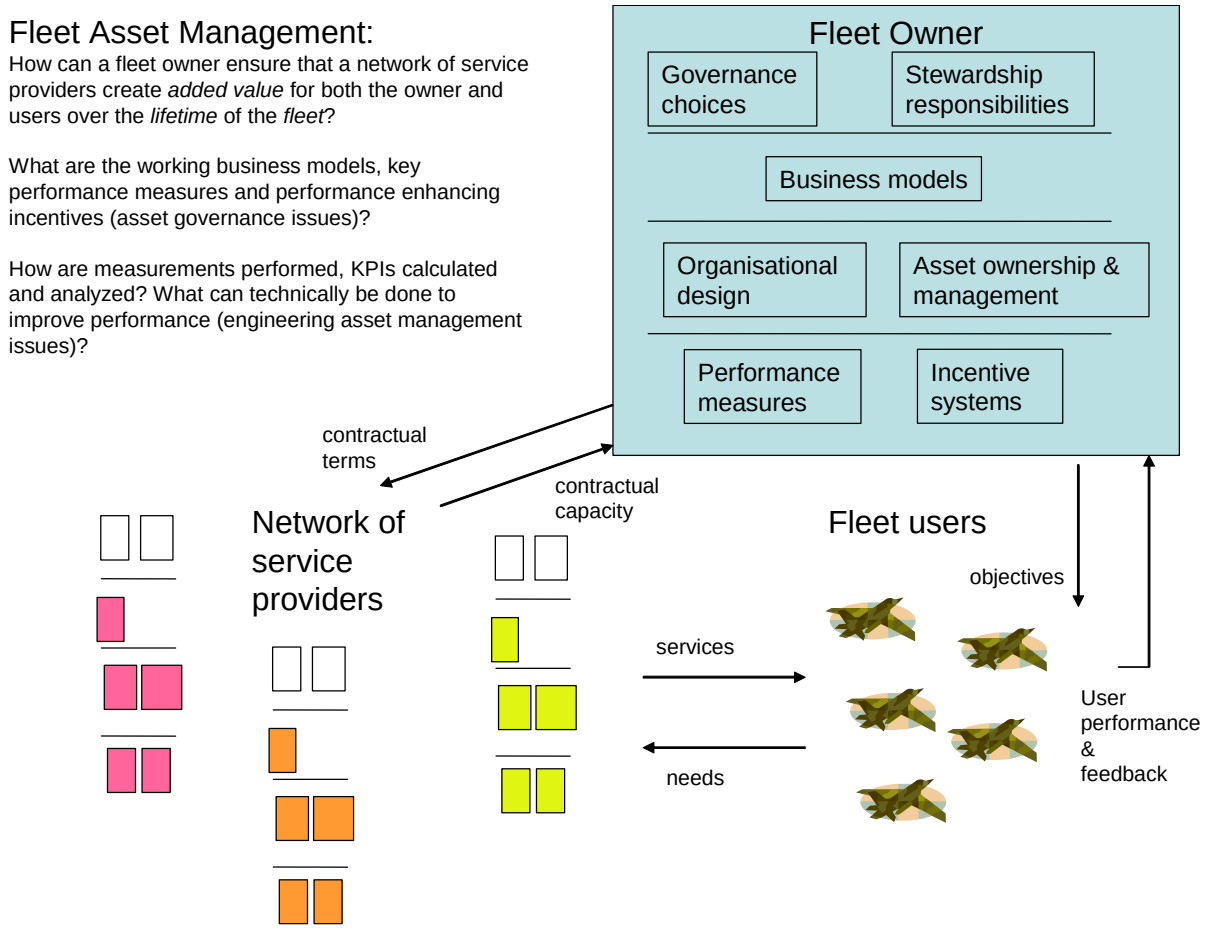

Figure 7. Networked fleet asset management

Future research is required to better understand the relationship between the stakeholders to be able to improve asset management and governance of asset fleets. Integration of the engineering and governance perspectives is believed to be a step forward. Ideally, the results of future research should support stakeholders in identifying their success factors and in the formulation of service and business models that jointly yield a win-win situation for the all the network members.

7. References

Alchian, A. A. and H. Demsetz. 1972. Production, Information Costs, and Economic Organisation. *American Economic Review*, 62: 777-795.

Alles, M. G., S. M. Datar and J. H. Friedland. 2005. Governance-linked D&O Coverage: Leveraging the Audit Committee to Manage Governance Risk. *International Journal of Disclosure and Governance*, 2 (2): 114-129 (accessed June 2005).

Andreou, A. N. and N. Bontis. 2007. A Model for Resource Allocation Using Operational Knowledge Assets. *The Learning Organization*, 14 (4): 345.

Barney, J. B. and W. Hesterly. 2006. Organisational Economics: Understanding the Relationship between Organisations and Economic Analysis. In *The SAGE Handbook of Organisation Studies*, Vol. 2nd ed, eds. S. R. Clegg, C. Hardy, T. B. Lawrence and W. R. Nord. London: SAGE Publications Ltd.

Bhagwat, R. and M. K. Sharma. 2007. Performance Measurement of Supply Chain Management: A Balanced Scorecard Approach. *Comp. & Ind. Eng*, 53: 43-62.

Bühner, R. 2000. Governance Costs, Determinants, and Size of Corporate Headquarters *Schmalenbach Business Review : ZFBF*, 52 (2): 160.

Chen, L. and S. Mohamed. 2007. Empirical Study of Interactions Between Knowledge Management Activities. *Engineering, Construction and Architectural Management*, 18 (1): 107-116.

Considine, M. and J. M. Lewis. 2003. Bureaucracy, network, or enterprise? Comparing models of governance in Australia, Britain, the Netherlands, and New Zealand. *Public Administration Review*, 63 (2): 131.

Cornish, N. and K. Morton. 2001a. Asset Governance - A radical new way to manage distribution networks in a competitive and deregulated market. *London Electricity's Distribution Business*, 482 (June): 18-21.

Cornish, N. and K. Morton. 2001b. Asset Governance - A Radically New Way to Manage Distribution Networks in a Competitive and Deregulated Market. In *16th International Conference and Exhibition on Electricity Distribution (CIRED 2001)*. Amsterdam, Netherlands: Institute of Electrical and Electronics Engineers.

Davis, J. 2007. What is asset management and where do you start? *American Water Works Association. Journal*, 99 (10): 26.

Dunis, C. and J. Miao. 2006. Volatility filters for asset management: An application to managed futures. *Journal of Asset Management*, 7 (3/4): 179.

Eisenhardt, K. M. and D. N. Sull. 2001. Strategy as Simple Rules. *Harvard Business Review*, 79 (1).

Fabrycky, W. and B. Blanchard. 1991. *Life-Cycle Cost and Economic Analysis*. Englewood Cliffs, NJ: Prentice Hall.

Farrell, L. and R. Davies. 2005. *National Grid officially recognised by Lloyd's Register for Asset Management* National Grid.

George, W., F. W. McFarlan and I. Marco. 2006. Organization Design and Effectiveness over the Innovation Life Cycle. *Organization Science*, 17 (2): 230.

Golubski, P. 2002. A Roadmap for Fleet Managers. *Fleet Equipment*, 28 (11): 10.

Gomez, P.-Y. 2004. La gouvernance de l'entreprise. *Revue Française de Gestion*, 30 (148): 249.

Guggenheim, R. and R. W. Stahr. 2006. Asset Management Program Implementation: What a long, strange trip it's been. *American Water Works Association. Journal*, 98 (1): 34.

Gulati, R. and D. Kletter. 2005. Shrinking Core, Expanding Periphery: The Relational Architecture of High Performing Organisations. *California Management Review*, 47 (3): 77-104.

Hagel, J. and M. Singer. 1999. Unbundling the Corporation. *Harvard Business Review*, 77 (2): 133-141.

Herder, P. M. and Z. Verwater-Lukszo. 2006. Towards Next Generation Infrastructures: An Introduction to the Contributions in this Issue. *International Journal of Critical Infrastructures*, 2 (2/3): 113-120.

Jabiri, N. Z., A. Jaafari, R. Platfoot and D. Gunaratram. 2005. Promoting Asset Management Policies by Considering OEE in Products' TLCC Estimation. In *Engineering Management Conference Proceedings*: IEEE International.

Jensen, M. C. and W. H. Meckling. 1976. Theory of the Firm: Managerial Behaviour, Agency Costs, and Ownership Structure. *Journal of Financial Economics*, 3: 305-360.

Kaplan, R. S. and D. P. Norton. 2001. *The Strategy-Focused Organisation: How Balanced Scorecard Companies Thrive in the New Business Environment.* Boston, Massachusetts: Harvard Business School Press.

Kim, Y.-M., J. Ahronheim, K. Suzuka and L. E. King. 2007. Enterprise Digital Asset Management System Pilot: Lessons Learned. *Information Technology and Libraries.*, 26 (4): 4-16.

Kitchen, H. 2006. A State of Disrepair: How to Fix the Financing of Municipal Infrastructure in Canada. *Commentary - C.D. Howe Institute* (241): 0_1.

Kleijnen, J. P. C. and M. T. Smits. 2003. Performance Metrics in Supply Chain Management. *Journal of the Operational Research Society*, 54 (5): 1-8.

Komonen, K., H. Kortelainen and M. Räikkönen. 2006. An Asset Management Framework to Improve Longer Term Returns on Investments in The Capital Intensive Industries. In *WCEAN*. Queensland, Australia.

Lin, S., J. Gao, A. Koronios and V. Chanana. 2007. Developing a Data Quality Framework for Asset Management in Engineering Organisations. *International Journal of Information Quality*, 1 (1): 100-126.

Mardiasmo, D., S. Tywoniak, K. Brown and K. Burgess. 2008. Asset Management and Governance: Analysing Vehicle Fleets in Asset-Intensive Organisations. In *The Twelfth Annual Conference of the International Research Society for Public Management (IRSPM XII)* Brisbane, Australia.

Matichich, M., J. Allen and R. Allen. 2006. Asset Management Planning and Reporting Options for Water Utilities. *American Water Works Association. Journal*, 98 (1): 80.

Mergelas, B. J. 2005. Condition-based asset management strengthens bottom line. *American Water Works Association. Journal*, 97 (2): 48.

Miller, D. 2005. Advantage by Design: Competing with Opportunity-based Organizations. *Business Horizons*, 48 (5): 393.

Mitchell, J. S. 2002. *Physical Asset Management Handbook*. 3 ed: Clarion Technical Publishers.

Mitchell, J. S. and J. Carlson. 2001. Equipment asset management – what are the real requirements? *Reliability Magazine*, 4 (14).

Moore, J. F. 1993. Predators and Prey: A New Ecology of Competition. *Harvard Business Review*, 71 (3): 75-83.

Moore, M. H. 1995. *Creating Public Value Strategic Management in Government*: Harvard University Press.

Narracott, M. and A. Bristow. 2001. Corporate governance in Australia. *International Financial Law Review*: 35.

Rosqvist, T., K. Laakso, and M. Reunanen, M. 2007. Value-driven maintenance planning for a production plant. *Reliability Engineering & System Safety*. In press. Available

online at www.sciencedirect.com.

Schmidt, S. L. and M. Brauer. 2006. Strategic Governance: how to assess board effectiveness in guiding strategy execution. *Corporate Governance: An International Review*, 14 (1): 13-22. http://www.blackwell-synergy.com/doi/abs/10.1111/j.1467-8683.2006.00480.x.

SEMI. 2000. Standard for Definition and Measurement of Equipment Productivity. In *SEMI E79-0200*: Semiconductor Equipment and Materials International, Mountain View, CA.

Sturgeon, T. 2002. Modular Production Networks: A New American Model of Industrial Organisation. *Industrial and Corporate Change*, 11 (3): 451-96.

TWPL. 2007. *PAS 55 - what makes TWPL different?* The Woodhouse Partnership Limited. http://pas55.net/ (accessed 28 November, 2007).

Wenzler, I. 2005. Development of an asset management strategy for a network utility company: Lessons from a dynamic business simulation approach. *Simulation Gaming*, 36 (1): 75-90. http://sag.sagepub.com/cgi/content/abstract/36/1/75.

Wittwer, E., J. Bittner and A. Switzer. 2002. The fourth national transportation asset management workshop. *International Journal of Transport Management* (1(2)): 87-88.

Woodhouse, J. 2004. *PAS 55: Specification for the Optimized Management of Physical Infrastructure Assets*. The Institute of Asset Management. http://www.iam-uk.org/downloads/PASworkshop.pdf (accessed 28 November, 2007).

Woodhouse, J. 2006a. Putting the total jigsaw puzzle together: PAS 55 standard for the integrated, optimized management of assets: The Woodhouse Partnership Ltd, Institute of Asset Management.

Woodhouse, J. 2006b. Putting the Total Jigsaw Puzzle Together: PAS 55 Standard for the Integrated, Optimized Management of Assets In *International Maintenance Conference*. Daytona Beach, Florida.

PUBLICATION VI

Utilisation of product lifetime information across organizational boundaries in the development of maintenance services

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Utilisation of Product Lifetime Information Across Organizational Boundaries in the Development of Maintenance Services

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Abstract - **Creating a successful service offering for a physical product and implementing the services require extensive information exchange across the boundaries of the service provider and client organisations. A change from a transaction- to relationship-based service model calls for new capabilities from the product manufacturer. This change, however, also offers new possibilities for the utilisation of lifetime information in a more effective way.**

Product lifetime information has several purposes of use including the development, management and implementation of services. Additionally, the manufacturer providing services has the advantage of efficiently utilising the accumulated information in the product development. The basic idea for the service provider is to create added value by processing, analysing and converting the gathered data into knowledge that can be utilised in providing better services. Thus, the asset owner will benefit from sharing the information by receiving better managed and implemented services resulting in improved equipment efficiency.

Sharing relevant lifetime information calls for transparency from all parties involved. Building the kind of framework presented in this paper for the shared information content and procedures for the utilisation of the information will help in clarifying the common objectives in the relationship between the customer and service provider.

Keywords - **maintenance services, lifetime information**

I. INTRODUCTION

Customer demands on more services, willingness to be more protected from the economic fluctuations, and willingness to accomplish growth are among the drivers that make the product manufacturers look for more profit-making business opportunities in the field of services. Development of the services calls for activities in the different processes of the company. Ref [1] proposes development in the following areas: service business development, e-Maintenance technologies and product development. e-Maintenance technology represents enhanced ways of gathering required asset information for supporting the maintenance activities and decision-making. Technology is developed based on service models and modes of operation. Thus, information is gathered for carefully specified purposes. On the other hand, developed new technology and gathered information can enable new service concepts.

Utilisation of product lifetime information and information on globally installed machinery base ("the fleet") offers a wide field of research and applications if no focusing is done. However, an overall view on the management of information is beneficial in order to understand the development targets and to develop the information sharing and utilisation.

A framework for the utilisation of information in the development, management and implementation of the maintenance services is presented which provides assistance in developing solutions where information is shared between organisations.

The study presented in this paper is part of a larger multi-disciplinary research project started in 2007. The paper will illustrate the ways how lifetime information on the installed machinery base is structured and how the various ways of use are described. On the other hand, the problems related to the service information sharing will be addressed and it is shown how the framework for the structured utilisation of information will help to overcome the problems.

II. CATEGORIZATION AND STRUCTURE FOR THE DATA TO BE UTILISED

The service operations may result in lots of information with no systematic utilisation. However, gathering equipment level lifetime information from an extensive installed machinery base typically offers the manufacturer, operating as a service provider, a great competitive edge. The product manufacturer is often the one from whom maintenance services are requested as it is assumed that product manufacturer has the best knowledge and information concerning its own products. Taking advantage of the possibilities to collect data and utilise these data in the operations is therefore something to focus on.

The data produced and gathered in service business and service operations can be categorized in various ways. One way of doing this is to base it on the purposes for which information is used. In our view, the purposes of service related information can be categorised as follows:

A. continuous development of maintenance services and maintenance planning based on technical information regarding the installed base
B. management of maintenance services
C. implementation of maintenance services; support for the delivery of single services.

Technical product information represents an important information type that can be included in all the above purpose categories. Part of technical product information, e.g. maintenance event data, may be even more useful if it is based on a wide installed machinery base. Key per-

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formance indicators (KPIs) as well as maintenance performance indicators (MPIs) are examples of typical information types for development and management purposes which can be used in various levels of system hierarchy.

A. Information utilised in the continuous development of maintenance services and maintenance planning

The availability performance of a system is dependent on the following factors: reliability performance, maintainability performance and maintenance support performance [2]. Maintenance support performance is a characteristic of logistics and maintenance support organisation and the preventive maintenance programme affects the reliability performance of the system. The operations affecting the overall performance can be improved by implementing more effective ways of gathering and utilising data and information.

The preventive maintenance programme developed for the target system composes the baseline for the maintenance activities, answering the question "what should be done and when?". In addition, there exists a question "how the maintenance operations should be done to gain optimal performance and cost-efficiency?". Lifetime information is needed in order to be able to answer the above questions.

Ref. [3] states that the following information items are required to make updates for the maintenance programme in a case where manufacturer instructions and experiences of the system are available.

- information on the predicted failure behaviour of the system by the analysis of the maintenance event data
- identification results of the reliability risks of the system by using the Failure Modes, Effects and Criticality Analysis (FMECA)
- maintenance programme proposed by system manufacturer and the initial implemented programme as well as the analysis of the differences in these programmes.

Acquiring the previously mentioned information items require systematic information exchange from the involved parties as well as ability to produce new information in co-operation. In addition, system specific information on e.g. structure and function as well as duty type and production volume is considered also as the baseline information for the development.

The proper performance management at the considered levels requires gathered information on the role of maintenance for the target process. In general, the maintenance objectives and the proper measures related to them should be derived from the strategic objectives of the concerned company and production. Value based approaches have been used for objective derivation in a hierarchy, an application of which has been presented in [4] as value-driven maintenance planning. Deriving the objectives and proper measures of maintenance services forms a slightly different situation where the fundamental objectives must come from the customer, however, ideally offering place for an application of value-driven planning methods.

The Balanced Scorecard (BSC) concept has been applied to maintenance performance management and assessing the role of maintenance in the company's processes by several authors, e.g. [5], [6] and [7]. Here, it is proposed that the role of the maintenance service in customer's processes is described by gathering information on the customer's value creation as well as on the customer's objectives, defined e.g. by applying the BSC concept. In addition to these BSC perspectives (namely financial, customer, internal and learning and growth) being converted into service objectives, we propose the following customer interface and customer process related factors to be included in the performance management of a service provider: 1) the level of co-operation between the key players, 2) the level of transparency and exchange of relevant information, 3) the level of information management and 4) networking ability. The factors illustrate also the fact that having the best asset related technical information is not adequate – the knowledge and information of customer's processes and environments plays a significant role in providing successful services.

The product lifetime information flows in these cases would follow the idea presented in Fig. 1. As a result, these overall goals, objectives and the chosen indicators and measures will give a baseline for the implementation of the services.

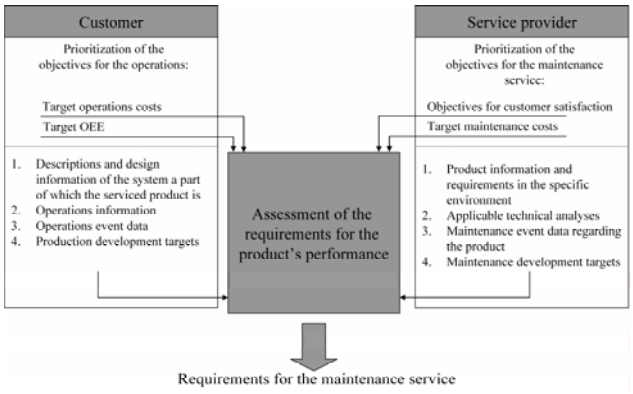

Fig. 1. An example of the product lifetime information flows in the customer-service provider interface when setting the service objectives.

Table I presents a set of information items utilised in the development of services. The categorization applied has been adapted from [8].

TABLE I
Examples of information items needed in the continuous development of services.

Category	Example information items Definition of the utilisation
Equipment related performance	Duty type and production volume information, operations and dynamic product data, OEE, failure information
	Maintenance programme planning and optimisation as well as operations performance optimisation.
Task related performance	Information on the working methods and time used for standard tasks
	Maintainability performance optimisation, working method optimisation
Cost related performance	Information on the total maintenance costs and the distribution and the criticality of the target systems, cost-effectiveness (benefit) of the performed maintenance tasks
	Improved allocation of the maintenance resources
Immediate customer impact related performance	Information on the new customer needs which have effects on the performance requirements
	Product and service development: introduction of new enhancements for the product and/or the technical service and maintenance of the product
Learning and growth related performance	Information on the development activities of the production system which require enhancements made for the product and the service related to it
	Development of new working methods based on customer needs, allocation of investments

TABLE II
Examples of information items needed in the management of maintenance services.

Category	Example information items Definition of the utilisation
Resource management information	Information on the planned stoppages, maintenance man hours already reserved, average duration of the considered maintenance task
	Accurate maintenance scheduling and resource allocation by taking into account the production schedules and stoppages.
Work planning information	Production environment information, development plans, maintenance and process data
	Timing and preparation of the maintenance task, safety and working instructions planning, competence management
Materials management information	Event data and CBM information, production system development information, new technology introduced
	Purchase timing of spare parts Reservation of the proper spare parts

B. Information needed in the management of maintenance services

Gathering information for the support of daily operational planning is a widely researched area. Gathering the relevant information for the management of maintenance services requires co-operation between the customer and service provider.

The information requirements for the management of services are typically focused on the aspects described in Table II. The table illustrates that the information needs for the various management purposes are to be carefully planned and that the ways how information items need to be brought together for specific purposes should be defined.

In table II, the information items have been categorized according to the utilisation purpose. Same information items can be utilised for various purposes and categorised accordingly. Many of the typical decision-making cases require the combination of various information items brought together. As an example, when making decision about the best possible timing of a specific maintenance task, the following information items are typically among the needed ones: 1) information on the next planned stoppages: when they will occur and how long they will last, 2) the typical duration of the maintenance task, 3) operating hours of the target and 4) CBM information.

C. Information needed in the implementation of maintenance services

Ala-Risku [9] has presented a framework for the utilisation of information needed during the different phases in the delivery of single service. The framework consists of a description of a single service delivery process with related information for each phase in the process. Fig. 2 presents an example of the information items utilised in the delivery process. It is emphasised here that the information consists of both technical asset information and relevant customer side process information.

The acquired data can be structured and categorized based on the principle of Fig. 2 according to the utilisation purposes of each information item. In addition, the actions needed to be done before the information is available for the user should be described. Analysis methods, practical solutions and steps for converting data into information should also be detailed.

Thus, regarding each information item, the following aspects should be carefully studied:

- reliability of the information produced
- choice of analysis methods to be used for producing the required information
- ways of disseminating information
- where appropriate, instructions on where to find the information and how to interpret it.

An important reason for acquiring maintenance event data is to support the planning and execution of future maintenance operations. Past experience should also be efficiently used in problem-solving situations; e.g. learning about failure causes by utilising maintenance records [10]. Information needs in these situations should be identified in advance to be able to build solutions that provide users with an easy access to the information when necessary. The framework for the information types presented in this paper offers a starting point for the collection, dissemination and exploitation of lifetime information.

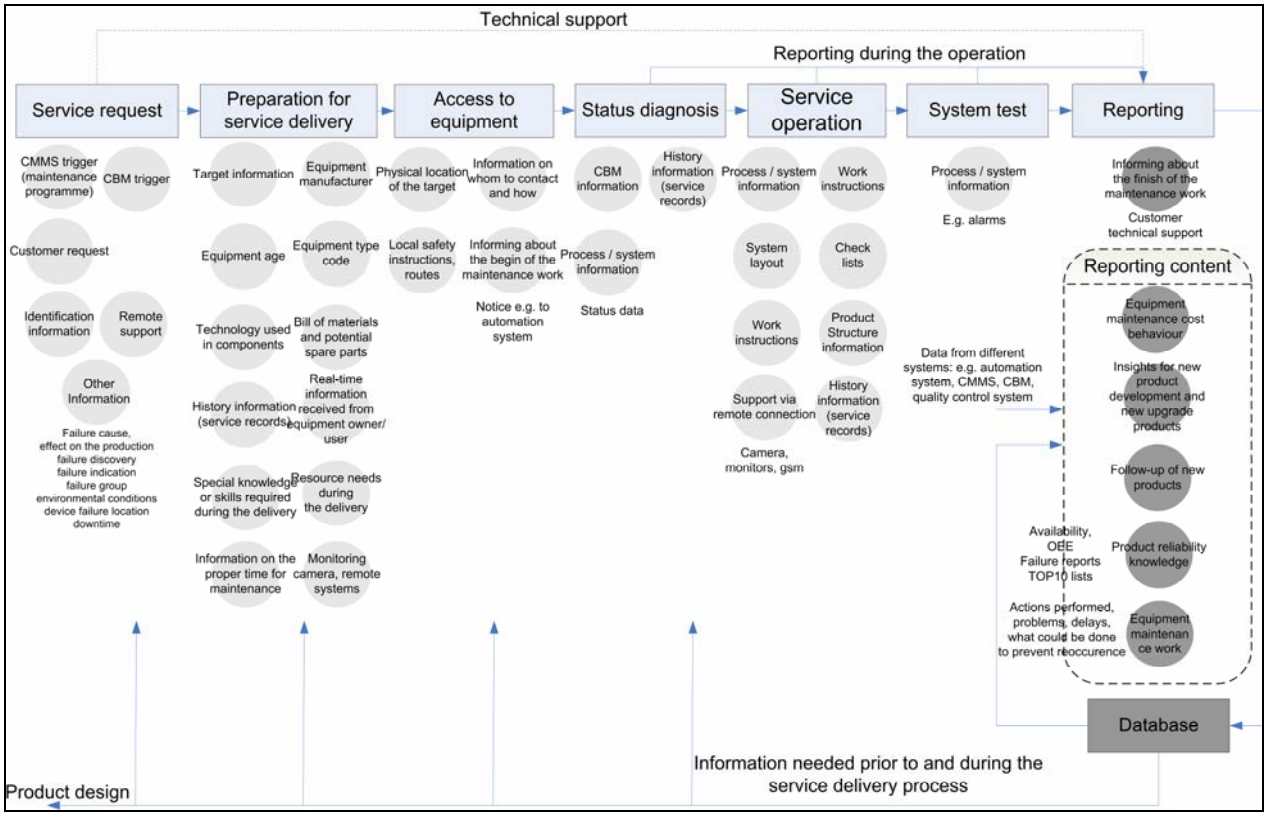

Fig. 2. The information items ideally utilised in the implementation of maintenance services (modified from [9]).

III. TRANSPARENCY REQUIREMENTS AND CO-OPERATION BETWEEN ORGANISATIONS AS AN ENABLING FACTOR FOR INFORMATION EXCHANGE

In the transition process of "servitisation" the main aim may be to transform from a machinery supplier to a solution provider, maintenance or performance partner and finally to the "value partner" [11]. In the case of a value partner, the basis of successful business model is on increasing understanding of customer's business, not only customer processes or operations and resources. This perspective has increased its significance in services.

Several types of information and knowledge can be gathered in relation to customer relationship management. Recently, the emphasis of the knowledge from customer, which means customers' knowledge about products, suppliers and markets that can be used through interactions to improve services and develop new products, has increased. For leveraging the different types of customer knowledge successfully it is relevant to consider a process-based view for utilizing the information and knowledge in the organization. The information processing can include e.g. following stages: information acquisition (or generation), information dissemination, information interpretation, information storage, organizational memory and information retrieval [12]. For efficient processing of information, certain level of transparency of information and adjusted capabilities and mechanisms for information exchange are needed.

Ref. [13] presents Value-Transparency as a potential mode of operation in a supply network, to improve relationship and to share information in order to achieve the certain goal. With relation to maintenance services, capabilities for information exchange are called for from several perspectives. From the customer point of view, the added value of the purchased services must be well illustrated. The purchase decision-making requires information on the added value the economic benefit compared to the price of the service and often the benefit compared to the case when the same operations are performed in the in-house organisation. The required information items include items from the customer's side, composing requirements and challenges for transparency and co-operation. The exchange of information required in operations may be prevented due to practical issues related e.g. confidentiality. The problems can be overcome by together analyzing the information requirements from both parties and pointing out the practical actions needed for converting the information into a form that can be shared.

Ref. [14] claims that lack of information in the networked production results in poor decision-making. A solution where a central decision maker is shared information from all the players involved, is introduced. In our research, the idea of a significant role of a central player in bringing together the required pieces of services and offering them as a whole as well as the related information requirements have been strongly present.

On the basis of qualitative interviews, the studied Finnish companies (four Finnish machine suppliers and

service providers) generally have a good access to the information on their installed machinery base. This is especially important for the competitive edge of their maintenance and spare part services. In the case of higher-end value solutions and partnerships, the situation is more complex, especially if the client would require services for the installed machinery base delivered by other firms as well. Here we come to meet the essential questions for value partnerships, e.g.: How to build the organization to promote the products and services and their development? What is the role of the intermediate operator (central player) in this case? How to effectively manage the life-time information in the complex, global environment?

Clients of service providers were also interviewed in this study. The client interviews have re-emphasized the following themes, which need specific attention: a need for further development of the predictive maintenance and remote diagnosis of equipment, a need to develop information exchange and interaction mechanisms between supplier and client as well as a need for advanced training services supporting the use of machinery. For further developing the information exchange and lifetime information utilization, as well as responding to these specific client needs there is a need for increased understanding of openness, transparency requirements and construction of mutual trust, and promotion of systematized feedback and interaction mechanisms.

For creation of mutual trust, which is a prerequisite for a successful service partnership, it is suggested that the relationship based on the utilization of life cycle information could be started with a step-by-step approach where the collaboration is enlargening on the basis of beneficial implementation of early phases, which increases the level of mutual trust. This is based on the theory that trust building is a cyclical process where positive outcomes build the trust incrementally, over time [15]. For efficient management of service provider's product/service portfolio, customer relationships should be evaluated on the basis of achieved level of trust, which would help in supplying and marketing different types of services for different types of customer relations. The continuous nurturing of collaborative relationship is required to retain and nourish the trust [15].

IV. DISCUSSION AND CONCLUSIONS

Summarizing suggestions based on the integration of earlier research in the area and the empirical interviews are as follows:

- For the efficient partnering and common benefits it could be suggested that the companies should collaborate in the early phase of a partnership in recognizing the needed information items and possibilities to utilize information.
- By systematically identifying and analysing the various utilisation possibilities for the acquired product lifetime information, the service providers are able to improve their maintenance service operations.
- For further developing the information exchange and lifetime information utilization there is a need for increased understanding of openness, transparency requirements and construction of mutual trust, and promotion of systematized feedback and interaction mechanisms.

REFERENCES

[1] H. Kortelainen, T. Ahonen, E. Jantunen and I. Salkari, "Future service concepts as a strategic choice for machinery manufacturers", *Conference on asset management & production reliability, Euromaintenance '08,* 2008.

[2] IEC 60050-1: International Electrotechnical Vocabulary, Chapter 191: *Dependability and quality of service*, 1990.

[3] T. Ahonen, M. Reunanen, J. Heikkilä and S. Kunttu, "Updating a maintenance programme based on various information sources", *The 4th international conference on safety and reliability, KONBiN*, 2006.

[4] T. Rosqvist, K. Laakso and M. Reunanen, "Value-driven maintenance planning for a production plant". *Reliability Engineering & System Safety*, 2007. In press. Available online at www.sciencedirect.com.

[5] J. P. Liyanage and U. Kumar, "Towards a value-based view on operations and maintenance performance management", *Journal of Quality in Maintenance Engineering*, vol. 9, no. 4, pp. 333–350, 2003.

[6] I. Alsyouf, "Measuring maintenance performance using a balanced scorecard approach", *Journal of Quality in Maintenance Engineering*, vol. 12, no. 2, 2006.

[7] A. H. C. Tsang, "A strategic approach to managing maintenance performance", *Journal of Quality in Maintenance Engineering*, vol. 4, no. 2, pp. 87–94, 1998.

[8] K. Y. Kutucuoglu, J. Hamali, Z. Irani and J. M. Sharp, "A framework for managing maintenance using performance measuring systems", *International Journal of Operations & Production Management*, vol. 21, no. ½, pp. 173–194, 2001.

[9] T. Ala-Risku, "Installed base information management with industrial service operations", *POMS 18th Annual Conference*, 2007.

[10] A. C. Márquez and A. S. Herguedas, "Learning about failure root causes through maintenance records analysis", *Journal of Quality in Maintenance Engineering*, vol. 10, no. 4 , pp. 254–262 2004.

[11] I. Salkari, V. Salminen and J. Pylkkänen, "*BestServ - Managing Service Business: Winning Best Practices and Success Stories*", Technology Industries of Finland, 2007.

[12] G. P. Huber, "Organizational learning: The contributing processes and the literatures", *Organization Science*, vol. 2. no. 1, pp. 88–115, 1991.

[13] R. Lamming, N. Caldwell and W. Phillips, "A Conceptual Model of Value-Transparency in Supply", *European Management Journal*, vol. 24, Nos. 2-3, pp. 206–213, 2006.

[14] P. Egri, D. Karnok and J. Váncza, "Information sharing in cooperative production networks", *Proc. of IFAC Workshop on Manufacturing Modelling, Management and Control*, pp. 115–120, 2007.

[15] S. Vagen and C. Huxham, "Nurturing collaborative relations: Building trust in interorganizational collaboration", *The Journal of Applied Behavioral Science*, vol. 39, no.1, pp. 5–31, 2003.

PUBLICATION VII

Developing collaborative relationship between industrial service provider and client: The case of industrial maintenance management

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Developing Collaborative Relationship between Industrial Service Providers and Their Client: The Case of Industrial Maintenance Management

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***Abstract*--Recent years have increased the number of studies focusing on development and co-production of industrial services together with partners. The complexity of managing industrial services (e.g. maintenance) also causes crucial managerial needs; e.g. how to find the focal areas that should be paid attention to in order to find solutions for developing the collaboration between service provider and client.**

This study aims to provide a comprehensive and objective viewpoint to the development of collaborative relationships in industrial environment. The paper especially focuses on studying the antecedents affecting the development of collaboration and realization of the common value in the case of maintenance of industrial asset fleet.

The current study is a part of larger applied research project focusing on the industrial service business development. Individual and group interviews in three case organizations as well as client interviews have been utilized in order to form a reliable view on the relationship development in maintenance management.

The results of the study bring forth the following development areas and also specific managerial recommendations related to these four main areas, which are; 1) strengthening the customer perspective, 2) collaborative capability development, 3) organizing and decision support, and 4) monitoring of relationship development.

I. INTRODUCTION

Today, a large number of industrial manufacturers aim to increase the portion of services from the total turnover of their business. Services are seen as value-adding for customers and the future potential of maintenance and related services are often expected to be greater than of products and physical assets.

The service-related issues have also been popular among management researchers for some time. Even though a significant effort of the research has been put into studying the service sector firms, the traditional distinction between products and services has also been seen as irrelevant in many cases [e.g. 7, 15]. In recent years, there are also some studies focusing on industrial services [e.g. 6, 10, 11, 12, 14, 16]. This indicates that inside service sectors there are several types of services, the management of which requires different types of methods and tools.

This study is a part of a larger multi-disciplinary research project started in 2007 and ending in 2010. In the first round of company interviews, the expert interviews in five industrial companies included questions related to success factors and challenges in the industrial service business. In the later parts, the interviews have been extended to several client companies to form a picture of relationships development between a service provider and a client.

The case study in the empirical part of this paper examines the requirements for developing inter-organizational cooperation based on the maintenance service of an installed base. Research is based on the analysis of the outcome of the qualitative interview study of the target companies within the theoretical framework. The goal in the case study was to provide a solid and controllable entity of the critical components and their relative causalities in a multidimensional field.

The basis of a collaborative relationship is that all parties gain benefits from their own point of view. Development of the co-operational relationship and realization of collaborative value require that the potential benefits, and, on the other hand, equivalent risks are understood in all participatory organizations. Furthermore, the successful development of the co-operational relationship requires that progression and the gained benefits can be measured by relevant instruments.

The study focuses on the necessities of the clarification of the potential benefits and the challenges of conveying the benefits from an objective point of view. The targets of development and proposals for solutions are analyzed based on the outcome of an interview study. The analysis is made to support decision-making and to help piece together and control the multidimensional field related to extended industrial services.

First, the literature review increases our understanding the motives and various factors related to collaboration, especially in the context of industrial services and their development. Furthermore, benefits and roles in collaboration in the field of industrial maintenance are discussed. After the review of earlier studies, the qualitative analysis of Finnish manufacturing and service firms and implementation of the case study of three companies cooperating in industrial service concept development is presented. Finally, conclusions focusing on four main areas of development are presented. The implications are derived from the empirical research including the case study and other relevant data as well as from the selected viewpoints from the literature review.

II. COLLABORATION IN INDUSTRIAL SERVICE DEVELOPMENT AND MANAGEMENT

A. The state of the art in research of collaborative and client-centric service development

Recent research results strengthen the picture of the customer orientation and efficient collaboration with the customer as an increasingly significant success factor in development and innovation processes of industrial services. This is why companies need to focus on value creation to customer. Woodruff [21] defines customer value as follows: "Customer value is a customer's perceived preference for and evaluation of those product attributes, attribute performances, and consequences arising from use that facilitate (or block) achieving the customer's goals and purposes in use situations".

The findings of an number of projects and publications related to e.g. following customer-centric critical success factors for developing new services can be summarized as by Edvardsson et al. [5]:

- develop a deep and thorough understanding of the customer and what creates value through the eye of the customer
- create a customer-centric service culture with in the company
- stay focused on your customers
- involve the customer in the development process
- focus on the whole integrated customer solution and the total customer experience

All of this requires deep understanding and management of customer knowledge on multiple subjects [5]:

- customers' needs and requirements, expectations and preferences
- customers' service context (when, how, why and where the service is used)
- customers' values and cognitive structures
- customers' experiences and behaviours

In collaborative service development firms need to take care of their knowledge processing mechanisms to cope with the different dimensions of customer knowledge. This is challenging especially in the large service entities as described for example in the case study in the empirical part of this paper.

Generally, recognized motives for interorganizational relationships can be categorized in three groups: the motives related to effectiveness, capabilities and positioning [4]. Companies may search for effectiveness through economies of scale, reducing time or by access to partner's resources. On the other hand they may search for appropriate capabilities to supplement their own competencies or to get new insights and knowledge. For improving their market position they may search for better market knowledge and building of better image and trust or to affect competitors' position. There are, however, studies which come to conclusion that around half of the participants in collaborative development believe that collaboration makes the product development more complex and expensive when compared to the option of developing on their own. Typical risks that are recognized by participants involved in collaborative development activities may be knowledge spillovers, losing control and ownership, and divergent objectives and targets.

According to Swink [20], the barriers causing problems in collaborative development can be grouped into physical and resource constraints, organizational and hierarchical barriers, relationship- and culture-based barriers and the barriers caused by lack of information and knowledge. Furthermore, Doz and Hamel [4] have recognized three main groups of gaps influencing the collaborative development: 1) the context of the alliance (strategic and organizational), 2) the content focus of the collaboration and 3) processes through which cooperation must be achieved. In all of these groups, there can be several divergent opinions or different practices of participants that may be reasons behind the failures. All of the factors causing uncertainties or risks in the relationships can not be taken into account in the early stage of relationships, but it is common that participants learn during the collaboration, maybe change their possibly unrealistic expectations of the results and influence the change in patterns of collaboration.

Customer value driven service development requires reliable and comprehensive information on the customer's business and operational processes. Furthermore, the customer may need to consider changes and development in its processes in order to maximise the value created through collaboration. Both the collection of the information on customer's processes and value potential and the identification of development targets favour close collaboration in the new service development. Thus, when developing new services, customers can be involved in the collaborative development process from the very beginning. Following figure [1] depicts what type of activities a customer may perform in different stages of new service development.

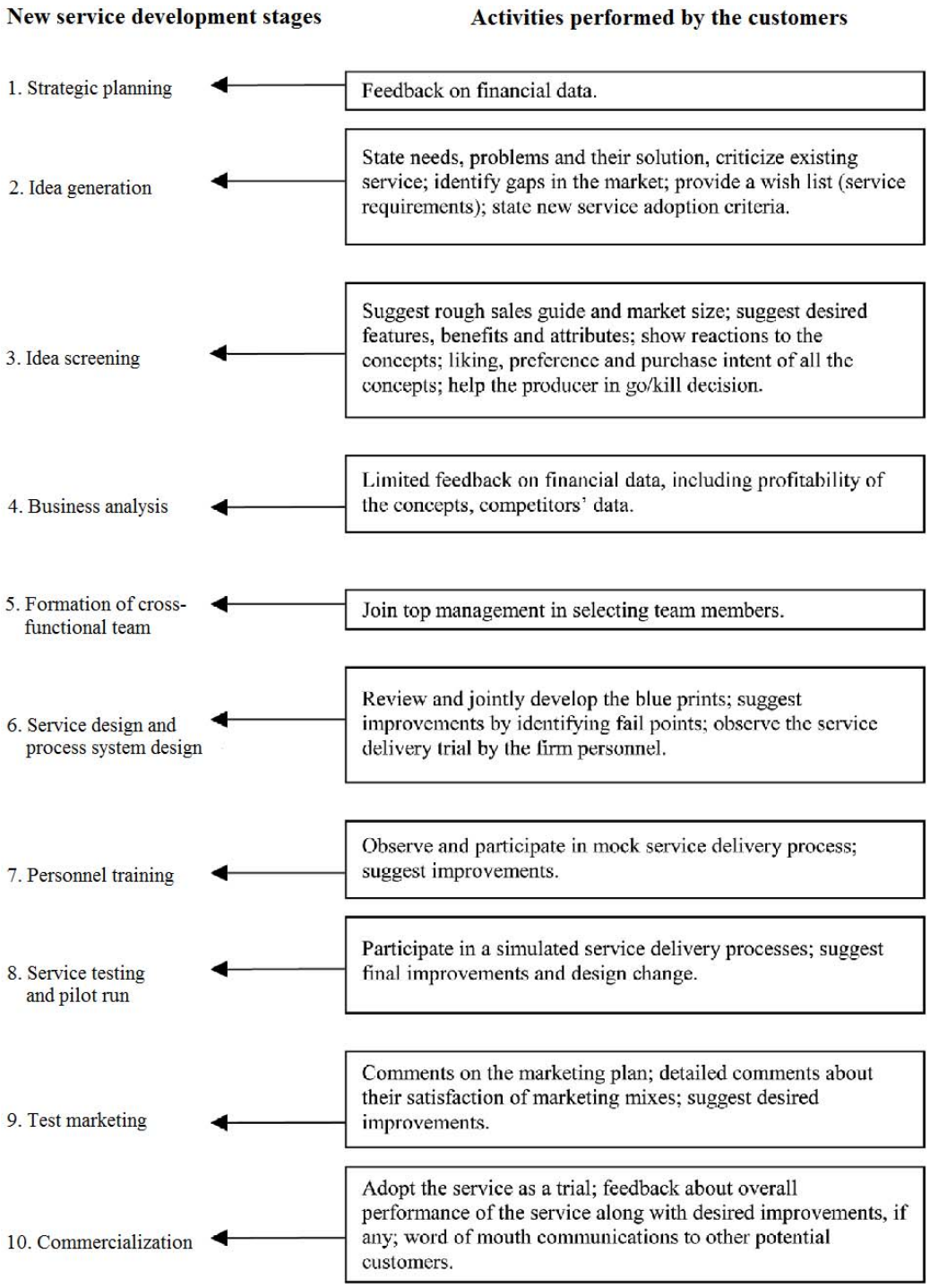

Fig. 1. Customer participation in the service development process [1].

B. The roles and the benefits in collaboration in the field of industrial maintenance

Industrial maintenance management has seen a significant change in the recent years. A clear indicator of this is that several industrial manufacturing firms aim to increase the service business and aim for the level of value partnerships instead of only supplying machinery and traditional maintenance services related to the equipment. To clarify this, Fig. 2 depicts the transformation procedure of industrial firms.

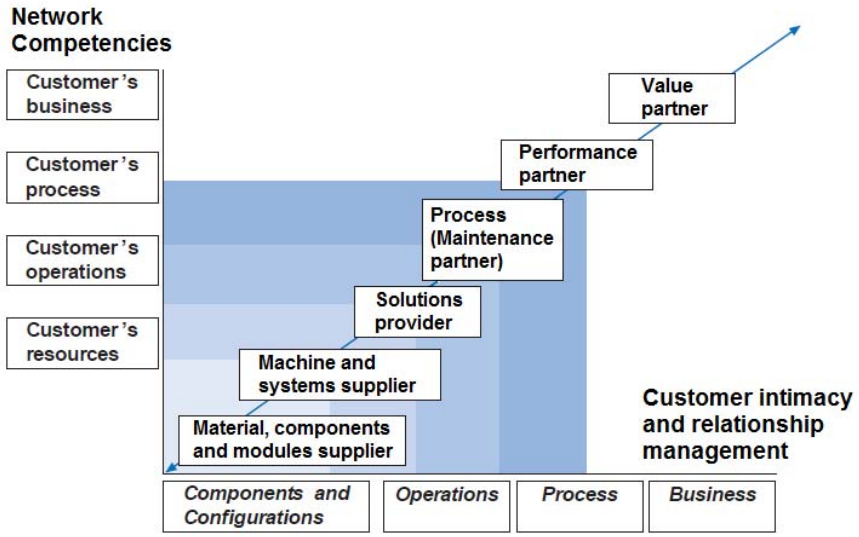

Fig. 2. Service provider's roles and required capabilities (adapted from [9, 18]).

This transformation requires deeper collaborative relationships with clients. Generally, the benefits in this type of collaboration can be seen as follows:

- service provider's targeted benefits are related to creation of new business, to volume growth and to improvement of the competitive position
- client's targeted benefits are related to efficiency of its own operations and production process
- networking of several service provider's aims to benefit from acquisition of resources and development of specific competences

In communicating the benefits of collaboration, it is essential to try to communicate the relationship value. There are some theoretical models that aim to explain the various factors and their relations to the relationship value. One of these models presented by Barry and Terry [2] is depicted below. As presented in Fig. 3, they have also presented hypotheses with regards to positive relationships and interdependencies between the elements in their model.

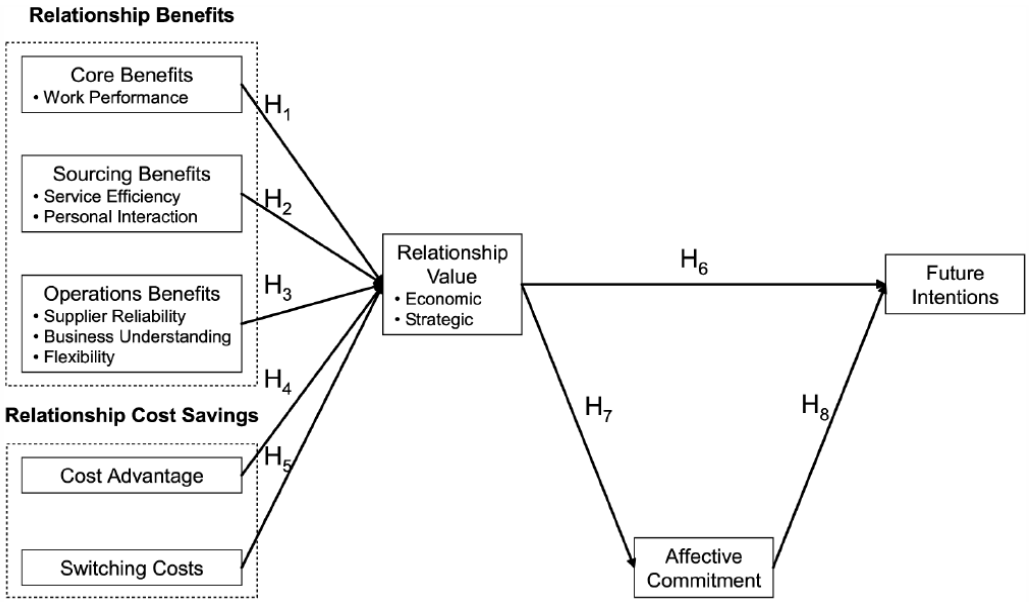

Fig. 3. A model with connections of relationship benefits [2].

The service provider needs to focus on the entire value proposition for the customer, as emphasized by Stremersch et al. [19], however, collaborative value creation can not start until common objectives are defined and partners have sufficient understanding of what the outcomes will be. Relationship value consists of multiple value-adding sub-areas. The management of this entity is a challenging task. On the other hand, the value creation mechanisms may greatly vary according to the customer segment or customer type; for instance loyal customers are more likely to focus on long-term benefits and engage in cooperative actions beneficial to both partners in a relationship, as suggested by Lam [13]. Partners should agree on all the value-adding sub-areas as the good 'core value' can be even destroyed by the components of the service with 'negative added value', such as untimely deliveries and bad management [8]. On the other hand, there are also other risks. From service provider's point of view several risks are related to moving towards the extended service business; from customer's point of view there are many risks related to acquisition and outsourcing of services; and from the point of view of both parties there are some typical risks related to co-operation itself. These are, for example, variances in the expectations, poor task definitions, contractual risks, vague border lines of responsibility, lack of information and accounting methods, poor or inadequate communication, misunderstandings, cultural differences, difficulties in managing the subcontractor network, and other risks related to new service development.

III. IMPLEMENTATION OF AN EMPIRICAL CASE STUDY: DEVELOPING COLLABORATIVE RELATIONSHIP BETWEEN INDUSTRIAL SERVICE PROVIDERS AND A CLIENT IN INDUSTRIAL MAINTENANCE

Although the number of studies focusing on industrial services as well as their management and development, has increased in recent years, there is need for studies focusing on particular problem areas within this field. On the other hand, the number of studies focusing especially on collaborative relationships in industrial maintenance services is still rather scarce. Due to the novelty and complexity of the research area, qualitative case study has been selected to be the main research approach in the current study trying to answer the research questions posed.

This study is a part of a larger applied research project the specific focus of which is on the development of service business based on the exploitation of the available product lifecycle information. The main objective of the whole project is to develop and demonstrate methodology and tools to enhance the development processes in order to optimise the services and techno-economic factors related to the production system and in order to create added value for the customer's value chain. The early part of the larger project included interviews and workshops of ten managers in five manufacturing and service firms. The background information from these qualitative studies has been utilized in a working package focusing especially on development of collaborative relationships between service providers and their client. The focused expert interviews at this stage included nine selected expert participants. Additionally, specific efforts were made in analyzing a case study focusing on the development of collaboration between two industrial service providers and their client firm. The main viewpoints from this case study are presented in following section below. The case study presents a concrete example of actual managerial problems related to the development of deeper collaborative relationship in industrial maintenance.

In this case study, the special focus was on developing collaborative relationship form maintenance service of industrial asset fleet, where two industrial service providers and a client aim to form a deeper collaborative relationship, and co-develop a maintenance service concept further to provide benefits for all parties included. An essential objective in the case study was to form an analysis of starting situation and its challenges from an objective perspective in order to take all collaborative parties into account. The main research question here could be formed as "what are the main prerequisites for developing a collaborative relationship based on the maintenance of industrial asset fleet and for realization of the common value?" The sub-questions were related to benefit-risk analysis of collaboration in industrial services, to means to gain value-added from maintenance, to communication of benefits, to improving the customer perspective in service development and to measuring success in collaboration.

In this case, the maintenance service package provided by the main service provider together with its partner is formed of few main service concepts, which are 1) audit and criticality analysis of the asset fleet, 2) audit of spare part supply and spare part providing services, and 3) remote diagnostics and management of asset information. There are clear benefits from customer's point of view seen in all of the services. Benefits from audits are related to improved efficiency and optimized scheduling and spare part levels. The potential benefits are also remarkable if management of asset information could be utilized in more predictive maintenance and in optimizing the production processes and thus, in saving energy and money by decreased costs. The assets in questions, i.e. automation systems, valves and pumps have a relatively long life-cycle, and therefore maintenance costs form a significant part in the total cost structure of industrial assets' lifecycle costs. This is a pilot case study focusing on one production site of the client only. The target for the main service provider is to broaden the offering of the concept if the results from the pilot study are promising.

The expert interviews in the studied firms consisted of the semi-structured questionnaire, in which the studied topics were dealing with 1) the starting point and objectives of collaboration, the practical implementation of collaboration, 3) functionality of collaboration, and 4) management and

continuous monitoring of collaboration. Main service provider in the case study has several contracts with clients including various long-term services for the asset life-cycle. So the interviewees were able to reflect their earlier experience in similar types of relationships. This particular case study was, however, first of its kind in which the main idea was to follow the above-mentioned three-step service package model and finally to deepen the relationship to managing asset information through remote diagnostics and aim for the collaborative maintenance management.

From the point of view of both client and the service provider, it would be essential to clearly present the concrete benefits, if possible in monetary terms, in order to really start the collaboration, to set the goals and to build up the trust between partners. In some parts of the already existing services, like spare part services, it is possible to utilize the existing references to show the calculations and values of services to the client. In broader and newer concepts it is much more difficult and communication of benefits is very challenging.

Generally, the prerequisites to successful relationships are relatively well understood in all three firms. Benefits at lower level services (audit services, spare part services) are also clarified rather well. Due to the complexity and wide nature of the whole service package, the ultimate vision is however still partly unclear, not only for the client, but also to certain parts in the main service provider's organization.

The expert interviews also dealt with problems faced or risks expected in the collaborations. Following types of problems have been typically experienced by the interviewees:

- Industry cycle changes in partner's business also affects on the other party in collaboration
- Fear of benefit leakage to other parties after own investments to development costs of collaborative service package
- Roles and responsibilities are not clear in the networked service management and effects of failure to the company image
- Insufficient commitment from own organization
- Matching personal chemistries and reaching the right person in the partner organization
- Technological challenges
- Lose of control, weakening of own capabilities and too strong a interdependence to service provider from customer point of view
- Too strong a personalization in firms' collaborative relationships causes individual persons' irreplaceability

Main challenges that expert interviews brought forth with regards to the implementation of collaborative relationships were also multiple. Need of communication of benefits was strongly emphasized in discussions related to selling of a developed service concept. This requires a detailed study of services effects on customer's production process. In this case, change of a key person also has caused change resistance due to insufficient knowledge on the issue. The interdependencies between the services in the whole service package and roles of partners were also not totally clear from client point of view. In addition, there was a need to improve internal collaboration and communication in the service provider's organization.

As one practical aim in the case study was to try to provide a comprehensive and objective picture of the early stages development in the collaborative maintenance service it was essential to realistically show the problems and risks, in addition to the potential benefits in collaboration. The final results from the qualitative study show that even though the firms had a clear picture of general prerequisites and potential benefits of collaboration, the realization of potentials were negatively affected by problems in wide communication, which again causes lack of trust. The observations integrated together with common view points of earlier studies focused our study further on four main development areas. These are discussed below in the conclusions of the study.

IV. DISCUSSION AND CONCLUSIONS

On the basis of our analysis of literature in this multi-disciplinary area and especially of the real-world case study and qualitative research in the field of industrial maintenance, we can derive four major areas of development. These are derived from the analysis of case study, but based on our other qualitative data they are also observed to be brought forth in multiple occasions by the interviewed managers. The literature review again brought forth same problem areas in other, similar type of environments and helped to add our understanding on the issue in order to focus on the correct development objects. These four areas of development in this context are

1) strengthening the customer perspective,
2) collaborative capability development,
3) organizing and decision support, and
4) monitoring of relationship development.

A. Strengthening the customer perspective

As the case study clearly shows, the broader the service concept as a whole, the broader its influence in the participating organizations. This means that the significance of collaboration, information sharing and efficient communication increases internally and in inter-organizational contexts.

In broad service packages, the critical success factors on the basis of theoretical and empirical viewpoints are customer participation and consideration of customer perspective, which need to be taken into account early and at the latest in selling stage with the help of the pilot projects and further development activities based on the pilot cases. On the other hand, there are various roles that customer may have in the different stages of service development, as shown previously in the literature review in Fig. 1.

In planning of pilot studies, it is essential to select the pilot object properly from the point of view of best potential common value. In some cases, the only possibility for the service provider to gain references through successful partnering in the early stages is to let the customer test the service for a certain time period. From economic point of view, the pilot cases should be seen as a part of new service development costs.

The following figure aims to draw together the various viewpoints related to strengthening the customer perspective in industrial service provision and in transforming customer's needs to the common value in relationship. The idea is to show the influencing factors that have an impact to potential common value and to communicated benefits to customer. These two main factors then form a picture of collaborative value from customer's point of view.

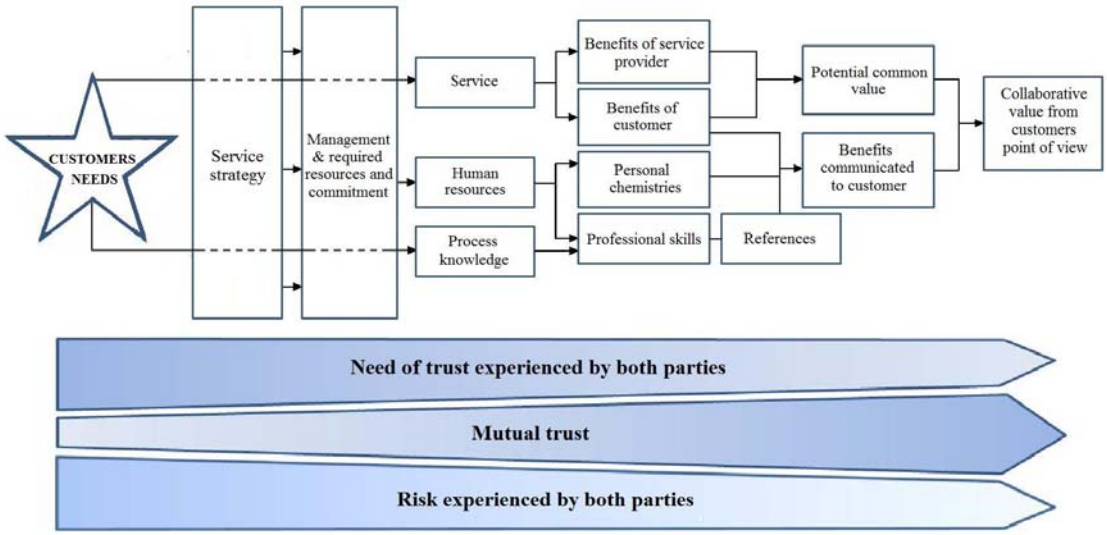

Fig. 4. Formation of the common value.

An essential element in the whole problem area is trust, as described in the previous chapter. Fig. 4 also shows that when this transformation of customers' needs to well communicated collaborative value really happens, we suggest that risks experienced and need of trust experienced by collaborative parties decreases and the level of mutual trust at the same time increases.

B. Collaborative capability development

Fig. 2 in the literature chapter showed us the idea of capabilities that should be developed when a manufacturing company extends to value-based industrial services and aims for close partnerships with clients. However, in developing collaborative relationships we also have to remember that leveraging the capabilities of the service provider also requires the development of customer's own capabilities and competence areas.

Customers also need to know well the cost structure, functionality and critical parts in the process. This is required for example to efficient utilization and realization of benefits of remote diagnostics and management of maintenance information. In practice, in the case study, the successful first stage in the service package, the audit of assets and analysis of criticality is seen as a gate to successful implementation of the other parts and the service concept as a whole. Indeed, the capability development in collaboration can generally be suggested to happen by step-by-step approach, the implementation of which eases if the broad service package can be seen as several main services which are interdependent on each other like the three main services in the maintenance case study.

C. Organizing and decision support

In complex, broad and multidimensional service entities the amount of required information and participating people increases so much that traditional management processes and tools may not be enough. Organizing and management of communication and decision-making requires systematic tools and efficient information systems and possibly changes in organizational structures and cultures.

Building up mutual trust as a prerequisite to successful collaboration is made possible by open communication and clearly defined common long-term objectives. A careful situational analysis in the starting stage eases the comm on understanding of benefit potential and makes possible to align shorter-term goals to the long-term objectives.

Piecing together the situation as a whole may significantly help in structuring the message to communicate to the client so that the potential benefits in collaboration can be distinguished and be communicated to different directions with different emphases. Furthermore, the experienced risks that may affect to trust can be better taken into account with risk management tools if the risks are clarified well enough and brought openly forth.

A well-structured method for decision support in this type of complex issue is Analytic Hierarchy Process, AHP [14]. There are some studies in which the principles of AHP have been also applied in the field of maintenance management (see e.g. [3]). Fig. 5 below depicts an example of the AHP-based hierarchy which has been developed in our case study of industrial maintenance management. The hierarchy reveals the main value-creating areas in this case. An illustrative example together with the client has also been implemented in this case. In the case study, client organization's participants gave relative weights to the main factors and sub-factors through ranking principles in AHP. The different alternatives to provide maintenance services can also be reflected against the weighted factors, and a final result can be a best option to provide the service based on customers value preferences. AHP allows us weight different factors differently in other cases where the main purpose can be something else compared to the mentioned case study.

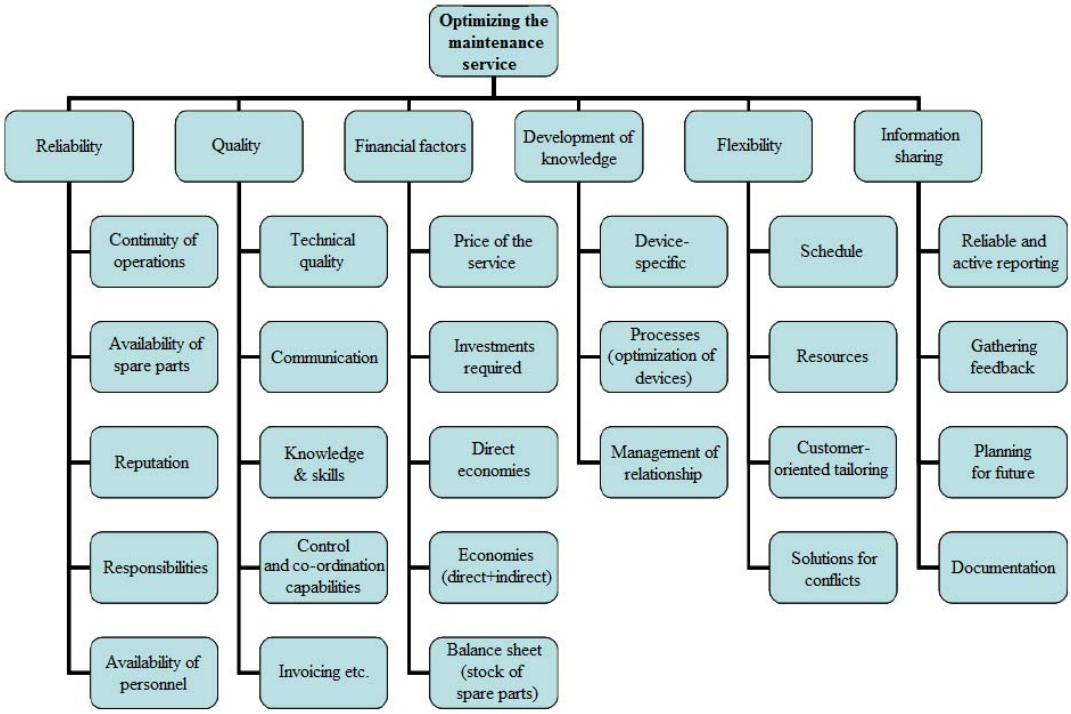

Fig. 5. An example hierarchy of maintenance service value elements.

D. Monitoring the relationship development

A collaborative relationship is continuously changing, dynamic entity, the active development of which has to be continued when relationship proceeds. The roles of the parties typically change when the relationship deepens, but at the same time it is essential to sustain the trust between partners and experience that benefits are realized when the relationship continues and practices become established.

The atmosphere needed to support the common value requires that the relationship and contracts related to it have been defined so that development and increased effectiveness benefits all parties. In addition, developing the relationship and realization of the common value also require monitoring and measuring success. In addition to quantitative indicators and economic ratios, progress also needs to be measured by qualitative measures from the point of view of parties involved. These measures need to be aligned on the basis of commonly defined clear objectives.

Generally combination of different types of measures in the large service entities is suggested. One special area that should be measured in collaborative service relationships should be communication. This viewpoint is strengthened in the case study where communicating the benefits and common value in the relationship is very much emphasized. In the starting stage of collaboration there where both inter-organizational as internal problems in communication, and for future cases, it would be recommended for the main service provider to clearly document the problem areas related to communication aspects in order to derive suitable measurement areas for monitoring the development of relationship.

E. Summarizing conclusions and needs for further research

The main suggestions in the empirical study – namely creation of the holistic picture to support decision-making, and open communication of benefits and risks in the collaborative relationship – aim to help in the mutual understanding of the targets and in the development of trust in the step-by-step approach. An essential prerequisite for developing the collaborative relationship in industrial service

business and realizing the common value is that the potential benefits of the broad service package as well as the risks involved are well understood in both service provider's and customer's organizations. In addition, developing the relationship also requires monitoring and relevant ways to measure progress. On the basis of empirical studies consisting of a case study on maintenance management collaboration and other interview material and qualitative data, as well as theoretical review of this multi-disciplinary issue, we have been able to draw conclusions and derive implications as well as make suggestions on four main themes; strengthening the customer perspective, developing collaborative capability, organizing and supporting decision-making as well as monitoring the relationship development.

It can be assumed that most of the above-mentioned implications with regards to these four areas can be generalized to other environments in which the service provider aims to develop a collaborative relationship with its client through a broad multi-dimensional service concept. On the other hand, partly the implications only scratch the surface of other complex problem areas. Therefore, an increasing number of case studies as well as quantitative research may be needed to explain the development areas of collaborative relationships between industrial service providers and client in a more detailed way in future research.

REFERENCES

[1] Alam, I. and Perry, C., "A customer-oriented new service development process," *The Journal of Services Marketing*, vol. 16, no. 6, pp. 515-535, 2002.

[2] Barry, J. and Terry, T., "Empirical study of relationship value in industrial services," *Journal of Business & Industrial Marketing*, vol. 23, no. 4, pp. 228-241, 2008.

[3] Crespo Marquez, A., *The Maintenance Management Framework*. London, UK: Springer, 2007.

[4] Doz, Y. and Hamel, G., *Alliance Advantage: The Art of Creating Value through Partnering*. Boston, Massachusetts: Harvard Business School Press, 1998.

[5] Edvardsson, B., Gustafsson, A., Johnson, M. D. and Sandén, B., *New Service Development and Innovation in the New Economy*. Lund, Sweden: Studentlitteratur AB, 2000.

[6] Gebauer, H., Friendli, T. and Fleisch, E., "Success factors for achieving high service revenues in manufacturing companies," *Benchmarking: An International Journal*, vol. 13, no. 3, pp. 374-386, 2006.

[7] Gebauer, H., Krempl, R., Fleisch, E. and Friedli, T., "Innovation of product-related services," *Managing Service Quality*, vol. 18, no. 4, pp. 387-404, 2008.

[8] Grönroos, C., "The relationship marketing process: communication, interaction, dialogue, value," *Journal of Business & Industrial Marketing*, vol. 19, no. 2, pp. 99-113, 2004.

[9] Kalliokoski, P., Andersson, G., Salminen, V. and Hemilä, J. BestServ: Feasibility study final report. Helsinki: Teknologiainfo Teknova, 2003.

[10] Kindström, D. and Kowalkowski, C. "Development of industrial service offerings: a process framework", *Journal of Service Management*, vol. 20, no. 2, pp. 156-172, 2009.

[11] Kosonen, V., BestServ: Industrial service business strategy: generic framework and case examples. Helsinki: Technology Industries of Finland, 2004.

[12] Kumar, R., Marketset, T. and Kumar, U., "Implementation and execution of industrial service strategy: A case study from the oil and gas industry," *Journal of Quality in Maintenance Engineering*, vol. 12, no. 2, pp. 105-117, 2006.

[13] Lam, S. Y., "Customer Value, Satisfaction, Loyalty, and Switching Costs: An Illustration From a Business-to-Business Service Context," *Journal of the Academy of Marketing Science*, vol. 32, no. 3, pp. 293-311, 2004.

[14] Ojasalo, K. "Developing Industrial Services - An Empirical Study," *The Business Review, Cambridge*, vol. 7, no. 1, pp. 58-62, 2007.

[15] Oliva, R. and Kallenberg, R., "Managing the transition from products to services," International *Journal of Service Industry Management*, vol. 14, no. 2, pp. 160-172, 2003.

[16] Panesar, S. and Markeset, T., "Development of a framework for industrial service innovation management and coordination," *Journal of Quality in Maintenance Engineering*, vol. 14, no. 2, pp. 177-193, 2008.

[17] Saaty, T. L., "How to make a decision: The Analytic Hierarchy Process," *Interfaces*, vol. 24, no. 6, pp. 19-43, 1994.

[18] Salkari, I., Salminen, V. and Pylkkänen, J., BestServ: Managing service business winning best practises and success stories, Helsinki: The Federation of Finnish Technology Industries, 2007.

[19] Stremersch, S., Wuyts, S. and Frambach, R.T., "The purchasing of full-service contracts: an exploratory study within the industrial maintenance market," *Industrial Marketing Management*, vol. 30, no. 1, pp.1–12, 2001.

[20] Swink, M., "Building collaborative innovation capability," *Research Technology Management*, March-April, pp. 37-47, 2006.

[21] Woodruff, R.B., "Customer value: The next source for competitive advantage," *Academy of Marketing Science*, vol. 25, no. 2, pp. 139-153, 1997.

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Toni Ahonen, Markku Reunanen & Ville Ojanen (eds.)

Title

Customer value driven service business development
Outcomes from the Fleet Asset Management Project

Abstract

Transformation in many companies from goods-dominant logic towards service-dominant logic has continued, and the present difficult economic situation in many companies has actually strengthened this motivation to develop new service businesses in addition to developing existing product-service solutions. The aim of this publication is to enhance the understanding of the industrial service business, with a focus on aspects deemed important in creating new successful business: the success factors and risks of a service provider, collaborative relationships and networking, information management in maintenance services and the customer value of services.

In the new service development process, there are numerous success factors to be considered in different phases. Our research has revealed some factors assessed high by industrial firms. We have found that, in addition to a profound understanding of the customers' production and business processes, the ability to build trust and a fast reaction to the changing client needs among other things are crucial for successful service development and implementation.

Collaborating more effectively with the customer has also been widely recognized as a prerequisite of successful service business. Our research contributes to this field, especially to the business scenarios of networked maintenance by exploring the forms of collaboration in a service provider-customer relationship. New, more collaborative, ways of working in a networked maintenance environment are needed and we propose a maintenance community model as a management framework for these environments. Information management and communication solutions for the purposes of complex maintenance networks are still underdeveloped. We propose ICT solutions that support the collaboration and information exchange in the network and at the same time allow individual members to operate effectively and independently on the terms of the nature of their business environment and related dynamics.

One challenge to systematic service innovation is the multidisciplinary nature of services integrating across technology, business, social, and client (demand) innovations. In many firms the success of selling and service provisions rests with a few individuals able to identify the customers' expectations and needs and to find appropriate solutions ad hoc. Despite the centrality of customer value to marketing, there is a lack of common systematic methods at organizational level for customer negotiations and composing service offerings based on customer value. This has also inhibited efficient utilization of existing customer data and gathering new relevant information. We propose a process for analyzing customer value when new services are created or for complementing the service offering, also when the customer specific benefits expected from the services are assessed.

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Tekijä(t)
Toni Ahonen, Markku Reunanen & Ville Ojanen (toim.)

Nimeke

Asiakasarvoon perustuva palveluliiketoiminnan kehittäminen

Fleet Asset Management -projektin tuloksia

Tiivistelmä

Useissa yrityksissä siirtyminen tuotekeskeisestä liiketoiminnasta palvelukeskeisiin liiketoimintamalleihin on käynnissä ja palveluliiketoiminnan kehittäminen katsotaan nykyisessä haastavassa liiketoimintaympäristössä ja taloustilanteessa yhä tärkeämmäksi. Tämän julkaisun tavoitteena on lisätä ymmärrystä teollisen palveluliiketoiminnan kehittämisestä. Keskitymme erityisesti seuraaviin kannattavan palveluliiketoiminnan kehittämisen kannalta tärkeisiin näkökulmiin: palvelutoimittajan menestystekijät ja riskit, yhteistyö ja verkottuminen, kunnossapitopalveluiden tiedonhallinta sekä palveluihin liittyvä asiakasarvo.

Uuden palvelun kehittämisprosessin vaiheisiin liittyy useita huomioitavia menestystekijöitä. Tutkimuksessamme on tunnistettu tekijöitä, jotka teollisten yritysten näkökulmasta ovat erityisen tärkeitä. Asiakkaan tuotanto- ja liiketoimintaprosessien hyvän ymmärryksen lisäksi esimerkiksi kyky rakentaa luottamusta ja nopea reagointikyky muuttuviin asiakastarpeisiin ovat välttämättömiä kannattavien palveluiden kehittämiselle ja toteuttamiselle.

Tehokas yhteistyö asiakkaiden kanssa on merkittävä kannattavan palveluliiketoiminnan menestystekijä. Fleet Asset Management -hankkeessa toteutettu tutkimustyö keskittyy tällä alueella erityisesti verkottuneen kunnossapitoliiketoiminnan skenaarioihin ja palvelutoimittajan ja asiakkaan yhteistyösuhteen erilaisiin yhteistyökäytäntöihin. Verkottuneessa kunnossapitoliiketoimintaympäristössä ja hankkeessa tarvitaan uusia yhteistyötä painottavia käytäntöjä. Kehitetty Maintenance Community -malli on tarkoitettu johtamisen viitekehykseksi tällaisiin ympäristöihin. Tiedonhallintaa ja kommunikaatiota tukevien sovellusten on todettu olevan edelleen puutteellisia verkottuneen ja kompleksisen kunnossapitotoiminnan tarpeisiin. ICT-järjestelmien osalta Maintenance Community -malli ehdottaa kehityssuuntaa, jossa yhteistyötä ja kommunikointia tuetaan tehokkaasti yhteisillä työkaluilla, mutta yksittäisille toimijoille annetaan samanaikaisesti mahdollisuudet toimia tehokkaasti omaan liiketoimintaansa liittyvillä reunaehdoilla.

Palveluinnovaatioiden kehittämisen haaste on palveluiden monialainen luonne, jossa yhdistyvät teknologiset, liiketoiminnalliset, sosiaaliset ja asiakasinnovaatiot. Monissa yrityksissä palveluiden tarjonta perustuu nykyisellään yksittäisten osaajien kykyyn reagoida asiakkaan tarpeisiin. Huolimatta siitä kuinka keskeiseksi asiakasarvo koetaan palveluiden markkinoinnin näkökulmasta, asiakasarvon analysointiin pohjautuvia keinoja palvelutarjoaman kehittämiseksi on niukasti tarjolla. Tämä on vaikeuttanut olemassa olevan asiakastiedon tehokasta hyödyntämistä ja uuden tärkeän tiedon hankintaa. Fleet Asset Management -projektissa on kehitetty lähestymistapa asiakasarvon analysointiin tarkoituksena hyödyntää sitä uusien palveluiden kehittämisessä tai palvelutarjoaman täydentämisessä sekä palveluista odotettavien asiakashyötyjen arvioinnissa.

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